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Lactobionic Acid: Health Benefits and Techno-Functional Applications in Food Industries

Article ID: 31000

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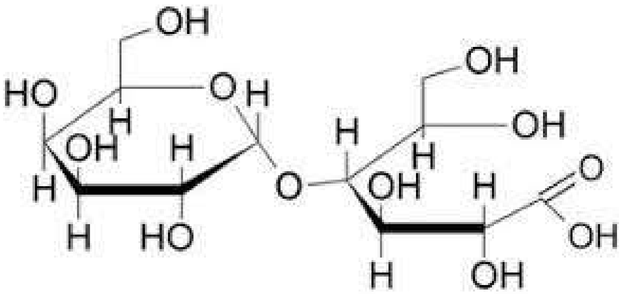
Introduction

Lactose is the unique and principal milk carbohydrate (disaccharide) that is composed of two monosaccharide viz: glucose and galactose. Edible lactose has wide applications in food and pharma industries. Apart from these, lactose derivatives, such as lactobionic acids, lactulose etc., are widely applicable in food and pharm industries. The market of lactose derivatives is increasing very rapidly.

Lactobionic Acid

Lactobionic acid (4-0-ß-D-galactopyranosyl-D-gluconic acid) is a unique lactose derivative with chemical formula is C12H22O12. It is made of galactose and gluconic acid, that are linked together with an ether types of linkage. It is highly soluble in water although less soluble or in soluble in organic solvent like glacial acetic acid, methanol and ethanol. Molecular weight of Lactobionic acid is 358.3 dalton; with melting point ranges almost 128-130°C. It provides almost 2 kcal/g energy therefore it is used as a low-calorie sweetener. Lactobionic acid and its salts are widely used in food and pharma industries as well as different research purposes.



Chemical structure of Lactobionic Acid

Table 1: Properties of Lactobionic Acid

Chemical structure	4-0-β-D-galactopyranosyl-D-gluconic acid
Chemical formula	C12H22O12
Molecular weight	358.3 dalton
Melting point	128-130°C
Energy contribution	2 kcal/g
Apparently density	0.66 gm/mL
Water solubility	100 mg/ mL
pH and PKa	2.37 and 3.6
Specific rotation	25.5°

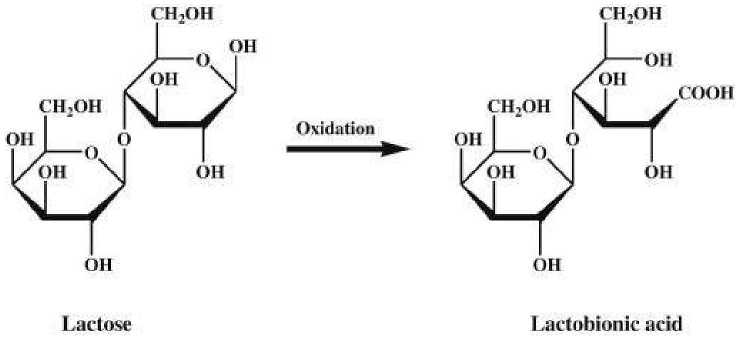
Production of Lactobionic Acid

It was first synthesis by lactose oxidation in the year 1930. During oxidation of lactose to lactobionic acid the free aldehyde group of glucose use to convert into carboxylic group.

However, different oxidation protocols are adopted for conversion of lactobionic acid from lactose. Different processes are:

1. Microbial oxidation (*Pseudomonas* spp).
2. Enzymatic oxidation (cellobiose dehydrogenase, glucose-fructose dehydrogenase).

3. Electrochemical oxidation (platinum, platinum-modified and gold electrodes).



Conversion of Lactobionic acid

Global Production

1. It is reported that growth of lactobionic acid production is only 5%/year.
2. The leading lactobionic acid producing countries are USA, Japan, China, Germany and India.
3. Reliable, Biopharmaceutical and Manus Aktteva Biopharma are the companies that are dominating in lactobionic acid global market.

Health Effects

Numerous health effect of lactobionic acid have been acknowledged in different scientific studies and these are:

1. Anticoagulant and Antithrombotic activity
2. Antioxidant
3. Wound healing
4. Prebiotic action
5. Enhancement of mineral absorption.

Applications: Food Industries

1. It is used as food additives as an antioxidant, stabilizer or gelling agent in different desserts.
2. Acidulant in different ferment milk products.
3. In bread it is used as age inhibitor.
4. Calcium lactobionate, a salt of this acid used as source of calcium for cheese making.
5. Flavour enhancer for foods or beverages.
6. It is also used as low calorie sweetner.

Lactobionic acids are also widely applied in cosmetic, pharma and chemical industries as well. Now, these days it is also applied for Nanoparticle diagnosis, Tissue engineering and for development of new drug delivery system as well. Calcium lactobionate, a calcium salt of lactobionic acid has been approved as USA–FDA (2011) as food preservative. However, it has been reported that excess dose of this acid can cause potent problem as bloating in colon.

Conclusion

Lactobionic acid is one the most valuable derivative of lactose. It can be synthesized from lactose by chemical, enzymatic methods. The therapeutic effect or health benefits of Lactobionic acid have been well acclaimed in scientific community through-out the world. However, application of lactobionic acid as an artificial/low calorie sweetener is also attracting food researchers for developing anti-diabetic foods. The possible application of lactobionic acid as nano/micro carrier for delivering bioactive components in food or drugs; also opens a new horizon of targeted therapy technology.

Suggested Reading

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Edible Insects as Food

Article ID: 31001

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Introduction

Insects have long been used as human food and animal feed in West Africa (Kenis and Hein, 2014; Riggi et al., 2014). However, compared to Central and Southern Africa, only few species are reported as being traditionally consumed by humans, the most common being grasshoppers and termites.

It is estimated that 1,900 species of insects are consumed by over two billion people in about 80 countries across Asia, Africa, and the Americas. Edible species are eaten as immature (eggs, larvae, pupae, and nymphs) and in some cases also as adults. Edible insects are obtained by three main strategies: wild harvesting, semi-domestication of insects in the wild, and farming.

Firstly, insects are healthy and nutritious alternatives to mainstream staples such as chicken, pork, beef and even fish because many insects contain more protein and are lower in fat than traditional meats, and high in calcium, iron and zinc.

Entomophagy

Entomophagy defines to cover the eating of arthropods other than insects, including arachnids and myriapods. Insects and arachnids eaten around the world include crickets, cicadas, grasshoppers, ants, various beetle grubs (such as mealworms, the larvae of the darkling beetle), various species of caterpillar (such as bamboo worms, mopani worms, silkworms and waxworms), scorpions and tarantulas. There are over 1,900 known species of arthropods which are edible for humans.

Major Groups of Edible Insect Species Consumed Worldwide

Globally, the most common insects consumed are beetles (31%). The consumption of caterpillars, which is especially popular in sub-Saharan Africa, is estimated at 18%. Bees, wasps and ants come in the third place at 14% and are especially common in Latin America.

Following these are grasshoppers, locusts and crickets (13%); cicadas, leafhoppers, plant-hoppers, scale insects and true bugs (10%); termites (3%); dragonflies (3%); flies (2%); and others (5%) (van Huis et al., 2013). Lepidoptera are consumed almost entirely as caterpillars and Hymenoptera are consumed mostly in their larval or pupal stages. Both adults and larvae of the Coleoptera order are eaten, while the Orthoptera, Homoptera, Isoptera and Hemiptera orders are mostly eaten in the mature stage.

Insects

Edible insects have the potential to become a major source of human nutrition, and can be produced more efficiently than conventional livestock. They are high in fat, protein and micronutrients), and can be produced with lower levels of GHG emissions and water consumption.

The efficiency of insects to convert feed into edible food is in part due to the higher fraction of insect consumed (up to 100%), compared to conventional meat (e.g. 40% of live animal weight is consumed with cattle). Insects are poikilothermic, so they do not use their metabolism to heat or cool themselves, reducing energy usage.

They tend to have higher fecundity than conventional livestock, potentially producing thousands of offspring. Efficiency is also increased by rapid growth rates and the ability of insects to reach maturity in days rather than months or years.

Insects as Feed Ingredients

Insects can be used as a replacement for fish meal and fish oil in animal diets. Global industrial feed production in 2011 was estimated at 870 million tons, worth approximately US$350 billion.

The most promising insect species for industrial production are BSF, the common house fly, the yellow mealworm, the lesser mealworm, silkworm (*Bombyx mori*), and several grasshopper species. BSF larvae convert manure to body mass containing 42% protein and 35% fat, which makes them a suitable source of feed for both livestock (Newton, 2005) and fish.

When fish offal was included in their diet, their lipid content increased, including omega-3 fatty acids, making BSF larvae a suitable replacement for fish meal/oil in fish and livestock diets. Substituting 50% of the fish meal by fish offal–enriched BSF allowed growth of rainbow trout similar to that of a fish meal–based control diet.

House fly maggots have also been proposed as poultry feed in both Western and tropical countries. They can convert poultry manure and at the same time produce pupae as a high-protein (61%) feed with a well-balanced composition of the amino acids' arginine, lysine, and methionine. Diets containing 10–15% maggots (which appear during biodegradation of chicken droppings using house flies) improved carcass quality and growth performance of broiler chickens.

The rearing technology for fly larvae needs to be further developed, as large volumes are required for supplementing commercial poultry diets. An automated process for growing and harvesting the larvae will be required for this technology to become commercially feasible. Acridids are an attractive and important natural source of food for many kinds of vertebrate animals, including birds, lizards, snakes, amphibians, and fish.

The Chinese grasshopper (*Acrida cinerea*) could replace 15% of chicken diets containing soybean meal and fish meal from 8 to 20 days posthatching without any adverse effects on broiler weight gain, feed intake, or FCR.The grasshopper *Zonocerus variegatus* can replace fish meal for rabbits. The yellow mealworm has been shown to be an acceptable protein source for African catfish (*Clarias gariepinus*) and for broiler chickens.

Silkworm (*B. mori*) pupae mash was successfully used as a replacement for fish meal in poultry diets, supporting both growth and egg production .Similar results were obtained with silkworm (*Anaphe infracta*) caterpillar meal. In Italy, preimaginal stages of *Spodoptera littoralis* have been evaluated to replace fish meal as possible feed for rainbow trout.

Controlling Insects by Using Them as Feed and Food

In the tropics there are numerous examples of pests that are also used as food and feed. Governments may even encourage people to consume insects in order to control plagues, as was the case during a locust plague in Thailand.

Control is often not intended; e.g., in Niger women can earn more money by marketing edible grasshoppers caught in their millet fields and harmful to the crops than by trading the crop itself. There are very few examples in which harvesting insects is considered a control method.

Example, in Vientiane Province, Laos, electric-light water traps were placed facing rice fields, but their primary aim was to capture edible insects and not to control pests (A. van Huis, personal observation). Grasshoppers such as Oxya chinensis, also edible but harmful to crops, were collected in rice fields in Indochina by drawing nets or baskets over the young rice plants.

Conclusion

Insects are sustainable source of protein for use in animal feed and for human consumption. Entomophagy is an age-old phenomenon dating back to pre-historic era and has served man for several millennia. The development of new policies is inevitable.

It will be necessary to listen to regulators to determine what is expected, to be sensitive to consumers who might demand specific regulations, and to collaborate with retailers.

We need to promote the establishment of appropriate international and national standards and legal frameworks to facilitate the use of insects as food and feed and the development and formalization of the sector.

Finally, the potential effects of insect production and rearing on the environment, and the environmental and trade implications of the international movement of insects, when drafting and implementing regulatory frameworks for insect production and use must be considered.

This would oblige regulators to pay attention to a broad range of regulatory areas, including phytosanitary legislation, biodiversity, disease control and environmental protection.

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Compost Making from Weeds

Article ID: 31002

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The depletion of soil nutrients occurs to a greater degree leading to imbalance in availability of nutrients, loss of soil fertility and drastic reduction in crop productivity because of intensive farming system productivity of the soils cannot be sustained with the fertilizer alone.

Therefore, organic manures should also be included in schedule to maintain the productivity of the soils. The concept of organic waste management and its use for plant nutrient recycle is becoming more essential for sustaining soil-health through improvement of physic-chemical properties and microbial diversity of soil.

Making composting from weeds may be a widely applicable process of handling biodegradable organic wastes. Composting and vermicomposting from weeds at one hand give the option to utilize the waste for enhancing soil nutrient availability while on the other hand provide direct relieve to stakeholder from the weeds in their farm and places vermicomposting technology is an aspect of biotechnology involving the use of earthworms for recycling of non-toxic organic waste to the soil. Composting from the weeds also required proper and scientific knowledge so that seeds of weeds are killed completely.

Generally, weeds compete with crops for nutrients, space, energy and sunlight etc which eventually reflects on the performance of the crop. Crop growth and yields are influenced by biotic and abiotic factors to effect crop yield. It removes substantial amount of nutrients from the soil depending on the density and species of weeds. The weed species locally available in large amounts like *Ipomoca carnea, I. aquatic, Chromolaena odorata, Eichhornia crassipes, Lantana camara, Calotropis gigantean, Parthenium hysterophorus, Hyptis suaveolense, Indigofera tintoria, Phaseolus trilobus, Croton bonplandianum, Vernonia cineraria,melilotus sp., Cannabis sativa, Xanthium strumarium* etc could be easily converted in to compost.

Weeds like Chenopodium album contain more than 8% potassium (K) on dry weight basis. Further, weeds also accumulate high amounts on other secondary and micronutrients e.g. 2.04 to 2.07% Calcium (Ca) in *Cirsium arverse* and *Polygonum hydropiperoides*, 585 ppm Zinc (Zn) in *Setaria lutescens*, 32 ppm boron (B) in and 39 ppm manganese (Mn) in Taraxacum sp., 0.71% magneseium Mg and 373 ppm iron (Fe) in *Polygonum hydropiperoides*.

Preparation of Compost from Weeds

As a thumb rules, weeds biomass intended to be composted should be collected before seed setting or it should be devoid of the vegetative propagates that help its regeneration. But in practical, it is not possible because often farmer do uproot late when seeds are already in the plants. There are weeds, which simultaneously have all the stages at a time including seed bearing plants, therefore, it is neither practical nor possible to uproot or cut only those plants devoid of flowers.

Almost all the weeds possess huge number of seeds. Therefore, it has to be assured to follow proper methods so that all the seeds are killed during number of seeds. Therefore, it has to be assured to follow proper methods so that all the seeds are killed during composing process.

Herewith, scientific methods of compost making from Parthenium is given, which can be followed for almost all the type of weeds.

Table 1. Nutrient Composition in Different Composts

Types of organic fertilizer	Nutrients (%)				
	N	P	K	Ca	Mg
Parthenium compost	1.05	0.84	1.11	0.90	0.55
Vermicompost	1.61	0.68	1.31	0.65	0.43
Farmyard manure	0.45	0.30	0.54	0.59	0.28

Compost Preparation from Parthenium Biomass

Parthenium hysterophorus is a menace to farmland, human being, animals, environment and bio-diversity. During interaction with farmers, it was found that if they use the compost made from the weeds in general and *Parthenium* in particular by recommended NADEP or open pit or heap methods (farmer practice), there was more germination of that type of weeds in the field from which such compost was made.

Although, it is always recommended by the experts to collect the *Parthenium* and other weeds biomass before flowering for making compost either by NADEP or open pit method. But it is not practically possible to collect only flowerless weedy plants in general and *Parthenium* in particular.

Methods

Methods: Make a pit of 3 x 6 x 10 feet (depth X width X length) at a place where water dose not stagnate during rainy season. Pit size can be increased or decreased on the availability of biomass but depth cannot be compromised. If possible, cover the surface and side walls of the pit with stone chips. If stone cheap are not available, make soil surface compact. Arrange about 100 kg dung, 10 kg urea or rock phosphate, soil (1 to 2 quintals) and one drum of water near pit.

Collect all the *Parthenium* and other uprooted weedy plants during process of weeding from the fields, bunds, road side and nearby area. Spread about 50 to 100 kg of *Parthenium* on the surface of pit. Over this, sprinkle 500 g urea or 3 kg rock phosphate. Make dung slurry by adding 5 to 10 kg dung in 25 litre water and sprinkle over the weed biomass.

If possible, add *Trichoderma viridi* or *Trichoderma harziana* (kind of fungi cultured powder) in the amount of 50 g/layer. All the above constituents will make one layer. Like first layer make several layers till the pit is filled up to one fit above the ground surface. Fill the pit in dome shape. While making layers, apply leg pressure to make weed biomass compact.

If there is no sufficient soil with weeds roots than add 10 to 12 kg of loamy soil on each layer. If pit is full with above described layers, cover it with mixture of dung, soil and husk. After 3-4 months we can get well decomposed compost. The 37 kg of compost can be obtained from 100 kg of raw *Parthenium* biomass.

In comparison to farmyard manure, NPK, Ca and Mg was found almost double in compost prepared from *Parthenium* biomass, however, it was little less than the vermicompost (table).

Benefits

Weed compost including of Parthenium is a type of biofertilizer which has no harmful effects on crop, human beings and environment. Weed compost is an eco-friendly biofertilizer that can be made by low cost inputs and application of it in crop fields will increase the fertility of soil. During the process, the temperature rises 60 to 70^{o} C due to which seeds are killed.

Precautions

Pit should be in open and shady upland. If you find fresh germination of weeds near the pit where weeds were collected to fill up the pit, destroy them otherwise they may contaminate the compost after flowering. Check the moisture level of compost. If there is dryness in the pit, make a few holes and pour water in the pit and close the holes. While it may take about 3 to 4 months to prepare the compost in a warm climate but, in cold regions it can take more time.

Summary

Weeds can be utilized for making good quality compost by following scientific methods. Weeds often possess large number of seeds, which should be killed during process of composting. Pit method is found suitable for making compost from the weeds. Therefore, farmers are advised to use pit methods instead of NADEP method to prepare compost from the weeds.

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Black Soldier Fly: A Natural Decomposer

Article ID: 31003

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Introduction

Entomoremediation is defined as a type of remediation in which insects are used in order to decontaminate a degraded soil. The candidacy of collembolans, ants, beetles and termites in entomoremediation is advocated because of their role as ecosystem engineers.

Entomoremediation - insects are used to decontaminate a degraded soil. Insects used for entomoremediation are called as entomoremediators.

Insects Involved

1. ***Hermetia illucens***
2. ***Chrysomya megacephala***
3. ***Tenebrio molitor***
4. ***Plodia interpunctella***.

Black Soldier Fly - *Hermetia illucens*

Hermetia illucens, the black soldier fly belongs to family Stratiomyidae and native of Southern USA. The adults of H. illucens measure about 16 millimetres long. These medium-sized flies have a predominantly black body, with metallic reflections ranging from blue to green on the thorax and sometimes with a reddish end of the abdomen.

An adult female lay between 206 and 639 eggs at a time. These eggs are typically deposited in crevices or on surfaces above or adjacent to decaying matter such as manure or compost and hatch in about 4 days.

The larval stage lasts about 22 days, of which the post feeding (prepupal) stage lasts around 7 days. The length of larval stage can be delayed by months due to low temperature or lack of food. The pupal stage lasts from 1 to 2 weeks.

Adults can live typically 47 to 73 days when provided with water and food, such as sugar in captivity or nectar in the wild, or survive for about 8 to 10 days on fat reserves gathered during larval stage when water is provided.

Black Soldier Flies as Promising Entomoremidiator

Black soldier fly larvae are the essential decomposers. In addition, they are excellent source of sustainable protein for aqua culture and as animal feed, and pet and human nutrition. They are also used for composting household food scraps and agricultural waste products. Black soldier fly larvae (BSFL) are used to compost waste or convert the waste into animal feed.

Fly larvae are among the most efficient animals at converting feed into biomass. Fly larvae also produce another valuable resource called frass. Fly larval frass is a granulated and odourless residue that can be used as organic fertilizer.

Mass Rearing of BSF (Black Soldier Fly)

Attract the insects.

⬇

Mating occurs reliably in a 2 x 2 x 4 m screen cage in a 7x 9 x5 m greenhouse.

⬇

Adults will be provided with water.

⬇

Larvae will be provided with a moist mixture of 50% wheat bran, 20% corn meal, and 30% alfalfa meal.

BSFL Prospects

Wastes are fully recycled when subjected to one larval digestion cycle. Wastes that can be treated using BSFL that includes:

1. Domestic kitchen waste.
2. Organic municipal solid waste.
3. Manure from cattle farm.
4. Night soil.
5. Wastes from fishery industries.
6. Bio leachate.
7. Persistent pollutants.
8. Coffee pulp.
9. Banana pulp.

BSFL as Feed

Black soldier fly larvae are used as feed. The harvested pupae and prepupae are eaten by poultry, fish, pigs, lizards, turtles, and even dogs. The insect is one of the few insect species approved to be used as feed in aquaculture in the EU.

BSFL as Food for Human

Black soldier fly larvae are edible to humans. The larvae are highly efficient in converting proteins, containing up to 42% of protein, much calcium, and many amino acids. In 432 hours, 1 gram (0.035 oz) of black soldier fly eggs convert into 2.4 kilograms (5.3 lb) of protein, which means more than 45,000 eggs are in 1 g of eggs.

Conventional vs BSFL Composting

Phenomenon	Conventional composting	BSFL composting
Duration	4-5 weeks	12-15 days
Conversion agent	Earthworm and microorganism	Black soldier fly larvae
Optimal temperature	60˚C to 75˚C	30˚C
Optimal moisture	40-60%	60-75%
Applicable feedstock	Except persistent pollutants	Almost everything

Conclusion

1. It is fast, efficient, and no hassle.
2. Soldier Flies are found almost everywhere but mostly in warm climates.
3. You can feed them anything biodegradable.
4. Meat and fermented waste are one of their favourite foods.

5. No special conditions are required for them to thrive.
6. They love darkness when in their larval stage.
7. When used in a Compot they will reduce your council waste by over 50% because you can feed them all your kitchen waste including meat, dairy, citrus, onions, oil, egg shells, fish, prawns, paper towels, absolutely anything bio-degradable. If you find them in your garden be grateful. They are awesome.

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Biofortification

Article ID: 31004

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Fortification is the addition of essential micronutrients including vitamins and minerals to foods to improve their quality. Food assistance programmes by WFP are in place using partially pre-cooked and milled cereals and pulses fortified with micronutrients to overcome nutritional deficiencies and provide health benefits with nominal risk.

For food fortification with iron, ferrous sulphate, ferrous fumarate, ferric pyrophosphate, and electrolytic iron powder compounds are commonly used. Similarly, food can be fortified with folic acid to improve levels of folates in diets. Salt iodization (fortification with iodine) was successfully achieved to reduce the incidence of goitre.

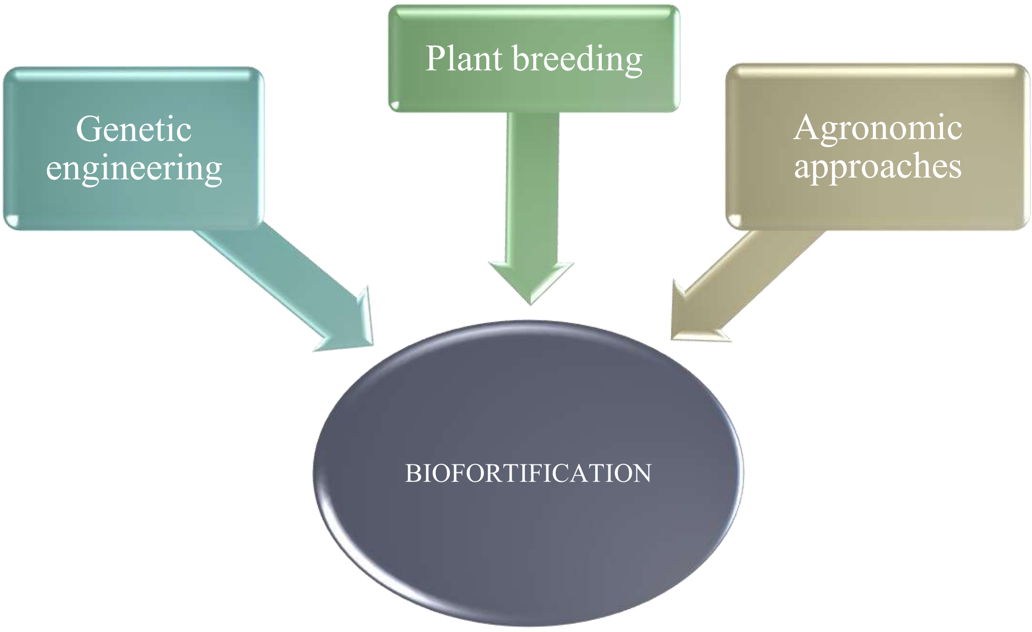

Fig: Approaches of biofortification for improvement of nutritional profile

Biofortification is a process of improvement of nutritional profile of plant-based foods through agronomic interventions, genetic engineering, and conventional plant breeding (Figure 1). Biofortification, the process of integrating nutrients into food crops, provides a sustainable and economic way of increasing the density of minerals/micronutrients in important staple crops.

Biofortification have multiple advantages that may complement other ways and techniques of improving micro-nutrient nutrition in food crops including pulses.

Agronomic Approaches

It can be achieved by applying mineral fertilizers to the plant through:

1. Foliar fertilization
2. Seed priming
3. Soil application of fertilizers
4. Seed coating
5. Soil inoculation with beneficial microorganisms.

Phytoavailability of minerals in the soil is often low; thus, to improve the concentration of minerals in the edible plant tissues, the application of mineral fertilizers with improved solubility and mobility of the minerals is required.

This method can be used to fortify plants with mineral elements, but not organic nutrients, such as vitamins, which are synthesized by the plant itself. This method was successfully implemented for Se, I, and Zn, as these elements had good mobility in the soil as well as in the plant.

For example, supplementation of inorganic fertilizers with sodium selenate significantly increased Se concentration. Foliar fertilization is the application of fertilizers directly to the leaves. It could be successful when mineral elements are not available immediately in the soil or not readily translocated to edible tissues.

Pulse crops were biofortified with micronutrients, Fe, Zn, and Se, through foliar application. Various plant growth-promoting (PGP) soil microorganisms including Enterobacter, Bacillus, and Pseudomonas can be exploited to increase the phytoavailability of micronutrients. These are used mostly as seed inoculants and enhance plant growth through the production of growth hormones, antibiotics, chitinases, and siderophores and the induction of systemic resistance and mineralization.

PGP microorganisms chelate iron via the production of siderophore compounds, solubilize phosphorus, and inhibit growth of pathogens, thus playing a significant role in soil fertility and iron fortification. Nutrient uptake also increased by phytosiderophores.

Genetic Engineering

Biofortification through genetic engineering is an alternative approach when variation in the desired traits is not available naturally in the available germplasm, a specific micronutrient does not naturally exist in crops, and/or modifications cannot be achieved by conventional breeding.

Along with increasing the concentration of micronutrients, this approach can also be targeted simultaneously for removal of antinutrients or inclusion of promoters that can enhance the bioavailability of micronutrients.

Recently, CRISPR/Cas9 and TALENs technologies were used to generate mutant lines for genes involved in small RNA processing of Glycine max and Medicago truncatula. Similarly, CRISPR/Cas9-mediated genome editing technology was used in cowpeas to successfully disrupt symbiotic nitrogen fixation (SNF) gene activation.

Plant Breeding

Biofortification through plant breeding is a cost-effective and sustainable approach that can improve the health status of low-income people globally. This approach has been used to control deficiencies of micronutrients including carotenoids, Fe, and Zn.

Conclusion

Micronutrients are essential for human growth and development, and their deficiency is a major concern that affects one in three people worldwide. Among various strategies, biofortification through plant breeding is considered the most economical and sustainable approach to tackle micronutrient deficiencies.

A greater micronutrient density and a high yield are prerequisites for effective biofortification, and these crops must be adopted by farmers and consumed by the target population. For efficient biofortification, the focus should be on increasing the bioavailability of micronutrients simultaneously with increase in their concentration.

This can be achieved by increasing the concentration of promoters that stimulate the absorption of minerals and by reducing the concentrations of antinutrients that interfere with absorption. Pulse crops are an important source of protein and energy, so improvement in their nutritional profile will significantly increase their consumption.

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Locust Outbreak: A Recent Threat to India

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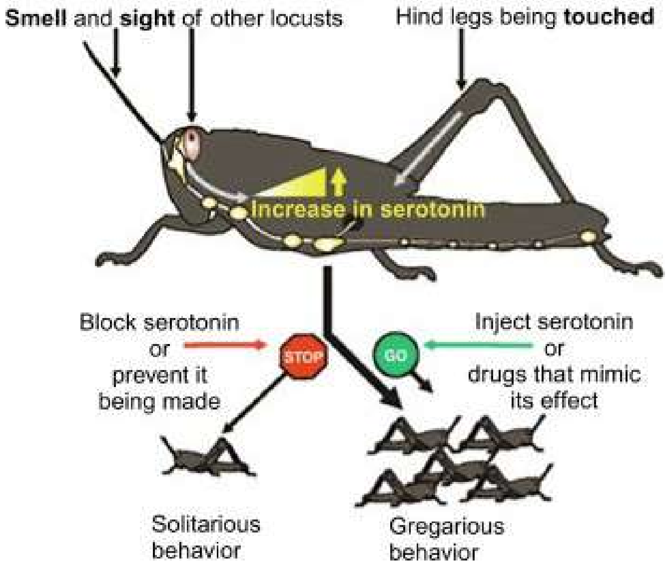
Introduction

Locust are those species of grasshoppers (Acarididae) which under certain favourable conditions, multiply, congregate, more together in their nymphal stages as bands. They swarm to distant areas in dense. Plagues of locusts have devastated societies since the Pharaohs led ancient Egypt, and they still wreak havoc today.



List of Locusts

S. No.	Common name	Scientific Name
1.	The Red Locust	*Nomadacris septemfaciata*
2.	The Brown Locust	*Locustana pardalina*
3.	The South American Locust	*Schistocerca paranensis*
4.	The Australian Locust	*Chortoicetes termenifera*
5.	The Tree Locust	*Anacridium Spp.*
6.	The Desert Locust	*Schistocerca gregaria*
7.	The Bombay Locust	*Nomadacris succincta*
8.	The Migratory Locust	*Locusts migratoria manilensis;* *Locusta migratoria migratoria-oides*
9.	The Italian Locust	*Calliptamus italicus*
10.	The Moroccan Locust	*Dociostaurus morocannus*

Phase Variation

Phase refers to different forms of insects. Uvarov (1921) proposed the "Phase theory of locusts" According to Uvarov and Zolotarvesvsky (1929) species of locusts are phase polyphonic, existing in series of forms.

Sharing the same genotype individuals may display different genotypes that incorporate variationsin morphology, colouration, reproductive features, and significantly in behaviour. From these two extreme forms or phases are indistinct.

They are:
1. Solitary phase or Phasis solitaria
2. Gregarious phase or Migratory phase.

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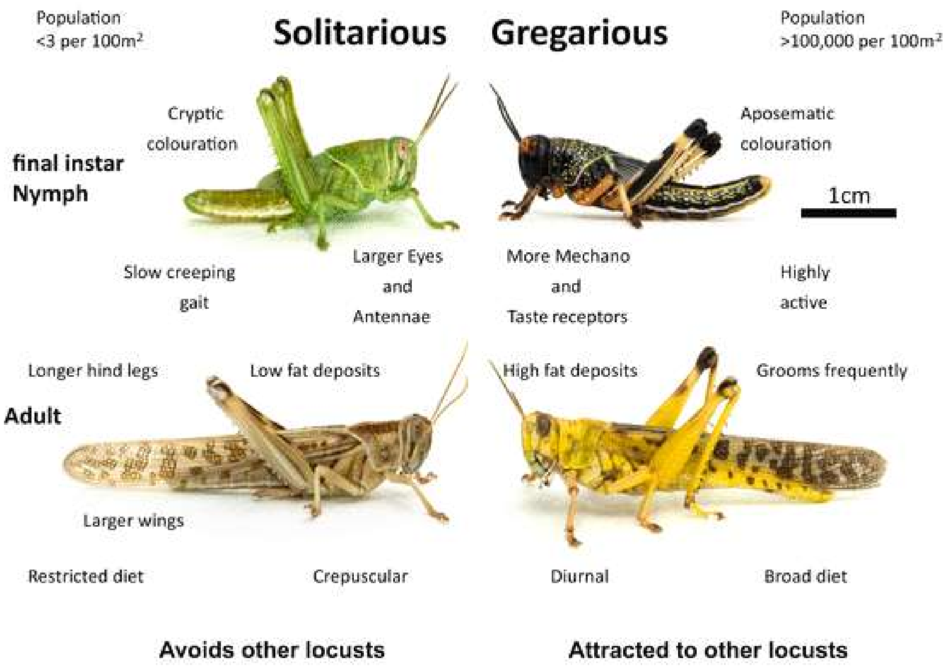

Locust Swarm

Locusts are the swarming phase of certain species of short-horned grasshoppers in the family Acrididae. These insects are usually solitary, but under certain circumstances become more abundant and change their behaviour and habits, becoming gregarious.

Locust Plague

The attack of the desert locust used to occur earlier in a phases of plague cycles. A period of more than two consecutive years of wide-spread breeding, swarm production and thereby damaging of crops is called a plague period. Followed by a period of 1-8 years called as the recession period again to be followed by another spell of plague.

Effects About Locust Plague

Around 2.25m ha land has already been affected as of April 2020. About 70,000 hectares (172,973 acres) of land in Kenya alone are already infested. 20.2 million people facing severe acute food insecurity in Ethiopia, Kenya, Somalia, South Sudan, Uganda and the United Republic of Tanzania. If left unchecked, the number of locusts could grow by 500 times by June 2020, when drier weather will help bring the outbreak under control. About 1 million ha of land has been targeted for rapid locust surveillance and control in the eight East African countries. 110 000 households have been targeted for rapid livelihoods protection in seven of the eight countries.

Effective control is estimated to be around $60m but, if an upsurge occurs, the cost will soar to $500m. WFP estimates that long-term response and recovery costs could top US$1billion if swarm growth is not controlled. The World Bank estimates that in Africa alone, more than 90 million hectares of cropland and pasture are at risk and damages and losses could amount to as much as US$9 billion in coming years.

Locust Diet

Locusts consume leaves and the tender tissues of plants. They are strong fliers as adults and tenacious hoppers as nymphs. Large swarms of locusts can completely strip the foliage and stems of plants such as forbs and grasses. Some species consume a variety of plants, while others have a more specific diet. They often eat dry plant matter on the ground and will forage for weak or dead grasshoppers when plant food is scarce. As nymphs have a large appetite, they cause more damage than adults.

Recent Locust Outbreak

Recent locust infestation was recorded in Africa, the Arabian Peninsula and South Asia is an outbreak of desert locusts which is threatening the food supply across the region.

The outbreak is the worst in 70 years in Kenya and the worst in 25 years in Ethiopia, Somalia and India. The plague began in June 2019 and has continued through 2020. The current outbreak began with heavy rains in 2018 in the Rub' al Khali of the Arabian Peninsula; in Spring 2019, swarms spread from these areas, and by June 2019, the locusts spread north to Iran, Pakistan, and India and south to East Africa, particularly the Horn of Africa. By the end of 2019, there were swarms in Ethiopia, Eritrea, Somalia, Kenya, Saudi Arabia, Yemen, Egypt, Oman, Iran, India, and Pakistan.

According to a recent report by the Food and Agriculture Organization (FAO), the locust swarm currently affecting parts of India was responsible for crop infestation in 2,80,000 hectares across 13 countries prior to arrival in India. It entered India through the western state of Rajasthan on 13 May 2020.

Conclusion

At present the primary method of controlling Desert Locust swarms and hopper bands is with mainly organophosphate chemicals applied in small concentrated doses (referred to as ultra-low volume (ULV) formulation) by vehicle-mounted and aerial sprayers and to a lesser extent by knapsack and hand-held sprayers.

Mechanical methods – digging trenches, beating and burning, Baiting – scattering locust food impregnated with insecticide, Dusting-applying, a fine dust impregnated with insecticide Spraying liquid insecticides.

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Endophytes: Potential Biocontrol Agents for the Plant Disease Management

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Phytopathogens are the most significant reason for the losses in global food production. Many strategies have been used in the plant disease management, but all of them have some drawbacks. Biological control has come up as a very popular and attractive way to manage the plant diseases because of its eco-friendly nature.

Endophytes living inside the plant tissues without causing any visible harm to the host. The antagonistic effects shown by endophytic microorganisms make them strong candidate for the plant disease management as bio control agents. Plants benefited by endophytes in many ways viz; by stimulating growth of plant, inducing resistance to multiple stress, protection from various pests, etc.

Endophytes, colonize the tissues of healthy plants for their whole life or at least a part of their life cycle, are able to protect plants against pathogens either directly by hyper parasitism, production of antibiotics, lytic enzymes production, competition for space and nutrients, or indirectly by inducing resistance, and promoting plant growth.

Introduction

To safeguard the crop plants from pests and thereby sustainable food production for human consumption is an ever-growing demand. The extensive use of pesticides has created various problems like; fungicide resistance, insecticide resistance, health hazard for humans and animals, negative impact on environment, etc.

To confront with these problems there is a need to develop and promote the ecologically safe and sound as well as economically viable techniques for pest management. Biological control gained popularity in recent years and become a very important tool for Integrated Pest Management (IPM). The antagonistic effects shown by endophytic microorganisms make them strong candidate for the plant disease management as bio control agents.

All plants are infested with microbes, either these micrbes are beneficial / not causing any visual harm to plants; like endophytes, epiphytes, rhizobacterias, mycorrhizas, etc, or they are disease causing; like plant pathogens.

All organisms reside in plant parts as whole or at least a part of their life cycle can colonize internal plant tissues without causing any visible harm to their host, called as Endophytes. (Petrini, 1991).

Endophyte-Plant Relationship

The endophytes can establish various relationships with their host plant, ranging from symbiotic to slightly pathogenic (Strobel and Daisy, 2003). In symbiotic/mutualistic relationship the endophytes and the plant both are benefited, as the endophytes obtain nutrients and get protection within the plant while the plant in return get various benefits via:

1. Availability of nitrogen by N2 fixation
2. Solubilization of immobilized nutrients
3. Phytohormones production
4. Sequestration of iron by siderophores
5. Oxidation of sulphur.

The plants also benefited indirectly by endophytes through various mechanisms, include

1. Induced systemic resistance (ISR).
2. Growth promotion of plants.
3. Anti-microbial activity.

Mostly the genera or sometimes species also, of the endophytes and plant pathogens is same, so in certain conditions endophytes can become parasites to the plants and vice-versa. Mutualistic interaction between microbes and plant is defined as a balance, under physiological, environmental and genetic control, that derive fitness benefits for both partners and disease is an exception in the plant–microbe interactions, it can explain as an 'unbalanced status' of a symbiosis.

Different Mechanisms of Disease Control by Endophytes

Potential mechanisms of plant pathogen inhibition by endophytes are by various means; directly by antibiosis and competition for nutrients/habitat or indirectly by induction of plant resistance response (M'Piga et. al., 1997).

Direct Inhibition of Plant Pathogens

Hyper parasitism: In hyper parasitism, endophyte directly attacks the pathogen by various means as penetrating the hyphae, twisting, and secreting lyase to decompose cell wall of pathogens.

Competition: Competition also play important role in the control of pathogens by endophytic microorganisms, since both plant pathogens and endophytes colonize the similar niche and compete for the same nutrients in the host plant. In this fight endophytic microorganisms wins and abolish growth of the pathogen. In Siderophore mediated competition for Fe3+ the endophytic organisms win by making the iron unavailable for the pathogen by sequestering it.

Antibiosis: Antibiosis is the ability of a microorganism to forbid growth of pathogen by the antibiotics production. Secondary metabolites are produced by endophytes, some of these compounds are antifungal and antibacterial and strongly suppress the pathogen (Gunatilaka, 2006). Polypeptides, Terpenoids, aromatic compounds, alkaloids, etc., are the examples of antibiotics produced by the endophytic microorganisms.

Table 1: Antibiotics Produced by Different Fungal Endophytes

Endophytes	Antibiotics produced	Target pathogens	References
Acremonium zeae	Pyrrocidines A, B	*Aspergillus flavus, Fusarium verticillioides*	Wicklow *et al.*, (2005)
Verticillium sp.	Massariphenone, ergosterol peroxide	*Pyricularia oryzae P-2b*	You *et al.*, (2009
Phomopis cassiae	Cadinane sesquiterpenes	*Cladosporium sphaerospermum*	Silva *et al.* ,(2006)
Muscodor albus	Tetrohydofuran, 2-methyl furan,2-butanone	*Stachybotrys chartarum*	Atmosukarto *et al.*, (2005)

Lytic Enzyme Production

lytic enzymes are the compounds that can hydrolyse a wide variety of biopolymers including proteins, cellulose, chitin, hemicellulose, DNA, etc (Tripathi et. al., 2008) and hydrolyses the plant cell walls. Chitinases, β-1,3-Glucanases, proteases, etc; are some lytic enzymes which play important role in inhibition of the pathogens.

Indirect Effects

In this case plants get benefited and protected by plant pathogens indirectly as endophytes enhancing plant resistance and promote the plant growth.

1. By enhancing plant resistance: Some endophytes induce resistance in plants thus indirectly protect them from pathogens. Induced systemic resistance (ISR) and Systemic acquired resistance (SAR) are two forms of induced resistances. Non-pathogenic rhizobacteria induce the ISR, jasmonic acid or ethylene acts as the signalling molecules. SAR, induced by the pathogenic infection, associated with the accumulation of pathogenesis-related (PR) proteins and signalling molecule is the salicylic acid (Vallad and Goodman, 2004;

Tripathi et. al., 2008). Endophytic microorganisms generally induced ISR but sometimes also associated with expression of pathogenesis-related genes.

2. By promoting plant growth and physiology: Through control in physiology of plants, endophytes boost the defence against phytopathogenic organisms (Giménez et. al., 2007). The healthy plant avoids variety of biotic and abiotic stresses. Phytohrmones are produced by some fugal endophytes, which contribute towards the enhancement of plant growth. Indole acetic acid (IAA) produced by Colletotrichum sp., an endophytic fungus in Artemisia annua, it influences the plant processes (Lu et. al., 2000).

Conclusion

Endophytes have great potential as biocontrol agent for plant protection, due to the antagonistic properties they have. They are showing positive results in lab as well as in field conditions by inhibiting growth of pathogen and by reducing disease severity, respectively. Although we already have eco-friendly biocontrol agents but still endophytes have more potential to manage the plant diseases. The immense potential of endophytic microorganisms to work as biocontrol agents against plant pathogens needs more research for its use in future plant protection strategies.

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Conservation Agriculture

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Need for Conservation Agriculture

Soil organic matter (SOM) is a fundamental attribute of soil quality. Optimum quantities of soil organic matter in the soils influences physical, chemical as well as biological properties of soils. It modifies soil fertility, shows positive effect on cohesive forces between minerals, contributed to improve water infiltration and favourable soil structure and ultimately helps in maintaining soil quality and productivity. It also plays a significant role to the plants to overcome different biotic (pest attack, disease infestation) and abiotic stresses (drought, salinity, heat, erosion, acidity/alkalinity, etc). But, the conventional agriculture practices which are generally followed by farmers involves intensive tillage, inappropriate soil management, excessive use of chemical inputs (fertilizer, pesticides), etc. some recent studies have shown that intensive ploughing of the soil exposes soil organic matter to the atmosphere and leads to rapid mineralization, reduces soil fertility, destroys soil structure-aggregates, and deteriorates aeration and also moisture status. Moreover, intensive tilling also enhances productive soil losses and soil erosion. For this purpose, there is a need to adopt some strategy to protect natural resources for up-keeping agricultural production system for obtaining profitable yield.

Conservation Agriculture: Future of Agriculture

FAO has elaborated a new approach of Conservation Agriculture which emphasises the need for a productive and remunerative agricultural system that can conserve and enhance the natural resources and environment, and also contributes to the ecosystem services for the betterment of the society. Sustainable crop production intensification must minimise the impact of climate change on crop production and also be part in mitigating the factors that cause global warming by reducing greenhouse gas emissions and by contributing to carbon sequestration in the soil. Conserving and enhancing biodiversity in crop production systems to improve ecosystem services leads to better productivity, a good environment and improved resilience against biotic and abiotic stresses too.

According to FAO, conservation agriculture is an approach to manage agroecosystems for sustained productivity, considerable profits and food security and characterised by the application of three linked principles, namely:

1. Continuous no or minimal mechanical soil disturbance (zero-tillage or reduced tillage).
2. Permanent soil cover or residue retention (retaining crop biomass, rootstocks and stubbles and cover).
3. Diversification of crop species (implemented by adopting a cropping system with crops in rotation, including a balanced mix of legume and non-legume crops).

Adaptability of Conservation Agriculture

Conservation Agriculture systems are widely adaptable. Conservation Agriculture is practised on soils that vary from 90% and to 80% clay. Established Conservation Agriculture systems obtain considerable yield in initial years of adoption and even higher than conventional intensive tillage systems in long-term. Further, the overall crop and biomass production within a season increase over time under Conservation Agriculture management compared to tillage-based management practices and upkeep soil health. It has been reported that the area planted with wheat adopting the zero-till drill has been increasing rapidly and presently 25% - 30% of wheat is zero-tilled in rice-wheat growing areas of the indo-gangatic plains of India.

Conservation Agriculture - Towards a Sustainable Agricultural Production System

1. Conservation Agriculture increases soil organic matter content and contributes in minimising the effect of global warming. It has been estimated that the global warming. It has been estimated that the total

potential for soil carbon sequestration by agriculture can reduce about 40 % of the estimated annual increase in CO2 emission (FAO, 2009)

2. Improves habitation and biodiversity of organism, from larger insects to soil-borne microorganisms, which help to improve physical, chemical and biological properties of soils.

3. Improves water infiltration and enhance groundwater recharge.

4. Minimise cost of production (15-16%) by saving energy, labour and water.

5. Improving nutrient and water use efficiency through crop residue incorporation / retention and decomposition increases recycling and availability of plant nutrients.

6. Use surface residues as mulch to control weeds, moderate soil temperature, reduce evaporation and improve biological activity.

Constrains for the Adoption of Conservation Agriculture

1. Lack of appropriate seeders especially for small and medium scale farmers although efforts have been taken to promote machinery for seeding in no-till systems.

2. The widespread use of crop residues for livestock feed and fuel, especially under rained situations farmers face a scarcity of crop residue due to less biomass production.

3. Farmer generally prefer to sow the next crop in time by burning the residue of the previous crop, this has become usual feature for the farmers in the rice-wheat system in north India.

4. Lack of knowledge about the potential of Conservation Agriculture to agriculture as well as to environment.

5. Lack of skilled and scientific manpower for managing Conservation Agriculture systems.

Conclusion

Conservation Agriculture offers a new paradigm for agriculture research and development. The adoption of Conservation Agriculture can be facilitated by locally identified and specially trained group leaders or by promoters. There is also a need to strengthen the knowledge and information sharing mechanisms. So, to get a sustainable agriculture production system maintaining good soil health by performing Corbon sequestration, minimising the effect of global warming by curbing CO2 emission from soils, obtaining profitable yield in cost-effective way, Conservation Agriculture is the only option in the present scenario.

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Bacterial Stalk Rot of Sorghum: Recent Occurrence and its Management in India

Article ID: 31008

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Introduction

Sorghum (*Sorghum bicolor* [L.] Moench) also called Indian millet, great millet, milo, durra, orshallu is a C4 cereal grass and belongs to the family Gramineae. The crop is hypothesised to have originated in Africa some 3000–5000 years ago. Sorghum is the fifth most produced grain globally in the world after maize, rice, wheat and barley with world sorghum production at 63 million tons in the 2016/17 season.

In India, sorghum is grown during the rainy kharif (June–October) and post-rainy rabi (September–January) seasons with over 90% of production purely rain-fed. Kharif sorghum, a yellow grain, is grown on over 53% of the production area and it accounts for 63% of production. Sorghum cultivation is challenged by several diseases caused by plant pathogens including fungi, bacteria and viruses.

In response to the climate change there are dramatic shift in diseased severity and pathogen behavior; minor pathogen emergence as destructive one (Garrett *et al.*, 2006). In particular Pokkah boeng (*Fusarium moniliforme* var *subglutinans*), and bacterial stalk rot (*Erwinia chrysanthemi*) have emerged as potential risk in certain sorghum growing areas during last few years.

Pokkah boeng is more or less regular in Maharashtara and northern Karnataka, while bacterial stalk rot is restricted to terai regions in India. The bacterial stalk rot of sorghum caused by *Erwinia chrysanthemi* Burkholder, McFadden, and Dimock is one of the most destructive diseases of sorghum crop. Saxena *et al.* (1991), reported this bacterium causing stalk and top rot of sorghum under natural conditions in India during 1987-88 crop season in sorghum field at Pantnagar, Uttarakhand.

The disease was wide spread affecting 60-80% of plants in different sorghum genotypes. Recently, Kharayat and Singh (2013) have also recorded the occurrence of disease incidence ranging from 7.50 to 46.85 % in Tarai region of Uttarakhand.

History

Dickeya dadantii (syn. *Erwinia chrysanthemi*, *Pectobacterium chrysanthemi*) (Samson *et al.,* 2005) is a plant pathogenic enterobacterium responsible for soft rot diseases in a wide range of plant species. However, variable pathogenic and phenotypic properties were notice from strains of different host plants have.

The genus *Erwinia* is named after Erwin Frank Smith and was established by Winslow *et al.* (1917) to include in plant pathogenic entereobacteria. Erwinia are motile by peritrichous flagella, usually 8-11 flagellate (Dickey, 1981), gram-negative, non-spore forming, straight rod with rounded ends, and occurs singly or in pairs. Size of *Erwinia* ranges from 0.8-3.2 × 0.5-0.8 µm (average 1.8 × 0.6 µm) depending on carbon source present in the medium and growth conditions (Grula, 1970).

In India, *Erwinia chrysanthemi* causing stalk and top rot of sorghum under natural conditions was reported during 1987-88 crop season in sorghum field at Pantnagar, Uttarakhand (Saxena *et al.*, 1991).

Symptomatology

The initial symptom is discoloration of the leaf sheath and stalk at a node. As the disease progresses, lesions develop on the leaves and sheath. Disease then develops in the stalk and rapidly spreads up the stalk and into the leaves. Lower leaves and leaf sheaths covering the internodes are chlorotic, and the rind is pale-straw instead of green in color.

The disease mainly affects sorghum stem showing water-soaked symptoms that later turn reddish dark brown colour. The infected stem pith is disintegrated and show slimy soft-rot symptoms with foul-smell and eventually the whole plant wilts (Hseu et al., 2008). The rot may involve only one or two internodes, or the entire length of the stalk, which finally dries up and its interior turns into a shredded mass of fibrous tissue.

Fig.1 Slimy soft rot on stem of sorghum infected by *Dickeya dadantii*.

Geographical Distribution and Economic Importance

E. chrysanthemi is pathogenic to a wide range of tropical and sub-tropical crops of diverse botanical families including ornamentals, as well as on greenhouse-grown crops in temperate regions. Only one species of bacteria, *Erwinia chrysanthemi* pv.*zeae* has been reported to cause stalk rot in sorghum (Saxena *et al.,* 1991).

It is a very aggressive pathogen that can cause death of the plant within two or three days after the appearance of initial symptoms, a brownish lesion in the infected area. Stalk rot is one of the most prevalent diseases of sorghum in most places where the crop is cultivated. The disease appears before the onset of flowering. The conditions favourable for the development of disease are cloudy weather, frequent rainfall and high temperature up to 30ºC. Disease incidence ranging from 7.50 to 46.85% in Tarai region of Uttarakhand has been also been reported by Kharayat and Singh (2013).

The economic, biomass and grain yield losses due to rapid progress of this bacterial soft rot disease is one of the most destructive features in natural condition. Loss due to stalk rot varies from season to season across the world and yield losses up to 60% have been reported in susceptible cultivars (Pande and Karunakaz, 1992).

Disease Management

Early and accurate diagnoses of plant disease are necessary to predict outbreaks and allow time for development and application of mitigation strategies. Clean cultural practices can be adopted to avoid the spread of disease from infected plant to healthy plant.

Studies on antagonists found *Trichoderma harzianum* and *Pseudomonas fluorescens* effective in inhibiting the mycelial growth of *Erwinia chrysanthemi* causing bacterial stalk rot of sorghum (Kharayat, 2013). Moreover, biocontrol agents colonized vermicompost has shown considerable potential not only in improving plant growth and suppression of stalk rot severity but also in increasing earthworm population in soil when used as pre plant soil amendment.

T. harzianum isolate Th-2 colonized vermicompost reduced the disease severity of bacterial stalk rot and increase of biomass yield of sorghum (Kharayat and Singh, 2016). Pre-plant soil application with antibiotic oxytetracycline and pre-plant soil application with two foliar sprays of *P. fluorescens* strain Psf-173 was found to reduce disease severity (Singh *et al.*, 2018).

Conclusion

Bacterial stalk rot caused by Erwinia chrysanthemi is emerging as a serious disease of sorghum in Tarai region of Uttarakhand. Due to the climate change there are dramatic shift in diseased severity and pathogen behavior where minor pathogen emergence as destructive one. High disease incidences (7.50 to 46.85%) recorded recently indicates threat to sorghum cultivation.

Some strains of Trichoderma, Pseudomonas and antibiotic oxytetracycline have been found effective against the disease. More research can be focus on the host-pathogen interaction, virulence pattern, variability and biochemical and molecular aspects of pathogenesis.

Integrated disease management practices including disease resistance, potential biocontrol agents and biodegradable chemical molecules couple with decision support system is needed to formulate effective management of the disease.

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Advanced Production Techniques in Manila Tamarind *(Pithecellobium dulce)*

Article ID: 31009

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Introduction

Pithecellobium dulce is a main member of the family Fabaceae and native to Mexico, South America, and Central America. It is introduced in Indonesia and Philippines by Portuguese and Spaniards, respectively. It is common in India, Malaysia and Thailand. In India, it is distributed throughout the country, however the plantations have been made in northern states as forest species and in Andaman Island as food tree.

The plant growing naturally on the waste land or being planted at community lands are main source of edible fruits. It is mainly grown as a hardy roadside tree or hedge plant. Its potential as a fruit has not been utilized. Leaves are browsed by horses, cattle, goats and sheep. The plants are multipurpose and are often planted as live fence or thorny hedge which is eventually thick and impenetrable. Plants when attain full size, branches become potential source of lac cultivation.

It is a very hardy and thorny tree and is small to medium sized semi evergreen tree which can be grown up to 20 m height. The crown is spreading but irregular and trunk is short (about 1 m height) with crooked branches and somewhat shiny branchlets. Bark is grey and smooth in young trees, turning to slightly rough and furrowed in old trees.

Bark exudes reddish brown gum when injured. Leaves are bipinnately compound with a pair of pinnate, each with two leaflets that are kidney shaped and dark green in colour. Spines are present in pairs at the base of the leaf. New leaf growth and shedding of old leaves occur almost simultaneously, giving the tree an evergreen appearance. It is an acrid organic fruit with a novel taste and has a broad spectrum of health benefits.

Health Benefits

1. Manages toothaches, sore gums and mouth ulcers.
2. Works as an antiseptic
3. The abundance of vitamin C in Manila tamarinds, boost the immune system immune system and reduces phlegm.
4. The bark extract is used to cure dysentery and chronic diarrhoea.
5. Its high thiamine content, promote the body convert sugars into energy, which impacts the mood and helps stabilize stress levels.
6. According to a study published in the Journal of Ethnopharmacology, Manila tamarind fruit exhibited strong anti-ulcer activity comparable to the standard drug, omeprazole.
7. A study published in the Evidence Based Complementary and Alternative Medicine found that fruit extracts protected the liver from oxidative.
8. Treats oily scalp and prevents hair loss.
9. Slow down the ageing - lightens the skin, removes dark spots, and cures acne.

Climate and Soil

In its native range, the climate is dry to semi-arid sub-tropical and tropical with mean rainfall ranging from 500 to 1000 mm. It can tolerate shade and drought conditions but susceptible to severe frost. It has been successfully planted in areas with a mean annual rainfall as low as 400 mm and with a maximum dry season of 4 to 5 months. Sweet tamarind reportedly grows well in semiarid region of India characterized by mean monthly temperature ranging from 7 to 8 0C in January and 40 to 42 0C in May and June.

Sweet tamarind is a drought hardy plant which can be grown in waste land. It tolerates a wide range of soil types including clays, rocky limestone soils, nutrient poor sand and soils with high, brackish water table. In India, the tree is reported to grow well on saline sites and on severely eroded, Montana wastelands.

Propagation

1. Propagation by seed: It is commonly propagated by seed. Seed are sown in polythene bag containing FYM, sand and Clay in equal proportion. Seed do not require scarification or other treatments for germination. Freshly harvested seed germinate easily in 1 to 2 days after sowing while dried seeds take 30-35 days for germination. Seed remain viable in storage for approximately 6 months. Seedlings raised on nursery are used for replanting after 4-6 months. Seedlings may be pricked out from the germination beds to transplant beds or polythene bags after 6 months and young plants need the shelter from dry and hot winds.

2. Propagation by vegetative method: It can be propagated through hardwood cuttings. The best time for taking cutting is in July-August and treatment with 1000 ppm IBA improves rooting. Budding, grafting and layering are also successful at limited scale.

Variety

PKM (MT) 1 (2008): It is an open pollinated seedling selection from Soolakkarai at Virudhunagar district. The best season is June – September and can tolerate sewage water stagnation and grows well in sandy, saline and alkaline soils. It is a regular bearer. The spirally twisted fruits with clear constrictions, pale yellow pods, and white attractive aril are found in clusters (2-3). The skin of fruits turns yellow at maturity and seeds turn black. It yields about 79 kg/tree/year which is 30.0% increase over local type. The highest yield obtained from this variety is 125 kg / tree / year. It can be cultivated throughout Tamil Nadu especially in the rainfed tracts of Southern districts.

Planting

It is multipurpose tree species. Its method of planting and after care differs with use. For hedge, seed are sown in 2-3 rows at 15 cm distance which develops an impenetrable fence after regular training and pruning. To develop a shelter belt, seedlings are transplanted at 3-4 m spacing around the orchard. For fruit production seedlings of Inga are planted in square system at 8 x 8 m spacing. Vegetative multiplied plants are planted at 6 x 6 m spacing. July - August is the best time for planting when the saplings are planted in the well prepared and filled pits of 60 x 60 x 60 cm. In problematic soil, pits size can be enhanced as per need.

Training and Pruning

Training is essential at initial stage to provide better frame work. As avenue plant, the tree trunk is kept clean up to 3-4 m height and then branches are allowed in all directions. It does not require regular pruning to produce fruits. *Pithecellobium* tree has fast growth rate and vigorous coppicing capacity and therefore can withstand any amount of pruning, lopping or browsing by animals. For hedge regular pruning is necessary.

Irrigation

It is hardy tree and grows very well even without irrigation. At initial stage, irrigation is required to establish the young plant. Once established, irrigation is not mandatory to produce fruits. Irrigation during summer improves fruit size and yield.

Orchard Management

Intercultural operation can be introduced at initial stage to control weeds and for better soil management. One or two weeding can be done as per needs.

Mulching

Manila tamarind is hardy and drought tolerant plants, however, paddy straw, dry banana leaf etc. can be used as mulch beneath the tree canopy. Black polythene mulch is very effective to conserve soil moisture.

Intercropping

Inter crops such as coffee, tea, cacao, cardamom can be taken under humid tropical conditions and other seasonal inter crops like cow pea, brinjal, can be grown at initial stage of manila tamarind.

Mineral Nutrition

The systemic information on nutritional requirement of manila tamarind is not available since the existing plantations are mainly in shelter belts and road side plantations where nutrients are generally not applied. However, application of 50 kg FYM during monsoon improves fruit set, fruit size and yield in a bearing tree. Application of 40-50 kg FYM and 500 g phosphatic fertilizer per tree has been found beneficial. Fertilizers should be applied during February-March and July-August and light irrigation should be given after application of fertilizers.

Insect Pests

1. Shoot hole borer cause damage by making holes in the trunk which can be controlled by plugging cotton swabs soaked in petrol/kerosene.
2. It is favourite host for thorn bug.
3. It has also been reported to be a host for lac insects.

Diseases

Plants are severely affected by leaf spot diseases. Fungi such as *Fusarium semitechim* var. majus, *Rhizoctonia* spp., *Colletrotrichum* spp., have been found on the manila tamarind. These can be managed by spray of fungicides. Trees are also affected by mosaic virus witches' broom.

Harvesting, Yield, Post-Harvest Management and Storage

Ripe fruits are manually harvested when peel colour turns from green to pink or when pulp becomes pinkish in colour. However, climbing on the tree is a risk because tree has thorny stem and branches. To harvest the fruits from a tall (10-15 m) tree, thin and long bamboo poles having a sharp pruning knife (skeel) fixed at the top of it, is used for harvesting. Harvested pods are separated from the twigs and packed in bamboo baskets and wooden basket for marketing. Fruit can be stored for a few days at room temperature. The pulp is extracted from the pods by removing the peel and seeds. Fresh fruits are eaten. The fruits do not store for long and must be eaten within a few days. The yield is about 11.85 t/ha.

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Diseases of Citrus and their Management

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Introduction

The genus citrus is one of the most important groups of fruit crops worldwide, belongs to the family Rutaceae comprising 140 genera and 1300 species distributed throughout the world. Citrus occupies an important place in the horticulture wealth and economy of India as the third largest fruit industry after banana and mango. India ranks sixth in the production of citrus fruit in the world.

Citrus fruits originated in the tropical and subtropical regions of south East Asia particularly in India and China. In 2015-16, total area under citrus in India was 923 thousand ha and production were 11,742 thousand metric tonnes respectively. In Maharashtra, total area was 108 thousand ha, with a production of 904 thousand metric tonnes (Anonymous, 2016).

Gummosis

Phytophthora parasitica, P. palmivora,P. citrophthora

Pathogen: Aseptate, intercellular & intracellular hypha. Sporangia are ovoid or ellipsoid. Sporangium attached with the sporangium at the right angles' sporangia germinate to release zoospore.

Favourable conditions: Prolonged contact of trunk with water as in flood irrigation; water logged areas and heavy soils.

Mode of Spread and Survival: Soil inhabitants, Sporangia spread by splashing rain water, irrigation water and wind.

Management: Preventive measures like selection of proper site with adequate drainage, use of resistant rootstocks and avoiding contact of water with the tree trunk by adopting ring method of irrigation are effective. Alternatively, the disease portions are scraped-out with a sharp knife and the cut surface is disinfected with Mercuric chloride (0.1%) or Potassium permanganate solution (1%) using a swab of cotton. Painting 1 m of the stem above the ground level with Bordeaux helps in controlling the disease. Also spraying and drenching with Ridomil MZ 72@ 2.75 g/l or Aliette (2.5 g/l) is effective in controlling the disease.

Scab / Verucosis

Elsinoe fawcetti

Symptoms: The lesions in early stages appear on the underside of the leaves as small semi-translucent dots, which finally become sharply defined pustular elevations. In later stages, leaves often become distorted, wrinkled, stunted and deformed. On the fruit, lesions consist of corky projections, which often break into scabs. The opposite surface corresponding to the warty growth shows a circular depression with a pink to red centre.

Pathogen: Ascostroma are simple, innate, intra or sub epidermal, partially erumpent at maturity, small pulvinate to crustose. Asci are ovoid. Ascospares are 1-3 septate oblong to elliptical and hyaline to yellowing conidia are produced in acervuli. Conidia are hyaline, ablong, elliptical with two-minute droplets of their ends.

Mode of Spread and Survival: The pathogen survives in off season as ascospores and spreads through Conidia.

Management: The diseased leaves, twigs and fruits should be collected and destroyed. Spraying of Carbendazim 0.1% is quite effective.

Canker

Xanthomonas campestris pv citri

Symptoms: Acid lime, lemon and grapefruit are affected. Rare on sweet oranges and mandarins. Affects leaf, twig and fruits. In canker, leaves are not distorted. Lesions are typically circular with yellow halo; appear on both sides of leaf, severe in acid lime (difference from scab) When lesions are produced on twigs, they are girdled and die. On fruits, canker lesions reduce market value.

Pathogen: It is Gram negative, non-spore forming, aerobic bacteria. It is rod shaped, forms chains and capsules and is motile by one polar flagellum.

Favourable conditions: Free moisture for 20 minutes, 20-30°C. Mode of survival and spread Wind and rain splashes. Survives in infected leaves for 6 months. Injury caused by leaf miner helps the entry of the bacterium.

Management: Streptomycin sulphate 500-1000 ppm; or Phytomycin 2500 ppm or Copper oxychloride 0.2% at fortnight intervals. Control leaf miner when young flush is produced. Prune badly infected twigs before the onset of monsoon.

Tristeza or Quick Decline

Citrus tristeza virus (CTV)

Symptoms: Lime is susceptible both as seedling or buddling on any root stock. But mandarin and sweet orange seedlings or on rough lemon, trifoliate orange, citrange; Rangpur lime root stocks tolerant; susceptible root stocks are grapefruit and sour orange. In sweet orange or mandarin on susceptible root stocks, leaves develop deficiency symptoms and abscise. Roots decay, twigs die back. Fruit set diminishes; only skeleton remains. Fine pitting of inner face of bark of sour orange stock. Grapefruit and acid lime are susceptible irrespective of root stock. Acid lime leaves show large number of vein flecks (elongated translucent area). Tree stunted and dies yield very much reduced. Fruits are small in size. Use of infected bud wood and *Toxoptera citricida* (aphid) is the important vector.

Pathogen: Citrus tristeza virus is long, flexuous rod and measure 2000x 12nm in size. Three strains viz., mild, severe and seedling yellow are reported.

Mode of spread: Use of infected bud wood *Toxoptera citricida* (aphid) is the important vector.

Management: For sweet orange and mandarin, avoid susceptible root stocks. For acid lime, use seedling preimmunised with mild strain of tristeza.

Exocortis of scaly butt: Viroid.

Symptoms: Affects only Rangpur lime, trifoliate orange and citrange root stocks. Vertical cracking and scaling of bark in the entire, root stock. Extreme stunting of plant. Pathogen Viroid is free RTVA without protein coat.

Mode of Spread and Survival: Transmission normally occurs through infected bud, wood, and contaminated tools. Not through vector and seed.

Management: Spray with any one of the systemic insecticides to control the aphid vector. Use virus-free certified bud wood; use tolerant stocks like rough lemon Periodically wash budding knife with disodium Phosphate solution.

Greening

Liberobactor asiaticum (Phloem limited bacteria)

Symptoms: This disease affects almost all citrus varieties irrespective of root stock. Stunting of leaf, sparse foliation, twig die back, poor crop of predominantly greened, worthless fruits. Sometimes only a portion of tree is affected. A diversity of foliar chlorosis. A type of mottling resembling zinc deficiency often predominates. Young leaves appear normal but soon assume on outright position, become leathery and develop prominent veins and dull olive-green colour. Green circular dots on leaves. Many twigs become upright and produce smaller leaves. Fruits small, lopsided with curved columella. The side exposed to direct sunlight develops full orange colour but the other side remain dull olive green. Low in juice and soluble solids, high in acid. Worthless either as fresh fruit or for processing. Seeds poorly developed, dark coloured, aborted.

Pathogen: Rickettsia like organism

Mode of spread: Infected budwood; psyllid vector-*Diaphorina citri*

Management: Control psyllids with insecticides. Use pathogen free bud wood for propagation. 500 ppm tetracycline spray, requires fortnightly application.

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Synthetic Wheat: A New Hope in Plant Breeding

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Introduction

Wheat is the chief staple food crop in several parts of the world in terms of the area cultivated as well as a food source. The farming of wheat is geographically distributed in such a plentiful manner that the crop is being reaped in one or another country all around the whole year.

It is a C3, self-pollinated crop belonging to the tribe Triticeae, under the family "Poaceae" of the plant kingdom. In the year 2017, about 771 million tons of wheat was harvested worldwide. In India, over 98 million tons of production was recorded in 2017. About 40% of the global population is fed by wheat. The Synthetic wheat is created by artificially hybridizing Durum wheat (T. *turgidum* ssp. durum; 2n=4x=28, AABB) with accessions of Ae. tauschii (syn Ae. *squarrosa*, T.tauschii; 2n=2x=14, DD).

It offers new resources for the yield potential, tolerance to drought, resistance of diseases, and nutrient-use efficiency. McFadden and Sears, in the year 1944, first reported about the artificial synthesis of hexaploid wheat.

5 Reasons Why to Pick Synthetic Wheat?

1. To explore novel genes like the grain hardness gene or the high molecular weight glutenin subunits (HMW-GS).
2. To establish genetic diversity into common wheat.
3. To use as bridge species to transfer major disease-resistance genes from tetraploid wheat and *Ae. tauschii* to common wheat.
4. To develop introgression lines (ILs).
5. For further genetic studies.

Production of Synthetic Hexaploid Wheat

1. An interspecific cross between *Ae. tauschii* and *T. turgidum:* First, we have to cross *Triticum turgidum* (AABB) and *Aegilops tauschii* (DD) to produce the F1 hybrid (2n=3x=21, ABD). Then through chromosome doubling of this F1 hybrid, we get the SHW *i.e.* Synthetic hexaploid wheat (2n=6x=42, AABBDD).

2. Direct cross for genetic transfer from diploid *Ae. tauschii* into hexaploid wheat: In this approach, first, we have to cross Hexaploid wheat (2n=6x=42, AABBDD) with *Ae. tauschii* (2n=2x=14, D^tD^t) to obtain F1 hybrid ($ABDD^t$) utilizing embryo rescue technique. Now, we have to backcross Hexaploid wheat with this F1 hybrid to get wheat with genome constitution $AABBD/D^t$). Then we have to backcross it again with the Hexaploid wheat and self the resultant to obtain the final Synthetic hexaploid wheat (2n=6x=42, $AABBD/ D^t$). No colchicine treatment is essential in this approach. But, Segregating of the D genome, and exhibiting instability as a consequence of aneuploidy, potentially make the genetic analysis more difficult- which is a major disadvantage of this approach.

3. Direct Cross of Tetraploid Wheat to Common Wheat: In this strategy, we achieve the F1 hybrid by crossing the Hexaploid wheat (2n=6x=42, AABBDD) and *Triticum turgidum* (2n=4x=28, AABB). Then we backcross it with Hexaploid wheat (AABBDD) and self the obtained progeny for a few generations (BC1Fn) to achieve the SHW (AABBDD).

Current Strategies for Utilizing Synthetic Hexaploid Wheat in Breeding Programs

1. Direct Phenotyping: For the genetic variation of insect or disease resistance and tolerance to an array of abiotic and biotic stresses, SHWs are evaluated.

2. Genetic Analysis via Crosses and Backcrossing: In this approach, 2 schemes are used:

a. The screening and identification of SHW with the characteristic features which are desired.

b. Backcrossing to elite cultivars for the aim of generating "Synthetic derived backcrossed bread wheat lines (SBLs)".

3. Advanced Backcross-Quantitative Trait Loci (AB-QTL) Analysis: It helps in the simultaneous revealing of QTL and the development of improved breeding lines. To identify exotic alleles superior to the elite alleles, unadapted germplasm is used from the wild species.

4. Development and Use of Introgression Lines (ILs) or Substitutions Lines: An IL set symbolizes the whole or nearly complete genome of a wild species in the homogeneous background of an elite cultivar (Zamir 2001). One major advantage of this is that it assesses the effect of introgressed segments in diverse target recipient backgrounds.

Table1. Impact of Synthetic Hexaploid in Wheat Improvement in Disease and Pests Resistance

Biotic Stress	Disease or Pest	Source of Resistance
Rust	Leaf Rust	*Ae. tauschii* Synthetic Hexaploid *Ae. tauschii* (*Lr21, Lr39*)
	Stem Rust	Synthetic Hexaploid *Ae. tauschii* Synthetic Hexaploid *Ae. tauschii* Synthetic Hexaploid
	Stripe Rust	Both parents of SH Synthetic Hexaploid
Nematodes	Cereal Cyst Nematode	Synthetic Hexaploid (*Cre3*)
Virus	Barley Yellow Dwarf	Synthetic Hexaploid
Leaf Spot Diseases	Septoria tritici blotch	Synthetic Hexaploid (*stb5*)
Insects	Hessian Fly	Synthetic Hexaploid (*H22, H23, H26, H32*)

Table 2. Some Released Synthetic Wheat and Derived Cultivars for Breeding Along with Country and Year.

Variety name	Country	Year
Shumai 830	China	2017
Tirgan	Iran	2017
PBW 677	India	2016
Kenya Hornbill	Kenya	2016
Bacorehuis F2015	Mexico	2015
Sarvar	Tajikistan	2014

Conclusion

We can conclude that synthetic wheat is another light in the science of plant breeding with an immense range of potential from exploring novel genes to develop introgression lines (ILs). It offers new resources for the yield potential, tolerance to drought, resistance of diseases, and nutrient-use efficiency. Further studies are recommended to dig up more potentiality of this approach.

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An Alien Pest of Maize – Fall Army Worm

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Introduction

Maize is known as the queen of cereals. In India, this is the third most important crop grown after rice and wheat. Maize is primarily grown throughout the year, especially 85% of maize is grown in kharif season. It is hampered by a numerous borers and sucking pests. Recently, there is an introduction of a lepidopteran borer into our country which is a devastating pest native to America, which is causing severe Economic damage. In India it is first observed in Shimogga, Karnataka.

Fall army worm: *Spodoptera frugiperda* (Noctuidae, Lepidoptera).

It is a polyphagous pest. Adult moth is a strong flier, can fly over 100 km in search of host plants.

Identification and Life Cycle

Males and females can be distinguished based on markings. Male moth has two characteristic marking that is a fawn coloured spot towards the centre and a white patch at the apical margin of forewing. Female is dull with faint markings. Usually a female moth lays over 100 eggs in single or multiple clusters covered with hairs.

Newly borne larvae in groups disperse from hatching site and reach to feed on epidermal layers of lower surfaces of young leaves. Larvae has 6 instars and then undergo pupation. Pupa is reddish brown in colour and takes 7-8 days to emerge into adult moth. Adult moth can survive 3-6 days.

The total life cycle takes 30-34 days. FAW larvae appears in shades of green, olive, tan and grey colour with four black spots in each abdomen segment. The head has a prominent white, Y inverted shape suture between the eyes.

Damage Symptoms and Control

1. Stage of symptom progression indicate the stage of larval growth.
2. The stage of larval growth decides the choice of pesticide/ control measures.

Presence of elongated papery windows: Start observing the maize crop from seedling stage. This type of damage is caused by 1st and 2nd instar FAW scraping on leaf surface.

At this stage,
1. Spray 5% NSKE or Azardiractin 1500 ppm @ 5 ml/ lit.
2. Application of Bt.var.kurstaki (Dipel 8l @ 2ml/lit of water.

3. Entomopathogenic fungi *Metarhizium anisopliae* (1x 108 cfu/g) @ 5g/lit.

When there is 10% damage in the field, it is better to resort to chemical pesticides which are recommended below for bigger larvae. Apart from pesticides sprays, put some sand/soil alone or mixed with lime/ash (9:1) into plant whorl. Ragged-edged holes are formed when larvae enter 3rd instar larvae. Spray application of Emamectin benzoate 5SG @0.4g/lit and Chlorantriniprole 18.5 SC @ 0.4 ml/lit proved effective against this pest. When larvae enter 5th instars, loosing larger portions of leaves whereas 6th Instar extensively defoliates leaves and produces faecal matter.

Hence, choosing a variety with tight husk and husk covering the tip offer some protection. Few other control measures include:
1. Intercropping of maize with suitable pulse crops. E.g. Maize + Pigeon Pea.
2. Use of Napier grass as trap crop.
3. Erect bird perches @10/acre.
4. Hand picking of egg masses larvae.
5. FAW pheromone traps @ 5/acre.

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Technologies of Composting Organic Wastes

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Composting is a process of allowing organic materials to decompose more or less controlled conditions to produce stabilized product that can be used as a manure or soil amendment. Composting is basically a microbial process, which change the property of the organic material or mixtures.

Crop Residue Composting

1. Collect the available crop residues and weeds.
2. Shred them to a size of 2 to 2.5 cm length.
3. Mix these wastes with green residues (freshly collected), if available.
4. Form the compost heap (4 feet height).
5. Add the bio-inoculants (2 kg of bio-mineralizer or 40 kg of cow dung for 1 tonne of waste).
6. Properly aerate the compost either by providing perforated PVC pipes or by mechanical turning.
7. Maintain the moisture at 60 % by regular watering.
8. The compost will mature in 60 days.

Vermi-Composting

Vermicomposting is a process of degradation of organic wastes by earthworms. The species like *Eisenia foetida* and *Eudrilus eugeniae* are effective in converting the agricultural wastes into compost. The various steps involved in making vermicompost are as follows.

Methods followed:

1. Heap method.
2. Pit method – aboveground and belowground.
3. Belowground method pit size : 10 X 1 X 0.3 m.
4. Each layer : 6-7cm thick.
5. Sprinkle water once in 8-10 days.
6. Release : 2-2.5 kg worms / pit.

Steps: Collect the predigested wastes and mix cattle dung @ 30 %. Place it in the pit/container layer by layer. Moist the residues at 60 % moisture Allow the verms in to the feed material / residues @ 1 kg/ tonne of residue Protect the pit or container from ants and rats (which are the enemies of verms). The residue will be composted in 30 to 40 days Remove the composted materials layer by layer at a weekly interval so as to avoid any damage /disturbance to the feeding verms.

Coirpith Composting

Coirpith is an agricultural waste produced from the coir industry. Approximately 180 grams of coirpith is obtained from the husk of one coconut.

Coirpith contains Carbon: Nitrogen in the ratio of 112:1 and contains 75 per cent lignin which does not permit natural composting as in other agricultural wastes. Mushroom Pleurotus has the capacity to degrade part of the lignin present in coirpith by production of enzymes like cellulases and lactases. The carbon: nitrogen ratio of coirpith is reduced from 112:1 to 24:1 as a result of composting.

Composting of Crop Residues and Weeds

Composting is one of the useful ways for utilizing the some of the weeds and noncommercial plants like Parthenium, Water hyacinth, lpomoea etc. instead of their eradication. The plants can be composted using Trichoderma viridi and Pleurotus sajorcaju as a microbial consortium with supplementation of urea. Select an elevated shady area of a thatched shed and mark an area of 5x1.5 meter. Cut the composting materials into 10 – 15 cm size. Spread 100 kg of these materials over the marked area. Sprinkle 1 bottle of microbial consortia over this layer. Again, spread another 100 kg of composting materials over this layer. Spread 1 kg of urea uniformly over this layer. Likewise repeat these processes of spreading composting materials, until a minimum of 1-meter height is reached. Sprinkle water to attain a moisture level of 50% to 60%. The surface of the heap is covered with a thin layer of soil. Water should be sprinkled depending upon the necessity to maintain the moisture around 50%. The bio-converted compost will be ready in about 40-days' time.

Method of Composting the Municipal Solid Wastes

Biodegradable municipal solid waste should be separated and collected for composting. Five hundred kg of material should be heaped in the compost yard. In that heaped waste, 1 kg of TNAU microbial consortium should be applied in the form of slurry to cover the full waste material. This 1 kg microbial consortium can be mixed with 5 litres of water to make slurry. This slurry is sufficient to cover 0.5 tonne of material Then, 50 kg of cow dung should be mixed with 30 litres of water to form cow dung slurry. This cow dung slurry should be sprayed over the heap of municipal solid waste Then, 1 kg of urea should be mixed with solid waste. 60% moisture should be maintained throughout the period of composting. Compost should be turned up once in 15 days to create good aeration, and for thorough mixing. Because of this practice, a uniform composted material will be obtained. Solid waste can be composted within 90 days wanted and partially composted material.

Value Addition of Poultry Waste

A known quantity of poultry droppings and coir pith @ 4:5 ratio should be mixed well to attain a C/N ratio of 25:1 to 30:1 which is considered to be the optimum C/N ratio for compositing. Pleurotus sajor-caju, a lignocellulolytic organism, should be inoculated into the mix @ 2 packets per tonne of waste in order to speed up the composting process. The mix should be heaped under the shade. The moisture content of the mix should be maintained within 40 – 50%. Periodical turning should be given on 21st, 28th and 35th day of composting. Another two packets of Pleurotus sajor – caju is to be added when turning is given on the 28th day of composting. A good quality compost will be obtained in 45 days.

Enriched Farm Yard Manure (EFYM) / Reinforced FYM

Phosphorus content in FYM is relatively low and complete utilization of nitrogen and potassium in the manure is seldom realized. Hence, heavy quantities intended to supply the needed quantity of phosphorus will result in wastage of nitrogen in most soils. To overcome this P insufficiency, addition of superphosphate to the manure is recommended and the process is called reinforcing / enriching and the resultant material is called "enriched farmyard manure". The Single Super Phosphate (SSP) can be sprinkled either in the cattle shed or on the manure heap. Rock phosphate can also be recommended for this purpose.

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Stem Weevil: The Biggest Threats to Passion Fruit Growing Farmers of Kodaikanal Hills

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Introduction

Kodaikanal hills located on a plateau above the southern escarpment of the upper Palani Hills at 2,133 metre, between the Parappar and Gundar Valleys. This region farmers were cultivating temperate fruits and this region was consider as one of the highest productions of warm temperate fruit crops viz., Apple, Peach, Pear, Plum, Avocado and Kiwi in Tamil Nadu. In the hills of kodaikanal, the passion fruit tree tenders' leaves are used for medicinal purpose.

This fruit is mainly consumed as a juice rather than fresh table fruit. Unfortunately, there are so many hurdles like biotic and a biotic factor for the farmers which who are all cultivating passion fruits. Among biotic factors, insect pests pose a challenge to the efficient horticultural fruit production especially in temperate region. Recently, the coleopteran pest stem weevil, *Philonis* spp. causing damage to the passion fruits and farmers facing hardship due this pest.

Passion Fruit

The passion fruit is one of the oldest fruits grown since centuries and this fruit belongs to the family of "Passifloraceae". The passion fruit is native to Brazil and in India, it is grown in the parts of Western Ghats (Coorg, Nilgiris, Kodaikanal, Malabar, Wynad and Shevroys). This fruit is commercially cultivated in Kodaikanal hills.

Due to its aroma and flavouring property, this fruit is used to produce a quality squash along with excellent nutritious juice. The passion fruit juice is used in preparation of ice creams, cakes and pies. The passion fruits are nearly round to oval shape and this tree vines are perennial, shallow rooted, woody and climbing by means of tendrils

Varieties and Climate

The most popular cultivated varieties are yellow, purple and giant granadilla. The flowers are single and fragrant, 5-7.5 cm wide and borne at a node on the new growth. Fruits are dark-purple or yellow, rounded or egg shaped and contain numerous small, black wedge-shaped seeds that are individually surrounded by deep orange coloured sacs that contain the juice, the edible part of the fruit.

Passion fruit develops well in tropical and subtropical regions, where the climate is hot and humid. Temperature, relative humidity, light intensity and precipitation have important influence on the longevity and the yield of the plants, but also favour the incidence of pests and diseases.

Insect Pests of Passion Fruit

Passion fruit is attacked by several pest species of insects and mites that feed upon all parts of the plant. A limited number of species are clearly of major economic importance. Few have key pest status, while some species are secondary pests because they are sporadic or occur at low population levels and therefore do not require control strategies:

1. Aphids: *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover) and *Macrosiphum solanifolii* Thomas (Hemiptera: Aphidae.

2. Mealy bugs: *Planococcus citri* Risso, *Planococcus pacificus* Cox (Homoptera: Pseudococcidae).

3. Fruit flies: *Bactrocera latifrons*, *B. dorsalis*, *B. cucurbitae* (Diptera: Tephritidae)**.**

4. Scales: *Coccus hesperidum* Linnaeus (Hemiptera: Coccidae), *Aonidiella aurantii* (Maskell) (Hemiptera: Diaspididae)**.**

5. Mites: *Brevipalpus phoenicis* (Geijskes) (Trombidiformes :Tenuipalpidae), *Tetranychus mexicanus* (McGregor) and *T. desertorum* Banks (Acari: Tetranychidae).

Even though sucking pests are dominating defoliators in passion fruit. In the case of kodai region the defoliators attack was more in passion fruit particularly stem weevil causing high damage level damage to the farmers of kodai region.

Stem Weevil

The stem weevil, (*Philonis* spp.) is included in the Curculionidae family. They are nocturnal. Adults of *P. passiflorae* are about 7 mm in length, brown with whitish elytra with two brown stripes. Adults of *P. crucifer* are 4 mm in length, brown with black markings.

Damage Symptoms

1. Grub of *Philonis* spp. feed within the stems, opening longitudinal galleries inside stems that prevent plant development.
2. The attacked stems are easily identified by the presence of excrement and sawdust (Santos and Costa, 1983).
3. As the grubs develops, infested stems become weak, frail and die. Simultaneously attack of several larvae is characteristic of weevil infestations, which causes hypertrophy in stems where the pupal cell will be constructed.
4. Attack by the stem weevil also causes fruit drop before maturation.

Stem weevil

Healthy fruit

Due to stem weevil

Stem holes treated with insecticide

Management

1. Periodic inspection of the crop is essential for an early detection of weevil-infested stems.
2. Infestation symptoms are detected on the crop, affected stems should be pruned and burned from the garden.
3. Basal application of FYM 25 t/ha and 250 kg/ha of neem cake and contact insecticide should be applied during early afternoon hours for stem weevil control, at the time of adult emergence.
4. After 4–5 days, systemic insecticides for control of future stem infestations should be used. Direct spray into foliage and vines with sufficient volume and pressure to wet the plant thoroughly. Do not apply sprays 3 days before harvest.

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Suitable Use of Technologies in Dairy Enterprises for Women Empowerment

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Rural women are not only engaged in routine household work as wives and mothers but also significantly contribute to family income through their productive family labour of looking after the dairying part of the mixed agricultural farming enterprise round the year. They can enhance their day-to-day family income by increasing the productivity of their milch animals through the optimum use of technical inputs and services made available at their doorstep at a reasonable cost through their own village cooperative.

By adopting modern tools and technologies they can reduce drudgery and save time. This further enhances the working capacity, saves a lot of energy, increases work efficiency and income of the farm women

Introduction

Woman empowerment is the process of building a woman's capacity to be self-reliant and to develop her sense of inner strength. Dairying in India is a female dominated enterprise. It is established beyond doubt that women always participated in dairy and animal husbandry activities in addition to their daily household chores.

Women spent more time than men in dairy production activities. Women spent about 294.34 min. daily in different dairy farm activities like feeding, watering, milking, housing, breeding, animal health care and marketing (John Christy and Thirunavukkarasu, 2002). The time spent by women was maximum in case of collection of fodder (254.68 hr/year), because cutting and collecting activity was performed only fortnightly and the amount of fodder required for the cattle was brought twice a week (Kishtwaria et al., 2009).

Women spend 2.2 hours/day/household in animal care activities. Men contributed about 50 per cent of the labour involved in grazing activity only. All other activities such as cleaning shed, milking, harvest and transport of grass for livestock was performed exclusively by women (Johnson et al., 2013). Rural women spent more time in most of dairy activities as compared to men.

Women Empowerment

Rural women are not only engaged in routine household work as wives and mothers but also significantly contribute to family income through their productive family labor of looking after the dairying part of the mixed agricultural farming enterprise round the year. They can enhance their day-to-day family income by increasing the productivity of their milch animals through the optimum use of technical inputs and services made available at their doorstep at a reasonable cost through their own village cooperative.

A study indicates that 71 percent households (92 percent of milk producing households), utilizes the technical inputs provided by the cooperatives. They are also apprised of the various aspects of scientific animal husbandry and indirectly become conscious of their own social welfare regarding family health, nutrition, family planning etc., which leads to the technical modernization of rural society.

Suitable Technologies Used by Rural Women in Dairy Enterprises

In dairy, most of the activities are performed by women. So, it is necessary to make use of such modern technologies that reduce drudgery, are less time consuming, and pose no ill effect on the health of cattle or even women.

Such as use of butter churner, production of compost instead of making dug cakes, use of wiper for lipai of cow dung instead of doing it by hand, use of pumps instead of manual milking, administration of urea molasses mixture in the cattle feed, use of solar water heaters for cleaning of animals and animal shed, knowledge and awareness about cattle vaccination and home remedies in case the cattle is suffering from any disease from experts and also have knowledge about high breeds of cattle. Lastly, women should use the milk and milk products for not only household consumption but also do marketing to increase their socio-economic status and hence contribute to the national economy.

These are some tools and technologies by which women can save their time and energy. It can improve cattle health and can increase the production also. These are following.

Name of the Technologies

1. Milk collection accessories.
2. Stainless steel milk funnel.
3. Stainless steel milk measures.
4. Stainless steel milk samplers.
5. Laminar air flow cabinet.
6. Water baths.
7. Milk analyser.
8. Milk cans.
9. Butter churner.
10. Lacto meter.
11. Cream separator.
12. Chaff cutter.
13. Milk pasteurizer.
14. Milking machine.
15. Revolving stool.
16. Trolley for disposing of animal dung.

				
Milk bucket	**Milk funnel**	**Milk measures**	**Milk samplers**	**Milk pasteurizer**
				
Air flow cabinet	**Water bath**	**Milk analyzer**	**Milk cans**	**Milking machine**
				
Butter churner	**Lacto meter**	**Cream separator**	**Chaff cutter**	**Revolving stool**

Conclusion

In today's world almost all agriculture, dairy and household equipment that are being designed and developed are based on the end user whether the male or the female will use it. Such technologies are being adopted that are familiar to the user, easy to adopt, reduce drudgery and are also time saving.

This further enhances the working capacity, saves lot of time and energy and increases working efficiency of the farm women. Reduced time taken to do a particular work gives the home maker some time for leisure and this entire time she can use to improve her mental and physical health. Farm women have to play a dual role in agriculture and dairy along with caring of children and household chores.

She is so occupied in all these activities that she cannot afford to think of her own self. She does not have time to do any other activity for her personal earning. But, on the contrary, women in urban areas live a completely different life just because they use modern technologies and drudgery reducing equipment. It can be said that if women start using modern drudgery reducing technologies in dairy sector, they can run it as a profitable enterprise.

Therefore, it is necessary that women become technologically empowered in animal husbandry. It is possible to achieve this by up gradation of their knowledge and skills in technologies. Government is encouraging dairy farmers to use technology in their process and to make digital environment the National Dairy Development Board (NDDB) launched a mobile app, 'Pashu Poshan', to educate the dairy farmers about balanced diet for the cows and buffaloes.

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Trichoderma – As a Biocontrol Agent and Corrival for Plant Diseases

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Biological control is defined as the reduction of inoculum density or disease producing activities of a pathogen or parasite in its active or dormant stage by one or more organisms accomplished either naturally or through manipulation of the host, environment, or by mass introduction of one or more antagonists (Baker and Cook, 1983).

The fungus, *Trichoderma viride* is a bio control agent, mainly used for the control of root rot diseases of pulses and oil seeds in Tamil Nadu. A mass production technology for *T. viride* has been developed by Tamil Nadu Agricultural University, Coimbatore.

Trichoderma is a very effective biological mean for plant disease management especially the soil born. It is a free-living fungus which is common in soil and root ecosystems. It is highly interactive in root, soil and foliar environments. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, my coparasitism, hyphal interactions and enzyme secretion.

The four main mechanisms involved in the biocontrol are:
1. Antagonist may parasite the other organism (Parasitism).
2. Antagonist may secrete metabolites (antibiotics) harmful to the pathogens (Antibiosis).
3. Antagonist may compete with the pathogens for nutrients or space (Competition).
4. Antagonist may cause death of the parasite by producing enzymes (Lysis).

Benefits of *Trichoderma*

1. Disease Control: *Trichoderma* is a potent biocontrol agent and used extensively for soil borne diseases. It has been used successfully against pathogenic fungi belonging to various genera, viz. Fusarium, Phytopthara, Scelerotia etc.

2. Plant Growth Promoter: *Trichoderma* strains solubilize phosphates and micronutrients. The application of *Trichoderma* strains with plants increases the number of deep roots, thereby increasing the plant's ability to resist drought.

3. Biochemical Elicitors of Disease: *Trichoderma* strains are known to induce resistance in plants. Three classes of compounds that are produced by *Trichoderma* and induce resistance in plants are now known. These compounds induce ethylene production, hypersensitive responses and other defence related reactions in plant cultivars.

4. Transgenic Plants: Introduction of endochitinase gene from *Trichoderma* into plants such as tobacco and potato plants has increased their resistance to fungal growth. Selected transgenic lines are highly tolerant to foliar pathogens such as *Alternaria alternata, A. solani*, and *Botrytis cirerea* as well as to the soil-borne pathogen, *Rhizectonia* spp.

5. Bioremediation: *Trichoderma* strains play an important role in the bioremediation of soil that are contaminated with pesticides and herbicides. They have the ability to degrade a wide range of insecticides: organochlorines, organophosphates and carbonates.

Advantages

1. Environmentally safe.
2. Economically cheaper, Easy to use.
3. No residual toxicity.
4. No development of resistant by pathogens.
5. It is multiplying in soil and protect the crops.
6. Broad spectrum of action.
7. It enhances the plant growth.

8. Compatible with other Bio fertilizers.
9. Not harmful to beneficial microbes.

Uses

Used in Damping off caused by *Pythium* sp. *Phytophthora* sp., Root rot caused by *Pellicularis filamentosa*, Seedling blight caused by *Pythium*, Collar rot caused by *Pellicularia rolfsii*, Dry rot caused by *Macrophomina phaseoli*, Charcoal rot caused by *Macrophomina phaseoli*, Loose smut caused by Ustilago segetum, Karnal bunt diseases, Black scurf caused by *Rhizoctonia solani*, Foot rots of Pepper and betel vine and Capsule rot of several crops.

Effective against silver leaf on plum, peach & nectarine, Dutch elm disease on elm's honey fungus (*Armillaria mellea*) on a range of tree species, Botrytis caused by *Botrytis cinerea*, Effective against rots on a wide range of crops, caused by *fusarium, Rhizoctonia*, and *pythium*, and sclerotium forming pathogens such as *Sclerotinia* & *Sclerotium*.

Recommended for

Trichoderma is most useful for all types of plants and vegetables such as cauliflower, cotton, tobacco, soybean, sugarcane, sugar beet, eggplant, pulses, tomato, banana, potato, citrus, onion, groundnut, peas, sunflower, brinjal, coffee, tea, ginger, turmeric, pepper, betel vine, cardamom etc.

Methods of Application

1. Seed Treatment: Mix seeds with talc formulation of *Trichoderma viride* @ 4g/kg of seed.

2. Soil application: Apply the talc product of *T. viride* @ 2.5kg/ha mixed with 50 Kg of well decomposed farmyard manure (FYM) or sand at 30 days.

Precautions

1. Don't use chemical fungicide after application of *Trichoderma* for 4-5 days.
2. Don't use *Trichoderma* in dry soil. Moisture is an essential factor for its growth and survivability.
3. Don't put the treated seeds in direct sun rays.
4. Don't keep the treated FYM for longer duration.
5. It should be used within four months from the date of manufacture.

Compatibility

1. *Trichoderma* is compatible with Organic manure *Trichoderma* is compatible with biofertilizers like *Rhizobium, Azospirillum, Bacillus Subtilis* and *Phosphobacteria*.
2. *Trichoderma* can be applied to seeds treated with metalaxyl or thiram but not mercurials. It can be mixed with chemical fungicides as tank mix.

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Impacts of Climate Change on Insect Pest

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Introduction

Agriculture is the basic activity by which humans live and survive on the earth. Assessing the impacts of climate change on agriculture is a vital task. In both developed and developing countries, the influence of climate on crops and livestock persists despite irrigation, improved plant and animal hybrids and the growing use of chemical fertilizers.

The continued dependence of agricultural production on light, heat, water and other climatic factors, the dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create the need for a comprehensive consideration of the potential impacts of climate on global agriculture.

Global Changes in Climate Will Influence

1. Activity, diversity and abundance of insect-pests.
2. Geographical distribution of insect-pests.
3. Development.
4. Expression of host-plant resistance to insects.
5. Pest outbreaks and invasion.
6. Effectiveness of crop protection technologies.

Direct Impacts of Climate Change on Population Dynamics

1. Development & Reproduction
2. Diapauses
3. Mortality
4. Flight & dispersal.

Impact of Climate on Insect Pest Scenario

Climate change driven global warming is affecting the distribution, demography and life history of many species, particularly insects. It is also influencing the phenology of insects including arrival times and emergence time of a range of insects. These changes are having, and will have, consequences for human livelihoods, including an increased spread of pest and diseases of important crops. Following are the notable effects of climate change on insect pest scenario and pest population dynamics.

1. Expansion of geographic ranges: Altered temperature and rainfall regimes with the predictable changes in climate will determine the future distribution, survival and reproduction of the species. With rise in temperature, the insect-pests are expected to extend their geographic range from tropics and subtropics to temperate regions at higher altitudes along with shifts in cultivation areas of their host plants. This may lead to increased abundance of tropical insect species and sudden outbreaks of insect-pests can wipe out certain crop species, entirely. At the same time; warming in temperate region may lead to decrease in relative abundance of temperature sensitive insect population. In future, projected climate warming and increased drought incidence is expected to cause more frequent insect outbreaks in temperate regions also.

Range extension in migratory species like *Helicoverpaarmigera* (Hubner), a major pest of cotton, pulses and vegetables in North India is predicted with global climate warming. Subsequently, these ongoing shifts in insect-pest distribution and range due to changing climate may alter regional structure, diversity and functioning of ecosystems.

2. Increase in number of generations: As temperature being the single most important regulating factor for insects. Global increase in temperature within certain favourable range may accelerate the rates of development, reproduction and survival in tropical and subtropical insects. Consequently, insects will be capable of completing a greater number of generations per year and ultimately it will result in more crop damage.

3. Risk of introducing invasive alien species: According to the Convention on Biological Diversity (CBD), invasive alien species are the greatest threat to loss of biodiversity in the world and impose high costs to agriculture, forestry and aquatic ecosystems by altering their regional structure, diversity and functioning.

It is expected that global warming may exacerbate ecological consequences like introduction of new pests by altering phenological events like flowering times especially in temperate plant species as several tropical plants can withstand the phenological changes. Invasion of new insect-pests will be the major problem with changing climate favouring the introduction of insect susceptible cultivars or crops.

4. Impact on pest population dynamics and outbreaks: Changes in climatic variables have led to increased frequency and intensity of outbreaks of insect-pests. It may result in upsetting ecological balance because of unpredictable changes in the population of insect-pests along with their existing and potential natural enemies. Outbreak of sugarcane woolly aphid *Ceratovacunalanigera Zehntner* in sugarcane belt of Karnataka and Maharashtra states during 2002-03 resulted in 30% yield losses. These situations of increased and frequent pest damage to the crops have made another big hole in the pockets of already distressed farmers by increasing the cost of plant protection and reducing the margin of profit.

5. Breakdown of host plant resistance: Expression of the host plant resistance is greatly influenced by environmental factors like temperature, sunlight, soil moisture, air pollution, etc. Under stressful environment, plant becomes more susceptible to attack by insect-pests because of weakening of their own defensive system resulting in pest outbreaks and more crop damage. Thermal and drought stress associated breakdown of plant resistance have been widely reported. With global temperature rise and increased water stress, tropical countries like India may face the problem of severe yield loss in sorghum due to breakdown of resistance against midge *Stenodiplosissorghicola* (Coq.) and spotted stem borer *Chilopartellus Swinhoe*.

The environmental factors like high temperature have been found affecting transgene expression in Bt cotton resulting in reduced production of Bt toxins, this led to enhanced susceptibility of the crops to insect-pests like bollworms viz., *Heliothisvirescens* (F.), *Helicoverpaarmigera* (Hubner) and *Helicoverpapunctigera* (Wallen).

6. Increased incidence of insect vectored plant diseases: Climate change may lead to more incidence of insect transmitted plant diseases through range expansion and rapid multiplication of insect vectors. Increased temperatures, particularly in early season, have been reported to increase the incidence of viral diseases in potato due to early colonization of virus-bearing aphids, the major vectors for potato viruses in Northern Europe.

Pest Management Adaptations to Changing Pest

1. Breeding climate-resilient varieties: To minimize the impacts of climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses. Considering late onset and/ or shorter duration of winter, there is chance of delaying and shortening the growing seasons for certain Rabi/ cold season crops. Hence, we should concentrate on breeding varieties suitable for late planting and those can sustain adverse climatic conditions and pest and disease incidences.

2. Alternation in sowing dates of crops: Global climate change would cause alternation in sowing dates of crops which alter host-pest synchrony. There is need to explore changes in host plant interaction under early, normal and late sown conditions in order to recommend optimum sowing dates for reduced pest pressure and increased yield.

3. Rescheduling of crop calendars: As such, certain effective cultural practices like crop rotation and planting dates will be less or non-effective in controlling crop pests with changed climate. Hence there is need to change the crop calendars according to the changing crop environment. The growers of the crops have to change insect management strategies in accordance with the projected changes in pest incidence and extent of crop losses in view of the changing climate.

4. GIS based risk mapping of crop pests: Geographic Information System (GIS) is an enabling technology for entomologists, which help in relating insect-pest outbreaks to biographic and physiographic features of the landscape, hence can best be utilized in area wide pest management programmes. How climatic changes will affect development, incidence, and population dynamics of insect-pests can be studied through GIS by predicting and mapping trends of potential changes in geographical distribution of agro-ecological hotspots and future areas of pest risk.

5. Screening of pesticides with novel mode of actions: It has been reported that, application of neonicotinoid insecticides for controlling sucking pests induces salicylic acid associated plant defence responses which enhance plant vigour and abiotic stress tolerance, independent of their insecticidal action. This gives an insight into investigating role of insecticides in enhancing stress tolerance in plants. Such more compounds need to be identified for use in future crop pest management.

In addition to the strategies discussed above, we need to decide the future line of research and devise policies for combating the pest problems under climate change regimes. Some of these are:
1. Evolve temperature tolerance strains of natural enemies.
2. Development of Weather and pest forecasting models.
3. Developing early warning systems/decision support systems.
4. Awareness regarding impacts of climate change.
5. Adoption of mitigation and adaptation measures.
6. Sensitization of stakeholders about climate change and its impacts.
7. Farmers' participatory research for enhancing adaptive capacity.
8. Promotion of resource conservation technologies.

Conclusion

In India, pest damage varies in different agro-climatic regions across the country mainly due to differential impacts of abiotic factors such as temperature, humidity and rainfall. This entails the intensification of yield losses due to potential changes in crop diversity and increased incidence of insect-pests due to changing climate. It will have serious environmental and socio-economic impacts on rural farmers whose livelihoods depend directly on the agriculture and other climate sensitive sectors.

Dealing with the climate change is really tedious task owing to its complexity, uncertainty, unpredictability and differential impacts over time and place. Understanding abiotic stress responses in crop plants, insect-pests and their natural enemies is an important and challenging topic ahead in agricultural research. Impacts of climate change on crop production mediated through changes in populations of serious insect-pests need to be given careful attention for planning and devising adaptation and mitigation strategies for future pest management programmes.

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Natural Powerful Antibiotics

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Abstract

Antibacterial foods are natural consumable, which contain natural antibiotic properties working to stimulate the immune function, increase the resistance to infections and prevent pathogens, antibiotic-resistant bugs from developing within the body. Antibacterial foods also help to keep our body healthy as immune system boosters and provide valuable nutrients to our overall health.

Keywords: antibiotics, natural foods, health benefits.

Introduction

In the ancient times, it is believed that antibiotics were the chemicals released by microorganisms, causing prompt deleterious effect on humans. However, later this notion was reversed, i.e., these compounds were used against microbes instead of isolating from them.

Antibiotics are generally of two types, bactericidal which kill the bacterial cell and bacteriostatic which inhibit the bacterial growth and may kill the bacteria. The first antibiotic was discovered by Alexander Fleming in 1928 from *Penicillium notatum*, a soil-inhabiting fungus, and the clinical trials on humans are conducted in 1940.

There are five generations of different classes of antibiotics, up till now, which have been discovered and are in clinical practice. Some of the natural antibiotics are garlic, turmeric, ginger, black pepper, honey and cabbage. Natural antibiotics help to kills gram-positive and gram-negative bacteria. They are also powerful antiviral and antifungal formula, increases blood circulation and lymph flow in all parts of the body.

Garlic

Garlic can rightfully be called one of nature's wonderful plants with healing power. It can inhibit and kill bacteria, fungi, lower (blood pressure, blood cholesterol and blood sugar), prevent blood clotting, and contains anti-tumour properties. It can also boost the immune system to fight off potential disease and maintain health (Abdullah et al., 1988).

It has the ability to stimulate the lymphatic system which expedites the removal of waste products from the body. It is also considered an effective antioxidant to protect cells against free radical damage. It can help to prevent some forms of cancer, heart disease, strokes and viral infections.

Garlic alone can provide us with over two hundred unusual chemicals that have the capability of protecting the human body from a wide variety of diseases. The sulphur containing compounds found in garlic afford the human body with protection by stimulating the production of certain beneficial enzymes.

Turmeric

Turmeric is one of the best natural antibiotic foods used in Ayurvedic and ancient Chinese medicine for thousands of years in order to treat various ranges of infections. The anti-inflammatory and antibacterial agents in turmeric have been proven to inhibit bacterial infections. Extensive researches have proven that most of the turmeric activities of the turmeric are due to curcumin.

Curcumin, as a spice, exhibits great promise as a therapeutic agent. It has very low toxicity, too. It has various useful properties with antioxidant activities and is useful in conditions such as inflammation, ulcer and cancer. It also has antifungal, antimicrobial renal and hepatoprotective activities. Therefore, it has the potential against various cancer, diabetes, allergies, arthritis, Alzheimer's disease and other chronic and hard curable diseases.

Recent studies have authenticated the use of turmeric for various diseases especially oxidative stress induced ones such as cancer, diabetes mellitus and inflammatory disorders. It also is used as hepatoprotective, nephroprotective, anticoagulant and anti-HIV to combat AIDS (Hamid et al., 2014).

Ginger

Ginger is a potential herb used worldwide for its immense phytotherapeutic properties. In Ayurveda it is known as Mahaaushdi which means use of this herb improves body functions and helps to eliminates toxins from the body.

Modern scientific research has revealed that ginger possesses numerous therapeutic properties including antibiotic, antimicrobial, and antioxidant effects, an ability to inhibit the formation of inflammatory compounds, and direct anti-inflammatory effects. Besides this, ginger is also effective against some kinds of cancers, stimulates blood circulation, controls blood pressure and hypertension, helps in lowering cholesterol, and is associated with combating heart problems.

Ginger is consumed worldwide as spice, flavouring agent, garnish, medicine, and food preservative and is used either fresh, in a fresh paste, or dry, in a dry powder. Fresh ginger can be substituted for dried ground ginger, although the flavours of fresh and dried ginger are somewhat different.

Black Pepper

Black pepper is one of the important spice rich in aromatic and medicinal components along with appreciable levels of several other functional components having health promoting properties. Black pepper contains lignans, alkaloids, flavonoids, aromatic compounds and amides (Agbor et al., 2006).

It also contains essential oil up to 3.5% and this oil constitutes sabinene, pinene, phellandrene, linalool and limonene. Pepper is described as a drug which increases digestive power, improves appetite, cures cold, cough, diseases of the throat, intermittent fever, colic, dysentery, worms and piles. It stimulates circulatory system.

It possesses a broad-spectrum antimicrobial activity. Analgesic (alleviate pain), antipyretic (reduces fever) and anti-inflammatory actions are described, with piperine having been shown to be one of the active compounds in such cases. Black pepper and its volatile oil are used in food and food items to aid:

1. Digestion.
2. Relieve gas.
3. Treat food poisoning.
4. Stomach chills.
5. Cholera
6. Dysentery.
7. Vomiting caused by hypothermia.

The uses of black pepper in various fields such as food processing, pharmaceutical industry etc, is increasing steadily due to its recognition as an important source of natural antioxidant having anticarcinogenic activity. It also has bioavailability enhancement nature, carminative property, anti-inflammatory action, cholesterol lowering capacity, immune enhancer ability, anti-pyretic, anti-periodic, antimicrobial and rubefacient activity (Murlidhar and Goswami, 2012).

Honey

Over 4000 years ago, honey was used as a traditional Ayurveda medicine, where it was thought to be effective to balance the three humors of the body. Honey has been used as medicine in many cultures for a long time.

In recent days, honey is becoming acceptable as a reputable and effective therapeutic agent. Honey has antimicrobial, anti-inflammatory, antioxidant activities, wound healing property and boosting of the immune system. Much of the therapeutic properties of honey are due to the high sugar concentration and the resulting osmotic effect (Allsop and Miller, 1996).

Studies have shown that honey has lower glycemic and incremental indices in type I diabetic patients (Abdulrhman et al., 2011) compared to glucose and sucrose. Honey is a potent inhibitor of the causing agent of peptic ulcers and gastritis, Helicobacter pylori. Honey is natural and will not raise blood-sugar levels; a mix of honey and water is a good cure for colic.

Cabbage

Cabbage (Brassica oleracea L. var. capitata) is one of the most important vegetables grown worldwide. It belongs to the family Cruciferae, which includes broccoli, cauliflower, and kale. Chemical components analysis has shown that the main constituents of cabbage are carbohydrates, comprising nearly 90% of the dry weight, where approximately one third is dietary fiber and two thirds are low-molecularweight carbohydrates (LMWC).

Other characteristic components are glucosinolates. Recent scientific studies have shown that cabbage and other vegetables in the cruciferous family include cancer-fighting compounds so that it's good for cancer patients. In addition, cabbage is rich in vitamin C – a natural antibiotic, so it can help boost immunity. Cabbage juice is also recommended in treating stomach ulcers. Fresh cabbage juice, prepared either separately or mixed with other vegetables such as carrot and celery, is often included in many commercial weight-loss diets, diets that improve the bioavailable content of nonheme iron, as well as alternative therapies for cancer patients.

Clinical research has shown positive effects of cabbage consumption in healing peptic ulcers, and facilitating the reduction of serum LDL levels. Cabbage is consumed either raw or processed in different ways, e.g., boiled or, fermented or, used in salads. Due to its antioxidant, anti-inflammatory and antibacterial properties, cabbage has widespread use in traditional medicine, in alleviation of symptoms associated with gastrointestinal disorders (gastritis, peptic and duodenal ulcers, irritable bowel syndrome) as well as in treatment of minor cuts and wounds and mastitis.

Cabbage leaves have been used for centuries to treat mastitis (breast infection), which typically occurs in nursing mothers. Patients are instructed to apply the leaf directly to the breast as needed to fight infection. It may be slightly stinky, but it's effective.

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Role of Botanical Pesticides in Integrated Pest Management

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Introduction

Botnical pesticides have proven to be suitable for the control of agricultural diseases and insects. Natural products and micro-organisms have been used as biopesticides worldwide as they can be sourced from the environment, they are generally safe to non-target organisms including humans, they have reduced persistence in the environment, and they are potentially acceptable for use in organic agriculture.

Botanicals are extracted from various plant parts (leaves, stems, seeds, roots, bulbs, rhizomes, unripe fruits, and flower heads etc.) of different plant species. Plant extracts are also called as Green Pesticides, Botanical Pesticides, Plant Pesticides, Botanicals, Ecological pesticides and the method which utilizes botanicals in insect pest management is called as Indigenous Integrated Pest Management or Ethno-Botanical Crop Protection.

Botanical pesticides possess an array of properties including toxicity to the pest, repellent, anti-feedant, insect growth regulatory activities against pests of agricultural importance. These have broad spectrum activity, are less expensive and easily available because of their natural occurrence, have high specificity to target pests, and no or little adverse effect on beneficial insects, resistance development to them is slow or less common, poses least or no health hazards and environmental pollution, have less residual activity and are effective against insecticide resistance species of insects, and have no adverse effect on plant growth parameters.

More than 2500 plant species belonging to 235 families have been found to possess the characteristics required for an ideal botanical insecticide. About 350 insecticidal compounds, more than 800 insect feeding deterrents, and a good number of insect growth inhibitors and growth regulators have been isolated from various plant species.

Botanical as Biopesticides

Phytochemicals are classified as either primary or secondary plant metabolites. of the estimated 3,08,800 plant species very, few have been surveyed and most remained unexploited and unutilized for pesticidal active principles.

Till date, about 2400 plant species have been reported to possess pesticidal properties belonging to 189 families among which about 22 families contain more than 10 plant species in each family with anti-insect properties.

Approximately, more than 350 insecticidal compounds, >800 insect feeding deterrents and quite a good number of insect growth inhibitors and growth regulators have been isolated from various plant species but, apparently only few have achieved the commercial status.

1. Neem (*Azadirachta indica*) leaf extract: Materials required: Neem leaves (80kg/ha). The fresh neem leaves were collected and soaked overnight in water. Next day, soaked leaves were taken out and ground and the extract obtained was filtered. The filtered extract was diluted @ 2.5-3 L in 50 L water and sprayed.

2. Pyrethrum: From the flowers of *Chrysanthemum cinerariaefolium*, two formulations of Pyrethrum i.e. Pyrethrum 0.2% dust and Pyrethrum 1% EC are registered for use against insect pests in vegetables and Pyrethrum is also used in combination with other insecticides as synergists for the control of household pests.

3. Niotine Sulphate: Nicotine is the extract from tobacco. Two formulations i.e. nicotine 40% solution and 10% DP are registered in India for export only.

4. *Parthenium hysterophorous:* The extract of this plant contains parthenin, pyroparthenin, anhydroparthenin and photoparthenin.These are sesquiterpene lactones which exercise cytotoxic, antitumour, allergic, antimicrobial, antifeedant, phytotoxic, insecticidal actions. The ovicidal action has also been demonstratd in *Dysdercus koenigi*.

5. Garlic (*Allium sativum*) extract: Materials required: Garlic bulbs (30gm). 30g of garlic bulbs were ground thoroughly in grinder with 50ml water. Ground mixture was soaked in little quantity of water over night and squeezed through muslin cloth and the volume was made up to 1L by adding water and sprayed.

6. Garlic–Chilli (*Capsicum annum*) extract: Materials required: Green Chilli 30g, and Garlic 30g. Garlic bulbs and green chilli (30g each) were ground separately in a grinder with little water. Grinded material was soaked in water overnight separately and the extract was squeezed using muslin cloth, both were mixed and the volume was made up to 1 L to obtain 3 per cent concentration.

7. Lantana (*Lantana camera*) plant powder: Materials required: Lantana branches with leaves and immature fruits (5kg). Lantana branches with leaves and immature fruits were chopped and dried. The dried material was grinded to prepare powder and the powder was mixed with 100L water and sprayed.

8. Lantana (*L. camera*) leaf extract: Materials required: Lantana leaves (1kg). Lantana leaves (1kg) were chopped and ground with little water and filtered. This filtrate was diluted in 30L of water and sprayed.

9. Chilli–Neem–Garlic extract: Materials required: Chilli, Neem leaves, and Garlic. Chilli, Neem leaves and fresh Garlic paste was taken in 1:4:1 proportion and boiled with 15 times water for 45 minutes to one hour in low flame and filltered the solution and mix it with 50L of water and sprayed.

10. Adhatoda (*Adhatoda vesica*) leaf extract: Materials required: Adhatoda leaves (1kg). Leaves (1kg) of Adhatoda were ground and mixed with 10L water and kept undisturbed for 24h and then filtered through a muslin cloth and sprayed.

11. Datura (*Datura stramonium*) plant extract: Materials required: Datura leaves (1kg), and Datura pods (1kg). Leaves and pods of Datura were dried and powdered by pounding. This powder was soaked in 40L water and kept for 24h and then filtered through a muslin cloth and sprayed.

12. *Vitex negundo*(Begunia): The alcoholic, methanol and petroleum ether extracts of leaf (5 and 10%) are reported to be effective against 2nd and 3rd instar larvae of *S. litura*. The leaf and branch extract caused repellence against paddy pests. The petroleum leaf extract caused malformed pupae in rice leaf folder.

13. *Acorus calamus* L. (Bacha): Powdered rhizome used for destruction of fleas, bed bugs, moths, lice etc. It is effective in killing insect pests of stored rice without any residual effect. Ether extract of rhizome shows ovicidal and mutagenic properties. The rhizome yields oil (1.5-3.5%, dry weight) containing asarone up to 82% and its beta isomer and other ingredients which is believed to be insecticidal.

14. *Adhatoda zeylanica* (Basanga): Leaves contain an essential oil (0.075%) chiefly containing limonene and an alkaloid vasicine. An infusion of leaves used against white ants and red spiders of tea. Leaf extract controls *Callosobruchus chinensis* (pulse beetles), petroleum ether extract works against *C. maculatus* and methanol extract against *Spodoptera litura*. All these extracts exercised antifeedant action.

15. *Anacardium occidentale* (Cashew nut): Cashew shell liquid contains phenolic constituents (2.7% of total oil). Several new pesticides have been prepared from cashew nut shell liquid. The shell oil is used to kill mosquito larvae.

16. *Catharanthus roseus* (Sadabihari): Leaf extract in water is a phagodeterrent against S.litura and aqueous leaf extract has toxicant action against YSB. The root extract acts as antifeedant against *S .litura*.

17. *Clerodendron inermi*(Genguti): Leaf extract in petroleum ether caused ovipositional deterrent effect in *C. chinensis* and toxicant effect on *A. moorei*.

18. *Plumbago zeylanica* (Dhalachita): The bark and root extract in alcohol caused toxic effect in *L. erysimi*.

19. *Melia azadirach* (Maha Nimba): It is a close relative of neem. The active principle is tetraterpenoid (limonoids). Plant extracts have behavioural, physiological and toxic effects which have been tested on *E. varivestis, N. lugens, M. separata* and *P. xylostella***.**

20. *Pongamia glabra* (Karanja): The oil extracts have been reported to be repellent for BPH, WBPH, Epilachna beetle, maize borer, citrus butterfly etc.

Some Plant Products Used as Biopesticides

Plant product used as biopesticide	Target pests
Limonene and Linalool	Fleas, aphids and mites, also kill fire ants, several types of flies, paper wasps and house crickets.
Neem	A variety of sucking and chewing insect
Pyrethrum / Pyrethrins	Ants, aphids, roaches, fleas, flies, and ticks
Rotenone	Leaf-feeding insects, such as aphids, certain beetles (asparagus beetle, bean leaf beetle, Colorado potato beetle, cucumber beetle, flea beetle, strawberry leaf beetle, and others) and caterpillars, as well as fleas and lice on animals
Ryania	Caterpillars (European corn borer, corn earworm, and others) and thrips
Sabadilla	Squash bugs, harlequin bugs, thrips, caterpillars, leaf hoppers, and stink bugs
Garlic extract	Spodoptera litura (leaf eating caterpillar), *Helicoverpa armigera* (fruit borer), and other lepidopteran pests
Garlic-Chilli-extract	*Helicoverpa armigera* (fruit borer), *Spodoptera litura* (leaf eating caterpillar), *Leucinodes arbonalis* (Brinjal fruit & shoot borer), *Amsacta albistriga* (red headed hairy caterpillar)
Fermented botanical spray	*Leucinodes orbonalis* (Brinjal fruit and shoot borer), Pod borers of pulses, Tobacco caterpillar *(Spodoptera litura)*
Adathoda vesica leaf extract	Defoliators and Sucking pests
Datura plant extract	Tea mosquito bug, Thrips, Jassids, Aphids
Ekka leaf extract	Termites
Lantana leaf powder	Aphids
Lantana leaf extract	Beetles, Leaf miners, Defol
Mixed leaves extract	Defoliators like Spodoptera litura, semi loopers
Panchapatre	Defoliators, Fruit borers, Sucking pests like Aphids and White□ies
Nilgiri leaf extract	Jassids, Aphids, Scales
Chilli-Neem-Garlic exract	Lepidopteran pests in Pigeon pea
Multiple plants leaf extract	Major pests and diseases

Conclusion

Overall study indicated that farmers used locally available natural resources for the management of insect pests. There were many types of indigenous botanical sprays used by the farmers in different crops against different insect pests like *Helicoverpa armigera* (fruit borer), *Spodoptera litura* (Leaf eating caterpillar), *Leucinodes orbonalis* (Brinjal fruit and shoot borer), Amsacta *albistriga* (Red headed hairy caterpillar), pod borers of pulses, tobacco caterpillar, Tea mosquito bug, Thrips, Jassids, Aphids, Termites, Spider mites, Beetles , leafminers, defoliators , whiteflies, scales etc.

All these sprays have been used since ancestral period. The information on methods of preparation of these botanical sprays was also collected from the farmers.

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Microbial Remediation of Depression and Other Psychological Disorders

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Introduction

The occurrence of different psychological disorders along with depression is on a perpetual increase. It has been assessed that about 4.4% (322 million) of the universal population are engulfed by depression and about 3.6% (264 million) are grieved from anxiety syndromes (WHO 2017).

The currently accessible pharmacological and psychosomatic treatments are not found to be much effective in terms of modest short-term reimbursements, austere ill effects and age restrictions, which has put a dire need to develop new alternatives. It is a well-established fact that the microbiota inhabits a wide variety of niches in the human body.

However, their abundance as well as diversity is more pronounced in the gastrointestinal (GI) tract. The most valuable attribute of the intestinal microbiota that has raised recent concerns is particularly in reference to the neurological, endocrinological, and immunological viewpoint where the gut microbiota uses ancient, evolutionarily conserved, biomolecular "languages" to interconnect with the host organism (Oleskin and Shenderov 2019).

However, the growing recognition of the role played by the gut microbes in human health has already been an established fact, but, the extension of this role, to encompass brain health, has come into focus in recent years. The 1014 microbial inhabitants of human gut are known to possess unique physiological roles in maintaining human health. These roles include immunomodulation, energy balance and activation of the enteric nervous system (ENS).

Microbial Communication to Brain

Microbes, by recruiting the bidirectional communication network of the gut-brain axis, exert an influence over many processes involved in brain development and function. Therefore, the disturbance in the human microbiome can account for various disorders. Since the communication is bidirectional, the alteration in microbial community is always experienced in case of any disease.

Surprisingly, the state of depression results in a decreased count of *Bifidobacterium* and/or *Lactobacillus*. The term 'psychobiotics' has been newly devised to designate another evolving class of probiotics which find their significance towards psychiatry. These microbes are endowed with "mind-altering" traits and they have got the unique ability of producing numerous biologically active composites, for instance, peptides, neurotransmitters, short chain fatty acids, immunomodulators and mediators which are usually allied with neurotransmission in mammals.

Such neuroactive compounds grant these microbes with the unique ability of imparting health benefit to the patients experiencing psychiatric illness. Therefore, the communication between the gut and brain has been known to impact the emotional state *via* GI tract. The dysregulation of microbiota-gut-brain axis affects the psychological functions (Dinan et al. 2013).

Microbially Contributed Psychobiotics

Psychobiotics may regulate level of neurotransmitters and proteins, including gamma-aminobutyric acid (GABA), serotonin, glutamate and brain-derived neurotrophic factor (BDNF), which play important roles in controlling the neural excitatory-inhibitory balance, mood, cognitive functions, learning and memory processes.

It has also been observed that the administration of probiotics like *Lactobacillus*, *Bifidobacterium*, and *Enterococcus* can decrease the levels of inflammatory cytokines. The anti-immunoregulatory effects of probiotics have been reported to activate the population of T regulatory cell as well as the secretion of IL-10.

In addition, probiotics contact with gut epithelium enteroendocrine cells and produce neuropeptides and neurotransmitter. Further, it has also been found that serotonin synthesis in gut can be regulated by microbes and the spore former members of gut microbiome are known to induce serotonin synthesis from gut enterochromaffin cells.

Approximately 95% of serotonin is derived from gut enterochromaffin cells and ENS neurons, which is associated with the regulation of GI secretion and motility. In addition, the brain serotonin pathways are involved in regulating cognition and mood.

Some strains of *Lactobacillus* spp. and *Bifidobacterium* spp., such as *Lactobacillus brevis*, *Bifidobacterium dentium* and *Lactobacillus plantarum* are known to produce GABA and serotonin.Additionally, several other strains like *L. plantarum* and *L. odontolyticus* are also known to produce dopamine and acetylcholine whereas *Lactobacillus helveticus* is known to increase the levels of serotonin and norepinephrine in the hippocampus.

The other microbial metabolites like short chain fatty acids and long chain fatty acids are also known to lay an explicit effect on the psychological health. Bacteria like *Clostridium*, *Bifidobacterium*, *Bacteroides*, *Eubacterium*, *Propionibacterium*, *Lactobacillus* etc. produces short chain fatty acids while *Bifidobacterium* is mainly involved in production of long chain fatty acids.

The administration of *B. longum* is responsible for reducing stress, depression and anxiety behaviors (Cheng et al. 2019).

Probiotics and Sleep Disorders

The microbes also help to treat the brain related disorders in an indirect manner, for instance, sleep deficit has also been found to induce depression, memory impairment and allergy. Several reports have also claimed that the administration of different fermented products containing probiotic microorganisms have the potential of improving the quality of sleep.

The effect of several psychobiotic strains on mental health has been proved in animal models. The administration foods rich in probiotic microflora, like, yoghurt is also known to significantly improve the status of mental health.

The relative level of noradrenaline increases in the gut lumen during the state of stress, and this may also account for the alterations in the microbial composition. Such chemical substances are acknowledged to modify the gene expression in some bacteria, which ultimately ends up in favoured progression of definite microbial communities.

The administration of psychobiotic microflora results in an altered microbial community and is also known to replace the microbes that were dominating during the state of depression and improves the mental health by secreting numerous bioactive compounds.

Therefore, it can be concluded that probiotics play a crucial role to regulate the aggregation of α-synuclein in enteroendocrine cells, production of microbial metabolites and activation of the vagus nerve in neurodegenerative and neurodevelopmental disorders. The vagus nerve plays an essential and wide-ranging role in coordinating parasympathetic activity, including regulation of heart rate and gut motility.

It possesses an abundance of sensory fibres, and is able to convey rich information on organ function throughout the body to the brain. Furthermore, vagal activity is found to be sensitive to nutrition, exercise and stress.

The stimulation of vagus nerve exerts anti-inflammatory effects and is used therapeutically for refractory depression, pain, and epilepsy. There is also evidence of both antidepressants and anxiolytics exerting vagal effects.

Conclusion

Several animal studies have found that the vagus nerve mediates the relationship between psychobiotics and their psychophysiological effects, as severing the vagus nerve (vagotomy) abolishes responses to psychobiotic administration.

Therefore, it has been proved by several researchers that microbes significantly affect the mental health in a direct as well as indirect way and the psychobiotic treatments could be a promising strategy to improve the quality of life for people who suffer from neurodegenerative and neurodevelopmental disorders.

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General Technique of Plant Tissue Culture

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Introduction

Plant Tissue Culture broadly refers to the in-vitro cultivation of plants, seeds and various parts of the plants like organs, tissues, embryos, organs, protoplasts.

Plant Tissue Culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of Known composition. Plant Tissue Culture is widely used to produce clones of plants in a method Known as micro propagation.

Term Used in Tissue Culture

1. Explants: An excised piece of differentiated tissue or organ is regarded as an explant. The explants may be taken from any part of the plant body e.g., leaf, stem, root.

2. Callus: The unorganized and undifferentiated mass of plant cells is referred to as callus. Generally, when plant cells are cultured in a suitable medium, they divide to from callus (a mass of parenchymatous cells).

3. De-differentiation: The Phenomenon of mature cells reverting to meristematic state to produce callus is dedifferentiation.

4. Re- differentiation: The ability of the callus cells to differentiate into a plant organ or a whole plant is regarded as re-differentiation.

5. Totipotency: The ability of an individual cell to develop into a whole plant is regarded as re-differentiation.

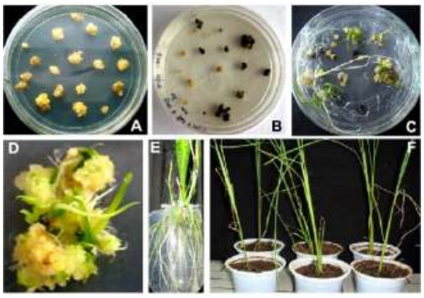
The Basic Steps Followed in the Plant Tissue Culture Techniques are

1. Selection of explants such as shoot tip.
2. Surface sterilization of the explants by disinfectants and then washing the explants with sterile distilled water.
3. Transfer of the explants on to the suitable nutrient media in culture vessels under sterile conditions (In laminar flow cabinet).
4. Growing the cultures in the growth chamber or plant tissue culture room, having the appropriate physical conditions.
6. Regeneration of plants from cultured plant tissues.
7. Transfer of plants to the greenhouse or field conditions following the acclimatization of the regenerated plants.

The Technique of In Vitro Cultivation of Plants Cells or Organs is Primarily Devoted to Solve Two Basic Problems

1. To keep the plant cells and organs free from microbes. This problem can be eliminated by using modern equipment's and careful handling during various operations.

2. To ensure the desired development in the cells and organs by providing suitable nutrient media and other environmental conditions. This problem remains in the area of active research and is likely to do so for quite some time in the future.



Sterilization Methods Used in Tissue Culture Laboratory

The materials, e.g., vessels, instruments, medium, plant material, etc, used in culture work must be freed from microbes. This is achieved by one of the following approaches:
1. Dry heat treatment.
2. Flame sterilization.
3. Autoclaving.
4. Filter sterilization.
5. Wiping with 70% ethanol.
6. Surface sterilization.

Media Preparation

1. Chemicals are dissolved in distilled water. the stock solution of vitamins, micro-nutrients and growth regulators and hormones are added and pH adjusted to 5.5-6.5 .
2. The solution is made to volume 50 to 100 ml quantities distributed in to 250 ml Erlenmeyer flask.
3. Flasks are supported with cotton plug and autoclaved at 1200C 15 min, all media are stored at 100C.

Generally nutrient consist of:
1. Inorganic salts (both micro & macro elements).
2. A carbon source (usually sucrose).
3. Vitamins (nicotinic acid, thiamine, pyridoxine).
4. Amino acids (eg. arginine).
5. Growth regulators (eg. Auxins).

Element and their Function

1. Nitrogen (N): Component of proteins , nucleic acids and some coenzymes Element required in greatest amount.
2. Potassium (P): Regulates osmotic potential, principal inorganic cation.
3. Calcium (Ca): Cell wall synthesis, membrane function, cell signalling.
4. Magnesium (Mg): Enzyme cofactor, component of chlorophyll.
5. Phosphorus (P): Component of nucleic acids, energy transfer, component of intermediates in respiration and photosynthesis.
6. Sulphur (S): Components of some amino acids (methionine, cysteine) and some cofactors.
7. Iron (Fe): Electron transfer as a component of cytochromes.
8. Manganese (Mn): Enzyme cofactor.
9. Cobalt (Co): Component of some vitamins.
10. Copper (Cu): Enzyme cofactor, electron-transfer reactions.
11. Zinc (Zn): Enzyme cofactor, chlorophyll biosynthesis.

12. Molybdenum (Mo): Enzyme cofactor, component of nitrate reductase.

Methods of Plant Tissue Culture

1. Type of in vitro growth-callus and suspension cultures.
2. Type of explants- single cell culture, shoot and root cultures, somatic embryo culture, meristem culture, another culture and haploid production, protoplast culture and somatic hybridization, embryo culture, ovule culture, ovary culture, etc.

Advantages of Plant Tissue Culture

1. The production of exact copies of plants that produce particularly good flowers, fruits.
2. To quickly produce mature plants.
3. The production of multiples of plants in the absence of seeds.
4. The regeneration of whole plants from plant cells that have been genetically modified.
5. The production of plants from seeds that otherwise have very low chances of germinating and growing, i.e.: orchids and *Nepenthes*.
6. To clear particular plants of viral and other infections and to quickly multiply these plants as 'cleaned stock' for horticulture and agriculture.

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Coronavirus (COVID-19) Prevention and Management in Dairy Farming

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The recent COVID-19 events and realities are unprecedented. We are truly seeing history being made which will have an effect on the dairy industry and society as a whole. Corona virus Disease 2019 (COVID-19) is a new type of corona virus that was first detected among citizens of Wuhan, Hubei Province, China in December 2019.

The condition that can spread from person to person. The outbreak of corona virus that causes serious respiratory disease and may be especially deadly for older people and those with weakened immune systems. Individuals can fight corona virus by taking steps to prevent its transmission the spread of the virus has raised concerns about how it may affect public health as well as dairy production.

Dairy farms are 24-hour, 7-day per week business and operations must continue. Following precautions will minimize the risk to dairy farmers, family and service providers to be on the farm.

Introduction

Women mainly participate in all operations related to livestock management. Livestock management has always been considered to be the sole responsibility of women. Women take responsibility for cutting fodder, cleaning sheds, milking dairy animals, processing animal and milk products and looking after the health of the herd. Livestock rearing is an important means of income generations in village for all categories of farmers including small, marginal and even landless farmer in rural India.

Dairy former can follow simple steps to minimize the spread of COVID-19 and other respiratory viruses:

1. Limit access by non-essential persons
2. Wash your hands regularly with soap and water for at least 20 seconds.
3. Avoid touching your eyes, nose and mouth with unwashed hands.
4. Always wear milking gloves.
5. Shower when you get home after working in the dairy and wash your work clothes.
6. Clean and disinfect frequently touched surfaces and objects in the dairy.
7. Practice social distancing by reducing the number of close physical contacts you have with others, only leaving your home/dairy to get necessary supplies.

It's always a best practice to thoroughly wash your hands with warm soapy water and maintain proper hygiene when in contact with livestock, including changes clothes and shoes prior to visiting the next farm. This ensures any zoonotic diseases, which are diseases caused by germs that spread from animals to people, are not transmitted.COVID-19 is known to spread through aerosol transmission and close human contact, not through food products. There is no evidence to suggest that dairy products can transmit COVID-19 and there is no evidence that this strain of corona virus is present in domestic livestock also heat treatment kills corona viruses, making pasteurization an effective safeguard against this virus.

The dairy farmers in Kanpur nagar are facing losses due to the lockdown. Nationwide lockdown has been imposed in backdrop of COVID-19 outbreak. Milk price dipped to almost half amid pandemic and farmers are forced to sell the milk at low prices. now we have to sell it at Rs 30-35 per kg. The demand is low as hotels and tea stalls are closed. It is becoming difficult to manage expenses. Despite strong demand for basic foods like dairy products during the corona virus pandemic, the milk supply chain has seen a host of disruptions that are preventing dairy farmers from getting their products to market. Mass closures of restaurants and schools have forced a sudden shift from those wholesale food-service markets to retail grocery stores, creating logistical and packaging nightmares for plants processing milk, butter and cheese. The sale of dairy products has been hit during the lockdown period as the uptake by the organized industry players has been affected due to shortage of workforce and transport issues. However, people living on agriculture and allied activities, mostly those losing their income from informal employment at this lockdown period, have to be provided with alternative avenues (cash transfers) till the economy bounces back (when this health crisis is successfully overcome).

Immediately after the nation-wide lockdown was announced, the Government of india declared an INR 1.7 trillion package, mostly to protect the vulnerable sections (including farmers) from any adverse impacts of the Corona pandemic. The announcement, among a slew of benefits, contained advance release of INR 2000 to bank accounts of farmers as income support under PM-KISAN scheme. The Government also raised the wage rate for workers engaged under the NREGS, world's largest wage guarantee scheme. Under the special scheme to take care of the vulnerable population, Pradhan Mantri Garib Kalyan Yojana (Prime Minister's scheme for welfare of the poor), has been announced. Additional grain allotments to registered beneficiaries were also announced for the next three months.

In spite of all these measures and in view of continuing restrictions on movements of people and vehicular traffic, concerns have been raised regarding negative implications of COVID19 pandemic on the farm economy.

Conclusion

The most positive things for the dairy farmers are that COVID-19 infection is expected to have no direct health hazard on the dairy cows and its products. So, consumption of milk might be unaffected, the farmers can even use this as an opportunity for utilising the milk production to increase the demand. In contrast, due to the limited movement of the people there could be short term effect on milk marketing and price might be lowered. The production could be decreased as well if the sufficient measures are not taken in due time. it is highly recommended that the government, main dairy processors and other input suppliers and policymakers might take responsible actions to minimise the economic loss by the farmers due to the current corona virus infections. Finally, the government, at this stage, has taken right decision to make all efforts for ensuring the safety of humans first but in the long run, it needs to make judicious decisions targeting the ways to overcome the current and anticipated future loss.

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A Multitasking Insect - Collembola

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Collembola are commonly known, as springtails represent one of the most abundant and widespread group of soil arthropod. The Collembolans or the springtails are characterized by a six segmented abdomen bearing median appendages ventrally, i.e., ventral tube, the tenaculum, and the furcula. The furcula and tenaculum may be reduced or absent in some families like Onychiuridae and Neanuridae. They formerly classified as primitively wingless insects, but now widely recognized as a lineage closely related to, but distinct from, the Insecta (Giribet and Edgecombe, 2012). The common name of the group derives from the ability to jump quite appreciable distance when disturbed and such mechanism is facilitated by the possession of springing organ carried on the fourth abdominal segment.

Springtails are colonizing in the soil habitats that provide enough humidity and food, such as organic matter, pH, or microorganisms. Some researcher regarded them as key indicator soil fertility and health but sometimes agricultural intensification tends to reduce collembo diversity. About 6500 species in 18 families have been described by different authors (Hopkin, 1997; Toldan et al. 2016). Like the oribatids, they also are extremely abundant in soil and leaf litter, with densities typically on the order of 104–105 individuals /m−2 and, again, higher in coniferous forests (Petersen and Luxton, 1982), but are more numerous than oribatids in many soils. Agricultural soils may be rich in Collembola. Edaphic species tend to be parthenogenetic (Hopkin, 1997), life-history trait characteristic of animals living in stable environments. Average fecundity typically ranges between 50 and 100 eggs per female; depending on climate, there may be one to four generations annually.

Life spans of species living within the soil-litter system range between 2 and 12 months or more. Like soil-dwelling oribatids, Collembola require a soil atmosphere approaching saturation. The diet of Collembola is of considerable variation, including moss protonema, bacteria, fungal hyphae and spores, algae, protozoans, arthropod feces, pollen, decaying plant materials and humus, other Collembola (living or dead), and stored products. Species are divided between those that masticate their food and those that are fluid feeders. Majority of species are fungivorous (Hopkin, 1997).

Economic Benefits

Soil biological management reduces input costs by enhancing resource use efficiency (especially decomposition and nutrient cycling, nitrogen fixation and water storage and movement). Less fertilizer may be needed if nutrient cycling becomes more efficient and less fertilizer is leached from the rooting zone. Fewer pesticides are needed where a diverse set of pest-control organisms is active. As soil structure improves, the availability of water and nutrients to plants also improves. It is estimated that the value of "ecosystem services" (e.g. organic waste disposal, soil formation, bioremediation, N2 fixation and bio control) provided each year by soil biota in agricultural systems worldwide may exceed US$ 1,542 billion.

Environmental Protection

Soil organisms filter and detoxify chemicals and absorb the excess nutrients that would otherwise become pollutants when they reach groundwater or surface water. The conservation and management of soil biota help to prevent pollution and land degradation, especially through minimizing the use of agro-chemicals and maintaining/enhancing soil structure and cation exchange capacity (CEC). Excessive reduction in soil biodiversity, especially the loss of keystone species or species with unique functions, for example, as a result of excess chemicals, compaction or disturbance, may have catastrophic ecological effects leading to loss of agricultural productive capacity.

Food Security

Soil biological management can improve soil health, crop yield and quality, especially through controlling pests and diseases and enhancing plant growth. Below-ground biodiversity determines resource use efficiency, as well as the sustainability and resilience of low-input agro-ecological systems, which ensure the food security of much of the world's population. In addition, some soil organisms are consumed as an important source of protein by different cultures and others are used for medicinal purposes. At least 32 Amerindian groups in the Amazon basin use terrestrial invertebrates as food, and especially, as sources of animal protein - a strategy that takes advantage of the abundance of these highly renewable elements of the rainforest ecosystem.

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Nursery: A Prospective Agro-Enterprise

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Introduction

Nursery raising is one of the highly economic enterprise and commercial venture in horticulture sector. As the demand for high quality planting material is steadily increasing there is need of setting up plant nurseries by small and marginal farmers as well as by gardeners and farmhouse owners. Also, there is profound scope for starting the small nurseries, which will serve to augment the income of needy section of rural society.

A nursery is a starting point for successful production. Nursery has emerged in this country as an important sector for diversification of agriculture with view to improve economic condition of farming community. It has established its credibility through increased productivity, generating employment for rural and urban people and enhancing export to a considerable level.

The history of civilization is rich with verses pertaining to agriculture. Almost all of them candidly connote the nature of agriculture as a food obtaining activity and nothing more, but with the advent of civilization, agriculture has grown in length and breadth. It's now a diversified activity. The demand of time has transformed agriculture from a subsistence-tool to an economic activity. It has become an enterprise now. The rapid growth of market economy has expedited the commercialization of agriculture sector which is gradually attaining the status of an enterprise.

Nursery raising is one of the highly economic enterprise in horticulture sector. The nursery management gained status of commercial venture as the demand for high quality planting material is steadily increasing due to interest in vegetable gardening, fruit tree cultivation, social forestry, agro-forestry and plantation crops.

The need of setting up plant nurseries to meet the demands of the people has been felt by small and marginal farmers as well as by gardeners and farmhouse owners. There is wide scope for agriculture graduates to become successful entrepreneurs in nursery business. To be a successful entrepreneur it requires certain characteristics viz. innovativeness, achievement motivation, economic motivation, risk taking ability, management orientation, decision making ability, market orientation and leadership ability etc. They are mean with a will to act, to assume risk and to bring about a change through organization of human efforts.

Now it is felt that, the economic growth and development of advanced countries is largely due to entrepreneurship among their community rather than capital. In today's changing scenario, skill entrepreneurial developments have become more important. Many entrepreneurial opportunities are emerging in various fields such as computer, electronics, medicine, agriculture, food technology etc.

Entrepreneurship development is an art and science which requires skills of communication, management and marketing to any entrepreneur. During 1970`s entrepreneurship was recognized as a vehicle for economic growth and industrial development and a potential solution to the problems of underemployment and unemployment

India has immense potential for entrepreneurship development in terms of diversity of rural occupations. Development of entrepreneurship ensures optimal utilization of resources, facilities and services. It also helps in developing capability to cope up with the impact of globalization. There are many factors that influence the entrepreneurial behaviour of human beings. The emergence of entrepreneurs in a society depends upon closely interlinked social, religious, cultural, psychological and economic factors. Understanding the role of these factors is essential for creating an environment which can facilitate the development of entrepreneurial attributes.

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Development of economy of any nation depends primarily on the important role played by entrepreneurs. The entrepreneur is an economic man, who tries to maximize his profits by innovations. However, the entrepreneurs are not simply innovators, but they are the persons with a will to act, to assume risk and to bring about a change through organization of human efforts. The part played by such entrepreneurs in agriculture is of vital importance in developing country like India, where there are enormous opportunities for using innovations to exploit the available resources. In the present scenario of increasing demand for organic agriculture and with the limitations in proper arrangements for backward and forward linkages, it is the entrepreneurial characteristics which play a major role.

With the launching of horticulture development programme as a part of the Employment Guarantee Scheme (EGS), by the government of Maharashtra, the nursery industry has received new impetus. The added emphasis on 'Food and Nutrition Security' has increased the awareness about the protective foods namely fruits and vegetables. The growing urbanization and enhanced sense of aesthetics has created large demand for the ornamental plants. Collectively, the horticultural plants are in more demand than they were before. To cater the needs of saplings, the nursery units are being run on large scale. There are around 15,000 nurseries in India, with more than 50,000 technical personnel involved in their commercial operations.

The setting up of a target of 4 per cent annual growth rate in agriculture in Agricultural Policy, 2000, the liberalization of trade regime, the establishment of Agricultural Export Zones (AEZs), the influx of Foreign Direct Investment (FDI) along with foreign technology and entrepreneurship in the field of nursery management technology will see a rapid growth of nursery industry. This is why; nursery is indeed prospective agro-industry.

Conclusion

Entrepreneurship is most needed component for the agriculture development. Considering these facts, it felt necessary to conduct the study on entrepreneurial attributes of nursery growers with objectives to know the entrepreneurial attributes, relationship between socio-economic characteristics with entrepreneurial attributes and reason for practicing nursery which will help to come out with the suitable policies and programmes for nursery production. The study will also help in developing good entrepreneurs in nursery business.

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Origin and Status of Agritourism in India: A Detailed Comprehension

Article ID: 31025

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Introduction

Agritourism has been a buzzword among the growing agripreneurs in India. The last few years have seen the concept of agritourism gaining impetus as an allied area of income generation in agriculture. Agritourism has branched out as an offshoot of rural tourism and has immense scope in India. Since agriculture is the main occupation of the people in India and other developing countries, there is a need for these countries to think of allied income generation strategies with agriculture, one of which is agritourism.

Agritourism is considered as one of the fastest growing sectors in the tourism industry. The concept has been successfully implemented in states like Maharashtra, Kerala, Rajasthan, Jharkhand, Gujarat, Punjab, Tamil Nadu and Himachal Pradesh. It has become a new avenue for earning income for the rural farmers. Realizing this, the government is encouraging active agritourism to augment income generating options for the rural section (Pal, 2016).

Origin and Status of Agritourism in Indian States

The Ministry of tourism in 2002-03 came out with the proposal of "Rural Tourism" to showcase, art, culture and heritage through rural life in villages. It also gave an option for inclusion of the natural environment as in natural Flora and Fauna along with art & craft, handloom, and textiles. The promotion of village tourism is also aimed at generating revenue for the rural communities through tourists' visits, thereby stopping or at least reducing the exodus from rural to urban areas (secretariat, 2013)

The state of **Maharashtra** is the pioneer state to develop and endorse Agri Tourism in the country. Agri Tourism Development Corporation (ATDC) established in 2005 and started the pilot Agri tourism project of 28 acres in Palshiwadi, Tal Baramati Dist Pune, 70 km from Pune city. The main activities include operating its Agri tourism centre of its own along with encouraging other potential and desiring farmers to take up Agri tourism venture. ATDC conducts training and research programs in the state. This is an umbrella platform wherein most of the agritourism sites are listed along with their contact details and price package.

Tourism is one of the key areas which can strengthen socio-economic activities of **Himachal Pradesh** besides attracting tourists to the land of enthralling beauty. The Himachal Pradesh Government has recently launched a scheme known as "Har Gaon Ki Kahani" (story of every village), in addition to "Home Stay Scheme", which is attracting a large number of tourists to lesser known and remote destinations of the State from few years. Under "Har Gaon Ki Kahani" scheme, the fascinating tales, folklore and anecdotes related to remote villages in Himachal Pradesh are set to attract tourists. This novel scheme aims at developing villages of historic importance as tourism villages by providing basic amenities that will provide tourists a glance into rustic life of the hill State.

The **Rajasthan** government has decided to promote agri-tourism vigorously. The convergence of tourism and agriculture will not only support the farmers with additional revenue and better sustainability but also create a multiplier effect on employment generation, says a report on agri-tourism in Rajasthan prepared by the FICCI and Yes Bank. It includes a mega food park at Roopnagar in Ajmer, which facilitates for visiting the organic farms and learn about different agriculture practices and produce. Government is considering developing similar kind of visits to orange orchards of Jhalawar and Sri Ganganagar, where tourists can see citrus fruits plants, taste them and understand the processing of fruits. Agritourism venture is also being promoted in upcoming Global Rajasthan Agritech Meet (GRAM).

In order to promote agri tourism concept, Govt. of **Karnataka** has come up with "Agri Tourism" in its Tourism Policy 2015 as one of its tourism products. Set guidelines to be followed are issued to the agritourism centres for maintaining authenticity and approval from government. Bringing regulation to tourists' visit can enhance the opportunities in agri tourism. This will not only help in increase in income of the farm, but also creates an atmosphere of entrepreneurship in agriculture. Agri-tourist involvement in basic agriculture activities such as milching, harvesting competitions, tree climbing, bullock cart race, buffalo race in wet fields namely "Kambala" in Karnataka, shooting a coconut target, fishing etc. could generate enormous joy at least cost. There is enough scope to expend this venture into core agricultural production belts such as northern Karnataka and central Karnataka apart from present area of Western Ghats and coastal area.

Villages in **Kerala** have made a concoction of its hospitality with the traditional way of farming to attract more tourists, creating a novel concept called "Farm Tourism/niche tourism". Kerala is undoubtedly India's most important plantation state with nearly half of the plantation area in the country and a major interest in all the four crops-tea, coffee, rubber and cardamom. Pathanamthitta is a spot-on farm tourism destination housing tropical diversity with fertile agricultural land where plantations, paddy, tapioca, varieties of vegetables and spices like cardamom, pepper etc. are extensively cultivated. The other famous destinations include Idulkki, Trishur, Kottayam, Mattupetty in Munnar, Palakkad, Wayanad and many others. Kerala has the pride of starting a rural tourism project at Kumbalangi near Kochi with support from the Department of Tourism, Government of India. Kumbalanghi is a perfect farm tourism village destination in central Kerala, close to the port town of Cochin which has a vast stretch of backwaters connected by interlocking waterways to the whole of Kerala. Thus, it creates a benchmark for Ecotourism in the country.

The **Uttar Pradesh** (UP) arm of the Confederation of Indian Industry (CII) has approved this agribusiness concept, agri-tourism, to attract tourists and also help the farmers and the rural community of the state make money. The Uttar Pradesh CII has joined hands with the Strategic Initiative and Advisory Government (SIG), an initiative of Delhi-based Yes Bank, to conduct a research on the same. The research aims to find out if the concept of agri-tourism is viable and beneficial for the state. The basic idea is to promote rural tourism and attract visitors to come and see the countryside, handicrafts, taste traditional food and enjoy folk music. State govt has plans to finance the interested farmers to start initiative of such kind. The CII is in talks with the tourism and agriculture department of Uttar Pradesh to promote this concept. It is necessary to adopt these types of new concepts to develop the economy of the state (Karjigi, 2019).

The concept of agritourism venture is not new to **Goa** which has wide experience in hosting the ecotourism and niche tourism but not pure agritourism. It is expected that by the year 2020, about 28 lakhs tourists may be visiting Goa and this number might go up by the year 2030 (Department of Tourism , Goa) taking into account the expected rise in number of tourists, it therefore offers a immense scope of economic opportunities for people of Goa. Having the direct and indirect linkages with other sectors of the economy of the State, agritourism has a bright future. Paradigm shift from "on shore tourism" to "off shore tourism" is a key turning point in Goa Tourism industry that has envisaged a tremendous potential. It has become imperative to shift the attention of tourists to the hinterlands which have been blessed with enchanting scenic beauty of natural forest as the carrying capacity of most of the famous beaches has reached maximum threshold level. The coastal agricultural research institute is promoting agro-eco-tourism in the backdrop of main stream tourism in Goa and adjoining regions (Bhandare, 2013).

Notable Institutions Facilitating Growth of Agritourism in India

1. Krishi Vigyan Kendra of Baramati, Pune, Maharashtra: Krishi Vigyan Kendra is a district level farm science centre established by the Indian Council of Agricultural Research (ICAR) at Baramati; district Pune for transfer of technologies to the farmers' fields. The aim of Krishi Vigyan Kendra is to reduce the time lag between generation of technologies at the research institutions and its transfer to the farmers' fields for increasing production/productivity and income from agriculture and allied sectors on a sustained basis. Four mandates have been envisaged in the design of the Krishi Vigyan Kendra. There are about 55 such centres established all over Maharashtra. Usually centres are run by NGOs are funded by Government. Pertaining to the agritourism venture, KVK itself is an agritourism centre with a vast land of 110 acres. It comprises of diverse the components of agriculture such as horticulture, fisheries, diary, core agricultural crops, apiculture, silviculture, and many more. A separate building is established under this project which hosts the tourists and trains the farmers who wish to start this venture.

2. MART - Maharashtra State Agri Tourism and Rural Tourism Co-operative Federation Ltd: According to its managing director, the federation would help farmers to supplement their income from farm produce by initiating tourism related activities on their farm. MART in partnership with NABARD has undertaken training and certification programmes for farmers. The society is mainly working for expansion of Agritourism in Western Maharashtra. The society encourages formation of farmers in tourism development. Till now 13 such co-operative societies are formed in various districts. MART has classified Maharashtra into six agritourism belts namely: Konkan, Pune, Nashik, Aurangabad, Amaravati and Nagpur. A complete list of operational farms affiliated to MART is given in the appendix.

3. Konkan Bhumi Krushi Paryatan Sanstha: It is a Mumbai based NGO working for overall development of Konkan region. Beautiful sea shores, coconut plantations, mangoes and cashewnut, fruit orchids, Sahayadri forests, rivers and backwaters all have the potential to attract tourists. Rural and agritourism development was considered as major issue and "Konkan Bhumi Krushi Paryatan Sanstha" was formed in 2010. The NGO is trying to consolidate funds from government to develop tourism in Konkan region. Farmers interested in developing Agritourism are given 3 days training in a work shop. Project feasibility is assessed and necessary help for promotion is given by MART. The members have advantage of strong marketing network through MART. Currently these sites are developed at Murud, Dapoli and Sindhudurg districts.

ATDC: Agri Tourism Development Corporation (Pune)

ATDC was established on 16th May 2006. Its aim is to Promote Agri tourism to help Indian Rural Social Economy to flourish and help rural youth to earn good respectable living in the villages and farming itself.

Objectives

1. To develop and promote agricultural tourism (Agri-tourism) as a potential vehicle for diversifying and stabilizing rural economies.
2. Creating jobs, increasing community income, providing a broader market base for local business.
3. Attracting tourists to the rural area, thereby supporting the growth of small tourism industries.
4. Through ATDC's projects, training and support, farmers benefit from the development of tourism.

In the last 4 years more than 500 farmers are trained under ATDC's Agritourism Training Programme and in 2007 there were about 52 farmers from Maharashtra started Agritourism activity on their farms to supplement the agriculture income. ATDC has published a directory of farmers in 2017 in its 1st edition and in 2017 being its latest edition which enlist all Agritourism centres registered under it for promotion and contact.

To guide and acquaint farmers about Agritourism, it started their first model project in Baramati "Malegaon Sheti Farm" on 110 acres. Later, Mr.Pandurang Taware started on his own in Palshiwadi village, 30 km away from Baramati. He has been involved in training the farmers and is pioneer in spreading the awareness of agritourism in the country wherever he gets an opportunity. He has got various awards from department of tourism as well as agricultural institutions for his noble work.

ICAR-Central Coastal Agricultural Research Institute - [CCARI], North Goa, Goa

A detailed survey of the existing agroeco-tourism was carried by the institute recently. Almost all agritourism centres were visited and information on various aspects including the facilities available, type of tourists visiting, type of cropping system, services offered, constraints and expectations from the government and ICAR institutes was collected.

Since Goa has carved a niche as internationally renowned tourist destination, the Agricultural Technology Dissemination Centre (ATDC) of this institute has taken up the promotion/publicity of agro-eco-tourism on top most priority. It is the endeavour of this institute to promote agro-eco-tourism in the backdrop of main stream tourism in Goa and adjoining regions.

Conclusion

1. Institutional interventions such as policy and research backstopping must include Government strategies and suggestions for agritourism development. Reduction of high initial investment through introducing low cost construction materials through extensive research and case studies would bring the

establishment cost to minimum level so that even the semi-medium and small farmers can also take up the venture.

2. Provision of loan through PACS/ Commercial banks under MUDRA or start-up scheme will encourage the young and interested farmers to take this venture. Provision of subsidy for low cost agritourism farms would strengthen as an agritourism.

3. The government needs to come up with the price policy mechanism with respect to tour packages in order to prevent loss to farmers. Market survey in the urban areas needs to be done to identify potential consumers for agritourism and agri-products.

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Recent Trends in Agricultural Extension

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Introduction

Extension is a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their standard of living and lifting social and educational standards. The extension system of India has witnessed paradigm shift from 'production led' to 'farmers led' system which in turn has transformed the researches in extension. (Girish, 2017). Effective extension involves adequate and timely access by farmers to relevant advice, with appropriate incentives to adopt the new technology if it suits their socioeconomic and agroecological circumstances. Critical to adoption are the availability of improved technology, access to modern inputs and resources, and profitability at an acceptable level of risk. Farmers get information from many sources. Public extension is one source, but not necessarily the most efficient. Thus, although extension can improve the productive efficiency of the agricultural sector, the virtues and limitations of alternative mechanisms need to be considered in assessing the cost-effectiveness of delivering information. The modern extension system includes

Decentralization

Agricultural extension systems in developing countries are struggling to prove their importance and relevance to agricultural and rural development. In order to solve complex development problems, national extension systems need to encourage the active participation of rural people in planning, implementing, and monitoring extension programs, especially at the regional, district, and county level.

Decentralization is a major undertaking that requires the full understanding of all parties involved, systematic capacity building at the lower system levels, and careful coordination to ensure successful implementation.

Privatization

Privatization of extension services can take different forms. Of the various types of decentralization categorized/defined by Rondinelli (1987), the most is a complete withdrawal of government from providing extension programs to farmers.

This option is sometimes known as total privatization. It can be of a partial nature, involving such strategies as cost-recovery, fee-based services, agricultural taxes for use in funding agricultural extension, and contracting with outside organizations for specific services.

Pluralistic Extension and Agricultural Innovation Systems

Faster the advancement of knowledge and its transfer through advisory systems (whether public, private or pluralistic), Coordinate agricultural development organizations, including knowledge systems, and promote agricultural innovation systems with a view to contributing to agricultural development and more particularly to the effectiveness of the agricultural extension system.

Public-Private Partnership

A public-private partnership is a contractual agreement between a public agency (federal, state or local) and a private sector entity. Through this agreement, skills and assets of each sector (public and private) are shared in delivering a service or a facility for the use of the general public. Each party shares risks and rewards potential in the delivery of the service and/or the facility.

Unified Extension Service

The extension services are being unified in the interest of optimum utilisation of resources and an efficient bureaucracy. Indeed, the farmer's time cannot and should not be wasted through individual visits of so many extension agents, each representing a different agricultural discipline.

Application of Electronic Information Technology

The advanced information technology is already making headway in the area of rural and agricultural development. A number of countries such as Laos, Vietnam and Mali, are experimenting with telecentres, which have already exhibited their benefits in several West European countries.

Client-Orientation

The old practice of delivering the same technical messages to all farmers using the same extension methodology is gradually being replaced by client-focused approaches.

Conclusion

1. Agricultural extension is an essential part in technology transfer.
2. The trend was the birth of unique and a better, effective and support extension systems.
3. It should be dynamic, location and time specific, updated and facilitate change enabling a better educational and social status for a rural community.

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Hardy Deciduous Shrub - Magnolia

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Type	Hardy deciduous shrub
Common name	Magnolia
Family	MAGNOLIACEAE
Flowering season	Mid to late spring (march to late spring)
Planting date	Late autumn to mid spring (October - march) for bare rooted; anytime from containers
Mature size/ shape	Height 2.5 – 3 m (8-10 ft.), spread up to 2m (7 ft).

The magnolia is native to Japan, where it grows wild in certain areas, but has long been cultivated in gardens there. It was named after the 18th century French botanist, Pierre Magnol Professor of Botany and Director of the Botanic Garden at Montpellier. Introduced into American gardens in 1862, it reached the British Isles some 15 years later.

Magnolia stellata is a deciduous shrub of rather rounded shape, reaching 3m (10 ft) or occasionally more, although being slow growing it is often seen at little more than 1.25 m (4 ft.). It is usually much wider than high and a plant 1.25 m (4 ft.) tall may have a spread of 2m (over 6 ft.). The starry white flowers, which have 12- 18 petals, open before the leaves in mid spring (March or early April). One of the advantages of this magnolia is the fact that is flowers while still a very small plant; indeed, plants under 30 cm (12 in) high will produce flowers. There is a so called 'pink' variety known as *Rosea*, whose buds are indeed pink, but whose open flowers are white as in the usual form. However, plants of *Rosea* are quite liable to set seed, which the ordinary type of magnolia practically never does. After the flowers have gone the plant produces narrow oblong leaves up to 10cm (4 in) long.

So far as winter frost is concerned it is perfectly hardy, but the opening flowers are liable to be damaged by frost or by the wind. This is a risk that you will have to take with all the early flowering magnolias. Such frosting of the flowers, although infuriating, does no harm to the shrub itself.

Magnolia stellata requires full light and a good soil, and is suited to a small garden. It is unsatisfactory on chalky soils, although it seems not to resent some alkalinity. However, it does rather better on neutral or slightly acid soil such as rhododendrons enjoy.

When planting young magnolias remember that they require a lightener such as well rotted manure or peat in the soil immediately around the roots. Mix it in with the garden soil to give a rather light mixture into which the new roots can run easily. All magnolias have rather thick fleshy roots and it is usually advisable to defer any planning until late spring (April).

If you plant in spring, the shrub must be thoroughly watered in and then a mulch of straw, dried bracken, or farmyard manure place around its base to prevent the soil drying out at this crucial time. If your soil is

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rather poor, much may be done by digging a hole 45cm (18 in.) deep and up to 2cm (6 ft.) across and filling this with a special mixture. This will ensure the plant getting off to a good start and, since it should remain in the garden forever, there is every reason for you to take a little trouble to help it get started successfully.

The plant is closely allied to *Magnolia kobus*, a quite rapid grower which reaches upto 12m (40 ft.) tall, but often takes a very long time before it begins to flower freely. *Magnolia stellata* is frequently grafted on this plant, although *Magnolia stellata* is one of the few magnolias that can be raised fairly easily from cuttings; choose firm but not yet woody growths. *Magnolia stellata* and *Magnolia kobus* have been hybridized to give *Magnolia* x *loebneri* which combines the early flowering of *stellata* with the larger dimensions of *kobus*; some grow to 7.5 m (25 ft.) and are slightly more across.

		
Magnolia stellata	***Magnolia spectrum***	***Magnolia kobus***
		
Magnolia loebneri	***Magnolia macrophylla***	***Magnolia sieboldii***
		
Magnolia verbania	***Magnolia wilsonii***	***Magnolia obovata***
		
Magnolia hypoleuca	***Magnolia guatemalensis***	***Magnolia fraseri***

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Salvia – Half Hardy Annual

Article ID: 31028

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Type	Half – hardy annual, hardy and half- hardy perennials; half- hardy sub-shrubs
Common name	Salvia
Family	LABIATAE
Flowering season	Summer
Sowing date	Late winter to early spring (January – February)
Mature size/ shape	15 cm- 1.5 m (6 in- 5 ft.)
Special uses	Some species are used as dried flowers.

The name salvia is derived from *Salvus*, the Latin word for safe or well. Salvias were once thought to have medicinal and curative properties. The half- hardy exotic salvias from the New World first appeared in Europe in 1744, when seeds were sent from Florida and Mexico.

The familiar red *Salvia splendens* used for summer bedding came from Brazil in 1822. *Salvia fulgens* of Mexican origin did not arrive in Britain until 1827, although it was grown on the Continent before this. Also, from Mexico came the brilliant blue *Salvia patens* in 1838. Salvias are well behaved garden plants, even though they have not been extensively bred or developed since their introduction.

Salvias are a very diverse group, comprising 700 species of hardy, half – hardy and tender annuals, perennials and mainly evergreen sub shrubs. The most popular species are the familiar half hardy annuals, including the fiery summer bedding plant *S. splendens*. The Victorians loved bedding plants and used this species to make a splash of colour wherever they could.

S. splendens and the bright red Blaze of Fire still bring colour into the garden every summer. It is best to treat it as a half hardy annual, starting from fresh seed each year. An attractive variation is the similar Purple Blaze, which grows in the same habitat and produces violet purple flowers. *S. patens*, a perennial, bears clear blue flowers during the summer and early autumn.

Although it is still not well known, *S. horminum* is becoming more popular. This true annual is a native of Southern Europe and grows to 45 cm (18 in). During the summer, tiny pink or purple flowers appear, but it is the brightly coloured 4 cm (1 ½ in) long bracts (flower bearing leaves) that make the most show. Monarch Bouquet, which produces a splendid mixture of white, rose, red, blue and purple bracts, is an excellent variety.

All half-hardy annual salvias are usually raised in heat under glass during the late winter and early spring. They should be planted out during late spring and early summer. The hardy and half-hardy perennial salvias are very attractive garden plants.

S. argentea, originally from the Mediterranean, is short- lived and often grown as a biennial. It has delicate rosettes of triangular shaped leaves covered in silvery white hairs. The white flowers flushed with mauve are 4 cm (1 1/2 in) long and appear in late summer and early autumn (July and August).

Salvia of garden origin is *S. virgata nemorosa*, which grows to a height of 60cm (24 in). The profusion of blue purple flowers makes a welcome display during the summer. Hardy perennial salvias should be planted in late autumn and mid spring (October and March) in well drained garden soil.

They should be cut down to ground level every year during November. Once popular as conservatory plants, the half-hardy sub shrubs are no longer as well known as the other groups. An interesting variety, *S. fulgens*, produces a wonderful show of red flowers during the summer. The leaves are white and woolly on the undersides.

This plant will spread about 45 cm (18 in) and reach 60-90 cm (2-3 ft.) in height. Sub shrubs are equally happy planted in pots or in greenhouse soil. Gross feeders, they appreciate liquid feeds every week during the growing season; and they should never be allowed to dry out. It is advisable to ventilate the greenhouse when temperatures exceed 13^{o}c 5^{o} F), as these plants are not lovers of heat.

S.neurepia and *S.rutilans*, two summer flowering half hardy sub shrubs, will thrive inside. They may be encouraging to grow at the base of a south facing wall outdoors, provided they are protected with straw or other litter during the winter. Most salvia are propagated from seed, but the half hardy sub shrubs are increased by taking cuttings from the non-flowered lateral shoots in late spring or early autumn.

Salvias are rarely bothered by pests and diseases, so they should grow quite well, provided they are adequately fed and watered. *S.officinalis* is the common herb sage, which is available in green or decorative leaved form.

		
Salvia patens	***Salvia splendens***	***Salvia fulgens***
		
Salvia horminum	***Salvia argentea***	***Salvia virgata nemorosa***

		
Salvia microphylla* Var. *Neurepia	***Salvia rutilans***	***Salvia officinalis***

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RNA Interference – A Key Tool for Crop Improvement

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Introduction

RNA interference (RNAi) is a method of blocking gene characteristics through inserting short sequences of ribonucleic acid (RNA) that match part of the target genes sequence, as a result no proteins are produced. RNAi has the capacity to turn out to be a powerful therapeutic approach in the direction of focused and personalized medicine.

Even more exciting is the use of RNAi in agriculture. RNAi has supplied a manner to control pests and diseases, introduce novel plant traits and increase crop yield. Plant biologists found out that introducing multiple copies of a gene that codes for purple petunia flowers led, not as expected to a deeper purple hue, but rather to plants with white or variegated flowers.

Through an unknown mechanism, the delivered transgenes have been silenced in addition to the plant's 'crimson-flower' gene (Novina and Sharp., 2004 and Napoli et al., 1990). Andrew Fire and Craig Mello observed that injecting double stranded ribonucleic acids (dsRNA) into the worm *Caenorhabditis elegans* caused the silencing of genes with sequences identical to that of the dsRNA. They called the phenomenon RNA interference.

Fire and Mello had been awarded the 2006 Nobel Prize for Physiology or Medicine for their discovery. In addition to its roles in regulating gene expression, RNAi is used as an immune response to infection and as a natural protection mechanism towards molecular parasites inclusive of jumping genes that affect genome stability.

General Metabolic Pathway of RNA Interference

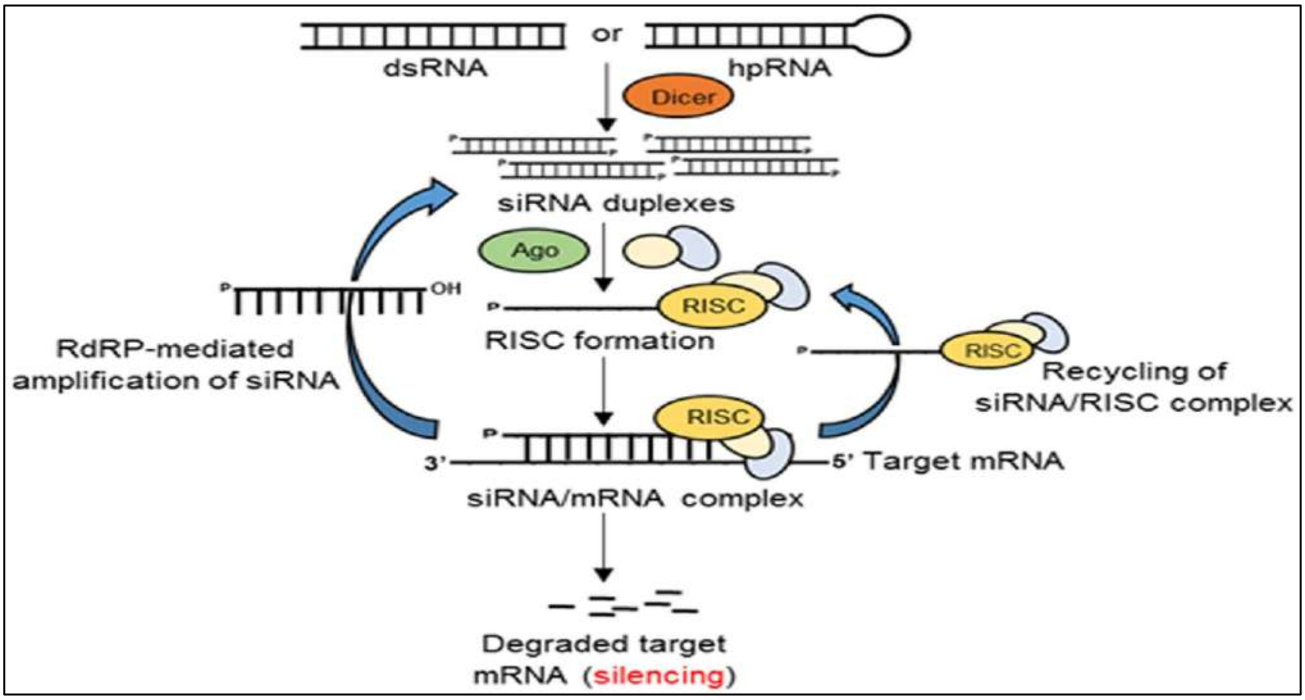

Figure 1. General metabolic pathway of RNA interference
(Source:https://www.frontiersin.org/files/Articles/245287/fpls-08-00200-HTML/image_m/fpls-08-00200-g001.jpg)

The entry of long double stranded RNA triggers the RNAi pathway of cells. This results in the recruitment of the enzyme Dicer. Dicer cleaves the dsRNA into short, 20-25 basepairs long, fragments, called small interfering RNA (siRNA). An RNA-induced silencing complex (RISC) then distinguishes between the two siRNA strands as either sense or antisense. The sense strands are degraded. The antisense strands on the other hand are incorporated to the RISC. These are used as guide to target messenger RNAs (mRNA) in a sequence-specific manner. Messenger RNAs (mRNA), which codes for amino acids, are cleaved by RISC. The activated RISC can repeatedly participate in mRNA degradation, inhibiting protein synthesis (Figure 1).

RNA Interference for Disease Resistance Strategies in Crop Plants

Gene silencing become first used to expand plant varieties immune to viruses. Engineered antiviral strategies in plants mimic natural RNA silencing mechanisms. This turned into first demonstrated while scientists developed Potato virus Y- resistant plants expressing RNA transcripts of a viral proteinase gene. Immunity has on account that been shown to different viruses which include the Cucumber and Tobacco Mosaic Virus, Tomato Spotted Wilt Virus, Bean Golden Mosaic Virus and Banana Bract Mosaic Virus. In addition, plant life also can be modified to produce dsRNAs that silence essential genes in insect pests and parasitic nematodes. This approach was used to develop root-knot nematode, corn rootworm and cotton bollworm resistant varieties.

RNA Interference for Male Sterility in Crop Plants

RNAi has also been used to generate male sterility, which is valuable inside the hybrid seed industry. Genes which can be expressed solely in tissues involved in pollen production can be cantered through RNAi. For instance, scientists have developed male sterile tobacco lines through inhibiting the expression of TA29, a gene important for pollen development. RNAi was extensively utilized to disrupt the expression of Msh1 gene in tobacco and tomato ensuing to rearrangements within the mitochondrial DNA associated with naturally occurring cytoplasmic male sterility. Some other target traits and genes are described in Table 1 precisely through RNAi technology in crop plants.

Table 1. Crop Metabolic Pathway Engineering through RNAi Technology (Source – ISAAA)

Target trait	Host crop plant	Gene targeted	Application
Nutrient content increment	Tomato	*Lyc*	lycopene concentration increased
	Tomato	*DET1*	Higher flavonoid contents
	Wheat, Maize	*SBEII*	Increased levels of amylose
	Canola, Cotton	*FAD2*	Increased oleic acid content
	Cotton	*SAD1*	Increased stearic acid content
	Maize	*ZLKR/SDH*	Lysine-fortified maize
Reduced alkaloid production	Coffee	*CaMXMT1*	Decaffeinated coffee
	Opium poppy	*COR*	Production of non-narcotic alkaloid
	Tobacco	*CYP82E4*	Reduced levels of nor-nicotine in leaves
Heavy metal reserve	Arabidopsis	*ACR2*	Arsenic hyper-accumulation
Reduced polyphenol	Cotton	*s-cadinene synthase*	Lower gossypol levels in cottonseeds
Ethylene sensitivity	Tomato	*LeETR4*	Early ripening tomatoes
	Tomato	*ACC oxidase*	Longer shelf life
Reduced allergenicity	Peanut	*Arah2*	Allergen-free peanuts
	Ryegrass	*Lolp1, Lolp2*	Hypo-allergenic ryegrass

Plant Functional Genomics and RNA Interference

An essential challenge in the post-genomic generation of plant biology is to determine the functions of all genes in the plant genome. Compared to other techniques, RNAi offers specificity and efficacy in silencing contributors of a gene or more than one gene family.

In addition, the expression of dsRNAs with inducible promoters can manipulate the volume and timing of gene silencing, such that essential genes are only silenced at chosen growth stages or plant organs. There are several approaches of activating the RNAi pathway in plant life.

The numerous RNAi techniques have blessings and disadvantages with recognize to how persistent their results are and the variety of plants to which they can be applied. These include the usage of hairpin RNA-expressing vectors, particle bombardment, Agrobacterium- mediated transformation and virus-triggered gene silencing (VIGS).

Conclusion

With RNAi, it would be viable to target more than one gene for silencing using a thoroughly-designed single transformation construct. Moreover, RNAi can also offer broad-spectrum resistance against pathogens with excessive degree of variability, like viruses. Recent studies have hinted feasible roles of RNAi-related approaches in plant biotic and abiotic stress adaptation. The complexities of RNAi pathway, the molecular machineries, and how it pertains to plant development are still to be elucidated.

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Linkage of Plant Genetic Resources, Plant Breeding and Seed System

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There is a huge difference in what we produce today and what is needed to feed a projected 10 billion world population by 2050 which is expected to increase anywhere between 59% and 98% (FAO, 2009; WRI, 2018). Better conservation and utilization of food plant diversity have potential to address this issue effectively.

The plant genetic resources refer to the genetic diversity of actual or potential value that exists in grains, legumes, vegetables and fruits. This PGR diversity is the chief biological basis for food security. However, this potential can only utilize in amalgamation with plant breeding and seed systems.

The present-day advances in yield potential, quality, pest resistance and other important traits have resulted because of breeding involving crosses from diverse genetic material. Farmers as well as breeders who rely on yield as seed depend on crop genetic resources. The diverse PGR available from seed and planting material of modern and traditional cultivars, landraces from farmers' fields and wild relatives can be utilised to identify elite donors of favourable alleles and incorporated into breeding program bringing the alleles into practical uses to develop a novel genotype combination which is tested for stability and worth followed by multiplication by seed production pipeline and distributed to seed growers and farmers after identification and release.

Therefore, conservation and sustainable use of PGR is necessary as they ensure crop production meeting environmental challenges and climate change. Their erosion is a long-term serious threat to the world's food security. The breeders are fully dependent on PGR, be it from farmers' field and sometimes on 'domesticated elsewhere' to subsequently develop elite breeding material through prebreeding.

The process of prebreeding the initial link in the chain connecting PGR, plant breeding practices and seed system. The crop wild relatives or collections are evaluated and identified for favourable traits deciding further scope as they are pure wealth of alleles for several traits like stress hardiness, quality and pest tolerance and resistance. Molecular marker techniques can be implemented to accelerate identification and transfer of useful alleles.

The diagram depicting linkage between PGRs, plant breeding and seed system is shown in Fig. 1. The efficiency is increased by the art of enhancement of genetic variability in the germplasm for its further use in regular breeding program, resetting the genetic diversity of crops by reintroducing genetic variability left behind and using genetic diversity that was not previously accessible due to genetic in-compatibilities or non-overlapping geographic range.

However, low utilization of PGRs may be due to lack of documentation and adequate description of collections, lack of proper evaluation and low seed availability due to inadequate seed regeneration. Moreover, the techniques of tissue culture such as ovary culture and embryo rescue are promising in trait transfer in cross incompatible species. Systematically developed advanced backcross populations derived from wild Cajanus species provide valuable resource for genomic studies to identify QTLs for important agronomic traits.

Backcross populations derived from complex interspecific crosses will help to improve levels of pest resistance by combining different components from different species into cultivated types. Varieties developed aiming yield and other traits are adopted by farmers as per consumer preference and market demand.

Participatory plant breeding is a demand driven approach where the farmers are almost equally involved as breeders in selections among variations in breeding program. This increases farmer skills to in selection and seed production efforts through participatory varietal selection. The result is a line or a population of genotypes ready to be adopted and suitable for farmers as per their criteria. The seed production and supply system involve an integrated approach to sustainable use of plant genetic resources for increasing production and achieving food security.

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Seed is not just a carrier of genetic diversity, but also a primary input for food security. The good quality seed is 'physically pure, genetically sound and physiologically viable', suits the efficient utilization of PGRs. The network should include several seed growers, testing and timely procurement. Restoration of PGRs also depends on sound regeneration systems. Seed systems provide framework for PGR and varietal multiplication, usage, availability and quality. Therefore, the linkage between Plant Genetic Resources, Plant Breeding and Seed System is quite inevitable and efficient in conserve, discover, utilize and make available the novel qualities in PGR.

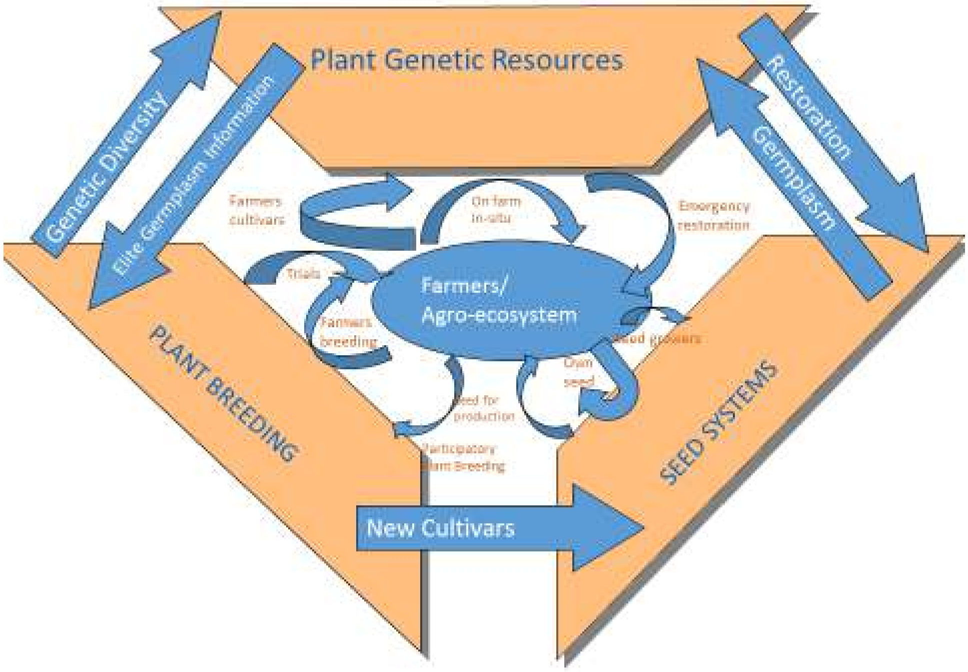

Fig. 1. Linkage relationship between plant genetic resources, plant breeding and seed systems

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Challenges and Risk Assessment of Nanomaterials

Article ID: 31031

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Introduction

The production and use of nanomaterials, which continue to grow, have given rise to many concerns and debates among public, scientific and regulatory authorities regarding their fate in biological systems. Soils contain many kinds of inorganic and organic nanoparticles, namely clay minerals, metal oxides and hydroxides, humic substances, allophane, and imogolite (Theng, B. K., & Yuan, G. (2008).

Organic nanoparticles can also be found in natural vegetation (Xia et at., 2010). Anthropogenic nanoparticles can be further divided into two categories: incidental, which are nanoparticles produced unintentionally in manmade processes (e.g., carbon black, carbon nanotubes and fullerenes, platinum- and rhodium-containing nanoparticles from combustion byproducts (Nowack B and Bucheli TD 2007) and engineered/manufactured, which are nanoparticles that are produced intentionally due to their nano-specific properties.

The main focus of current nanomaterial toxicity research is engineered nanoparticles, such as metals, metal oxides, single-walled and multiwalled carbon nanotubes, C-60, polymeric nanoparticles used as drug carriers, and quantum dots. The increase in relative surface area that occurs as particle size decreases down to the nanoscale gives rise to novel and enhanced material properties, but it also renders them more biologically reactive (Nel et al., 2006 and Kahru et al., 2010).

The release of nanoparticles into the environment can occur through many processes, such as spilling and washing consumer products incorporating nanoparticles; during synthesis and production; as an accidental release during transport or use; from industries that exploit nanotechnology, for example wastewater treatment and drug delivery Nanoparticles have been shown to produce cytotoxic, genotoxic, inflammatory and oxidative stress responses in different mammalian cells in vitro.

The International Organization for Standardization defines Engineered Nanomaterials, or ENMS, as materials with external dimensions between 1 and 100 nm, the nanoscale, or having an internal surface structure at these dimensions. (Jeevanandam et al., 2018) Nanoparticles can be both incidental and engineered. Incidental nanoparticles include particles from dust storms, volcanic eruptions, forest fires, and ocean water evaporation. Engineered nanoparticles (EMMs) are nanoparticles that are made for use in cosmetics or pharmaceuticals like ZnO and TiO2. They are also found from sources such as cigarette smoke and building demolition.

Engineered nanoparticles have become increasingly important for many applications in consumer and industrial products, which has resulted in an increased presence in the environment. This proliferation has instigated a growing body of research into the effects of nanoparticles in the environment. The properties of NPs and their impact in inhibiting challenges and toxicity risks are summarized in Table 1.

Table 1. Summary of Five Basic Nanomaterial Properties and their Potential Risks and Challenges

Nanomaterial properties	Risk description
agglomeration or aggregation	Weakly bound (agglomeration) and fused particles are significant risk criteria as they lead to poor corrosion resistance, high solubility and phase change of NMs. This further leads to deterioration and the structure maintenance becomes challenging.
reactivity or charge	NPs can be charged either by functionalization or spontaneous degradative reactions. Chemical species and their charge-related critical functional groups will be a significant factor for specific functionality and bioavailability of NMs.

impurity	Inherently, NPs interact with impurities due to their high reactivity. Due to this reason, encapsulation becomes a prime necessity for solution-based NP synthesis (chemical route). In the encapsulation process, the reactive nano-entities are encapsulated by nonreactive species to provide stability to the NPs.
contaminant dissociation	The contamination of residual impurities in the NP is considered as a major risk factor. For example, sulfur impurities may present in iron oxide NPs depending on the precursor used for their production (FeCl3 or Fe2(SO4)3. Similarly, nickel, yttrium, or rubidium metal impurities may be present in the carbon nanotubes (CNTs) that are adsorbed on the CNT surface.
size	Reactivity and agglomeration of NPs is mostly dependent on their particle size. It is well known that the process of agglomeration will happen at slower rates in smaller particles. After the synthesis of the NPs, it is impossible to retain their original size. Hence, encapsulation becomes highly inevitable in NP synthesis. The exceptional size-dependent chemistry of NPs is distinguished from classical colloid chemistry by categorizing NPs according to their particle size.
recycling and disposal	NMs are not bound to any hard-and-fast safe disposal policies. The experimental results of NP exposure are not available and their potential toxicity issues are still under question. Hence, the uncertainty of a nanomaterial's effect is yet to be developed for permanent disposal and recycling policies.

Nanomaterial Regulations

Nanomaterials possess characteristics such as high chemical bioactivity and reactivity, cellular as well as tissue and organ penetration ability, and greater bioavailability. These unique properties of NMs make them superior in biomedical applications. However, these merits are also avenues for potential toxicity. Thus, regulations via legislation, laws, and rules have been implemented by several government organizations to minimize or avoid risks associated with NMs. However, there is no specific international regulation, no internationally agreed upon protocols or legal definitions for production, handling or labelling, testing toxicity and evaluating the environmental impact of NPs.

Medical standards related to ethics, environmental safety, and medical governance have been modifed to cover the introduction of NMs into the biomedical field. Currently, the USA and the European Union (EU) have strong regulatory bodies and guideline legislation to control the potential risks of NMs. The European Commission has developed several pieces of EU legislation and technical guidance, with specific references to NMs.

This legislation has been employed inside EU countries to ensure conformity across legislative areas and to guarantee that a NM in one sector will also be treated as such when it is used in another sector. According to the European Commission the term nanomaterial means "a natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate, and where for 50% or more of the particles in the number size distribution, one or more external dimensions is in the size range of 1 nm to 100 nm". As the specifications of the materials and products meet the substance definitions of the European chemical agency (REACH) and the European Classification and Labelling of Chemicals (CLP), the provisions in these regulations apply. In addition, the EU has formed the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), to estimate risks associated with NMs. In 2013, EU cosmetics regulation 1223/2009 was replaced by Directive 76/768/EEC.

The regulation defines the term nanomaterial as "an insoluble or bio-persistent and intentionally manufactured material with one or more external dimensions, or an internal structure in the range of 1 to 100 nm which includes man-made fullerene, single-walled carbon nanotubes, and graphene flakes". It can be noted that cosmetics face regulations and moderations from USFDA's Federal Food, Drug, and Cosmetic Act (FFDCA), Personal Care Products Council (PCPC), Voluntary Cosmetic Registration Program (VCRP), EU cosmetics product notification portal (CPNP), REACH, Scientific Committee on Consumer Safety (SCCS) and International Cooperation on Cosmetic Regulation (ICCR).

These regulations from the US and EU, as well as other countries such as Japan and Canada, reveal that nanotoxicity via cosmetics are of major concern for both scientific policymakers and industries producing consumer products. In the US, regulatory agencies such as the Food and Drug Administration (FDA), the United States Environmental Protection Agency (USEPA) and the Institute for Food and Agricultural Standards (IFAS) have initiated protocols to deal with the possible risks of NMs and nanoproducts. Since 2006, the FDA has been working on identifying sources of NMs, estimating the environmental impact of NMs and their risks on people, animals and plants, and how these risks could be avoided or mitigated (Thomas, et al., 2006). The European Medicines Agency (EMEA) and United States Food and Drug Administration (USFDA) help in regulating the medical usage of hazardous NMs. Apart from this, a book entitled "Principles for the Oversight of Nanotechnologies and Nanomaterials" was published by a coalition of US domestic and international advocacy groups and was endorsed by 70 groups on six continents. This article demands for a strong and comprehensive oversight of products generated from NMs.

This encompasses a precautionary foundation for specific nanomaterial regulations, health, and safety of the public and workers, transparency, public participation, environmental protection, as well as the inclusion of broader impacts and manufacturer liability. Similarly, the Nanomaterials Policy Recommendations report covers ways to avoid or reduce the risk of NMs in food-related industries. This report also advises companies to adopt a detailed public policy for NMs usage, publish safety analyses of NMs, issue supplier standards, label NPs below 500 nm and adopt a hazard control approach to prevent exposure to NPs.

Organic suppliers including the UK Soil Association, the Biological Farmers of Australia and the Canada General Standards Board have already banned the use of engineered NPs in food. Researchers and manufacturers should be educated on the regulatory laws and legislations prior to nanomaterial production to avoid these types of bans against NMs. It is currently agreed that NMs are not intrinsically hazardous per se and many of them seem to be nontoxic, while others have beneficial health effects. However, the risk assessment in the future will determine whether the NMs and their products are hazardous or any further actions are needed.

Conclusion

The toxicity profiling of NMs is a highly demanded research area worldwide in recent times. Natural NMs have been present in the ecosystem for years, and they possess some mechanisms to cause less harmful effects among living organisms. However, research advancements have found some acute toxic effects of nanosized particles in living systems. NMs from anthropogenic activities and engineered NMs in consumer products are able to cause toxic effects in living creatures. Additionally, emerging NPs, such as viral NPs and nanozymes, should be subjected to rigorous cytotoxicity tests to establish benign mechanisms of application and dosage levels. In order to minimize or avoid the potential hazards of engineered NMs in consumer products, regulations and laws have been implemented in many countries. Extensive research in the field of nanotoxicology and strict laws by government agencies are essential to identify and avoid toxic NPs.

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Conservation Agriculture - A Step Towards Sustainability

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Agricultural production systems are always under the confluence of biotic and abiotic stresses. In the present scenario, the scope to increase food and agricultural production through area expansion is limited.

Conservation Agriculture been perceived by practitioners as an effective tool for Sustainable Land Management, as it is based on augmenting yields and profits, to attain a balance of agricultural, economic and environmental benefits. Thus, in many parts of the world, it is gaining acceptance as a potential alternative to both conventional agriculture and organic agriculture. The principles on which conservation agriculture is based on are rebuilding the soil, optimizing crop production inputs, including labour and boosting profits. Although, it possesses tremendous potential for all sizes of farms and agro-ecological systems; But, conceivably, smallholder farmers, especially those facing acute labour shortages would be profited by its adoption unswervingly. This concept combines profitable agricultural production with environmental concerns and sustainability that successfully works under various Agro-ecological zones and farming systems. CA is a holistic, resource-conserving and productive approach to agriculture which can possibly address the challenges to food security. This concept can make the most of available water while addressing labor shortage, adapting to climate change by enhancing ecological functions, and responding to demands for sustainable value chains and quality food products. It can satisfy the demand for food through sustainable land management by reducing tillage and improving soil cover, moisture conservation, carbon sequestration and microbial life on soil. By means of this distinctive concept, farming communities turn out to be providers of more healthy living environments for the wider community through reduced use of fossil fuels, pesticides, and other pollutants, at the same time sustaining environmental integrity and services.

Furthermore, CA considerably reduces the cost of cultivation by saving in labour, time and farm power and reduces pollution for environment. Farm litter which is considered harmful, if left as such, can serve as a good source of crop nutrition, with proper utilization by adopting suitable conservation practices under organic farming. The concept believes that collective social and economic benefits from both production and environment protection, including reduced input and labour costs, are greater than those from production alone.

In the present context of climate change conservation agriculture has its prominence since it improves soil health through positive soil carbon budget with co-benefits of resource conservation and environmental safety. In order to ensure benefits, all the three principles of CA are implemented simultaneously to promise the yield advantage. On long term basis, Conservation Agriculture in organic farming is believed to sustain and conserve the natural resources and sustaining the livelihood security of resources poor farmers of mountain region. This concept deserves a serious consideration as it promises to address global food security challenges through effective management of agro-ecosystems for improved and sustained productivity, increased profits and food security concurrently preserving the resource base and environment for the humanity in 21st century.

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Agrochemicals Affecting Soil Microbiota

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Introduction

The World Health Organization (WHO) states that in developing nations, there are three million cases of agrochemical poisoning. The prolonged intensive and indiscriminate use of agrochemicals adversely affected the soil biodiversity, agricultural sustainability, and food safety, bringing in long-term harmful effects on nutritional security, human and animal health. Most of the agrochemicals negatively affect soil microbial functions and biochemical processes.

The alteration in diversity and composition of the beneficial microbial community can be unfavourable to plant growth and development either by reducing nutrient availability or by increasing disease incidence. Currently, there is a need for qualitative, innovative, and demand-driven research in soil science, especially in developing countries for facilitating of high-quality eco-friendly research by creating a conducive and trustworthy work atmosphere, thereby rewarding productivity and merits.

Soil receives the bulk of complex agrochemical compounds, several of which are poisonous to the activity of non-target beneficial soil micro-organisms. More than 95% of the applied herbicides and 98% of insecticides reach non-target soil micro-organisms than their target pest, as they are sprayed proportionately across the entire field, irrespective of the affected areas.

Hence, of the total quantity of applied pesticides, about 0.1% reaches the target organisms while the remaining quantity pollutes the soil and environment. This indiscriminate use of pesticides not only disturbs the soil biodiversity but also adversely affects soil microcosms comprising of soil micro-fauna in field communities and soil ecosystem. Large quantities of pesticides reaching to the soil have a direct effect on soil microbiota, which is a biological indicator of soil fertility influencing plant growth and development. Similarly, several studies have reported the impact of numerous pesticides on subduing soil enzyme activity(s) which affects the nutrient status of soil and include hydrolyzes, nitrate reductase, urease, oxidoreductases, nitrogenase, and dehydrogenase activities.

Further, biological nitrogen fixation (BNF) and their associated biotransformation (i.e., ammonification, nitrification, denitrification, phosphorus solubilization and S-oxidation) are also affected by pesticide applications. In addition, reduced microbial carbon biomass (MCB) and functional diversities of many non-target soil microbial populations are affected because of intensive applications of pesticide in contemporary agriculture.

Elaine Ingham, American microbiologist and founder of Soil Foodweb, stated, “If we lose both bacteria and fungi, then the soil degrades”. Microorganisms in the soil are exclusively important because they impact soil structure, functions, and fertility. These organisms are primarily decomposers of organic matter, but also perform many other functions such as provide nitrogen (N), phosphorus (P), potassium (K), etc., through fixation and mineralization.

Thereby helping plants grow, detoxify harmful chemicals, suppress disease-causing organisms, and produce substances that may stimulate plant growth. Soil microbes also mineralize the essential plant nutrients in the soil to improve crop productivity, produce plant hormones that stimulate plant immune system, encourage growth, and activate stress responses. For example, Rhizobium converts the atmospheric elemental N into biology.

Factors comprising both above and below-ground biodiversity and population dynamics drive soil health. On a global scale, renewed efforts and focus on management strategies for food supply and security, nutrition, health, and soil sustainability are mandated for understanding the impact of agrochemicals on soil microbiota.

Impacts of Agrochemicals on Soil Microbiota and Agrobiology

Herbicides show a reduction in the total microbial population within 7 to 30 days after application depending on the type of herbicidal molecules and adversely affect the microbial biodiversity indirectly by altering the physiology or biosynthetic mechanisms. This, in turn, affects soil enzymatic activity, cellular membrane composition, protein biosynthesis, and the amount of plant growth regulators (gibberellins synthesis, transportation of Indoleacetic Acid (IAA), ethylene concentration, etc.).

The application of excessive and higher doses of herbicides has also been reported to result in the death of many sensitive microbes. The detrimental effects of applied chemical herbicides on soil microbial diversity depend on the degradability, adsorption and desorption, bioavailability, bioactivity, persistence, concentration, and toxicity of agrochemicals along with soil factors such as texture, vegetation, tillage system, and organic matter. The reduction in soil microbial functionaries is more under conventional tillage than in no-till (NT) system.

Under conventional till (CT) system, the soil microbial biomass carbon (MBC) and mycorrhizal colonization decrease after 12 days of application of herbicide fomesafen and mixtures of fluazifop- butyl + fomesafen. Some microbial communities are more sensitive to the interaction effect of herbicides with other compounds than the use of a single herbicide, as is the case with butachlor when applied in combination with cadmium. Other herbicides in combination with inorganic fertilizers and heavy metals suppress the functions of soil microbes. Following the application, herbicides undergo physical and biochemical transformations and produce several secondary metabolites which are more lethal or persistent to non-target microbial communities.

This is exemplified by the effect of 2,4-D and its metabolites on Burkholderia cepacia-a group of gram-negative bacteria. The herbicidal action also depends on the type of formulation being used in addition to the active ingredient such as surfactant and solvent. The addition of surfactant polyoxyethylene amine in glyphosate makes herbicide more toxic to the bacterium as compared to glyphosate acid alone. The use of biochar as a soil amendment may counter the negative effects of herbicides on soil biota. The soil type can also play a critical role in the herbicidal effect.

The effect can be more severe in coarse-textured soils. The herbicidal molecules belonging to the triazines group are more hazardous when applied over a long time due to their residual effect and persistence in soil. The repeated applications of atrazine can significantly reduce the intensity of soil microbes. Similarly, atrazine and metolachlor can alter the biodiversity of different species of actinomycetes and bacteria in soil. Glyphosate, a nonselective herbicide belonging to organophosphate group, can decrease the activity of phosphate enzyme up to 98%; inhibit growth and activity of soil biota, and have toxic effects on mycorrhizal fungi when tested under laboratory conditions.

Fungicide bavistin has an inhibitory effect on several soil microbial populations, but the impact is non-significant. AMF can be sensitive to some molecules of fungicides but not to all. Benzoyl is responsible for the long-term reduction in mycorrhizal associations with many fungicides being toxic to hyphal growth and thus root colonization of AMF associations of pea. Emisan (holding 6% 2-methoxyethylmercury chloride) and carbendazim (benzimidazole fungicide and a metabolite of benomyl) both have a damaging effect on AMF in groundnut. However, applications of Cu can provide a stimulus to mycorrhizae in groundnut. Applications of metalaxyl favor AM colonization in roots of soybeans and maize.

There is a significant impact of pesticide contamination in soil ecosystem. The repeated use of such complex chemicals (fertilizers, weedicides, insecticides, etc.) inevitably kill the microbial life that is invaluable for the healthy soil ecosystem. Soil-dwelling microbes can be genetically modified using insecticides in a manner that is no longer helpful to the soil ecosystem and may eventually become resistant to the chemicals, intended to exterminate them. Insecticides have a higher effect on soil microbes compared to herbicides, albeit less than that of fungicides. Some insecticides are detrimental to the growth and survival of beneficial microbes, but others may have stimulating or no effects.

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For example, insecticides of the carbamate group (e.g., carbofuran, methiocarb, and carbaryl) have a wide range of negative impact on soil microbial environment and enzymatic activity. Similarly, insecticides belonging to the chemical group of organophosphates (i.e., dimethoate, diazinon, chlorpyrifos, quinalphos, and malathion) inhibit the growth and population of soil bacteria, fungi, and enzymes. Arsenic, DDT, and lindane also have a negative effect on the microbial biomass, microbial processes, and enzymatic activities that are attributable to their long-standing residual effect and persistence in soil.

Conclusion

The mandate for agriculture development is to feed and provide adequate nutrition and surplus to the mounting human population without compromising on ecology and environment of the biosphere. Pesticides and their use are considered as magic bullets in developing nations. Pesticides cause serious hazards to soil environment and human health because a lot of pesticides and their derivatives remain in the soil system for a considerable period. Most pesticides negatively affect the biological functionaries of microbes, their diversity, composition, and biochemical processes. Pesticides cause imbalance of soil fertility which directly affects crop yield.

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Role of Women Entrepreneurship in Economic Development

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Entrepreneurship plays a vital role in the growth of any economy. Development of entrepreneurship culture and qualitative business development services are the major requirements for industrial growth in India. The economic development of India is sparking largely by the enterprising spirits of the people of the nation. The characteristic of enterprising, emerges from the inter play of behaviour and activity of special segment of the population known as entrepreneurs.

India is moving towards a flourishing entrepreneurial activity to give us the benefits of economic growth, employment, new products, services etc. The small savings of rural areas are contributed more in establishing the small and micro enterprises in India. In the light demise of rural artisanship, entrepreneurship has gained more focus as an empowerment too and in this process role of women cannot be ignored.

The women are blessed with innate power that can make them as successful entrepreneurs. Women entrepreneurship is inherent and also natural process. 48 percent of the total population is women in India while their share in participation in the economic activities is only 34 percent. Women entrepreneurship has been recognized during the last decade as an untapped source of economic growth. Apart from creating jobs for themselves and others by being different women entrepreneurs also provide the society with the different solutions to management, organization and business problems as well as to the exploitation of entrepreneurial opportunities.

The topic of women in entrepreneurship has not gain its importance both in society in general and in the social sciences. In the wake of this rapid entrepreneurial development, women entrepreneurship is gaining importance in developing economies like India but with social and stereotypical roles women are expected to play their entrepreneurial journey is full of hurdles.

Concept of Women Entrepreneurship and Status of Women Entrepreneurs in India

According to Lall & Sahai (2008),Women Entrepreneurs may be defined as the women or a group of women who initiate, organize and operate a business enterprise. As per Government of India women entrepreneurs are those who have enterprises controlled by them with minimum financial interest of 1% of capital employed and at least 51% employment is given to women.

Khokhar & Singh (2016) stated that being almost half of India's population women entrepreneurship is very important. The study of 20 Indian states has revealed that the status of women entrepreneurship in India is under developed. Women entrepreneurship is less than one third of total. Vinay & Singh(2015) stated that every woman has some entrepreneurial traits, but this capital has been underutilized in India. A women entrepreneur is a woman who can face demanding role of business leader while balancing family and social life and can be economically independent as well. They can be strong contributors to nation's economy.

Despite many success stories women entrepreneurs are still constrained by gender roles and stereotypes. Due to their reproductive role women have to devote more time to their families and thus can contribute less to business. For the same reasons they are less mobile.

Therefore, problems faced by women entrepreneurs are different from those of a male entrepreneur. Singh (2008) explains the reasons behind entry of women in entrepreneurship. Some of the major reasons are:
1. Lack of exposure to successful entrepreneurs.
2. Social constraints and stereotypes.
3. Lesser network
4. Low priority by banks.

Goyal & Prakash (2011) have stated that women have a plethora of skills. They are quick learners, persuasive, have open style of problem solving, ability to lose gracefully are among a few of their qualities. Jalbert (2008) studied the role of women entrepreneurs in global economies. He found that women entrepreneurs contribute towards the economic strength of the country and to improve national competitiveness by bringing in new ideas and assets. They perform exceptionally well in

maintaining long term business relations, good organizational skills, better money management skills and are sensitive to people and cultures. Goyal & Prakash (2011) mentioned in his study about the changing role of women. Early Indian women entrepreneurs begin their journey by initially extending their kitchen activities, the 3Ps: Powder, Pappad and Pickles. But with improvement in skills and training, proper ecosystem India is witnessing a paradigm shift from 3Ps to 3Es that is electronics, engineering and energy.

Role of an Entrepreneur in Economic Development

From the literature review it can be seen that entrepreneurs play crucial role in economic growth and development. The major contributions of entrepreneurs to the economic development are as follows:

1. Creation and distribution of wealth.
2. Reduces Concentration of Economic Power
3. Creates Large-Scale Employment Opportunities
4. Promotes Balanced Regional Development
5. Promotes Country's Export Trade
6. Increasing Gross National Product and Per Capita Income .
7. Improvement in the Standard of Living
8. Induces Backward and Forward Linkages

Gender issues in Entrepreneurship:

1. A gender-based stereotype that financing women led venture is riskier.

2. Biased attitudes of banks and informal lending groups putting unrealistic and unreasonable securities to get loan to women entrepreneurs.

3. Inadequate financial resources and working capital of women entrepreneurs as well as their inability to provide tangible security for getting the load are serious issues. High investment in certain sectors discourages women from venturing into new areas.

4. Family obligations of women entrepreneurs discourages the financial institutions due to the belief that they can at any time leave their business and become housewives again. The result is that they are forced to rely on their own savings, and loan from relatives and family friends. The interest of the family members is a detriment factor in the realization of women folk business aspirations.

5. The literacy rate of women in India is found at low level compared to male population. Although great advances are being made in technology, many women's literacy, structural difficulties, and lack of access to technical training prevent the technology from being beneficial or even available to females.

6. Though the risk tolerance ability of the women folk in day-to-day life is high compared to male members, while in business it is found opposite to that. Investing money, maintaining the operations and ploughing back money for surplus generation requires high risk-taking attitude, courage and confidence.

7. Low-level management skills among women entrepreneurs are exploited by intermediaries who take major profit.

8. Women entrepreneur's business adventures are often affected due to lack of knowledge of availability of raw materials and low-level of negotiation and bargaining skills are the factors.

Women entrepreneurs are the main actresses in changing the culture of the society. In India, women are workaholics and participate outside the house and develop the sense of independence. Majority of women operate medium and small enterprise under difficult conditions. It is difficult for them to find premises, find markets for their products, access information, training and credit especially in the rural areas.

Their low level of education and multiple responsibilities both at home and business prohibit them to travel for trade fair and training. Women entrepreneurs need to be better organized into women entrepreneur's association which helps identify higher potential business opportunities, develop markets for their products, improve product quality and marketing skills, practice good financial management and secure better premises.

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An Overview of the Digital India Programme with Special Reference to Agriculture

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Government of India with a vision to transform India into a digitally empowered society and knowledge economy and launched a major programme called "The Digital India programme" on 2nd July 2015 by prime minister Narendra Modi .The focus is on being transformative i.e. to realize IT + IT = IT. The motive is to transform the entire ecosystem of public services through the use of Information technology (IT). The focus is on making technology central to enable change.

The Government of India aims to achieve growth on multiple fronts with the Digital India Programme more specifically, the government aims to target nine Pillars of the Digital India' that they identify as being:
1. Broadband Highways.
2. Universal access to phones.
3. Public internet access Programme: under this programme the post offices become multi service centers.
4. e-Governance reforming government through technology.
5. e-kranti electronic delivery of services.
6. Information for all.
7. Electronic manufacturing target net zero import.
8. IT for jobs (ix)Early harvest programmes.

Ongoing Services Under Digital India Programme

Digi locker	Centre of Excellence on Internet of Things (IoT)
MyGov	National scholarship portal:
eSign framework	Digitize India Platform
Swach Bharat Mission Mobile App	Wi-Fi hotpots
Bharat Net	Next generation network
e-Hospital	Electronics Development

Use of Information and Communication Technology (ICT) and data ecosystems to support the process of development and delivery of timely, localized information and services to make farming profitable and sustainable enterprise as digital agriculture. ICT as a tool in agriculture has the potential to change the face of Indian agriculture in terms of crop productivity and profitability.

Government has, among others, initiated several measures viz.
1. e-Governance portals viz. farmer portal, kisan call centre and mkisan portal to benefit farmers to get right information's for efficient farming under varying agro-climatic conditions

2. Soil health card software has been standardized e-Governance program, to provide integrated nutrient management recommendations using soil test crop response method.

3. Information on weather; soil health; seeds, nutrients, pests; irrigation; crops, good agricultural practices, farm machinery; marketing infrastructure; farm commodity prices, arrivals, procurement points; electronic certification for export & import; drought relief & management; livestock, fisheries management; training; monitoring implementation and evaluation of schemes are being provided to farmers through multiple channels including Common Service Centres, Internet Kiosks and SMSs Under National e-Governance Plan in Agriculture.

4. eNAM: National Agriculture Market is an electronic trading portal which links all the existing APMC markets to create unified national market for different agricultural commodities.

5. National mission on agricultural extension and Technology is aiming at strengthening of agricultural extension to enable delivery of appropriate technology and improved agronomic practices to farmers through different interactive methods of information dissemination, use of ICT, popularization of modern technologies, capacity building etc.

6. AgriMarket app is a mobile application has been developed with an aim to keep farmers updated with the crop prices in markets within 50km of their own device location. In case person does not want to use GPS location, there is another option available to get the price of any market and any crop. This app also helps farmers to avoid of distress sales.

Other ICT Attempts for Indian Agriculture

Internet/PC with net access: ikisan Portal, ITC e- Choupal, Mahindra kisan mitra Currently available apps for Indian agriculture are: Agriplaza, Rallis Mitr, Shriram Smart Kisan, Shriram Farm Connect, Yara Check IT, Cropalyser, Citrus Diseases Key, Plant Health from APS, My IPM, Fertilizer 2.0, Deficiencies AG PHD,BASF Disease ID, Farming´s Future, IFFCO kisan, Agri app, My Agri Guru, Kisan Suvidha etc.. IFFCO kisan App is the currently available no. 1 app for farmers.

It is an individual farmer suvidha app, which help the Indian farmers/kisan to take informed decisions by accessing customized agricultural information related to their need. "Mridaparikshan digital lab" in collaboration with Southampton University based on Britain will help farmers to assess the fertility of soil and elements required boost the productivity. This information will be transferred to Mobile based application in farmers mobile. Therefore, it gives all relevant information without any field survey.

How Can the Digital India Programme Help Farmers?

1. Better prices realization: Digital India is helping farmers to get better market price of produce and reducing transaction costs. It has potential to connect each farmer to anywhere in the country. This would help farmers to cut the role of middleman and would help to realize better profits.

2. Digital India has created a virtual ecosystem for the farmers to get timely, localized information and services to farmers, making agriculture profitable and sustainable. It can help in providing data regarding soil variability, moisture and nutrient levels, rainfall variability, timing of planting and harvesting and market price volatility to farmers.

3. With the help of digital technology there is a provision of tailor-made recommendations to farmers based on crop sown, real time observed weather and projected market prices.

4. Digital India Programme is helping the government to reach the needy and poor farmers for the direct cash transfers system replacing agricultural subsidies.

5. Digital India will also support social media platforms to build human capacity. One of the best examples of this is Digital Green, a platform that uses videos that have farmers explain best management practices to other farmers.

6. Mobile money initiatives like Bhim (Bharat interface for money), PM Jan Dhan Yojana, etc. can allow farmers to bypass poor banking infrastructure and support savings and access credit digitally.

Indian agriculture needs to be made more market-oriented through reform in existing policies and digital technologies. There is a need of easy access to information regarding availability and knowledge needed for use of those technologies. Rural connectivity is also important for providing low cost data .It would help rural youth to realize their full potential and farmers to increase their profitability by accessing equitable markets.

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Strategies for Doubling Farmer's Income

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Food security was the prime focus of the country during the past planned development era. Farmers have adopted Various Green Revolution technology through which India achieved a commendable position in food production, but overtime farming itself turned non-profitable due to rising costs and uneconomical holdings.

The strategy didn't actually recognize the need to increase farmers income results in farmers' distress across the country over time has shocked the entire agrarian foundations. Unless farmers' income increases substantially, distress cannot be tackled (Chand, 2016). The Hon'ble Prime Minister of India in an address to farmers in District Sheopur in Madhya Pradesh exhorted to double the incomes of farmers by 2022. Subsequently, the announcement was formalized in the Union Budget 2016-17 stating that an important objective of the Government is to double the income of farmers by the year 2022.

Ever since the announcement was made, several scholars expressed their views in support of the possibilities of achieving double farmers income while some notable scholars expressed their reservations too.

Why We Need to Care About Farmers?

263 million Indians are farmers and agricultural worker and 430 million (agricultural statistics at a glance, 2014) depends on farming. If so, many Indians do not have the basic financial security, India cannot be considered as prosperous country.

Trend in Farmers' Income: All India

As per Chand et al.(2015), the real income grew at the compounded rate of 3.94 per cent per annum during 2004-05 to 2011-12 which is the fastest compared to previous two decades. Chand et al. (2015) reveals that total income per an average agricultural household grew annually at 11.75 per cent from to Rs.77,112 during 2012-13 from Rs.25,380 during 2002-03. That is, it doubled in about 6 years. However, when measured in real terms (after neutralizing the effect of inflation), the income growth was 5.24 per cent and doubling of income would take 14 years at this rate. Large farmers took a smaller number of years to double their incomes compared to lower marginal farmers.

There are several ways for increasing the income of farmers. Some can be realized within a year or so and others may be realized over the years depending on the process involved. Also, the strategies and the plan should be different for different states/regions and the clientele groups. Due to the varied geographical diversity of the country, we must understand that strategies to doubling farmer's income will be different for each state and, we should not forget that marginal and small farmers constitute 85% of the operational holdings in the country. Each state needs to start by drawing up a plan stating what it is and what would it take to double incomes say in a specified time span, say from 2020-21 up to 2028-29.

Some of common strategies we should focus upon are:

1. Enhancing Production through Yield increase.
2. Cost reduction possibilities:
    a. Smart nutrient management
    b. Low input agriculture(Promotion of organic farming)
    c. Farming system approach /Integrated farming system
3. Big focus on irrigation with large budgets and integrated policies, with the aim of per drop more crop.
4. Diversification towards high value crops is required to improve income and improve resource use efficiency:

a. Staple crops (Cereal, Pulse, Oilseed) occupied 77% of Gross cropped area but contribute only 44% of output of the crop sector.
b. High value crops like fruits vegetables condiments spices etc occupy 19% of Gross cropped area and contribute the same 44% of output of the crop sector
c. Focus on Agro forestry.

5. Promotion of ancillary activities Poultry, Beekeeping and Fisheries etc.

6. Promotion of dairy sector: India is the largest milk producing country in the world, producing 50 million metric tonnes of milk. India is also the world's largest and fastest growing market for milk and milk products

7. Promoting Agri-preneurship.

8. Land holdings have halved in last 2 decades, which has a detrimental impact on farming which can be resolved by creating a greater number of non- farming jobs

9. Easy access to affordable crop insurance with quick settlement so that a farmer is no longer one environmental disaster away from ruination

10. Easy access for basic services likes health and education, so that farmers should not afraid of this debt.

11. Research institutes should result in technological breakthroughs for shifting production frontiers along with increase in input use efficiency.

12. Policy and reforms:
a. Enable Healthy Credit Environment:
i. Bank regulatory reforms.
ii. Improving access to credit.
b. Marketing reforms for improving terms of trade of farmers.
c. Land on lease.
d. Forestry on private land.
e. Promoting Value chain.
f. Promoting producers' alliances.
g. Linking production to processing.
h. Coordination and involvement of states.
i. Infrastructure Support.

If collaborative efforts are made by the Centre and all the States and UTs, the Country can achieve the goal of doubling farmers' income in near future.

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Azospirillum – Associative Symbiotic N2 Fixer

Article ID: 31037

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Azospirillum was isolated by Beijerinck (1922) in Brazil from the roots of Paspalum and named it as Azotobacter paspali and later named as Spirillum lipoferum. Dobereiner and Day (1976) reported the nitrogen fixing potential of some forage grasses due to the activity of S. lipoferum in their roots. Dobereiner coined the term "Associative symbiosis" to denote the occurrence of N2 fixing spirillum in plants. Taxonomy was re-examined and Tarrand et al. (1978) designated this organism as Azospirillum.

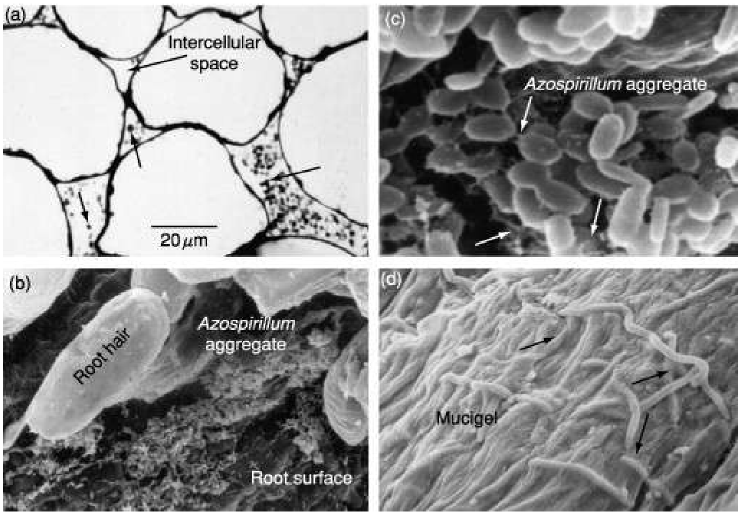
It is an aerobic or micro aerophilic, motile, gram negative bacterium. Non spore former and spiral shaped bacterium, inhabiting the plant roots both externally and internally. Being a micro aerophilic organism, it can be isolated on a semi solid malate medium by enrichment procedures.

Classification

Species: (7). Family – Spirillaceae
1. *A. brasilense*
2. *A. lipoferum*
3. *A. amazonense*
4. *A. halopraeferens*
5. *A. irkense*
6. *A. dobereinerae*
7. *A. largimobilis*

Morphology

1.	Cell size	Curved rods, 1 mm dia, size and shape vary
2.	Accumulate	PHB
3.	Gram reaction	Negative
4.	Development of white pellicles	2-4 mm below the surface of NFB medium



Physiology

1.	Nature	Chemoheterotrophic, associative
2.	Sole carbon source	Organic acids, L-arabinose, D-gluconate, D-fructose, D-glucose, Sucrose, Pectin
3.	N source	N_2 through fixation, amino acids, N_2, NH_4^+, NO_3

4.	Respiration	Aerobic, Microaerophilic
5.	Growth media	NFBTB (NFB) medium
6.	Doubling time	1 hr in ammonia containing medium 5.5 – 7.0 hrs in malate containing semisolid medium

Mechanism of Action

1. Contribution by BNF
2. Production of PGP substances by bacteria:
    a. Increases root hair development, biomass.
3. Production of PGP substances by plant:
    a. Morphological changes in root cells.
    b. Increased activity of IAA oxidase
    c. Increase in endogenous IAA
    d. Increased mineral and water uptake, root development, vegetative growth and crop yield.
4. Competition in the rhizosphere with another harmful microorganism.
5. Polyamines and amino acids production.
6. Increased extrusion of protons and organic acids in plants.

Benefits

1. Promotes plant growth.
2. Increased mineral and water uptake, root development, vegetative growth and crop yield.
3. Inoculation reduced the use of chemical fertilizers (20-50%, 20-40 kg N/ha)
4. Increases cost benefit ratio.
5. Reduces pathogen damage.
6. Inhibit germination of parasitic weeds.
7. Restoration of arid zone, margine mangrove ecosystem.
8. Reduces humic acid toxicity in compost. - Recommended for rice, millets, maize, wheat, sorghum, sugarcane and co-inoculant for legumes.

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Speed Breeding – A Tool to Accelerate Crop Research

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Summary of Article

Conventional breeding takes minimum 8 – 10 years of breeding cycles to develop a new variety. The biggest problem of conventional breeding to achieve high yielding and more vigorous crop is it require more generation to develop. Speed Breeding is a next generation advance technology where plants can be grown in an artificial environment with enhanced light duration to create longer daylight condition to speed up the breeding cycles of photo-insensitive crop. So, let's have some basic knowledge about it.

Introduction

Generally, conventional breeding takes minimum 8 – 10 years of breeding cycles to develop a new variety. Speed Breeding is a next generation advance technology where plants can be grown in an artificial environment with enhanced light duration to create longer daylight condition to speed up the breeding cycles of photo-insensitive crop.

The speed breeding experiments in wheat revealed that the quality and yield of the plants grown under controlled climate with extended daylight were the same as those of crops grown in regular glass house conditions (kumar et al., 2018).

Speed breeding or Shuttle breeding is inspired from extra-terrestrial experiments by NASA (USA), to grow crop seeds in space, using an enclosed chamber and an extended photoperiod inspired the scientist in the University of Queensland and University of Sydney in Australia to develop a speed breeding platform. (Kumar et al., 2018). The key scientist involved in the development of speed breeding and protocol was Dr. Lee Hicky, Brande Wuff, Amy watson and Sreya Ghosh. (Watson & Ghosh., 2018).

			
Lee Hicky	**Brande Wuff**	**Amy watson**	**Sreya Ghosh**

Need of Speed Breeding

The biggest problem of conventional breeding to achieve high yielding and more vigorous crop is it require more generation to develop, but the speed breeding sorted out that problem. Farmers will have to produce 60 – 80 % more food by 2050 to feed 9 billion people and speed breeding is a potential technique to achieve it. Speed breeding, greatly shortens the generation time and accelerates breeding and research programmes. We can produce wheat generation from seed to seed in just a six week, which means we can do harvest of six generations per year. Plant pathogen interactions, plant anatomy and flowering time can be studied in detail and repeated using this technology (Kumar et al., 2018).

Importance of Speed Breeding

1. Ultimately reduce the crop duration and increase the generation advancement throughout the year.
2. Rapid increase in the genetic gain of the favourable traits which lacks in double haploid breeding.
3. Development under speed breeding was normal although accelerated, and the harvested seeds from speed-bred plants were completely viable.

4. Approach have been demonstrated to be an efficient system for rapid screening of wheat germplasm for adult plant resistance to various diseases.
5. Speed breeding in fully controlled environment growth chambers can accelerate plant development for research purposes like rapid trait introgression.
6. It can be used for phenotyping of adult plant traits, mutant studies and transformation (Watson & Ghosh et al., 2018).
7. Speed breeding as a platform can be combined with several other technological such as marker assisted selection, genomic selection, CRISPR gene editing, etc. to get to the end result faster (Kumar et al., 2018).
8. In wheat crosses, to achieve 98.438 % of homozygosity through selfing requires 6 years in conventional breeding (1 generation/year), 3 years in shuttle breeding (2 generation/year), 2 years in glass house control (3 generation/year) while speed breeding require only 1 year (6 generation/year) (Watson & Ghosh et al., 2018).

So far speed breeding was reported in Photo insensitive crops (Watson & Ghosh et al., 2018) viz. Bread wheat, Durum wheat, Barley, Chickpea, Oat, Canola, Pea, Quinoa, Grass pea, Peanuts, Lentils and Potatoes.

Speed Breeding Set Up

1. Light: In the PAR region (400–700 nm), particularly blue, red and far-red ranges, are suitable. This can be achieved through LEDs and other lighting sources (e.g., halogen lamps), sodium vapor lamps. PPFD of ~450–500 µmol/m2/s at plant canopy height is recommended. (Watson & Ghosh et al., 2018)

2. Photoperiod: Photoperiod of 22 h with 2 h of darkness in a 24 h diurnal cycle is recommended. Reports says 18 h photoperiod was sufficient to achieve faster generation for wheat, barley, oat and triticale.

3. Temperature: A higher temperature of 22°C for 22 h should be maintained during the photoperiod, whereas a fall in temperature of 17°C for 2 h during the dark period can aid in stress recovery.

4. Humidity: Most controlled environment chambers with a range of 60–70% is ideal.

Limitations

1. Short day plants require the photoperiod to be less than the critical day length to flower, so speed breeding is an odd one in case short day plants

2. The Speed Breeding procedures take place in an artificial environment. This is acceptable for many activities, such as crossing, SSD and screening for some simple traits but selection for adaptation in the target environment couldn't be carried out.

3. The initial investment to build a glasshouse or purchase a growth chamber with appropriate supplementary lighting and temperature control capabilities is high.

4. Ability to shorten generation time further through early harvest of immature seed can interfere with the phenotyping of some seed traits.

5. Technologies, determining the optimal way to integrate Speed Breeding into a crop improvement program needs careful consideration and may require significant redesign or restructure to the overall program (Watson & Ghosh et al., 2018).

Shuttle Breeding

In early 20th century there was no such innovative technology was invented to increase the generation advancement. Dr. Norman E. Borlaug, father of green revolution, who hardly worked to feed the emerging population founded the new method called shuttle breeding in CIMMYT, Mexico, 1968. Shuttle breeding denotes the growing of breeding population at two or more locations in alternate manner. i.e., they shuttle between the two or more contrasting locations involving in regard to latitude, altitude and rainfall has proven a most efficient way to introduce and select genes for photoperiod insensitivity (Kumar et al., 2011). Shuttle breeding combines the features of pedigree and bulk methods and simply it is similar to modified pedigree-bulk method. First shuttle breeding has been implemented by Dr. N. E. Borlaug in wheat crop at Mexico of two different locations viz., Cd. Obregon and Toluca city.

Importance of Shuttle Breeding

1. Ultimately increase the generation advancement from 1 generation/year to 2 generations/year of wheat.

2. Shuttle breeding has been responsible for the production of photoperiod insensitive and widely adapted germplasm.

3. The photoperiod insensitive genes, Ppd1 and Ppd2, abound in CIMMYT's spring wheats and along with the dwarfing genes, Rht1 and Rht2 resulted in lodging tolerant with higher yielding was obtained. (Hoogendoorn et al., 1988).

4. This is superimposed with rust resistance (Borlaug, 1968), the new genetic combination provided adaptation to most irrigated wheat growing areas of the subtropics and lead to the green revolution.

Shuttle Breeding in INDIA

IARI, Regional station, Wellington, Tamil Nadu played a historically role in introduction of high yielding wheat varieties namely Lerma Rojo 64A, Sonora 63, Sonora 64, Mayo 64 along with 630 selected samples of superior semi dwarf wheat lines from Mexico by noble laureate Dr. N. E. Borlaug.

Reason behind of Indian green revolution were first multiplied at this station during summer season of 1964. The seeds thus harvested during wheat off-season (summer) of 1964 were distributed count. Indian wheat breeders of all ICAR institutes and SAU's in reducing the varietal development period to half i.e., from eight years to four years.

This important research activity cannot be undertaken elsewhere in the country as reliably as at Wellington. Regional research station, Dalang Maidan, Himachal Pradesh, was established in 1947. This station is mainly meant for the screening of yellow rust and powdery mildew resistant of wheat and barley variety.

Nearly more than 30,000 lines are grown and screened every year under natural epiphytotic conditions. Generation advancement of wheat, barley, chickpea, mustard and lentil are carried out during off season.

Conclusion

Both speed breeding and shuttle breeding is a very powerful tool to accelerate the crop research and breeding programmes. The study has clearly shown that generation time can be reduced substantially within a speed breeding/SSD system, and hence new varieties could be developed up to two years quicker compared to using conventional field-based pedigree breeding strategies.

The study has demonstrated that speed breeding technologies previously developed for wheat and barley can be successfully transferred to the cultivated peanut and other crops, offers breeders a new tool to develop improved cultivars more quickly. To meet the ongoing demand in food production and to feed a global population of 9–10 billion by 2050, speed breeding is considered as the most innovative way of approach, followed by shuttle breeding.

Future Thrust

To respond faster to the changing climate, evolving pathogens a breakthrough technology in genetics and plant breeding programme should be needed and speed breeding will definitely full fill that in future. Shuttle breeding paves the way for screening of any diseases newly emerged across the countries like Ug99.

NASA is looking at ways to provide astronauts with nutrients in a long-lasting, easily absorbed form freshly grown fresh fruits and vegetables through speed breeding technology. As it increases the breeding generation per year, a greater number of researches will be carried out and documented. A key question to answer is the relationship between microgravity and plant lignin content. Lignins in plants have functions whose closest analogy is that of bones in humans.

They give structure and rigidity to plants and the means to stand upright against gravity. We already know that space causes bone and muscle loss in humans because the physical demands are lower in space. So what about lignins? NASA's idea of growing plants in space do validate most of the theories and will become the reason for the evolution of more new theories.

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Biotechnology: Single Cell Protein

Article ID: 31039

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Introduction

Many countries in the world are facing malnutrition by means of protein deficiency in human and animal food. Hence, biologists have directed their attention to the use of microbial proteins in animal and human diet.

Biomass production has played a significant role in our attempts to make good protein component of world food shortages. It is vital to produce protein in large quantities in all available methods. Single Cell Protein (SCP) refers to sources of mixed protein extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria that are grown from agricultural wastes.

The microbial biomass contains about 45 to 55 % protein on an average. In some bacteria, the protein content is as high as 80%. Along with protein, the biomass also contains other essential nutrients so that it is an ideal supplement to conventional food supply.

Production Process

SCPs are produced, when the waste materials including wood, straw, cannery and food processing wastes, hydrocarbons, residues from alcohol production, human and animal excreta are subjected to fermentation by microbes.

SCPs are found in very low concentrations and thus extracting SCPs from the waste remains a challenge. Precipitation, centrifugation, floatation, coagulation and the use of semi-permeable membrane are the alternate ways developed by the engineers to increase the SCP yield (Vrati, 1983).

Choice of Microorganism for SCP Production

The criteria used in choosing appropriate strains for SCP production includes, substrate must be used as carbon and nitrogen source with high specific growth rates and productivity. It should be able to show tolerance towards pH and temperature, non-pathogenicity and absence of toxins.

The microorganism must be easily available for harvesting with high protein yield (Table 1).

Bacteria	Algae	Yeast	Fungi
Brevibacterium	*Chlorella pyrenoidosa*	*Candida utilis*	*Chaetomium cellulolititicum*
Bacillus megaterium	*Scenedus musacutus*	*Candida intermedia*	*Aspergillus niger*
Lactobacillus species	*Porphyrium sp*	*Saccharomyces cerevisiae*	*Rhizopus chinensis*
Cellulomonas species	*Sprulina maxima*		*Tricoderma viridae*

Table 1. A variety of bacteria, mould, yeast and algae are being employed in SCP production.

Potential Substrates for SCP Production

1. Sulphite waste liquor – Candida utilis biomass has been produced as a protein supplement by fermentation of sulphite waste liquor.
2. Cellulose – cellulose from wood waste and natural sources are the starting material for SCP production.
3. Whey.
4. Glucose.

The carbon source present in the medium must be able to cultivate heterotrophic organisms. Examples of those carbon sources includes fossil carbon like n-alkanes, gaseous hydrocarbon, methanol, ethanol, renewable sources like carbon dioxide molasses, polysaccharides, distilleries, confectionaries and canning industries. Solid substrates like salts of potassium, manganese, zinc, iron and ammonia are also included in the medium to facilitate cultivation of many microorganisms (Anupama and Ravindra, 2000).

Types of Fermentation

Microbial cells are produced:

1. As a source of protein for animal or human food.
2. For use as a commercial inoculum in fermentation of food, agriculture products and in waste water treatment.

SCPs are produced generally by two types of fermentations:

1. Submerged fermentation.
2. Semisolid state fermentation.

Submerged fermentation is the one, where the substrate to be fermented is necessarily placed always in a liquid that containing nutrients needed for the growth. The substrate is held in fermentor that is operated continuously and simultaneously biomass product is continuously harvested.

The obtained product is further filtered/centrifuged and dried. This process has higher operating cost. In semisolid fermentation, the substrate preparation is a simple solid waste (Ex. Cassava waste).

The basic steps involved in SCP production are:

1. Production of suitable medium containing proper carbon source.
2. Prevention of contamination of medium and fermenter.
3. Production of appropriate microorganism.
4. Separation of microbial biomass and processing.

The process of SCP production involves some engineering operations likely stirring, mixing of multiphase system, heat transfer from liquid phase to surroundings and transport of oxygen (Fig.1).

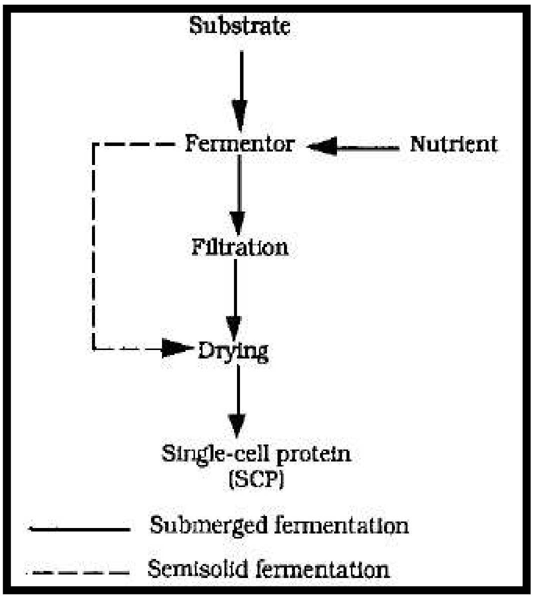

Fig.1.Flowchart for SCP production

Advantages of SCP

As compared with traditional methods of producing proteins for feed or human foods, large scale production of the microbial biomass includes the following advantages:

1. Microorganisms have high rate of multiplication.
2. Microbes possess high protein content.
3. They can utilize large number of carbon sources.
4. Strains with high yield and good composition are produced easily.
5. Microbial biomass does not depend on seasonal and climatic variation.

Conclusion

Single cell protein (SCPs) with rich protein (60-70%) with a high concentration of vitamins B complex and low-fat values are suitable for human and animal consumption. The use of SCP as food ingredient is still in stages of development.

There are a lot of prospects concerning improvement of using SCP in various means. Genetic engineering could enhance the synthesis of SCP with huge yield with no toxic by-products produced with the SCP. The application of agro-industrial waste in bio-processes such as cultivation of SCP provides a solution to the pollution problems.

Further research and development will facilitate the usage of SCP as a supplement in diet in developing and underdeveloped countries to fight against malnutrition.

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Phosphobacteria and Mycorrhizae

Article ID: 31040

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Phosphate Solubilising Microorganisms: Introduction

Though most soils contain appreciable amounts of inorganic P, most of it being insoluble forms, cannot be utilized by crops unless they are solubilized. Soils also contain organic P that could not be utilized by plants only when it is mineralized.

Phosphate solubilizing microorganisms not only able to solubilize insoluble forms of inorganic P but are also capable to mineralize organic forms of P, thus improving the availability of native soil P making their P available to plants.

PSM can also solubilize P from rock phosphate (RP), slag or bone meal making their P available to plants. Thus, PSM biofertilizer being economical and environmentally safe offers a viable alternative to chemical fertilizers.

Microorganisms Involved

Many microorganisms can solubilize inorganic phosphates, which are largely unavailable to plants. Microbial involvement in solubilization of inorganic phosphate was first shown by Stalstron (1903) and Sacket et al.

(1908) gave conclusive evidence for bacterial solubilization of RP, bonemeal and TCP. Various bacteria and fungi reported to solubilize different types of insoluble phosphates. Not only solubilizes but also mineralize organic P compounds and release orthophosphates.

In general, PSM constitute 0.5 – 1.0% of soil microbial population with bacteria and out numbers the fungi by 2 – 150 folds. But bacteria may lose the P solubilizing ability while sub culturing and fungi do not lose. Among bacteria, aerobic spore forming bacteria are more effective P solubilizers.

Mechanism of PO_4 Solubilization

Different mechanisms were suggested for the solubilization of inorganic phosphates
1. Production of organic acids.
2. Chelating effect.
3. Production of inorganic acids.
4. Hydrogen sulphide production (H2S).
5. Effect of carbon dioxide.
6. Proton extrusion.
7. Siderophore production.

Mycorrhizae

Mycorrhiza (fungus root) is the mutualistic association between plant roots and fungal mycelia. Frank (1885) gave the name "mycorrhiza" to the peculiar association between tree roots and ectomycorrhizal fungi. 95% of the plant species form mycorrhizae. It can act as a critical linkage between plant roots and soil. This association is characterized by the movement of plant produced carbon to fungus and fungal acquired nutrients to plants. Mycorrhizal fungi are the key components of the rhizosphere are considered to have important roles in natural and managed ecosystems.

Types of Mycorrhiza

Mycorrhizal associations vary widely in structure and function. Two main groups of mycorrhizae are recognized; the ectomycorrhizae and endomycorrhizae, although the rare group with intermediate properties, the ectendotrophic mycorrhizae.

1. Ectomycorrhiza: The fungal hyphae form a mantle both outside the root and within the root in the intercellular spaces of the epidermis and cortex. No intracellular penetration into epidermal or cortical cells occurs, but an extensive network called the Hartignet is formed between these cells. Sheath or Mantle increases the surface area of absorbing roots and offers protection to the roots. Hartignet can act as storage and transport organ for P.

Ectomycorrhizae are common on trees, including members of the families pinaceae (Pin, Fir, Spruce, Larch, Semlock), Fagaceae (Willow, Poplar, Chesnut), Betulaceae (Birch, Alder), Salicaceae (Willow, Poplar) and Myrtaceae.

The fungi forming Ectomycorrhizal association are coming under Basidiomycotina and Ascomycotina. eg: Laccaria laccata, Suillus, Rhizopogan, Amanita

2. Endomycorrhizae: Endomycorrhizae consist of three sub groups, but by far the most common are the Arbuscular Mycorrhizal fungi. Fungi under AM are the members of Endogonaceae and they produce an internal network of hyphae between cortical cells that extends out into the soil, where the hyphae absorb mineral salts and water. This fungus does not form an external mantle but lives within the root.

In all forms, hyphae run between and inside the root cells which includes:

Ericoid mycorrhiza	Associated with some species of Ericaceous plants
Orchid mycorrhiza	Associated with orchid plants
Arbuscular mycorrhiza	Associated with most of the plant families

Arbuscular Mycorrhizal Fungi

The most important one is AM: AM, an endomorphic mycorrhiza formed by the aseptate phycomycetous fungi are associated with majority of agricultural crops, growing under broad ecological range.

Class	Zygomycotina
Order	Endogonales
Family	Endogonaceae

150 species of AMF are known.

Colonization Process

Roots do not show visual morphological changes due to AM colonization. AM fungal infection into a host occurs by germination of spore, hyphal growth through soil to host roots, penetration of host roots and spread of infection inter and intracellularly in the root cortex.

Colonization occurs under two phases:
1. Extra metrical phase
2. Intra radical phase.

Extra Metrical Phase

Events occurring outside the root after the germination of chlamydospores. Mycelium explores larger soil volume. Fungal growth can be 80-130 times the length of root. Extra metrical hyphae (EMH) are larger in diameter than inner hyphae. Once the fungus recognises the plant, appressorium is formed in the host roots and penetration occurs via the appressorium. EMH ends with resting spores in soil.

Intra Radical Phase

Events occurring inside the root cortex. After penetrating the cortex, the fungus may produce intercellular as well as intracellular hyphae in the cortical cells. Forms two morphological structures namely arbuscules and vesicles inside the cortical cells.

Arbuscules

Arbuscules are the first formed structures after the hyphal entry into the cortical cells. Arbuscules are the fine dichotomously branched hyphal filaments look like little trees. Arbuscules start to form approximately 2 days after penetration. They are considered as the major site of exchange between the fungus and host root. They are short lived (4-13 days) and degenerate.

Vesicles

Following the formation of arbuscules, some species of fungi also form vesicles in the roots. Terminal or intercalary hyphal swellings of the hyphae called vesicles. Vesicles contain lipids and cytoplasm. They act as P storage organ and they ever be present in the root. Size of the vesicles is about 30-100 µm. In vesicles P can be accumulated as polyphosphates. EMH, vesicles and Arbuscules play a key role in nutrient transfer particularly in mobilisation of phosphorus.

Mechanism of Action

The beneficial effect on plant growth and yields following inoculation with VAM is attributed to
1. Improved mineral nutrition, especially P (P, Zn, Cu, K, S, NH_4).
2. Mobilization of nutrients through greater soil exploration.
3. Protection of host roots against pathogen infection.
4. Improved water relation
5. Better tolerance to stress like salinity, heavy metal pollution
6. Protection against transplantation shock.

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Quality of Cow Milk Affected by Subclinical Mastitis in Vidarbha Region

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Introduction

India ranks first in livestock population in world. Generally, cow and buffaloes breed specially use for dairy purpose. Mastitis is considered as one of the costliest diseases affecting dairy cows. Mastitis is a complex disease that occurs in clinical and subclinical forms in Buffaloes and Cows.

The mastitis is characterized by biochemical changes in composition of milk. These compositional changes reflecting the degree of physical damage are well marked and can be used as a basic indicator for diagnosis of subclinical mastitis. These changes not only alter the nutritional quality of milk but also preservation quality.

Mastitis is characterized by physical, chemical and bacteriological changes in the milk and pathological changes in the glandular tissue of the udder and affects the quality and quantity of milk. The bacterial contamination of milk from the affected cows render it unfit for human consumption and provides a mechanism of spread of diseases like tuberculosis, sore-throat, fever, brucellosis, leptospirosis etc. and has zoonotic importance. (Sharma 2011). Many studies conducted previously to estimate the economic loss due to mastitis in India were based on the data collected from organize dairy farms.

Materials and Methods

The present experiment was based on the survey made during the year 2013-14 in four villages in Bhandara district. Total 100cow, 25cow from each village viz., Palandur, Dighori, Kolari and Kharashi around Bhandara were screened against subclinical mastitis by Modified California Mastitis Test (MCMT) as per method of Schalmand Noorlandure (1957).

Out of 100 cows, 400 halves were tested and35 cow i.e., 10, 09, 09 and 07 (35 %cow) and 65 quarters i.e., 18, 17, 16 and 14 (16.25 quarters) in Palandur, Dighori, Kolari and Kharashivillages were found positive for presence of subclinical mastitis. The milk samples were collected in sterilized glass bottles. Milk samples from all four quarters were collected separately at the time of milking in morning.

Total 25 milk samples obtained from subclinical mastitis quarters and 25 samples from normal quarters of same cow (5 cow from each village) subjected to chemical analysis viz., fat by Gerber's method as described in BIS: 1224 (Anonymous, 1958) Solids not fat percentage was determined according standard procedure as described in SP: 18, Part-XI of BIS (Anonymous, 1981) Total solids determined according to Gravimetric method described in SP: 18 Part-XI of BIS (Anonymous, 1981) [3] and pH was determined by using indicator strip described in SP: 18 Part-XI of BIS (Anonymous, 1981) and digital pH meter.

Analysis of the milk samples were done at Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur. A student't' test was used to test the significance between normal and subclinical mastitis milk of cow described by Snedecor and Cochran (1994).

Results and Discussion

The fat percentage of normal milk was range between 3.80 to 4.40 per cent than that of subclinical mastitis milk range between 3.2 to 3.70 per cent. The average fat percentage in normal milk and subclinical mastitis milk was observed as 4.16 ± 0.040 and 3.48 ± 0.026 per cent respectively (Table 1). The average percentage of fat significantly ($P<0.01$) decreased in subclinical mastitis milk samples.

Mohamed etal. (2001) and Sonea (2009) [11] also reported that the composition of milk was significantly decreased in infected halves of mastitis udder in cow. Present results are in agreement with their results. The solid not fat percentage of normal milk was rent between 9.00 to 10.10 per cent than that of sub clinical mastitis milk range between 7.40 to 8.40 per cent.

The average solids not fat content in normal milk 9.73 ± 0.053 per cent and that of subclinical mastitis milk was 8.03 ± 0.059 per cent. Thus, it decreased significantly in all subclinical mastitis samples. Antre (2011). noticed decreased solid not fat content of cow milk affected by subclinical mastitis. The total solids percentage of normal milk was rent between 13.60 to 14.10 per cent than that of sub clinical mastitis milk range between 11.25 to 12.00 per cent.

The average total solids percentage in normal milk and subclinical mastitis was observed as 13.86 ± 0.030 and 11.68 ± 0.047 per cent, respectively. The average total solids per cent of subclinical mastitis milk deceased significantly ($P<0.01$). Sung (2001) observed that, the total solids content of milk was positively correlated with milk somatic cell count (SCC). The pH percentage of normal milk was rent between 6.35 to 6.80 per cent than that of sub clinical mastitis milk range between 6.69 to 7.15 per cent.

The average pH content in normal milk and subclinical mastatis milk was 6.60 ± 0.025 and 6.95 ± 0.027 respectively. Thus, pH increased significantly ($P<0.01$) by 0.35 unit in subclinical mastitis as compared to normal milk. More or less Similar results were reported by Boechat and Favarin (1992) and Antre et al. (2011). They also observed increase in pH values of cow milk affected with subclinical mastitis. Increased in pH of subclinical mastitis milk in the experiment could be due to increased permeability of the gland tissue to blood components which results in higher values in milk.

This might be partially due to increased movement of bicarbonate ions into milk, since the lactose production decreased and the alkaline salts from the blood entered the milk which becomes more alkaline showing pH above 7.0 as indicated by Rao (1990).

Conclusions

1. The prevalence of subclinical mastitis in Lakhani tahsil was 33 per cent by Modified California Mastitis Test (MCMT) and 38 per cent by Draminski Mastitis Detector (DMD) in crossbred cows.

2. The subclinical mastitis can be well detected by Modified California Mastitis Test (MCMT) and Draminski Mastitis Detector (DMD). But the Draminski Mastitis Detector was 5 per cent more efficient and easier to test subclinical mastitis milk.

3. The pH in subclinical mastitis milk increased whereas fat, solids not fat, and total solids gets decreased significantly which hampered the milk quality.

Effect of Subclinical Mastitis on Quality of Cow Milk

Samples	Normal Milk				Subclinical Mastitic Milk			
	Fat	Solids not fat	Total solids	pH	Fat	Solids not fat	Total solids	pH
1	4.35	9.80	13.70	6.63	3.40	7.85	11.90	6.95
2	4.00	10	14.00	6.75	3.20	8.20	11.85	7.05
3	3.95	9.60	13.80	6.38	3.60	7.65	11.80	7.1
4	4.30	10.10	14.10	6.65	3.50	8.20	11.50	6.99
5	4.40	9.70	13.80	6.48	3.70	7.75	11.60	6.98
6	4.15	9.80	14.00	6.63	3.40	8.31	12.00	6.70
7	4.35	9.60	13.90	6.78	3.40	7.40	11.70	7.00
8	4.25	9.30	14.10	6.65	3.50	8.15	11.26	6.85
9	3.85	9.90	13.85	6.72	3.70	7.80	11.40	6.99
10	3.90	10.05	14.00	6.80	3.30	8.25	11.55	6.82
11	4.25	10.10	13.75	6.48	3.50	7.55	11.25	6.79
12	4.00	10.00	13.60	6.57	3.30	7.65	11.80	7.03
13	4.25	9.80	13.95	6.55	3.70	8.30	11.66	6.99
14	4.25	9.40	14.10	6.75	3.60	8.40	11.90	7.00
15	3.80	9.00	13.85	6.58	3.50	8.20	11.61	6.74
16	4.20	9.60	13.70	6.35	3.40	8.15	11.90	7.04
17	3.90	9.90	13.95	6.62	3.50	8.25	11.65	7.13
18	4.40	9.50	13.60	6.42	3.30	8.30	11.95	7.15
19	4.30	9.65	13.95	6.52	3.50	8.20	12.00	6.69

20	4.35	9.60	13.65	6.70	3.60	8.10	11.40	6.80
21	4.40	9.80	13.70	6.65	3.40	8.40	11.85	6.98
22	4.20	9.55	13.90	6.75	3.50	7.55	11.35	7.03
23	4.20	9.60	13.90	6.55	3.40	8.30	11.50	7.05
24	3.80	9.90	13.75	6.46	3.60	8.05	12.00	6.80
25	4.30	10.05	13.90	6.62	3.50	8.00	11.80	7.10
Av.	**4.16**	**9.73**	**13.86**	**6.60**	**3.48**	**8.03**	**11.68**	**6.95**
SE(m) ±	0.040	0.053	0.030	0.025	0.026	0.059	0.047	0.027
					't' cal=14.24**	't' cal=20.11**	't' cal=38.64**	't' cal=9.42**

** Significant at 1% level (P<0.01)\

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Fertilizer Use Consequences on Environment

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Fertilizer is one of the significant supporters of expanded harvest creation. As of late, concern has been communicated that over-dependence on mineral composts may cause unreasonable ecological punishments like eutrophication of surface water, nitrate (NO_3-) contamination of groundwater, Heavy metal pollution of soil, atmospheric pollution because of emission of nitrous oxide and ammonia, acid rain, etc. Despite the fact that there are rates of these issues in a few pieces of the world, not many of such issues in India can be connected to compost use.

Major environmental consequences related to fertilizer use.

Nitrate Pollution of Groundwater

Pollution of groundwater from fertilizer N is caused by leaching. The magnitude of loss depends upon soil conditions, agricultural practices, agro-climatic. conditions, and type of fertilizers and methods of application. The time taken by nitrate "to move from the root zone to the water table, therefore, varies considerably.

In sandy soils with high water table and high rate of fertilizer application, it may reach the water table in matter of days whereas in heavy soils, low rainfall and low rate of application' with deep water table, it may take years.

Eutrophication

Another major problem associated with excess fertilizer use is the eutrophication of surface water causing several diseases. Arable soils leak considerable amounts of nitrate, phosphate, potassium and other nutrients mainly through run-off and erosion, which enrich the water body in terms of nutrients leading to luxurious growth of algae and other organisms and resultant eutrophication problems in ponds

Ammonia Volatilization

Volatilization of NH_3 is not only a major loss of N but also a cause of environmental pollution. From the atmosphere NH_3, is washed out by clouds and redeposit' on the terrestrial ecosystem in the atmosphere it is oxidized to N_2O, which acts as a greenhouse gas and is responsible for the destruction of ozone layer.

It also forms salts with acidic gases and these salt particles can be transported long distances especially in the absence of clouds. The deposition close to the source is substantial, but hard to estimate due to interaction with other pollutants. In northern Europe, it has been estimated that 94% of the NH_3, released from agricultural sources is redeposited into surrounding ecosystems.

Acid Rain

The effect of acid rain on ecosystems is gradually being documented, particularly in temperate region Nitrogenous fertilizers contribute substantially towards emissions of ammonia, one of the agents causing acid rain.

A high atmospheric concentration of ammonia can result in acidification of land and water surfaces, cause plant damage and reduce plant bio-diversity in natural systems. Excess of ammonia deposited causes eutrophication effect of N. Deposition of NH_3 contributes to acidification of soils if nitrified.

Greenhouse Gases

Greenhouse gases (GHGs) are atmospheric compounds that store energy, thus influencing the climate. Each of the GHGs has a different global warming potential that takes into account the effectiveness of each gas in trapping heat radiation and its longevity in the atmosphere.

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For instance, one kilogram of methane (CH_4) is estimated to have the same warming potential as 21 kilograms of carbon dioxide (CO_2), and one kilogram of nitrous oxide (N2O) has an equivalent impact to approximately 310 kilograms of CO_2.

Nitrogen Gas (N_2)

Large amounts of nitrogen gas are emitted to the atmosphere via denitrification, including that of nitrogen fertilizers. Nitrogen gas constitutes 78 per cent of the atmosphere and it has no direct greenhouse effect. Release of N2 reduces nitrogen (N) available to crops, but is not otherwise detrimental to the environment.

Nitrogen Oxides (NO and NO_2)

Nitrogen oxides are not GHGs. Nitrogen fertilizer input accounts for only 0.5 per cent of NO emissions. Both nitric oxide (NO) and nitrogen dioxide (NO2) react in sunlight with volatile organic compounds to form tropospheric ozone (O_3). Ozone is toxic to crops, even at low concentrations, and detrimental to the health of sensitive individuals.

Nitrous Oxide (N_2O)

Nitrous oxide has a greenhouse effect and is considered to be detrimental to the ozone layer. According to experts of the Intergovernmental Panel on Climate Change (IPCC), N2O is responsible for 7.5 per cent of the calculated greenhouse effect caused by human activity. The concentration in the atmosphere is increasing at a rate of about 0.2 per cent per year.

Although nitrogen fertilizers can be a direct or indirect source, they account for only 0.8 per cent of the N2O emissions. Moreover, new, more efficient nitrogen fertilizers coupled with site-specific fertilization practices reduce N2O emissions.

Methane (CH_4)

Methane is a GHG. Within agriculture, CH_4 is emitted mostly by ruminant digestive process and from livestock wastes. Rice paddy fields are also a major source of CH_4 that is formed by the anaerobic decomposition of organic matter. The addition of readily decomposable organic matter significantly increases CH_4 emissions. The impact of mineral fertilizers on CH_4 emissions is not clear, but seems minor.

Fertilizers and Gas Emissions

The use of phosphate and potash fertilizers does not contribute directly to GHG emissions, but all forms of nitrogen fertilizers may lead to N2O emissions. Since there is no significant uptake mechanism for N2O in agricultural systems, mitigation focuses on emission reduction.

In general, agricultural practices that increase nutrient use efficiency and diminish nitrogen leaching are also appropriate for minimizing N2O emissions. Best management practices, which match the nitrogen supply to crop requirements and integrate animal manure and crop residue management into crop production, result in a net reduction in N2O emissions.

The proper balance of nutrients optimizes the efficiency of applied and residual soil nitrogen. Other agricultural practices that minimize nitrogen losses include the adoption of reduced tillage practices, the prevention of water-logging through improved drainage and the treatment of sodic soils.

Trace Element and Heavy Metals Contamination

There is an increasing concern about the occurrence 'of trace elements in the environment in concentrations which can be harmful for animal health. Many fertilizers. phosphatic fertilizers in particular, contain varying amounts of trace elements such as F, As, Cd, Co, Cr, Hg. Mo, Ni and Pb (Table). The main issues concerning these potentially harmful elements are:

1. Soil accumulation and possibility of the long-term effects on crop yields and quality.
2. Plant uptake and the content of the element in animal feed and human diet.
3. Potentially damage to the soil micro flora. and iv) direct exposure to humans through contact and ingestion. The famous incidences of "itai-itai" and "minamata" diseases due to Cd and Hg toxicity respectively are the examples of potential threat of heavy metal pollution.

Fertilizer	Heavy metal (mg kg-1) fertilizer			
	Cu	Zn	Mn	Mo
Single super phosphate	26	115	150	3.3
Diammonium phosphate	--	--	--	109
Muriate of potash	3	3	8	0.2
Ca-ammonium nitrate	0.2	6	11	--
Urea	0.4	0.5	0.5	0.2
Ammonium sulphate	0.5	0.5	70	0.1
Triple super phosphate	7	75	200	0.1
Ammonium 'phosphate	3	80	160	2
Complex fertilizer	22	276	--	--
Rock phosphate	100	200	0.5	--

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The Threat of Agroterrorism in India: A Key Security Challenge

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Introduction

Agriculture is one of the most vital sectors for India's socio-economic stability where more than 70 per cent Indian population depend directly or indirectly for employment than on any other sector. It holds a key in reducing Indian's malnutrition issue and has the potential to spur India's overall gross domestic product growth. 4 per cent of agricultural growth would add at least a per centage point to GDP which can boost exports and improve India's trade deficit.

In addition, economic transformation in developing countries is propelled by increases in agricultural incomes underpinning industrial growth. However, in the present scenario of terrorism, religious violence and economic competition, the risk of malicious attempt to sabotage agriculture is increasing. Agroterrorism is a deliberate or intentional introduction of a disease/pest agent either against livestock or plants with an aim to generate fear, create serious economic insecurity and undermine social stability.

Agroterrorism which is the subset of bioterrorism not only affects the animals, plants or plant food chain but it has also psychological impact on the public's trust on government to provide satisfactory quality control over the foodstuffs. And ultimately it could cause the trade embargo of agricultural products with the rest of the world.

Countries like India, where economy is largely dependent on agriculture, such attacks that too on major crops, for instance one of the recent examples of outbreak of cotton leaf curl disease in Northwest India can lead to potential threat to economic security, leading to disruption that could have catastrophic consequences.

History and Potential Economic Impacts

It is very important to understand the risks and threats of agroterrorism for a given country by conducting historical study in order to be prepared for any such situation or circumstances.

1. Mau Mau: It was a nationalist liberation movement in Kenya whose sole aim was to end the British colonial rule. For that the Mau Mau used a local plant toxin, the African milk bush plant botanically known as *Synadenium grantii* to poison the cattle at the British mission station in 1952.

2. Contract Workers: In 1985, USDA claimed that Mexican contract workers were involved in deliberately spreading screwworm *(Cochliomyia hominivorax)* to introduce sterility among livestock in Mexico close to the border of the United States.

3. Sewer Water: In 2000, reports from Palestinian news sources claimed that Israeli settlers in the West bank had released contaminated and sewer water into Palestinian agricultural fields. This act was occurring again and again and was done in order to make the Palestinian farmers leave their land.

4. FMD threat: Similarly, a person in 2011 was arrested after threatening US and UK livestock with the deliberate spread of foot-and-mouth disease virus which would have caused the destruction of property and resulted in major economic loss.

Various other examples of biological and toxic weapons that has been used by countries for centuries to destroy and weaken the enemy has been presented in table1. Moreover, even disease outbreaks that fall short of worst-case scenarios could quickly become trade and economic issue as illustrated in table 2.

Wisconsin Department of Agriculture, Trade and Consumer Protection has estimated that any disease outbreak that play havoc with the transportation of dairy products will cost the state $10 million a day. Similarly, USDA Economic Research report estimated loss in costs to range from $200 million to $2.0 billion for future years, depending on the particular severity of the outbreak.

Table 1

Country	Biological warfare agents used	Motive	Reference(s)
Germany	*Bacillus anthracis* (anthrax) and *Burkholderia mallei* (glanders)	To attack draft horses in several countries	Casagrande etal. (2011); Wheelis (1999)
Germany and France	Agricultural pathogens like rinderpest, wheat rust, late blight pest and several beetle pests of crops	To destroy the livestock and staple crops of their enemies	Casagrande etal. (2011); Geissler and Moon (1999)
UK	5 million cattle cakes filled with *Bacillus anthracis* spores	To be dropped on Germany to destroy livestock and plants	Kohnen (2000)
USA	Spores of wheat rust and rice blast; hog cholera and Newcastle disease virus	To attack the staple crops of China and USSR; to attack livestock	Whitby (2006); Suffert etal. (2009)
Japan	Fomites, vectors like fleas, contaminated food and water supplies	To cause widespread epidemics among Chinese civilians. (However, techniques proved unreliable, caused Japanese casualties as well)	Harris (2002)
Russia	Various agroterrorism agents and diseases studied like *Brucella* spp. (causing brucellosis), *Mycoplasma mycoides* (causing contagious bovine pleuropneumonia), Orf virus (causing contagious ecthyma in sheep) as well as potato mosaic virus, wheat stem rust, maize rust and many more	To launch a biological weapon organisation whose purpose was to apply advances in biotechnology to create new and lethal biological weapons that could be mobilized during wartime.	Leitenberg and Zilinskas (2012)
Iraq	Wheat smut fungus dispensed through canister devices; another bioweapon used T-2 mycotoxin from a naturally occurring plant fungus	To destroy Iran's wheat fields. However, it not only destroyed the crop yields but also caused explosions in grain elevators, freight cars, storage silos etc; infected wheat, peanuts, grains besides potentially lethal to humans and killed one out of every 10 inhabitants in Orenburg Russia.	Crossette (2000); Koblentz (2009)

Table 2

Country	Trade and Economic loss	Reference (s)
Britain	In 1996, due to 'mad cow' outbreak about 10,000 jobs in the UK's wholesale and retail meat industry were lost, with domestic beef purchases decreased by 17.5% and exports declined by 78.8%	Booth (1998)
Pennsylvania	In 1983, poultry industry suffered a virulent avian influenza that resulted in about $60 million in its complete eradication and almost $250 million in increased consumer costs	Dunn (1999); Knowles (2002)
Hong Kong	In 1988, avian influenza became zoonotic, caused economy breakdown as influenza type diseases are the most financially costly	Dunn (1999); Brown (1999)
New York	In a study of the economic impact of west Nile virus (1999), hospitalized cases of WNV disease have cost a $778 million in health care expenditures and lost productivity	American Society of Tropical medicine and Hygiene (2014)
Democratic Republic of the Congo	Monkey pox outbreaks (2003) resulted in economy collapse	WHO (2019)
Japan	The economic impact of *Ecoli*O157:H7 outbreak (1996) was estimated to be about 82,686,000 yen	Abe, Yamamoto and Shinagawa (2002)

Consequences of Agroterrorism in Indian Scenario

India is the second most populous country of the world having more than a billion population and is still increasing. It has extreme poverty in many areas with huge public health deficiencies and many of its cities are extraordinarily dense which make it vulnerable to such attacks. A major outbreak in such a country where more than half population is dependent upon agriculture is likely to have devastating and far-reaching consequences.

Also, Indian agriculture is heavily dependent upon cattle, possibilities of such incidences like danger of illegal trade of diseased livestock or other agricultural products from one country to another, can lead to massive outbreak of an epizootic disease as cattle are very prone to transcontinental spread of diseases. The best documented example being African horse sickness in India.

This disease crossed Sahara and reached India via neighbouring countries. It caused the death of more than 2 million animals which was absolutely gut-wrenching. Similarly, Bengal famine of India caused due to brown spot disease of rice during 1942-43, serves as an illustration of how similar and devastated an Agro terror could be if it were to be unleased.

Conclusion

Agroterrorism is a high-impact worrisome event because even though the disease outbreak is limited, costs of a disease outbreak can be great. Such an attack could undermine physiological, political, social and economic importance of a country.

We can take steps to combat agroterrorism by the development of counter-measures focussed on surveillance as India has a really weak surveillance system for reporting diseases even in the best of times, technology of early detection, increase biodiversity, public awareness, sharing information and intelligence as well as increasing research are essential components of threat mitigation. This will help our country to increase emergency preparedness and response to turn it into a resilient society.

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Organic Dairy Farming - A Trend to Sustainable Dairy Sector

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Introduction

Organic dairy farming signifies rearing dairy animals on organic feed (i.e. pastures developed with no composts or pesticides), have access to pasture or outside, along with the limited utilization anti-toxins and hormones. Products obtained from organic dairy farm are the organic dairy products. Organic farming is a system of production, a set of goal-based regulations that permit farmers to deal with their own particular situations individually, while maintaining organic integrity (Oruganti, 2011).

In this system livestock must be fed with organic feed except under very unusual situations like national, state or local weather emergency or a fire or flood on an organic farm. Among the allowed materials are: feeds produced through organic production practices, natural vitamin and mineral supplements, and fresh water from non-contaminated sources.

In organic dairy farms breeding targets should not be at discrepancy with the animal's natural behaviour and should be directed towards good health. The organic approach to animal health care focuses on prevention of disease through diet, shelter, breeding and husbandry practices, rather than treatment (Harisha et al., 2014).

At the moment, India is the largest producer of milk in world supported by a surprising growth rate in dairy sector. Dairy farming has the potential for providing added income to the farmers together with achieving major goal of organic farming i.e. diversified production and sustaining biological cycle within farming method (Maji et al., 2017).

Changing to organic dairy production requires commitment and awareness of what's involved. Becoming organic can lower cost of production for grassroot people (smallholder dairy farmers) while at the same time raise their profits. However financial returns shall depend greatly on the demand generated. Due to rich heritage of dairy farming traditions suitable for organic production systems with good returns, India is in a unique position to utilize this opportunity.

However, for this purpose, several policy issues require immediate attention. Creating awareness among farmers and their training through dairy field functionaries, capacity building through participatory research network and incentives for interested farmers (like subsidized inputs and supply of market information) shall be the priorities. Therefore, the following study was conducted to judge awareness of dairy farmers about organic milk production and their concerns about transition to organic dairy farming.

Objectives of Organic Dairy Farming (Harisha Et Al., 2014)

1. To raise animals in a system that takes into consideration, the wider issues of environmental pollution, human health on consumption of animal products allowing them to meet their basic behavioural needs and reduce the stress.
2. To produce healthy animal products which are free from toxic chemical residues.
3. Exploit the natural behaviour of animals in their production systems to reduce stress.
4. Use of low external input which lessens the cost of production and allows for a sustainable system of production since most materials can be recycled in the farm and also made locally available.
5. Bridging the nutrients gap in soil, crops and animals i.e. animals feeding on crops and cultivated crops by products.
6. To promote animal welfare by using humane methods of production and utilization of farm animals.

Benefits of Organic Milk

Organic milk has more beneficial Omega-3 (Lairon and Huber, 2014), less damaging Omega-6 (Benbrook et al., 2013). Omega-3 is an essential fatty acid which is required for healthy growth and its deficiency leads to various health problems.

Regular intake of omega 3 fatty acids protects from various diseases and helps to reduce the incidence of heart disease, inflammation (in skin diseases like eczema), cancer, and arthritis (Annon, 2014).

The organic milk also contains greater amounts of conjugated linoleic acid (CLA) (Mercola, 2014). Conjugated linoleic acid (CLA) increases the body's metabolic rate, immunity to disease, and muscle growth.

It also reduces abdominal fat, cholesterol, and allergic reactions (Annon, 2014). Organic cows are grazed on pastures that are grown through organic means. Therefore, their milk is not contaminated with harmful chemicals such as the residues of pesticides, fertilizers and hormones (Singh et al., 2011).

Furthermore, this nutrient-rich organic milk does not contain traces of antibiotics, urea, or fertility hormones, as these are not fed to the cows to increase their milk production.

Organic milk has a two to three times higher concentration of antioxidants like lutein and zeaxanthin than non-organic milk (Mercola, 2014). Lutein is extremely important for eye health and is effective in preventing numerous eye diseases such as macular degeneration and cataracts. Zeaxanthin is also important for good eye health. It protects the eye from UV damage and the impact of free radicals. It is very helpful in preventing cataracts, diabetic retinopathy, glaucoma and macular degeneration.

Organic milk has a higher concentration of vitamins such as Vitamin A and Vitamin E than conventional milk. Since organic cows' graze on fresh grass and clover, the milk they produce has about 50% higher Vitamin E and 75% higher beta carotene (Nielsen and Nielsen, 2004).

Constraints in Organic Dairy Farming

Some of the constraints in the development of organic dairy farming have been enlisted by Kamboj and Prasad (2013) include lack of knowledge and awareness, around 70 per cent of milk produced in country came from small holders, incidence of diseases, restriction on landless organic dairy farming not permitted as per the National Standards of Organic Production (NSOP), limited availability of organic feed ingredients for formulating compound organic feed, problem of maintenance of proper records, limited reach of certification services and lack of proper procurement, processing and marketing infrastructure and network.

Opportunities

Native breeds of livestock, which predominate in tropical countries, are less susceptible to stress and disease, and so the need for allopathic medicines and antibiotics is much lower. Grass-based, extensive production systems and forest-based, animal production systems that are prevalent in many areas of these countries have considerable potential for conversion into organic animal husbandry.

Literacy is on the rise and the media are making consumers more aware of and concerned about animal welfare issues and healthy foods. This may well boost the domestic consumption of organic foods (Hamadani and Khan, 2015).

Conclusion

Organic dairy farming offers numerous opportunities for a developing country like India to increase the income of farmers and earn valuable foreign exchange through quality organic products. India has some excellent breeds of indigenous cattle and buffaloes possessing natural resistance against many diseases.

These breeds are well adapted to Indian climate and food availability situations. Most of the dairy husbandry practices are traditional with a close resemblance to prescribed organic practices.

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Management of Guava Fruit Fly, *Bactrocera correcta*

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Guava is commonly called a poor man's apple in the tropics and known for its delicious, pleasant aroma and outstanding nutritional values throughout the world. Due to various constraints, guava production is severely affected. Among all the known factors, insect pests are of prime importance.

The guava is subjected to attack by several kinds of pests and about 80 species of insects have been recorded on guava, but only a few of them have been recognized as a pest of regular occurrence and causing significant damage. Among insect pest, the fruit fly is the major limiting factor in obtaining a good quality of fruits to cause considerable losses.

Fruit fly, *Bactrocera correcta* are one of the most diversified and noxious pests on a wide range of tropical and sub-tropical fruits and vegetables. *Bactrocera correcta* is a species of tephritid fruit flies that is widely distributed in Southeast Asia. It is a serious pest species with a broad host range. Crop loss varies from a few per cent to 100 per cent depending on fruit fly population, locality, variety and season (Kumar et al., 2011). The female fruit fly punctures the fruits by its ovipositor and lays six or more banana shaped eggs into healthy, ripening fruits just beneath the skin.

Management

Fruit flies are very difficult to manage because they are polyphagous, multivoltine, high fecundity and adults are high mobility. Only adults are exposed while eggs and maggots remain protected in the host tissue. Sanitation, summer ploughing to expose pupa, poison food trap, bagging of fruits, use of hydrolysed protein, pheromone trap, spraying of botanicals and chemical insecticides are the management of practices for fruit fly.

Bagging or wrapping the fruits has been found more practicable in guava (Mitra et al., 2008). Bagging is a superior option of fruit fly management over conventional practice of pesticide spray for its efficacy and zero pesticide residues in the fruit. The use of pheromone trap (methyl eugenol) @ 25/ha stands as the most outstanding alternative among the various alternate strategies available for the management of fruit flies.

Methyl eugenol, when used together with an insecticide impregnated into a suitable substrate, forms the basis of male annihilation technique (MAT). Use chemical insecticides such as malathion 50 EC @ 2 ml/lit or dimethoate 30 EC @ 1ml/lit, two rounds at fortnight interval before ripening of fruits. Field releasing of parasitoids such as *Opius compensates, Spalangia philippinensis*, parasitoid wasp, *Diachasmimorpha kraussi*.

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A Dirty Little Secret: Mud Puddling Behaviour in Butterflies

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Nutrition is a central issue in biology at a variety of levels – much of organismal and evolutionary biology is concerned with how organisms extract nutrients from their environment, allocate nutrients to different goals, or avoid becoming food for other organisms, ecologists study how elements move through the landscape and food webs, and metabolism is a central process for cellular biology.

The term 'puddling' stems from the mud-puddling which is one of the most conspicuous behaviour seen in insects like butterflies. Butterflies and moths regularly congregate around mud, dung and even blood, tears or decaying flesh. As this behaviour very little known, but there are a couple of interesting observations that may help explain the icky phenomenon.

Although this behaviour is known from temperate-zone as well as tropical habitats, it is far more common in tropical regions. Butterflies get most of their nutrition from flower nectar. Though rich in sugar and nectar but lacks some important nutrients that need for reproduction. For those, butterflies visit puddles. By sipping moisture from mud puddles, butterflies take salts and minerals from the soil. This behaviour is called puddling, and is mostly seen in male butterflies. That's because males incorporate those extra salts and minerals into their sperm.

When butterflies mate, the nutrients are transferred to the female through the spermatophore. These extra salts and minerals improve the viability of the female's eggs, increasing the couple's chances of passing on their genes to another generation. In fact, it is believed that butterflies congregate on mud and other such substances primarily for salts. The salts and amino acids absorbed during mud-puddling play various roles in butterfly ecology, ethology and physiology. Males seem to benefit more from the sodium uptake as it aids in reproductive success, with the precious nutrients often transferred to the female during mating. This extra nutrition helps ensure that the eggs survive.

Mudpuddling by butterflies catches our attention because they often form large aggregations, with dozens of brilliantly coloured butterflies gathered in one location. Puddling aggregations occur frequently among swallowtails and pierids. A slightly strange experiment can be performed to test the 'salt theory' (it's best performed when no one else is around). Firstly, find a sandy bank or a muddy patch situated in direct sunlight where there are plenty of butterflies.

Next, pour a salt mixture over a wet, but butterfly-free, patch (in the less civilised version of this experiment you can replace salt with urine – butterflies are attracted to the sodium and ammonium ions). You can return to the spot later and observe the butterflies on your newly created "mud-puddling" spot.

Herbivorous Insects Need Sodium

Herbivorous insects like butterflies and moths don't get enough dietary sodium from plants alone, so they actively seek other sources of sodium and other minerals. While mineral-rich mud is a common source for sodium-seeking butterflies, they can also procure salt from animal dung, urine, and sweat, as well as from carcasses. Butterflies and other insects that get nutrients from dung tend to prefer the dung of carnivores, which contains more sodium than that of herbivores.

Butterflies Lose Sodium During Reproduction

Sodium is important for both male and female butterflies. Females lose sodium when they lay eggs, and males lose sodium in the spermatophore, which they transfer to the female during mating. Sodium loss is much more severe, it seems, for the males than for the females. The first time it mates, a male butterfly may give away a third of its sodium to its reproductive partner.

Since the females receive sodium from their male partners during mating, their sodium procurement needs aren't as great. Because males need sodium, but give so much of it away during mating, puddling behaviour is much more common in males than in females. In one 1982 study of cabbage white butterflies *(Pierisrapae),* researchers counted only two females among the 983 cabbage whites observed puddling.

A 1987 study of European skipper butterflies *(Thymelicuslineola)* found no females puddling at all, although 143 males were observed at the mud puddle site. The researchers studying European skippers also reported the area population consisted of 20-25% females, so their absence from the mud puddles didn't mean females weren't in the vicinity. They simply didn't engage in puddling behaviour the way the males did.

In most lepidopterans, the males pass complex spermatophores to their mates which are used to transfer, besides sperm, various types of nuptial gifts. These gifts may consist of minerals such as sodium or calcium phosphate they may contain toxic secondary plant metabolites or they contribute nutrients such as amino acids.

Due to the low sodium content of land plants, many terrestrial herbivores are expected to crave sodium. Among the Lepidoptera with their herbivorous caterpillar stages, mineral reserves assembled during the larval phase may often be limiting, and there should be strong selection for strategies to replenish mineral stocks.

Toxic plant metabolites which serve as pheromone precursors and nuptial gifts by male butterflies are collected through a special, sexually selected behavioural repertoire. Mudpuddling might be seen as the analogous case with regard to minerals. This idea is supported by the fact that most individuals engaged in puddling behaviour are males (Adler 1982).

Other Insects that Drink from Puddles

Butterflies aren't the only insects you'll find gathering in mud puddles. Many moths use mud to make up their sodium deficits, too. Mud puddling behaviour is common among leafhoppers, too. Moths and leafhoppers tend to visit mud puddles at night, when we are less likely to observe their behaviour. Most puddling observations have been made in Lepidoptera (various butterfly and moth species), but they include other insect orders.

Among the Hymenoptera there are some records of honey bees puddling (Butler, 1940) and feeding on sweat or tears is common among sweat bees (Halictidae) and stingless bees (Ba¨nziger 2007). Ants may also puddle as they readily visited salt baits (Kaspari et al., 2008). Flies (Diptera) are among the most common groups found on excrements, carrion, sweat and mammalian eyes (Ba¨nziger et al., 2009), but this is rarely considered puddling, even though such substrates may only be primary resources for a subset of fly species.

For example, tephritid fruit-flies feed on bird droppings, but fruits, yeasts, honey dew, and substances grazed from the surface of leaves are probably their main resources.

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Micro and Nano-Plastics: Human Health

Article ID: 31047

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Introduction

Nanotechnology has become one of the fastest growing branches of science that has successfully solved problems in medicine, industry, pharmacy and agriculture. The preparation, characterization and applications have drawn the attention of researchers worldwide to contribute with new ideas and come up with unique new material.

However, the same unique characteristics of engineered nanoparticles including small size, ability to cross cell membranes, and toxicity to cancer and microbial cells are indeed the same reasons they are categorized as hazardous pollutants when they finally reach open water systems through excretion into sewers or mishandling and improper disposal. Examples of such pollutants are metal nanoparticles, printer ink nanoparticles, and antineoplastic cyclophosphamides. Accumulation of mineral-based plastics, including microplastics, is becoming a very a serious global problem. Plastics are widely used, they are produced in millions of tons each year, studies report that only 10% of plastics are recovered and that by 2050, landfills will be filled with an estimate of 12 billion tons of plastic waste.

The term microplastics refer to plastic particles of size less than 5 mm, they originate from incomplete degradation of plastics, weathering of plastics in the environment as well as microbeads used for drug delivery process and cosmetic products. Their danger lies in their runoff to marine environment compromising aquatic life, and finding their way to algae and mussels, they get incorporated with sea salt eventually reaching human beings through either the food chain or through direct contact. This in turn leads to cellular toxicity.

Moreover, microplastics have been identified as carrying vectors for other pollutants in the environment. Due to their hydrophobic nature, the particles carry chemical pollutants via sorption, and transport them rendering toxicity assessment more complicated. Currently, the global community considers microplastics as a marine pollutant of emerging concern. To mitigate the oceanic microplastic pollution, it is necessary to reduce inputs from inland.

Plastics are highly versatile materials that have brought huge societal benefits. They can be manufactured at low cost and their lightweight and adaptable nature has a myriad of applications in all aspects of everyday life, including food packaging, consumer products, medical devices and construction. By 2050, however, it is anticipated that an extra 33 billion tonnes of plastic will be added to the planet. Given that most currently used plastic polymers are highly resistant to degradation, this influx of persistent, complex materials is a risk to human and environmental health.

Continuous daily interaction with plastic items allows oral, dermal and inhalation exposure to chemical components, leading to the widespread presence in the human body of chemicals associated with plastics. Indiscriminate disposal places a huge burden on waste management systems, allowing plastic wastes to infiltrate ecosystems, with the potential to contaminate the food chain.

Of particular concern has been the reported presence of microscopic plastic debris, or microplastics (debris ≤1 mm in size), in aquatic, terrestrial and marine habitats. Yet, the potential for microplastics and nanoplastics of environmental origin to cause harm to human health remains understudied.

Occurrence of Micro- and Nano-Plastics in the Environment

In addition to larger items of plastic litter, concern has been raised that microscopic plastic debris (microplastic) (<1 mm) may also be detrimental to the environment and to human health (Thompson et al. 2004; Cole et al. 2011).

Microplastics have been studied mostly in the context of the marine environment, and have been found to be a major constituent of anthropogenic marine debris. There is sparse information available on the presence of microplastics in environments other than the oceans, for example in terrestrial soils or freshwater environments. The presence of microplastic particles (Dubaish and Liebezeit 2013) and synthetic polymer fibres (Zubris and Richards 2005) has been reported in sewage sludge and in the soils to which they had been applied (Zubris and Richards 2005), where they were still detectable five years after application.

Micro- and Nano-Plastics and Human Health

In terms of human health risks, microplastics as contaminants in the wider environment represent a concern because it has been shown that they can be ingested by a wide range of aquatic organisms, both marine and freshwater, and thus have the potential to accumulate through the food chain.

Aquatic organisms for which ingestion of microplastics has been documented in the field include those from across the marine food web, including turtles, seabirds, fish, crustaceans and worms (reviewed by Wright et al. 2013).

Ingestion of Micro- and Nano-Plastics and Uptake Across the Gut

Whilst the potential clearly exists for microplastics to be present in food items, there is currently no evidence for the unintentional ingestion or subsequent translocation and uptake of microplastics into the human body through the diet. There is, however, a huge interest worldwide in the use of micro- and nanospheres as pharmaceutical drug delivery systems through oral, intravenous and transcutaneous routes (Kim et al. 2010), and in the migration of nanopolymers from packaging materials into food (EFSA 2011; Lagaron and Lopez-Rubio 2011). Based on these growing and fast-moving fields, an enhanced understanding of the mechanistic pathways by which micro- and nanoparticles could enter the human body is starting to emerge, although many aspects of this field remain to be elucidated.

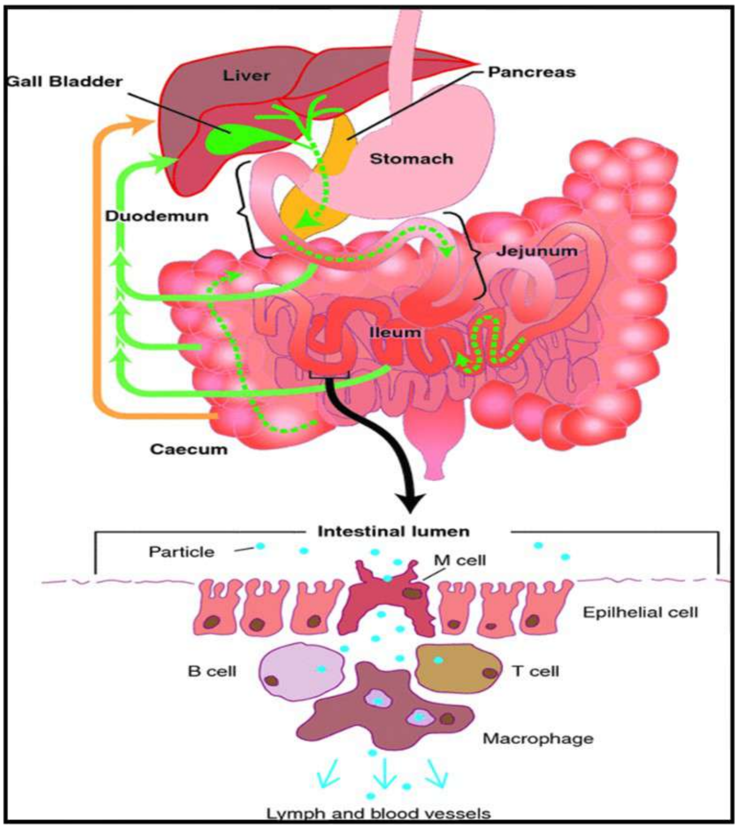

Fig. 1: A diagram illustrating a proposed recirculation pathway for polymer nanoparticles (ammonium palmitoyl glycol chitosan) after oral administration. The nanoparticles are taken up into the blood from the gut through M cells, and from there through the lymphatic system (shown in yellow) and into the liver and gall bladder. Particles are then re-released into the gut together with bile (shown in green) before excretion in faeces and urine. Adapted from Garrett et al. (2012).

Garrett et al. (2012) used a novel bio-imaging technique, multimodal nonlinear optical microscopy, to document uptake of polymeric nanoparticles by enterocytes in the mouse gut in vivo. They studied a novel amphipathic polymer specifically designed for drug delivery, ammonium palmitoyl glycol chitosan (GCPQ) of 30–50 nm in diameter and showed that after uptake by enterocytes, particles accumulated at the base of the villi.

From there, they passed into the blood stream and were transported to the liver, where they were detectable in the hepatocytes and intracellular spaces, before recirculating through the bile to the small intestine (Garrett et al. 2012) to be excreted with faecal matter. This is similar to previous results for larger micron-scale polystyrene and latex particles, suggesting that both micron and nano-scale polymers are treated in a similar manner (Jani et al. 1996), with uptake across the gut, recirculation and eventual elimination through faecal matter and urine (Fig. 1).

This information is of high interest in terms of drug delivery, yet it also suggests that ample opportunity exists, following ingestion, for micro- and nanoplastics in food or water to enter, circulate and bioaccumulate within the body.

Conclusions

This short account has identified some of the most widely encountered plastics in everyday use and illustrated some of the attempts that have been made to assess their potential hazards to human health. Different routes of exposure to human populations, both of plastic additives, micro- and nanoplastics from food items and from discarded debris are discussed in relation to the existing literature for nanomedicines and nanocomposite packaging materials, for which an increasing body of knowledge exists.

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Improved Production Techniques of Jamun

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Introduction

Jamun, *Syzygium cumini* is a constituent member of the family of Myrtaceae. Jamun is a popular indigenous fruit of India. It has got very valuable place in Ayurvedic medicines. It is believed to be a boon for diabetic patients. But in India, its organised orcharding is still lacking mainly because of lack of proper information on cultivation practices and non-availability of dwarf and high yielding varieties. In this booklet all the information on jamun cultivation has been collected and presented in a simple and interesting form.

It is also known as black plum, Indian black cherry, Ram jamun etc. in different parts of India. The tree is tall and handsome, evergreen, generally grown for shade and windbreak on roads and avenues. The original home of jamun is India or the East Indies. It is also found in Thailand, Philippines, Madagascar and some other countries. The jamun has successfully been introduced into many other subtropical regions including Florida, California, Algeria, Israel, etc.

In India, the maximum number of jamun trees are found scattered throughout the tropical and subtropical regions. It also occurs in the lower range of the Himalayas up to an elevation of 1,300 meters and in the Kumaon hills up to 1,600 meters. It is widely grown in the larger parts of India from the Indo-Gangetic plains in the North to Tamil Nadu in the South. The data about its total acreage in India are not available.

Uses and Composition

Sl. No	Nutrient	Percentage
1	Moisture	28.2
2	Protein	0.7
3	Fat	0.1
4	Mineral	0.4
5	Fibre	0.9
6	Carbohydrate	19.7
7	Calcium	0.02
8	Phosphorus	0.01
9	Iron	1.0
10	Calorific value	83/100 g

The tasty and pleasantly flavoured fruit is mostly used for dessert purposes. The fruit is usually eaten with salt. The jamun fruit has sub-acid spicy flavour. Apart from eating fresh, it can be used for making delicious beverages, jellies, jam, squash wine, vinegar and pickles. A little quantity of fruit syrup is very useful for curing diarrhoea.

A mixture of jamun juice and mango juice in equal quantity is very useful for quenching thirst for diabetic patient. Jamun is used for preparation of wine particularly in Goa. The vinegar prepared from juice extracted from slightly ripe fruits is stomachic, carminative and diuretic, apart from having cooling and digestive properties.

Powdered seeds are also very useful for the cure of diabetes. Seed powder is used as a lotion for the cure of ring worm. Jamun seeds can be used as a concentrate for animals because it is rich in protein, carbohydrate and calcium. Its wood is used for manufacturing railway sleepers. It is not attacked by wood decaying insects or fungi. There are a lot of other uses of jamun fruits too.

Soil

The jamun tree can be grown on a wide range of soils. However, for high yield potential and good plant growth, deep loam and a well-drained soil are needed. Such soils also retain sufficient soil moisture which is beneficial for optimum growth and good fruiting. Jamun can grow well under salinity and waterlogged conditions too. However, it is not economical to grow jamun on very heavy or light sandy soils.

Climate

Jarnun prefers to grow under tropical and subtropical climate. It is also found growing in lower ranges of the Himalayas up to an altitude of 1300 meters. The jamun requires dry weather at the time off towering and fruit setting. In subtropical areas, early rain is considered to be beneficial for ripening of fruits and proper development of its size, colour and taste.

Species

The genus Eugenia comprises of 1,000 species of evergreen trees and shrubs, most of them being tropical in origin. Some of the old-world *Eugenia* species are now placed in the genus *Syzygium*. It belongs to the family *Myrtaceae*. Many of these species yield edible fruits and some of these are of ornamental and medicinal value.

A wild species *S. frniticosum* with small edible fruits is grown as windbreaks. The large evergreen tree has small dark purple fruits with prominent elongated seeds. The fruit is an astringent (causing contraction of body tissue) even when ripe. A popular fruit is the rose apple or gulab-jamun (*S. jambos*). It is found in South India and West Bengal. The tree is very ornamental. The fruit is yellow in colour, generally insipid in taste and has high pectin content.

S. zeylanica, small tree with edible fruits, is found on the Western Ghats and S. *malaccensis* (Malay rose apple) found in South India. Another related fruit found in South India is Surinam cherry (*S. uniflora*). It is a small tree with blight red aromatic fruits. *S. javanicum* (water apple) is also found in South India and West Bengal. *S.densiflora* is used as rootstock in jamun (*S. cumini*) and is resistant to the attack of termites.

Varieties

There are no standard varieties of this fruit under cultivation. The common variety grown under North Indian conditions is "Ram Jamun". It produces big sized, oblong fruits, deep purple or bluish-black in colour at full ripe stage.

The pulp of the ripe fruit is purple pink and the fruit is juicy and sweet. The stone is small in size. The variety ripens in the month of June- July and it is very common both in rural as well as in urban. Jambo type, Kongan Bagaduli and Seedless are popular varieties ruling the major jamun cultivable area.

Propagation

The jamun is propagated both by seed and vegetative methods. Due to existence of polyembryony, it comes true to parent through seed. Though vegetative methods followed in most cases have attained some success, seed propagation is still preferred. However, seed propagation is not advisable as it results in late bearing.

The seeds have no dormancy. Fresh seeds can be sown. Germination takes place in about 10 to 15 days. Seedlings are ready for transplanting for the use as rootstock in the following spring (February to March) or monsoon i.e. August to September.

Propagation of jamun is economical and convenient. Budding is practiced on one-year old seedling stocks, having 10 to 14 mm thickness. The best time for budding is July to August in low rainfall areas. In the areas where rains start easily and are heavy, budding operations are attempted early in May-June. Shield, patch and forkert methods of budding have proved very successful. The possibility of better success has been reported in forkert method compared to shield or 'T' budding.

Jamun is also propagated through soft wood and inarching but it is not adopted commercially. In this method one-year old seedlings raised in pots are inarched with mother jamun trees with the help of wooden stands during June-July. About 60% air layers are obtained with 500 ppm IBA in lanolin paste, provided air layering is done in spring and not in the rainy season.

Better rooting through cutting is obtained in Jamun under intermittent mist. Semi-hardwood cuttings of both *S. jambos* and *S.javanica*, 20-25 cm long, taken from the spring flush and planted in July treated with 2000 ppm IBA (Indole Butyric Acid) give better results.

Planting

Jamun is an evergreen tree and can be planted both in spring i.e. February -March and the monsoon season i.e. July-August. The latter season is considered better as the trees planted in February- March have to pass through a very hot and dry period in May and June soon after planting and generally suffer from mortalities from the unfavourable weather conditions.

Prior to planting, the field is properly cleared and ploughed. Pits of 1 x 1 x 1 m size are dug at the distance of 10m both ways. In fertile soils even 7 x 7m a little closer spacing is also followed for grafted plants. Usually, work of digging of pits is completed before the onset of monsoon.

The pits are filled with mixture of 75% top soil and 25% well rotten farmyard manure or compost. Another common way of growing jamun trees is to plant them as shade trees near the farm dwellings and wells. Here they provide a welcome shadow besides fruit.

Fertilizer Application

The jamun trees are generally not manured. This is not because they do not require manuring or fail to respond to it but because they can stand a good deal of neglect. An annual dose of about 19 kg farmyard manure during the pre-bearing period and 75 kg per tree bearing trees is considered.

Normally, seedling jamun trees start bearing at the age of 8 to 10 years while grafted or budded trees come into bearing in 6 to 7 years. On very rich soils, the trees have a tendency to put on more vegetative growth with the result that fruiting is delayed. When the trees show such a tendency, they should not be supplied with any manure and fertilizer and irrigation should be given sparingly and withheld in September-October and again in February-March.

This helps in fruit bud formation, blossoming and in fruit setting. Sometimes this may not prove effective and even more drastic treatments such as ringing and root pruning may have to be resorted to. A fruit grower has, therefore, to be cautious in manuring and fertilizing jamun trees and hence, has to adjust the doses according to the growth and fruiting of trees.

Irrigation

In early stages, the jamun tree requires frequent irrigations but af1cr the trees get established, the interval between irrigations can be greatly decreased. Young trees require 8 to 10 irrigations in a year. The mature trees require only about half the number, which should be applied during May and June when the fruit is ripening. During autumn and winter months, just an occasional irrigation may be applied when the soil is dry. This will also save the trees from the ill effects of frost in winter.

Intercropping

In the initial years of planting, when a lot of interspace is available in the orchard, appropriate intercrop especially legumes crops and vegetables can be taken dunng rainy season.

Training and Pruning

Regular pruning in jamun is not required. However, in later years the dry twigs and crossed branches are removed. While training the plants, the framework of branches is allowed to develop above 60 to 100 cm from the ground level.

Insect Pests

Among the pests, white fly and leaf eating caterpillar cause great damage to the tree.

White fly *(Dialeurodes eugenia)*

It damages jamun tree in all parts of India. Affected fruits get wormy appearance on the surface. White fly can be controlled in the following ways:

1. Maintain sanitary conditions around the tree.
2. Pluck all affected fruits and destroy them.
3. Dig up the soil around the tree trunk so that the maggots in the affected fruits and pupae hibernating in the soil are destroyed.

Leaf Eating Caterpillar *(Carea subtillis)*

This caterpillar is only found in Coimbatore. The insect infests the leaves and may defoliate the tree. It can be controlled by spraying Rogor 30 EC or Malathion @ 0.1 per cent.

Other Pests

Besides the above insects, the jamun crop is seriously damaged by pests like squirrels and birds like parrots and crows. These have to be frightened away by beating the drums or flinging stones.

Disease: Anthracnose *(Glomerella cingulata)*

The fungus incites leaf spots and fruit rot. Affected leaves show small scattered spots, light brown or reddish brown in colour. Affected fruits show small water soaked, circular and depressed lesions. Ultimately, the fruits rot and shrivel. Spraying with Dithane Z- 78 @ 0.2% or Bordeaux mixture at : 4:4:50 concentration shall check the disease.

Flowering and Fruiting

Flowers are borne in the axils of leaves on branchlets. In North Indian conditions, flowering starts in the first week of March and continues up to the end of April. The pollen fertility is higher in the beginning of the season. The maximum receptivity of stigma is one day after anthesis. The jamun is a cross-pollinated and the pollination is done by honey bees, houseflies and wind.

The maximum fruit set can be obtained by hand pollination when it is done after one day of anthesis. Thereafter, a sharp decline is observed in fruit set. There is heavy drop of flowers and fruits within 3 to 4 weeks after blooming. Later natural fruit drop can be reduced with two sprays of GA3 60 ppm, one at full bloom and another 15 days after initial setting of fruits.

The pattern of growth and fruit development of jamun can be divided into three phases: the first phase from 15-52 days after fruit set having slow growth of fruit, the second phase from 52 to 58 days after fruit set having fast growth and the third and last phase from 58 to 60 days after fruit set having slow growth and very little addition in fruit weight.

Harvesting and Yield

The seedling jamun plants start bearing after 8 to 10 years of planting, while grafted ones bear after 6 to 7 years. However, commercial bearing starts after 8 to 10 years of planting and continues till the tree becomes 50 to 60 years old. The fruit ripens in the month of June -July. The main characteristic of ripe fruit at full size is deep purple or black colour.

The fruit should be picked immediately when it is ripe, because it cannot be retained on the tree in ripe stage. The ripe fruits are handpicked singly by climbing the tree with bags slung on the shoulder. In some areas, plastic tarpaulins are spread below the canopy and by manually the branches are shaken and the fallen fruits are collected. Care should be taken to avoid all possible damage to fruits. The average yield of fruits from a full-grown seedling tree is about 80 to 100 kg and from a grafted one 60 to 70 kg per year.

Storage and Marketing

The fruits are highly perishable in nature. They cannot be stored for more than 3 to 4 days under ordinary conditions. However, pre cooled fruits packed in polythene bags can be stored well up to three weeks at low temperatures of 8 to 10°C and 85 to 90% relative humidity.

The fruit is packed and sent to the market almost daily. For marketing, well ripe and healthy fruits are selected. Damaged, diseased and unripe fruits are discarded. These selected fruits are then carefully packed in wooden baskets and sent to the local markets. At present, the fruits are sold @ Rs. 200-250/Kg.

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Cultivation Practices of Sesbania (AGATHI) as Leafy Vegetable

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Introduction

Agathi, *Sesbania grandiflora* L. is a constituent member of the family of Fabaceae and native to South East Asia. Mainly used for culinary, fodder, fuel, soil improvement, fibre, gum or resin, Ornamental, boundary or barrier or support, Health benefits and therapeutic uses. Leaves are very nutritious. 100 gram of leaves contain protein 8.4 g, fat 1.4 g, carbohydrate 11.8 mg, Vitamin A 15.44 g, Thiamine (Vitamin B1) 0.21 mg, riboflavin (Vitamin B2) 0.09 mg, niacin 1.2 mg (Vitamin B3), Vitamin C 169 mg, Calcium 1130 mg, Phosphorus 80 mg and iron 3.9 mg. the flowers are also edible. Because of its Vitamin A rich nature, regular inclusion in food helps to avoid eye defects like evening blindness.

It is a perennial tall lanky tree which can be grown as a bush also. It is a well-known small, loosely branching, legume plant of the Tropical Asia including, India, Indonesia, Malaysia, Myanmar and Philippines. Leaves, seeds, pods and flowers of S. grandiflora are edible.

Flowers are the most widely used part, and white flowers are preferred to the red. In the Philippines, unopened white flowers are a common vegetable, steamed or cooked in soups and stews after the stamen and calyx have been removed. The raw flowers are eaten as salad in Thailand. Young leaves are also eaten, usually chopped fine and steamed, cooked or fried. Tender pods are eaten like string beans. Agathi leaves taste bitter, sour, and mildly tart.

Most cooks counteract this bitterness with coconut milk, and some swear by the addition of garlic to combat the stomach pain arising from consuming too much agathi. The flowers are also bitter and astringent, but the white is less so than the red.

Climate and Soil

It is best adapted to regions with annual rainfall of 2,000-4,000mm and is also grown successfully in semi-arid areas with 800mm annual rainfall and up to 9 months dry season. It is adapted to the lowland tropics up to 800m, occasionally to 1,000m MSL and the environments with mean annual temperatures of 22-30ºC. It is frost sensitive and intolerant to extended periods of cool temperatures.

Poor shade tolerance, less than that of *S. sesban. S. grandiflora* is more suitable for the wetter/humid sites. It can be grown on a wide range of soils including those that are poor and waterlogged. It tolerates saline and alkaline soils and has some tolerance to acidic soils. Agathi may grow in alkaline, poorly drained, saline, low fertility soils. It is well adapted to heavy clay soils.

Sesbenia grandiflora is often maintained in gardens and around crop fields for its nitrogen contribution to the soil. The light shade cast by its canopy does not block much light, allowing the growth of companion plants. Falling leaflets and flowers recycle nutrients to the ground. Due to its fast-growing habit, seedlings are used for green manuring similar to annual green manure crops.

Fruits, falling leaflets and flowers make excellent green manure or mulch and improve soil fertility. It is a well-suited annual for dense planting, growing for short periods and ploughing under to improve soil before planting food crops. S. grandiflora is ideal for rehabilitating eroded soils.

Varieties

In agathi, no varieties have been identified till now through systematic breeding programme. But based on the flower colour, agathi can be classified in to four distinct groups, which are as follows:
1. Sita: This group produce white colour flower.
2. Peeta: It is a yellow flowered strain.
3. Neela: This group of plant produce blue colour flower.
4. Lohita: It is a red flowered strain.

Among these four groups, white and red flowered groups are used as vegetable and other two groups are more popular for their medicinal uses. Red flowered strain is more nutritious than white flowered one due to their high content of phenolic compound.

Field Preparation

Two to three times deep ploughing, 15 tonnes of FYM incorporated during last plough.

Propagation

It is propagated through seeds. After ten days seeds are started to germinate. It may also be easily propagated by stem and branch hardwood cuttings. Sesbania species tend to seed prolifically from early age. It is thought that *Sesbania sesban* is pollinated by bees, whilst the larger flowers of *S. grandiflora* are pollinated by birds.

The seed can be easily harvested and can be grown without problems of dormancy. It is able to produce ripe pods within nine months of planting. The seeds are collected from the best trees in May and sown for raising of seedlings in nursery. Scarification may improve uniformity of establishment but is not considered essential. The viability of seed is about six months and 1 kg seed contain about 16000 seeds.

The seeds are sown during May- June in polythene bags or in nursery beds. The seeds germinate in a week. The seedlings become ready for transplanting after 30-45 days of sowing. The seedlings are planted in 30cm3 size pits.

Spacing

1m x1m. Usually it is used as a shade crop for chillies, and standard for betelvine.

Sowing and Spacing

One should wait for warm weather for sowing. A soil temperature of at least 25°C is needed for proper germination. In subtropical areas it is sown during November – December, while in tropical areas sowing should be done from October to January. Seedlings are planted at 1.5m × 2 m spacing.

Establishment of Plantation

Planting pits of adequate dimensions should be dug in advance of planting. For biomass production the spacing will, be done in proper manner. Where Sesbania is being established along with another crop in agro forestry or mixed cropping management system, then the planting design will vary with the overall management objectives.

It is popular as an agro forestry crop with field crops such as cotton, maize and vegetable crops as it provides green manure and useful shade and wind protection. It is also grown as an alley crop. Generally, it is much faster to establish compared to other common tree legumes like Leucaena, Gliricidia and Calliandra. Commonly planted as individual trees or in rows, spaced 1-2m apart along fence lines, field borders and the bunds of rice fields.

In fertile sites, it will attain a height of 5-6m in nine months. Height increments are greatly reduced in the second year of growth. It can be planted at high densities (up to 3,000 stems/ha) to produce pole timber, or sparsely planted to produce dry-season forage and food. The leaf canopy is open and casts only light shade, making it popular in gardens.

Sesbenia grandiflora cannot be coppiced or pollarded. The structure of the tree is shaped by pruning so that the canopy remains low, within reach for convenient harvesting. Agathi is tolerant to low fertility level of soils.

Irrigation

Irrigation requires weekly interval. Whenever necessary irrigate the field.

Manures

Twenty days after sowing apply any complex fertilizers. No need to apply urea separately.

Weeding

Monthly once manual weeding is essential.

Pest

Weevil (attack leaves and stems), Stem borer, Larvae damage tender stem.

Disease

Collar seedling blight, Fungus leaf spot, Gray leaf spot, Mosaic symptom on leaf, Root rot and wilt, Powdery mildew and Fungus causing gall.

Harvest

Leaves are started to harvest 70 days after sowing. Next harvest is every 40 days once. We can maintain the plant up to 10 years.

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Relevance of *Wolbachia* in Biocontrol of Insect Pests

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Introduction

Wolbachia is a gram-negative, obligatory bacterial endosymbiont that is extremely widespread among arthropod organisms, and has attracted significant attention due to its potential for insect control and vector-borne disease suppression. With the resurgence of vector-borne disease, some have been pessimistic about the effectiveness of conventional control measures, such as long-term insecticides. In addition, increased use of insecticides has given rise to questions about adverse environmental impacts. Therefore, the need for innovative environmentally friendly management methods to supplement existing insect control initiatives has been suggested.

For these reasons, there is increasing interest in the possible application of *Wolbachia* in biocontrol programmes, either to increase biocontrol agent populations or to reduce pest species populations. *Wolbachia* manipulate host reproduction to promote their own spread and maintenance in host's populations by a number of phenotypes.

Incompatible Insect Technique (IIT)

Another tactic applied using cytoplasmic incompatibility (CI) is similar to the sterile insect technique (SIT), where sterile male mass inundative releases are used to reduce and/or destroy natural populations. One big prerequisite for any SIT strategy effectiveness is the ability to deliver significant numbers of sexually active fit males to the field population. However, the equipment used to create sterile males (e.g., irradiation and chemosterilization) also leads to loss of release male fitness. In an Incompatible Insect Technology (IIT) strategy based in *Wolbachia*, female sterility is artificially maintained by regular releases of cytoplasmic incompatible males. Since *Wolbachia* is not transmitted paternally, the form of infection present in the release strain is not identified in the region.

When the size of the field population is declining due to incompatible matings, the proportion of release strain males is increasing. As with traditional SIT, the increasing ratio of incompatible matings over time will lead to population depletion and likely extinction of the population. SIT and IIT can be combined with traditional biological monitoring using parasitoids, predators and pathogens. SIT requires the release of both sexes while only males should be released in the case of IIT. The release of females infected with *Wolbachia* can result in the development of viable offsprings if the females released are compatible with either wild or males released.

Wolbachia infects several genera of tephritid fruit flies such as *Anastrepha, Bactrocera*, *Rhagoletis, Dacus, Ceratitis, Carypomya* and others. *Wolbachia* can cause complete cytoplasmic incompatibility in novel hosts resulting in complete suppression of laboratory populations by single releases of infected males, potentially making it a valuable tool for the management of pests.

Parthenogenesis Induction

Wolbachia-induced female parthenogenesis (thelytoky) is less common than CI, and has been documented so far only in species with arhenotokous development (in which males develop from unfertilized eggs), such as mites, hymenopterans (for example, wasps) and thrips. Instead of producing sons from unfertilized eggs, infected females produce daughters who, unlike males, can transmit the bacteria to their offspring like CI, *Wolbachia*-induced parthenogenesis is caused by cell cycle disruption during early embryonic development, leading to the development of diploids in unfertilized eggs (thelytoky).

In both *Trichogramma* sp. and *Leptopilina clavipes*, anaphase during the first embryonic division is abortive, resulting in one diploid nucleus instead of two haploid nuclei. The first mitotic division is complete in the wasp *Muscidifurax uniraptor*, and diploid females are formed after two cell nuclei are fused.

Feminization

Feminization caused by Wolbachia was first described in isopods, and was more recently described in insects where it occurs through various mechanisms. *Wolbachia* has been shown to proliferate within the androgenic gland in several isopod species from the order oniscidea, leading to androgenic gland hypertrophy and impaired activity.

The genetic males thus evolve as females. Feminisation in insects is currently known in two distinct host species, *Eurema hecabe* and *Zyginidia pullula*. The exact feminization mechanism is unclear at the moment, although in *E. hecabe*, *Wolbachia* tends to interfere with the process of sex-determination and must work constantly for full feminisation during development.

Removal of the *Wolbachia* results in intersexual activity during activity. It has been postulated that feminizing *Wolbachia* will lead to the evolution of new systems of sex-determination, such as shifts from female heterogamety to male heterogamety48, although there has been no definitive evidence for this.

Male Killing

Male killings induced by *Wolbachia* have been described in four different arthropod orders: Coleoptera, Diptera, Pseudoscorpiones and Lepidoptera. *Wolbachia* killing of males occurs mainly during embryogenesis in each of the mentioned infections, which can lead to more food for the surviving female progeny.

Insight into the mechanism of killing males comes from *Ostrinia scapulalis*, the lepidopteran host. The all-female broods found at O infected with *Wolbachia*. The first diagnosis of scapulalis was the result of feminisation caused by *Wolbachia*. When the mothers were treated to remove *Wolbachia* with tetracycline, all-male broods were produced.

Application of *Wolbachia* in Biocontrol

The use of *Wolbachia* in biocontrol work would be influenced by simple manipulation. Manipulations involve the elimination, transfer, or modification of genes. Infections may be removed by applying antibiotics (e.g. rifampicin, tetracycline) to an arthropod host's larval diet or adult feeding stages. In a changed method, *Wolbachia* was removed by adding rifampicin in the diet of the Drosophila host wasp in a parasitoid wasp.

Elimination can also be accomplished by rearing hosts at high temperatures, or rearing hosts under crowded conditions. Yet therapies to remove *Wolbachia* can also kill bacteria other than *Wolbachia*. The loss of these latter species, depending on their position in the host arthropod, may or may not be of concern; for example, nutritional symbiont versus pathogen. (Robert et al., 2012) Field populations of major crop insect, African army worm (*Spodoptera exempta*), showing a positive correlation between the prevalence and severity of nucleopolydrovirus (SpexNPV) infection and three strains of *Wolbachia*.

Laboratory bioassays have shown that infection with one of these strains, a male-killer, increases SpexNPV host mortality by 6–14 times. Instead of protecting their lepidopteran host from viral infection, these studies have shown that *Wolbachia* makes them more vulnerable and potentially has consequences for the biological control of other insect pests.

Conclusion

Wolbachia infects taxa of various arthropods. Its hosts include economically important pest species and beneficial species being studied to combat these pests. Our haphazard survey indicates that one or more *Wolbachia* strains are infected with at least 46 per cent of these pest and beneficial species.

Many biocontrol research programs therefore include *Wolbachia* as a component although their presence may be unsuspecting. Arthropod monitoring for infection can be done readily using PCR techniques and specific primers of *Wolbachia*.

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Virus-Like Diseases of Citrus in India, their Diagnosis and Management

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Introduction

Huanglongbing (HLB), already citrus greening illness, is the most damaging of citrus species making significant danger the world citrus industry. The sickness was accounted for from China in 1919 and now known to happen in excess of 40 distinct nations of Asia. Three types of gram-negative bacterium in particular *Candidatus Liberibacter asiaticus, Candidatus Liberibacter africanus* and *Candidatus Liberibacter americanus* are the easygoing living beings of HLB.

Citrus in India has been known to experience the ill effects of specific issue bringing about low creation, twig dieback, slow passing and even abrupt shriveling ascribed to "dieback", a sickness that was first seen in the eighteenth Century in focal India. Evidence for the nearness of HLB in India was in the long run acquired at the infection Research Centre, when transmitting the HLB pathogen by the Asian psylla, D. citri by exhibiting those trees with dieback indications perpetually demonstrated positive for HLB. From that point, citrus developing areas of India and was viewed as chief reason for citrus dieback illness From a few studies led alongside atomic test (constant PCR) in 16 conditions of India affirmed its appropriation in completely examined states (with the exception of Arunachal Pradesh): Andhra Pradesh, Assam, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura and West Bengal.

Citrus greening infection or HLB Rein ruler while assessing maladies of financial plants in southern China and utilized English term "yellow shoot" of citrus in the report, nonetheless, for an extensive stretch it (around then the name "HLB" was not utilized) was believed to be available in India. Around then it was accepted that the HLB was brought about by abiotic factors like Zn insufficiency/harmfulness and poor seepage framework. it became built up that greening was uniting and creepy crawly transmissible with end brought about by infection, mycoplasm like living beings (MLOs) were accepted to be related with plant ailments for the most part with "yellow" side effects looking like with greening indications. On close assessment, these life forms supposedly had bacterial cell divider notwithstanding cytoplasmic layer, recommending that they were gram negative genuine microscopic organisms .Thus, it was inferred that the HLB specialist was gram negative bacterium. Later on, it was affirmed by Electron Microscopy that South African "greening", Indian "dieback".

Materials and Methods

Three field overviews will be done in the fundamental citrus forests in the nation. The primary goals of the study were to consider the symptomatology of the normally happening citrus greening in the different citrus species and to gather agent tests for additional etiological work.

For field determination, a sum of a thousand citrus trees were deliberately inspected (10 trees/plantation) for the nearness of citrus greening sickness. The plantations were haphazardly picked however the test trees were chosen based on an unmistakable general decrease and articulated foliage side effects demonstrative for citrus greening.

The field analysis was performed by intently inspecting the outer foliage side effects which are regularly found related with citrus greening. So as to watch the trade mark. Photos of agent indications were taken.

The disease incidence of each location was evaluated according to the following formula:

$$\text{Incidence (\%)} = \frac{\text{Total Number of infected trees in each location}}{\text{Total number of trees inspected.}} \times 100$$

Detection of Huanglongbing

1. For the conclusion of HLB, two atomic methods have been utilized: traditional Polymerase Chain Reaction (PCR) and constant PCR (RT-PCR).
2. Quantitative. Organic ordering strategies are additionally accessible. Because of low pace of join transmission of the bacterium related with HLB, the achievement rate for natural ordering of HLB is variable.
3. Scratch technique for HLB recognition in citrus leaves utilizing iodine-starch response.

Results: Management Strategies

1. Inoculums Reduction and Vector Control: General agreement all through the world on three general administration rehearses for the administration of the malady; the planting of ensured clean planting materials, compelling control of its vector psyllid populaces and expulsion of contaminated trees that fill in as an inoculums hotspot for psyllid securing. The general control system has been to annihilate every single existing wellspring of HLB inside a region, at that point replant with sans hlb trees developed from clean budwood. Psyllid populaces should likewise be decreased however much as could be expected. Organic control of the psyllid vector is just conceivable in areas that don't support develop of psyllid populaces and is frequently undermined when hyper-parasites are available. Forestalling HLB from entering to sound region is a lot simpler than attempting to kill or control it. It is essential to abstain from bringing engendering materials from HLB-contaminated regions to non-tainted zone.

2. Chemical Control: Through Chemical control we will be used combination of penicillin and streptomycin (PS) was effective in eliminating or suppressing the Las bacterium and provided a therapeutically effective level of control for a much longer period of time than when administering either antibiotic separately using a propagation test system with Las-infected periwinkle and citrus plants.

Nutrition

The utilization of nourishing applications to control or balance the malicious impacts of HLB.

Use of Tolerant Rootstocks

Rootstocks to be specific two Rangpur limes (FCAV and Limeira), three trifoliate oranges [Rubidoux, FCAV, and Flying Dragon (FD)], Swingle citrumelo, Sunki, and Sun Chu Sha Kat mandarins, Orlando tangelo, Carrizo citrange, utilized for tried HLB.

Conclusion

HLB is the most wrecking infection of citrus natural product crops. Most business citrus types of Nepal like mandarin and sweet orange are truly defenceless to the infection while corrosive lime is somewhat lenient, yet it is transporter of HLB bacterium filling in as concealed wellspring of inoculums. The illness is available in India last earlier years and has spread numerous business citrus pockets of the nation throughout the years. Research endeavours is found predominantly centred around recognized and malady ordering leaving insufficient consideration regarding its drawn-out administration. It has come about to enormous decrease of citrus plantations particularly situated underneath 1000 m height where populace of vector – psyllid is plenteous. Thusly, effective HLB the executive's techniques will be embraced in India to spare nation's citriculture.

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Remote Sensing and GIS in Agriculture

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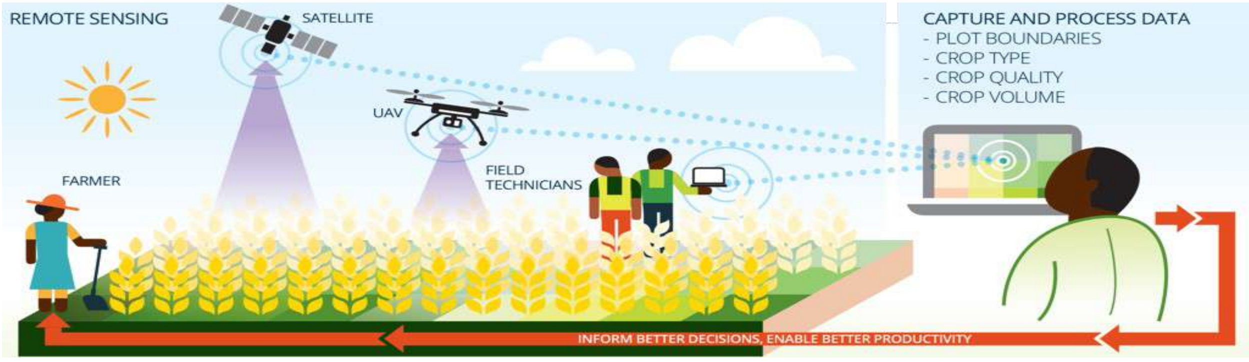
Agriculture is a major economic sector of the country, providing employment opportunities to more than 50% of the working population of the country. It is therefore clear that agriculture has been the main driver for the Indian remote sensing program. With the help of remote sensing and GIS, we can observe the earth for agricultural monitoring. Various national level agricultural applications have been developed which demonstrate the use of remote sensing data provided by sensors / satellites launched by the space agency of the countries, the Indian Space Research Organization (ISRO), some of which crop in Harvesting and production are included. Assessment, crop acreage, production estimation, cropping system analysis, agricultural water management, drought management, and monitoring, horticultural development, precision farming, accurate formation, soil resource mapping, potential fishing area forecast, water development, climate impact on agriculture and so on.

The main and important application in agriculture through remote sensing is crop production forecasting. This is reliable and timely information of the area under each crop grown in the country at different aggregate scales like tehsil, district, state and country and the potential production forecasts long before the crop to take a policy dimension on many issues before export. Are very important -Port, MSP, storage facilities for transportation requirements etc. Distant time intervals in the number of remote sensing data and spectral bands provided in spatial format at different resolutions are ideally suited to make these estimates.

Seasonal agricultural operations are also monitored with the help of remote sensing. For this, remote sensing images obtained during the early stages of the crop sowing season are used to detect sowing progress, although individual crop growth may not occur. The area where the transplant has taken place can be seen differently than in the places where it is yet to begin. After a few weeks, it will be possible to estimate the total cropped area in the country, although how low each crop is is not possible at this stage. As crops reach maximum growth levels, such estimates are made possible by similar logic, it is possible to monitor harvesting operations using satellite data.

Agriculture provides humanity with food, fibers, fuel, and raw materials that are paramount for human livelihood. Today, this role must be satisfied within a context of environmental sustainability and climate change, combined with an unprecedented and still-expanding human population size, while maintaining the viability of agricultural activities to ensure both subsistence and livelihoods. Remote sensing has the capacity to assist the adaptive evolution of agricultural practices in order to face this major challenge, by providing repetitive information on crop status throughout the season at different scales and for different actors. We start this review by making an overview of the current remote sensing techniques relevant for the agricultural context. We present the agronomical variables and plant traits that can be estimated by remote sensing, and we describe the empirical and deterministic approaches to retrieve them. A second part of this review illustrates recent research developments that permit to strengthen applicative capabilities in remote sensing according to specific requirements for different types of stakeholders. Such agricultural applications include crop breeding, agricultural land use monitoring, crop yield forecasting, as well as ecosystem services in relation to soil and water resources or biodiversity loss.



Precision Agriculture

GIS-GPS-RS technologies are used in combination for precision farming and site-specific crop management. Precision farming techniques are employed to increase yield, reduce production costs, and minimize negative impacts to the environment. Using GIS analytical capabilities, variable parameters that can affect agricultural production can be evaluated.

These parameters include yield variability, physical parameters of the field, soil chemical and physical properties, crop variability (e.g., density, height, nutrient stress, water stress, chlorophyll content), anomalous factors (e.g., weed, insect, and disease infestation, wind damage), and variations in management practices (e.g., tillage practices, crop seeding rate, fertilizer and pesticide application, irrigation patterns and frequency).

Finally, we provide a synthesis of the emerging opportunities that should strengthen the role of remote sensing in providing operational, efficient and long-term services for agricultural applications.

1. Crop production forecasting: Remote sensing is used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the quantity of crop that will be produced in a given farmland over a given period of time.

2. Assessment of crop damage and crop progress: In the event of crop damage or crop progress, remote sensing technology can be used to penetrate the farmland and determine exactly how much of a given crop has been damaged and the progress of the remaining crop in the farm.

3. Horticulture, Cropping Systems Analysis: Remote sensing technology has also been instrumental in the analysis of various crop planting systems. This technology has mainly been in use in the horticulture industry where flower growth patterns can be analysed and a prediction made out of the analysis.

4. Crop Identification: Remote sensing has also played an important role in crop identification especially in cases where the crop under observation is mysterious or shows some mysterious characteristics. The data from the crop is collected and taken to the labs where various aspects of the crop including the crop culture are studied.

5. Crop acreage estimation: Remote sensing has also played a very important role in the estimation of the farmland on which a crop has been planted. This is usually a cumbersome procedure if it is carried out manually because of the vast sizes of the lands being estimated.

6. Crop condition assessment and stress detection: Remote sensing technology plays an important role in the assessment of the health condition of each crop and the extent to which the crop has withstood stress. This data is then used to determine the quality of the crop.

7. Identification of planting and harvesting dates: Because of the predictive nature of the remote sensing technology, farmers can now use remote sensing to observe a variety of factors including the weather patterns and the soil types to predict the planting and harvesting seasons of each crop.

8. Crop yield modelling and estimation: Remote sensing also allows farmers and experts to predict the expected crop yield from a given farmland by estimating the quality of the crop and the extent of the farmland. This is then used to determine the overall expected yield of the crop. GPS plays an important role in the creation of yield maps for specific types of crops. For instance, during harvests, GPS can be used to map out expected yields of a given crop from one piece of land based on the land characteristics and the seed characteristics.

9. Identification of pests and disease infestation: Remote sensing technology also plays a significant role in the identification of pests in farmland and gives data on the right pests control mechanism to be used to get rid of the pests and diseases on the farm.

10. Soil moisture estimation: Soil moisture can be difficult to measure without the help of remote sensing technology. Remote sensing gives the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.

11. Accurate planting: GPS also comes in handy when planning the planting of a given crop. Each seed has specific spacing and depth required depending on the soil type. Using GPS, it is easier to tell what spacing a given seed requires and to what depth the seed should be planted in order to return maximum yields.

12. Irrigation monitoring and management: Remote sensing gives information on the moisture quantity of soils. This information is used to determine whether a particular soil is moisture deficient or not and helps in planning the irrigation needs of the soil.

13. Soil mapping: Soil mapping is one of the most common yet most important uses of remote sensing. Through soil mapping, farmers are able to tell what soils are ideal for which crops and what soil require irrigation and which ones do not. This information helps in precision agriculture.

14. Soil sampling: Soil sampling is one of the most important uses of GPS in agriculture. It is important to know what type of soil is available on a given farmland as this will help in determining the type of crop to be planted on that farm.

15. Monitoring of droughts: Remote sensing technology is used to monitor the weather patterns including the drought patterns over a given area. The information can be used to predict the rainfall patterns of an area and also tell the time difference between the current rainfall and the next rainfall which helps to keep track of the drought.

16. Land cover and land degradation mapping: Remote sensing has been used by experts to map out the land cover of a given area. Experts can now tell what areas of the land have been degraded and which areas are still intact. This also helps them in implementing measures to curb land degradation.

17. Identification of problematic soils: Remote sensing has also played a very important role in the identification of problematic soils that have a problem in sustaining optimum crop yield throughout a planting season.

18. Crop nutrient deficiency detection: Remote sensing technology has also helped farmers and other agricultural experts to determine the extent of crop nutrients deficiency and come up with remedies that would increase the nutrients level in crops hence increasing the overall crop yield.

19. Reflectance modelling: Remote sensing technology is just about the only technology that can provide data on crop reflectance. Crop reflectance will depend on the amount of moisture in the soil and the nutrients in the crop which may also have a significant impact on the overall crop yield.

20. Determination of water content of field crops: Apart from determining the soil moisture content, remote sensing also plays an important role in the estimation of the water content in the field crops.

21. Crop yield forecasting: Remote sensing technology can give accurate estimates of the expected crop yield in a planting season using various crop information such as the crop quality, the moisture level in the soil and in the crop and the crop cover of the land. When all of this data is combined it gives almost accurate estimates of the crop yield.

22. Flood mapping and monitoring: Using remote sensing technology, farmers and agricultural experts can be able to map out the areas that are likely to be hit by floods and the areas that lack proper drainage. This data can then be used to avert any flood disaster in future.

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How Do Plants Feel Stress?

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Introduction

Plants are sessile organism which is easily exposed to various abiotic and biotic stresses, such as high or low temperature, drought, salinity and pests and diseases (Bita and Gerats, 2013). These stresses can hamper directly or indirectly the growth, development, and plant productivity. Plants possess numerous adaptive, avoidance, or acclimation mechanisms in order to cope with different stress conditions.

However, this stress tolerance mainly depends upon how signals are perceived and transduced in plants. Plants generally had four well developed sensor mechanism which trigger stress responses, when exposed to any sort of stress.

Mechanism

The primary sensor found in plants for perception of any stress conditions can be plasma membrane, histone sensor of nucleus, cytosol and two unfolded protein sensors present in endoplasmic reticulum of plants (Mittler *et al*., 2012).

These signals are then further decoded by many secondary messengers such as reactive oxygen species (ROS), MAP kinase, calcium ions and inositol phosphates and phytohormones which then results in different signalling pathways (Liu *et al.,* 2016).

1. Ca^{2+} signalling pathways: Plasma membrane is the most common and easily available target for any such changes occurring in plant's surroundings. These changes adversely affect both composition as well as physical state of plasma membrane, influencing the membrane fluidity and further affecting the transfer of calcium ions across the membrane (Saidi *et al*., 2009).

This change in inward flux of calcium acts as sensors of plants to predict the change in its surroundings (Goraya *et al*., 2017). Ca^{2+} ions further initiate the phospho - protein cascades thereby targeting the major stress responsive genes or transcription factors resulting in tolerance against stress situations (Sajid *et al.,* 2018).

2. G protein-mediated signalling: G-proteins are another very crucial secondary messenger which had a direct role in providing stress tolerance in plants. The coupling of G-proteins leads to the release of secondary messengers via effectors such as ion channels or enzymes (Wang *et al.,* 2017).

G protein subunits along with phospholipases (PLCs and PLDs) results in cascade of many phospho - protein reactions further their expression shows modifications during severe dehydration, high salt, and during cold acclimation and ABA signalling (Tuteja, 2009).

3. Kinase signalling pathways: Mitogen-activated protein kinases (MAPKs) are located mainly in cytosol and nuclear region of plants and are directly involved in the signalling of multiple environmental stresses (Jean and Heribert, 2018).

After the detection of environmental changes at the cell surface, MAPKs causes phosphorylation and dephosphorylation of substrates resulting in transcriptional reprogramming and post-translational modification (PTM) which finally results in the regulation of proteins and providing tolerance against stress.

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COVID-19: A Briefing

Article ID: 31054

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Introduction

The coronavirus disease (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is also known as the COVID-19 virus. In January 2020, the WHO declared the outbreak a Public Health Emergency of International Concern, and by March 2020, the WHO characterized the outbreak as a global pandemic. The COVID-19 virus has zoonotic importance, which means it is transmitted from animals to humans and has since spread between humans. It is primarily spread through saliva droplets or discharge from the nose.

What is Genetic Material of COVID-19?

Coronavirus (SARS-CoV-2), which causes COVID-19, the genetic material is only RNA. Once the virus, goes inside cell, the virus uses its genetic material — RNA to grow and multiply inside the cells.

Epidemiology and Pathogenesis

All ages are susceptible. Infection is transmitted through droplets by coughing and sneezing by symptomatic patients. Asymptomatic patients can also spread the disease.

The virus can remain viable on surfaces for days in favourable atmospheric conditions but are destroyed in less than a minute by common disinfectants like sodium hypochlorite, hydrogen peroxide etc. Infection is acquired either by inhalation of these droplets or touching surfaces contaminated by them and then touching the nose, mouth and eyes. Studies have identified angiotensin receptor 2 (ACE_2) as the receptor through which the virus enters the respiratory mucosa.

The presence of this virus is also found in human faecal matter and contaminated water supply and subsequent transmission via aerosolization/feco-oral route is also hypothesized. As per current information, transplacental transmission from pregnant women to their foetus has not been described. However, neonatal disease due to post-natal transmission is described. The incubation period varies from 2 to 14 d [median 5 d].

Clinical Features

The common clinical features are fever (not in all), cough, sore throat, headache, fatigue, myalgia and breathlessness. Conjunctivitis has also been described. In a subset of patients, by the end of the first week the disease can progress to pneumonia, respiratory failure and death. This progression is associated with extreme rise in inflammatory cytokines including IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1A, and TNFα. The median time from onset of symptoms to dyspnoea was 5 d, hospitalization 7 d and acute respiratory distress syndrome (ARDS) 8 d.

Recovery started in the 2nd or 3rd wk. The median duration of hospital stays in those who recovered was 10 d. Adverse outcomes and death are more common in the elderly and those with underlying co-morbidities (50–75% of fatal cases). Fatality rate in hospitalized adult patients ranged from 4 to 11%.

Different Diagnostic Testing for COVID-19

A key part of containing the outbreak caused by diseases, such as COVID-19, is diagnostic testing. One of the fastest and most accurate detection methods is real time reverse transcription–polymerase chain reaction (real time RT–PCR).

RT-PCR

Reverse transcription polymerase chain reaction (RT-PCR) is a laboratory technique combining reverse transcription of RNA into DNA (in this context called complementary DNA or cDNA) and amplification of specific DNA targets using polymerase chain reaction (PCR). It is primarily used to measure the amount of a specific RNA.

For RT-PCR test, a simple swab taken from inside a person's throat or nose. The coronaviruses have RNA, and this RNA present in swabs from patients contain a minute quantity of RNA, which is not adequate for the testing process.

The RNA is reverse transcribed to DNA using a specific enzyme. Then additional short fragments of DNA are added that are complementary to specific parts of the transcribed viral DNA. If the virus is present in a sample, these fragments attach themselves to target sections of the viral DNA. Some of the added genetic fragments are used for building DNA strands during amplification, while the others are used for building the DNA and adding marker labels to the strands, which are then used to detect the virus. The RT-PCR test is also the most expensive of all those used for Covid-19. Initially, the cost of the test was capped at Rs 4,500 by the ICMR.

Antigen Testing

It is the 'spike protein' present on the surface of the coronavirus that facilitates its penetrance into the human cell. Nasal swab is collected for this test, which is then immersed in a solution that deactivates the virus.

On a test strip, a few drops of this solution are then put on. This has to be done within an hour of the immersion of the swab in the solution. The test strips contain artificial antibodies, which binds to coronavirus proteins. If a person is infected with coronavirus, the test lines will appear on the paper strips within 15 minutes. If a person tests negative through antigen testing, they still need to get an RT-PCR test done for confirmation. If a person tests positive, however, a confirmation RT-PCR is not required. Antigen tests are much cheaper than the RT-PCR, and cost Rs 450 each.

Antibody Tests

Antibody tests are also known as serological tests. Antibodies are naturally produced by the body's immune system to fight off infections. Antibody tests cannot be used to diagnose Covid-19, but can reveal whether a person was recently exposed to the virus.

For the antibody test, a few drops of blood are placed on a cassette or cartridge that contains the SARS-CoV-2 proteins. If the blood samples contain antibodies, they will immediately bind to the viral proteins. The positive result is indicated in the form of lines, like a home pregnancy test. Antibody tests can be useful to carry out surveys to check whether a population has been exposed to the virus.

Preventive Measures for COVID-19

1. Clean your hands with soap and water, or an alcohol-based hand rub. Cover nose and mouth with bent elbow or a tissue while coughing or sneezing.
2. Don't touch your eyes, nose or mouth.
3. Stay home if you feel unwell.
4. Wear a mask and Maintain a safe distance from anyone who is coughing or sneezing.

Treatments

There is still no specific antiviral treatment for COVID-19 similar to MERS-CoV and SARS-CoV. Isolation and supportive care including oxygen therapy, fluid management, and antibiotics treatment for secondary bacterial infections is recommended . Currently, no vaccination is available for this disease.

Conclusion

The current COVID-19 pandemic is clearly an international public health problem. Due to rapid transmission, countries around the world should increase attention into disease surveillance systems. There is no anti corona virus vaccine to prevent or treatment, but some supporting therapy work. More research in to this area is needed to fight with this global pandemic. Till then, social distancing and other preventive measures are best to combat this disease.

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Khaira Management: A Way to Improve Paddy Productivity

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Introduction

Paddy (*Oryza sativa* L.) is one of the most important staple food crops, feeding more than half of the world population. To feed present population, we need to improve the production per unit area. Even though high yielding and input responsive varieties are available, a large yield gap exists between the farmers' fields and research stations in developing countries. In addition to adequate irrigation water and macro nutrients balanced supply of micronutrients is vital for overcome this yield gap. After nitrogen (N), phosphorus (P) and potassium (K), widespread zinc (Zn) deficiency has been found responsible for yield reduction in paddy. Globally, more than 30 per cent of soils are low in plant-available Zn. Compared with legumes; cereals are generally more prone to Zn deficiency leading to a significant reduction in grain yield and nutritional quality. Besides, frequency of Zn deficiency is greater in paddy than other crops. Hence, *khaira* disease due to Zn deficiency is considered one of the most important nutritional stresses limiting irrigated paddy production in Asia at present.

Zinc

Zn is one of the eight essential micronutrients. It is needed by plants in small amounts, but yet crucial to plant development. In plants, zinc is a key constituent of many enzymes and proteins. It plays an important role in a wide range of processes, such as chlorophyll production and membrane integrity. Thus, Zn deficiencies affect plant colour and turgor. Zn is only slightly mobile in the plant and quite immobile in soil.

Soil Conditions that Can Result in Zinc Deficiency Include

1. Low availability of Zn in the soil.
2. Low or organic matter content of the soil.
3. Restricted root growth due to hardpan, high water table etc.,
4. High soil pH.
5. Calcareous soils or limed soils.
6. Low soil temperature.
7. Anaerobic and waterlogged conditions.
8. High phosphorus level in the soil.

The Important Symptoms of *Khaira* Disease Due to Zn Deficiency

1. Burning appearance of plants.
2. Reduction in growth.
3. Reduction in yields.
4. Symptoms appear between 2 to 4 weeks after transplanting in case of paddy.
5. Dusty brown spots on upper leaves of stunted plants.
6. Uneven plant growth and patches of poorly established hills in the field, but the crop may recover without intervention.
7. Tillering in paddy decreases and can stop completely and time to crop maturity increases under severe Zn deficiency.
8. Increase spikelet sterility in rice.
9. Chlorotic midribs, particularly near the leaf base of younger leaves.
10. Leaves lose turgidity and turn brown as brown blotches and streaks appear on lower leaves, enlarge, and coalesce.
11. White line sometimes appears along the leaf midrib.

12. Leaf blade size is reduced.

Management

1. Spread zinc sulphate ($ZnSO_4$) fertilizer uniformly all over the nursery seedbed.
2. Drench seedlings or pre-soak seeds in 2-4% $ZnSO_4$ suspension.
3. Apply 12.5 kg $ZnSO_4$/ha, if green manure (6.25 t/ha) or enriched Farm yard manure.
4. Apply 25 kg of $ZnSO_4$along with 50 kg sand as a basal before transplanting.
5. Apply 5-10 kg Zn/ha as Zn sulphate, apply 0.5 – 1.5 % $ZnSO_4$/ha as a foliar spray at tillering (25-30 DAT), 2-3 repeated applications at intervals of 10-14 days.
6. Zn chelates (e.g., Zn-EDTA) can be used for foliar application.

Conclusion

Zn is very essential plant nutrient for paddy. It is deficient in all parts of the globe with different types of soils. Under these conditions application of Zn fertilizer is necessary for healthy crop growth and higher yields. Soil and foliar applications of Zn fertilizers are recommended for correcting paddy *khaira* disease.

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Mechanism of Variability in Plant Pathogenic Bacteria

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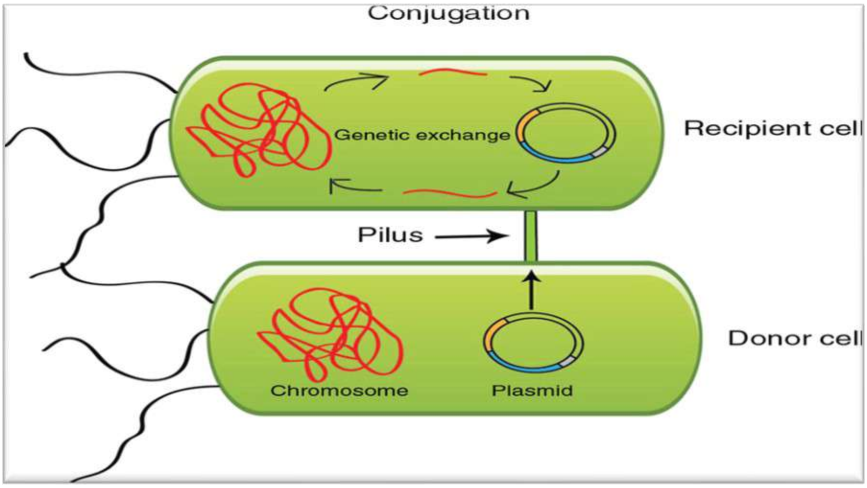
Introduction

New pathotypes develop with the presentation of new kind of assortment and mixtures to our yields. Fast and exact recognition of new harmfulness will help plan technique for creating safe cultivars specifically area and will likewise give a base to reproducing cultivars with sturdy obstruction or planning methodologies for the drawn-out administration of significant ailments. Understanding the job pathogens play in forming the hereditary structure of plant populaces and networks requires a comprehension of the pathogens 'decent variety, their starting points, and the developmental exchange that happens among pathogens and their hosts.

Bacterial Conjugation

Bacterial conjugation is the exchange of hereditary material between microscopic organisms through direct cell to cell contact, or through an extension like association between the two cells. Bacterial conjugation is frequently mistakenly viewed as what might be compared to sexual propagation or mating since it includes some hereditary trade. So as to perform conjugation, one of the microscopic organisms, the benefactor, must play host to a conjugative or mobilizable hereditary component, regularly a conjugative or mobilizable plasmid or transposon (Ryan and Ray, 2004). Most conjugative plasmids have frameworks guaranteeing that the beneficiary cell doesn't as of now contain a comparative component.



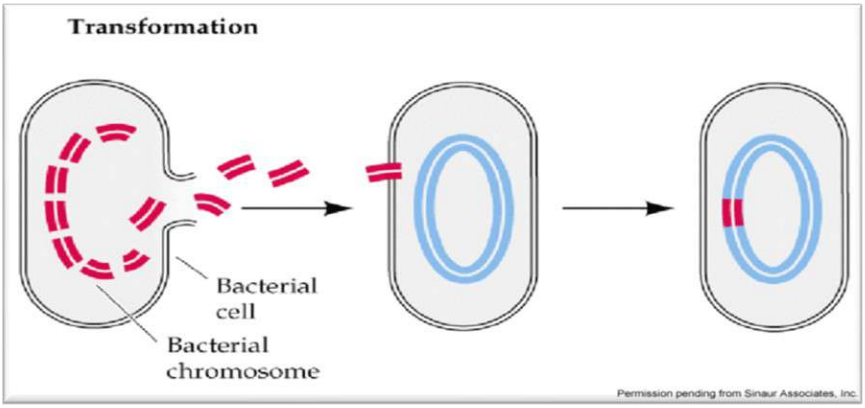
There are two classes of conjugative plasmids as for move:

1. Self-transmissible plasmids, which encode all the qualities important to elevate cell-to-cell contact and move of DNA
2. Mobilizable plasmids, which don't advance conjugation, yet can be productively moved when present in a cell that contains a self-transmissible plasmid.

The self-transmissible plasmids are typically enormous. They code for 2030 proteins explicitly required for bacterial cells to shape a mating pair, build up a little pore, and move plasmid DNA through the pore from one cell to the next. The hereditary data moved is frequently useful to the beneficiary cell. Advantages may incorporate anti-infection opposition, other xenobiotic resistance, or the capacity to use another metabolite. Such advantageous plasmids might be viewed as bacterial endosymbionts. Some conjugative components may likewise be seen as hereditary parasites on the bacterium, and conjugation as a system that was advanced by the versatile component to spread itself into new has.

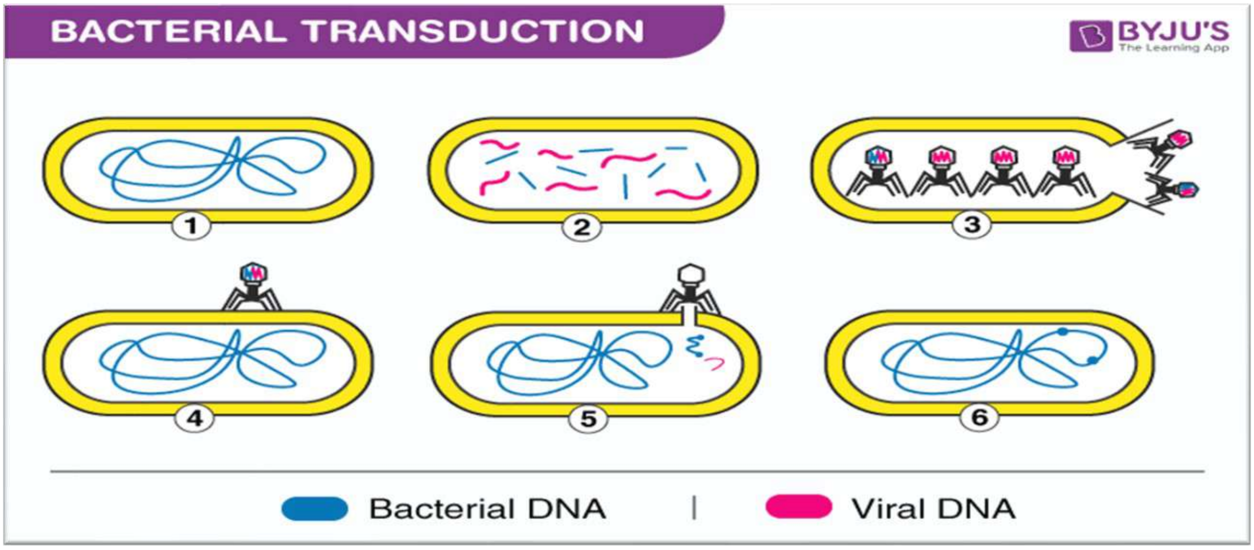
Transformation

The take-up of bare DNA atoms and their steady upkeep in microscopic organisms is called change. The marvel was found in 1928 by Griffith. Microscopic organisms have grown profoundly concentrated capacities that will tie DNA pieces and transport them into the cell. Skill alludes to the condition of having the option to take up exogenous DNA from the earth. There are two distinct types of capability: characteristic and fake. A few microorganisms (around 1% everything being equal) are normally fit for taking up DNA under research center. Such species convey sets of qualities indicating the reason for the hardware for bringing DNA over the phone's layer or films. Fake fitness isn't encoded in the cell's qualities. Rather it is instigated by research facility methodology in which cells are latently made porous to DNA, utilizing conditions that don't typically happen in nature (Kunik et al., 2001).



Transduction

Bacteriophages can move qualities starting with one bacterial cell then onto the next, a procedure known as transduction. There are two assortments of bacteriophage-interceded quality exchange: summed up transduction and particular transduction.



Summed up transduction happens because of the lytic cycle. During the time spent bundling bacteriophage DNA, the head structures of certain bacteriophages will bundle irregular parts of the bacterial chromosome. In this manner, the lysate contains two sorts of particles that contrast just in the sort of DNA they contain. The majority of the particles contain viral DNA. When these infuse their DNA, the lytic cycle will rehash and new bacteriophage particles will be delivered. A little division of the particles, perhaps as high as 1%, contain sections of the bacterial chromosome instead of the bacteriophage DNA. At the point when one of these particles infuses its DNA into the cell, the cell isn't murdered.

The recently presented DNA contains just bacterial qualities and is allowed to recombine with the chromosome. Some transducing bacteriophages can present 100-200 kilobases of DNA. Since the bacterial sections that are bundled are basically arbitrary, for all intents and purposes any bacterial quality of the bacterial chromosome can be transduced (subsequently, the expression "summed up" transduction). Whole plasmids can be transduced by phages. A few plasmids, strikingly those encoding anti-infection obstruction in staphylococci have advanced signs to permit proficient bundling by phage particles and resulting move by transduction. Studies on spread of anti-microbial opposition have uncovered summed up transduction to be a noteworthy instrument of quality exchange in nature. Specific transduction requires a mild bacteriophage. In this class of transduction, a bacterial quality becomes related with the bacteriophage genome (for example by recombination). At the point when such a bacteriophage lysogenizes another bacterial host, it carries with it the related bacterial quality.

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Ergonomic Aspects Related to Farm Workers

Article ID: 31057

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Ergonomics (also known as Human Engineering) is still a new concept in Indian agriculture. It is necessary to create greater awareness about its contribution in improving the quality of life of workers and operators. The development of more complex machines and the increasing awareness about occupational health and safety aspect have made ergonomics and product safety the dominant consideration in design of tractors and farm equipment. It is important to know how to increase the efficiency of human power application in agricultural operation by utilizing ergonomic principles without jeopardizing the health and safety of the workers so as to get maximum benefits.

Ergonomics is defined as the study of the design of a workplace, equipment, machine, tool, product, environment, and system which takes into consideration human being's physical, physiological, biomechanical, and psychological capabilities and optimizes the effectiveness and productivity of work systems while assuring the safety, health, and wellbeing of the workers (Fernandez and Marley, 1998). In simple way, the aim of ergonomics is to fit the job to the worker, not the worker to the job.

A large percentage of the work force in the world is associated with agriculture and related trades. Agriculture has undergone many changes throughout the ages with rapid industrialization and increased population. The farming system continues to utilize manual power, animal power and mechanical power but the utilization of power operated agricultural machinery and implement increased day by day and is capable for doing better quality of field operation. With high degree of mechanization of farm machinery, a safe comfortable environment for the operators is important consideration for getting productivity and customer satisfaction are to be enhanced. Farm mechanisation in India is in the initial stages, with the mechanisation level ranging from 40–45%, which is very low compared to that in developed economies, where mechanization has reached beyond 90% (World Bank Open Data 2019, Feder Unacoma, PwC) analysis India's farm equipment market is 7% of the global market, with more than 80% of the value contribution coming from tractors. Even though the growth of mechanization has been slow, the overall food-grain production in India grew from over 50 million tonnes in 1950–51 to 283 million tonnes in 2018–19. The adoption rates of farm equipment have increased as indicated by the sales of tractors sale and the rise in farm power availability (FPA) in the recent past. Domestic sales of tractors have increased from 3 lakh units in FY09 to 7.8 lakh units in FY19, registering a phenomenal CAGR of 10%.4 In addition to the impressive domestic sales volumes, India has exported 92,095 units of tractors during FY19. Average FPA in India has also risen from 1.1 kW/ha in 1995–96 to 2.02 kW/ha in 2017–18. India is also one of the largest manufacturers of equipment such as tractors, harvesters and tillers (Anon, 2019).

Need of Comfort

Tractor is the main prime mower in the agriculture works. Operating a tractor imposes lots of physical and mental stress upon the operator. The operator needs more comfort during various agricultural operations because they have to bear more noise, dust, and vibration hazards as compare to other peoples. With constant need to improve operator's comfort and safety, progress have been made in subsidizing noise, dust and the emphasis is being diverted to reduce the ride vibration levels. Farm workers functioning as the drivers of agricultural tractors are exposed to noise, dust and whole body vibration which may be extremely severe depending upon such factors as attached farm equipment, speed of travel, condition of fields etc. working under such an environment results in human fatigue, which contributes driving related accidents and others health hazards. Physical agents are forms of energy that can harm the body when exposure takes place. It includes mechanical energy, which impact on the body from noise, vibration and also from dust when working under field's conditions. Others physical agents include hot and cold temperatures which can affect the body's normal internal temperature. They may be specific part of production process or an unwanted by products. Exposure to excessive noise, dust, vibration, extreme temperature and radiation can lead to acute or chronic health effect. Physical working capacity diminishes with age and sex. In the same age and sex group also, there are individual variations due to the weight, nutrition etc. When a person dose physical work, he has to stop the work either due to cardio-respiratory limitations, muscular fatigue or others kinds of problems on his body parts (Saha et al.,1979).

Status of Noise, Dust and Vibration

Noise: Noise is unwanted sound. Sound is a form of mechanical energy caused by the vibration of the air. The ear is a remarkable organ. The normal range of hearing begins at approximately 0 decibel, a level at which a person with excellent hearing is able to detect a sound. Typically, a person begins to identify sounds when a level of 10 to 15 dB is reached; this is the threshold of hearing. The other end of scale is known as the threshold of pain (140dB), or the point at which the average person experiences pain. In assessing noise, a special measure called "dBA" indicates damage to hearing. The dBA rating is provided for many pieces of agricultural equipment. The higher the dBA number, the greater the risk of damage to hearing.

Effects of noise on health: Excessive noise has the potential to impair hearing, or even destroy it. Noise may also put stress on other parts of the body causing the abnormal secretion of hormones, the tensing of muscles and other health effect. Sleepleness and fatigue are among the symptoms. Noise also interferes with communication, which can affect normal function including job performance and safety. The specific health effect depends on the types of noise involved and the duration of exposure (Solecki, 1998).

Dust: Modern agriculture is based on highly efficient equipment, especially high-speed, powerful tractors and agricultural machines. Tractors with mounted and trailed implements allow the mechanization of many agricultural operations. Use of tractors allows farmers to accomplish the main tillage and care of plants in the optimum time without major manual labour. Dust is often unavoidable in agricultural work. As a rule, loosening of the soil results in the formation of dust. The nature of the dust in the air is variable, and depends on meteorological conditions, season, kind of work, type of soil and so on. Dust concentration due to tractor operator can vary from a few mg/m3 to hundreds of mg/m3 (Kundiev, 1983). Dust may contain dried fecal material, fertilizers, fungal spores, mold, pesticides, and herbicides. During land development and tillage operation, soil dust causes a lot of irritation to the tractor operator. The exposure limit as prescribed by the Swedish National Board of Occupational Safety and Health are 10 mg/m3 and 5 mg/m3 for normal dust and organic dust, respectively.

Effects of dust on health: There is a strong need to generate data and then to take corrective measures to safeguard the health of worker engaged in agricultural activities. Exacerbation of asthma by specific allergens and nonspecific causes has been associated with airborne dust. Several farm antigen exposures can trigger asthma, and they include pollen, storage mites and grain dust. Mucous membrane inflammation is a common reaction to airborne dust in individuals with allergic rhinitis or a history of atopy. Plant parts in grain dust appear to cause mechanical irritation to the eyes, but endotoxin and mycotoxin exposure may also be associated with the inflammation of the eyes, nasal passages and throat. Farmers may be exposed to several different substances that can cause acute pulmonary responses (Wattie,1990). Polluted air reduces the capacity of red blood cells to carry oxygen to the body. It promotes and aggravates heart, blood and other diseases.

Vibration

A particularly important source of danger to which a worker is exposed in machine operation is mechanical vibration. Low frequency ride vibrations in tractor operation affect work output and operator health. Vibration is nothing but it is an oscillation of mass about a 19 fixed point. When a body comes in contact with mechanical sources of vibration the tissues of the body become displaced from their resting position.

Effects of vibration on health: Whole body vibration is transmitted to the body through the supporting surfaces such as the feet, buttocks or back. There are various sources of whole-body vibration such as standing on a vibrating platform, floor surface, driving and construction, manufacturing and transportation vehicles. The health effect of whole-body vibration on tractor driver are abdominal pain, general feeling of discomfort including headaches, chest pain, nausea, loss of equilibrium (balance), muscle contractions with decreased performance in precise manipulation tasks, shortness of breath, influence on speech, degenerative spinal change, lumbar scoliosis etc. The heavy equipment operators and drivers are particularly at risk for accident and injury due to the above factors (Taylor, 1974).

Practical experiences and the literature reveal that the human body is strained much more during driving the tractor under different field conditions and at the same time he exposed to noise, dust, vibration, exhaust fumes, rain, and sunshine, etc. Tractor drivers have lots of problem like pain in shoulder, lower back and buttocks due to the whole-body vibration and postural discomfort. Most of the tractor drivers have a temporary threshold shift in hearing due to tractor noise. This exposure to noise could also be a slow and painless way for causing total hearing loss. The health concerns associated with the use of tractor has not been properly documented in our country. It is necessary to study the problem related with tractors operator who is working under different field conditions and it would be helpful in obtaining a proper trade-off between the human health and engineering.

Summary

Good ergonomics would be helpful in many ways such as workers will feel good about their task, productivity can be increased, Health and safety can be improved and they also got the job satisfaction. Workplace without concerning ergonomics cause fatigue as well as disease common musculoskeletal disorders. that efficiency of the same task can be improved by involving ergonomics (Agravat et al., 2019). It means to design the worker friendly devices/machines ergonomics is the key.

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Fight COVID–2019 with Healthy Diet

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The COVID-19 pandemic has turned the world's attention to the immune system, the body's defence force against disease-causing bacteria, viruses and other organisms that we touch, ingest and inhale every day. Good nutrition is most crucial to ensure body's immune system, as infections such as the current COVID takes a huge toll on the body especially when coping with symptoms like high fever, cough etc. During these conditions, the body needs extra energy and nutrients, which have to be provided by consuming a healthy diet. It is important to note that "no foods or dietary supplements can prevent COVID-19 infection", but maintaining a healthy diet will ensure a strong immune system, to reduce the effect of infection on the body.

In situations where strict lockdown and physical distancing regulations are in place, the governments have also ensured measures towards protected access to food, and reduce disruptions in food chains and supplies. Hence, it is still possible to purchase and consume a healthy diet during this COVID crisis. Also, the situation is leading to consumption of more of local foods, seasonal foods and less of processed foods. However, diets can vary greatly from place to place based on multiple factors including eating habits, culture, availability, accessibility and affordability. Yet, when it comes to good nutrition choices, there is a lot that everyone knows about selecting the right combination of available foods to attain healthy diet regardless of where and how we live. Given below are few recommendations to ensure good nutrition during COVID 2019.

1. Eat a variety of foods within each food group and across all the food groups to ensure adequate intake of important nutrients.

2. Eat plenty of fruits and vegetables. Fresh fruits and vegetables provide lots of vitamins and minerals like folate, vitamin A, E, K, C and B vitamins along with fibre that we need for good health.

3. Include whole cereals, millets and pulses in daily menu. Consume handful of nuts if feasible. Use healthy fat combinations such as sesame / groundnut / coconut with sunflower / safflower / soya bean / rice bran oils to ensure a good ratio of poly and monounsaturated fatty acids.

4. Continue to practice good food hygiene. Because of COVID-19 pandemic, food safety is of greatest concern. COVID-19 is a respiratory virus and is not a food-borne disease. There is no real-time scientific evidence that the disease can be spread through contact with the food purchased, though laboratory testing under controlled conditions proved so. However, practicing food safety is of prime importance, which can be achieved by keep the food clean; separating raw and cooked foods; cooking food thoroughly; keeping food at safe temperatures; and using safe water and raw materials.

5. Staying well hydrated, mainly through drinking ample amounts of plain water (Approximately 6-8 glasses/day) helps our immune system. Drinking plain water instead of sugar- sweetened beverages, helps reduce risk of consuming too many calories for maintaining a healthy weight.

6. Consume herbal decoctions made with a mix of herbs and spices like basil leaves, cinnamon, pepper, ginger, turmeric, mint leaves and honey. Herbal steam inhalations also help in keeping the nasal and throat cavities free from symptoms of infection.

7. Current COVID lockdown situations can lead to consumption of comfort foods high in fat, sugar, salt and calories, that are very palatable but hazardous to health. Staying at home and overconsumption of energy dense foods can lead to various health ailments in the long run. Hence, avoid eating too much of these ingredients not only as comfort foods, but across everything consumed. Consumers are advised to check food labels to practise limited purchase and consumption of these ingredients.

8. Limit consumption of alcohol. Alcohol based beverages have little nutritional value, and are high in calories, and excess consumption is linked to numerous health problems. If alcohol is to be consumed, it should at moderation only.

Above mentioned recommendations if followed may help improve the immune system and help to reduce inflammation. Following are few more important practices to be followed to ensure better management at household level.

1. Panic buying is a critical concern observed during this COVID situations. People are worried that food might be running out from supermarket shelves. But many retailers all over India are working to overcome this challenge by restocking the shelves, and ensuring the food supply on regular basis. Small farmers and vendors are selling perishable foods directly to consumers. Hence it is suggested not to buy more than the family needs to reduce the risk of unnecessary food waste.

2. It is also important to reduce household-level food waste, by practising few tips like cooking smaller portions, utilisation of leftovers, buying smartly, avoiding storage of foods in refrigerators, practicing first in - first out, understanding dates and food labels on foods, turning unused waste into compost.

With the lockdown situation and home cooking making a resurgence, coupled with children at home, this time should be utilized to orient them with lifelong habits that support a healthy diet. It is not just diet; other lifestyle factors are also critical part of maintaining wellbeing and a healthy immune system. A healthy lifestyle including additional strategies like not smoking; regular physical activity; adequate sleep; and coping with stress, will all contribute towards a healthy immune system.

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Ways and Means to Improve Nutrient Use Efficiency in Rainfed Pulses

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Introduction

India is the largest producer, importer and consumer of pulses in the world, being an inseparable ingredient in the diet of the vast majority of population. Since time immemorial, pulses have been cultivated on marginal ad sub-marginal lands, which are characterized by poor soil fertility and moisture stress, and consequently their yield potentials have not been realized. Further, more than 90 per cent areas under pulses are rainfed. Drought and heat stress may reduce seed yields by 50%, especially in arid and semi-arid regions. Pulses are predominantly grown under resource poor and harsh environments frequently prone to drought and other biotic and abiotic stresses. As a result, the productivity of the pulses in India is quite low even less than 1 tonne per hectare compared to wheat and rice. Among the many reasons attributed for its lower productivity, lower yield potential, cultivation in marginal lands, below average management efforts, non-availability of quality seeds, prevalence of higher temperature during its growing environment, susceptible to pod borers and wilt diseases are important. To increase the pulse production, rainfed rice fallow lands offer a huge potential niche for pulses production. Farmers are often pressed to use inadequate quantity of manures and fertilizers to rainfed pulses for economic reasons. Therefore, there is a great scope of increasing the production in rainfed areas through efficient nutrient management.

Major Nutrient Management Issues in Rainfed Pulses

1. Inadequate and unbalanced use of fertilizers.
2. Emerging multi-nutrient deficiencies particularly of secondary and micronutrients.
3. Low fertilizer use efficiency.
4. Declined crop response ratio.

Crop responsiveness to fertilizer is maximized and environmental impact of fertilizers reduced, and often eliminated, when crops are managed for improved nutrient use efficiency through best management practices which balance production inputs at the appropriate levels.

Nutrient Requirements of Pulses

Of the 16 essential elements required for the nutrition of plants, pulses specially need adequate amount of P, Ca, Mg, S and Mo. Phosphorus is required for proper root growth and growth of rhizobia. Calcium and magnesium are required to stimulate growth and to increase the size of the nodules, pod formation and grain setting. Sulphur is required for nodulation and protein synthesis, molybdenum for nitrogen fixation and assimilation and boron for reproduction.

Inadequate Use of Fertilizers

Pulses remove good amount of nitrogen and phosphorus along with other nutrients from soil. When N supply from soil becomes limited, they meet their N requirement by symbiotic fixation. One tonne of legume biomass removes nearly 30-50 kg N, 2.7 kg P, 12-30 kg K, 3-20 kg Ca, 1-5 kg Mg, 1-3 kg S, 200-500 g Mn, 5 g B, 1 g Cu and 0.5 g Mo. Pulses require a high amount of P and Ca. Besides, they have a greater demand for micro nutrients such as Mo, B, Co, Cu and Zn. Co and Mo are particularly beneficial for nodulation.

Pulses have the unique ability to trap atmospheric nitrogen in root nodules in association with rhizobium bacteria and consequently only a small amount of nitrogen (20 kg/ha) as starter dose is recommended. The process of nitrogen fixation peaks at 2 - 3 weeks before the onset of flowering and then starts degenerating. The scarcity of soil moisture further restricts biological nitrogen fixation. Consequently, pulses in rainfed areas often experience nitrogen deficiency at the peak reproductive stages viz., at flowering and pod formation. Phosphorus deficiency in soils is wide spread and most of the pulse crops have shown good response to 20–60 kg P_2O_5/ha depending upon nutrient status of soil, cropping system and moisture availability. Method of supplying this nutrient need to be further explored for increasing the efficiency of phosphorus application. Super phosphate is recommended and is costly and hence to reduce the cost, alternate sources like rock phosphate can be used. The efficiency of rock phosphate can be increased by bio-amending with FYM and *phosphobacteria*.

Placement of phosphatic fertilizers and use of bio-fertilizers enhance the efficiency of applied as well as native P. Foliar nutrition of some micronutrients proved quite effective. The amount and mode of application is determined by indigenous nutrient supply, moisture availability and genotypes. Balanced nutrition is indispensable for achieving higher productivity. At the same time, in view of increasing nutrients demand, there is immense need to exploit the alternate source of nutrients viz., organic materials and bio-fertilizers to sustain the productivity with more environment friendly nutrient management systems.

Lack of Organic Manure Application

Intensive cultivation of pulses without addition of organic matter resulted in multiple nutrient deficiency especially for nutrients like zinc and sulphur. Declining trend in the addition of organic matter is a serious concern in general and in particular for pulse crop production. With the reduced generation of FYM in Indian farms, other methods of addition like residue management and incorporation of green manures needs attention in maintaining soil health and improving the productivity. There is a need to deliver in-situ pulse crop residue management for improving soil organic matter and soil fertility.

Nutrient Deficiency Symptoms

When pulse plants are not supplied with adequate amount of these nutrients, they develop deficiency symptoms.

Nitrogen	Stunted growth, small sized seeds, pale green coloured leaves, premature yellow colouring of leaves, shortened crop duration.
Phosphorus	Reduced growth dark green or bluish green leaves
Potassium	Pale green coloured chlorotic leaves, chlorotic symptoms appearing on the margin and in between veins, necrotic spotted veins, plants susceptible for diseases
Magnesium	Interveinal chlorosis on older leaves, pale necrotic spots, leaves prematurely shed
Sulphur	Similar to N deficiency symptoms, reduction in yield
Manganese	Interveinal chlorosis of the terminal young leaves
Zinc	Reduction in size of young leaves, thick brittle leaves forming upward cups, brownish orange chlorosis of the older leaves.

Nutrient Management Technologies for Pulses Involve

1. Integrated nutrient management with major and micro nutrients.
2. Foliar nutrition of pulses.
3. Balanced nutrition.

Input Supply (Micronutrients and Fertilizer Application)

Legumes fix atmospheric nitrogen. However, availability of quality of *Rhizobium* inoculum is limiting. Phosphorous is becoming a limiting macro-nutrient which will affect the pulses production. A common difficulty in recovering P from the soil is that it is not readily available to plants because P reacts with aluminium, iron and calcium in the soil to form complexes. These nutrients are essentially insoluble resulting in very little movement of P in the soil solution, and none of the complexes can be taken up directly by roots. The use of phosphate solubilizing bacteria (strains from the genera of *Pseudomonas*, *Bacillus* and *Rhizobium* are among the most powerful P solubilizers) as inoculants simultaneously increases P uptake by the plant and thus crop yields.

Soils in many states in India are deficient in micro-nutrients such as boron, sulphur, zinc and magnesium. Application of small quantities (0.5 to 2 kg ha^{-1}) has resulted in 40-120% increase in grain yield. Hence, making these micro-nutrient fertilizers easily available to smallholder farmers in remote areas will go a long way in enhancing productivity and production of pulses. **I**mproved management practices (including application of micronutrients) have increased the yield by 31-57% in green gram, 26-38% in pigeon pea and

27- 39% in chickpea. Similarly, in black gram and green gram grain yields increased by 33-42% in response to improved management when compared to control.

Foliar Spray of Nutrients

There is no possibility of basal application of fertilizers for rice fallow pulses, since the pulses are sown prior to harvest of rice crop. Therefore, fertilizer incorporation becomes impossible. Hence, foliar fertilization with the spraying of 2% DAP and 1% KCl is recommended at 30 and 45 DAS of the pulse crop both in rainfed and irrigated conditions. To mitigate the drought effect on the pulse crop, cycocel spray at 100 ppm (100 mg/lit) is recommended. Cycocel spray will enhance the root development, which facilitates the crop to get moisture from deeper layer. To check the flower dropping during drought situation, NAA (4ml in 4.5 lit) spray is advocated, first spray at floral initiation and another spray at 15 days thereafter.

Conclusion

BNF is important in farming systems and can be ameliorated by simple and in expensive inoculation procedures. Extended use of biological fertilizers could reduce the cost of chemical fertilizers ensuring that economic benefits accrue to the farmers while at the same time maintaining soil fertility and sustainability of agro ecosystems. By following the low-cost technology, the production of pulses can be improved effectively. Incorporation of biofertilizer encourages soil microbial population substantially, thereby increases the soil fertility. Application of fertilisers, various biofertilizers and foliar spray of nutrients supply essential nutrients nitrogen, phosphorous and also increases the crop yield through growth promoting hormones, vitamins and biocontrol of pathogens. By using these, the pulse production could be well augmented under rainfed and rice fallow situations.

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Climatic Hazards on Agricultural Crops

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Introduction

There are different types of weather/climatic hazards which affect crop productions in agricultural sector . Generally, in different times These climatic hazards vary from one climatic zone to another. Hazard and disaster can be ranked according to impact criteria, and the probability of a hazardous event can be placed on a scale from zero to certainty (0 to 1) (Gobin et al., 2013). In view of climate change, it is important to assess the impact of climate extremes on agriculture. The climatic hazards may affect crops and agricultural productivity negatively if they are not checked. In every agricultural zone there is one particular hazard which affect the crop productions and reduce the annual crop yield. Those climatic hazards are flood, drought, cyclone, heavy rain fall etc.

Floods

Generally, occur in every part of the world, it occurs due to excessive rainfall, discharges, overflow of river banks, high release from dam, from pipes and fluctuations in ground water tables. It has capability to cover the entire farmlands with water and damage the economic crops as they are washed away by flood. It washes away valuable soil nutrients, which leads to land degradation and affects environmental pollutions. Due to extreme weather condition the frequency of flood hazard is expected to be higher. It also affects world's poor majority whom live in rural areas. Crops can be selected on their relative ability to tolerate excessive moisture. Field crops are generally less sensitive than vegetable crops in terms of yield. In addition to the choice of crop species, planting dates could be shifted when possible by delaying dates of sowing or planting to avoid probable periods of flooding during the sensitive growth stages. In most instances, crops are more sensitive at their early developmental phase than at the later stages in terms of yield.

Drought

It is one of a disaster in slow motion covering huge areas. Due to moisture deficient, abnormal rainfall or irregular rainfall or more water need due to high temperatures or combination of all the three factors. Absence of rains over period affects various human activities, results in widespread crop failure, depletion in lakes / reservoirs, etc.

Basically, droughts are categorized into four types, permanent drought, seasonal drought, contingent and invisible drought. It increases demand of water , water stresses in crops, the crops may wilt during the period, it causes higher evapotranspiration and leads to poor agricultural yields.

The management options to cope up with early season drought are:

1. Raising a community nursery for cereal crops and transplant the seedlings with the starting of the rainy season.
2. Sowing of alternate crops / varieties depending upon the time of occurrence of sowing rains.
3. If there is poor germination and inadequate plant stand, it is better to resow the crop. If the dry spell after sowing is brief, gap filling is also advocated.

Frost

It is also a climatic hazard which occur due lower environmental temperature, it forces the water to form ice blocks which may not be easily removed. It is occurring Polar regions in the world where daily temperature is less than 6°C. All cultivated lands are covered by frozen particles of water/ice clouds. It affects agricultural productions by prevents early tillage operations, proper growth of the plants, inaccessibility of farmlands to the farmers and more water which may result to flooding.

Winds

In agricultural zones excessive winds occurs with little or no vegetation cover or wind breakers /shelter belts. In southern parts of the world strong winds affect maize crops particularly during the winter /rainy seasons. During the summer /dry/harmattan season excessive winds are common in most northern parts of the world . Excessive winds velocities washes away soil nutrients from the agricultural lands and dries up the seeds and grains.

If the wind is too strong the plants oscillate and sway until the roots or stem fail. The mechanisms of root and stem failure are very similar in different plants although the exact details of the failure may be different. Cereals and other herbaceous crops can often recover after wind damage and even woody plants can partially recovery if there is sufficient access to water and nutrients. Wind damage can have major economic impacts on crops

Rainfall

It leads to an increase in water requirements of crops and crops can also suffer from water stresses. Excessive rainfall is the occurrence of many rainfall events which leads to an increase in rainfall depths. Excessive rainfall is not beneficial to crops since plants have optimum depth of water required for their metabolic activities. Excessive rainfall washes away the essential nutrients in the soil, flooding, poor physical development of the growing crops and accelerates the decay of the growing crops after maturity. Recent rain and cold conditions have brought detrimental effects to some of the early planted vegetables. The low temperatures would have greatly inhibited absorption of water and mineral nutrients for many warm season vegetables. If the soil is flooded, oxygen in the soil would be depleted within 24 hours. Plants are injured in the water saturated soil. Symptoms usually include wilt; yellowing and drop of older leaves; epinasty curvature that is most commonly seen on tomatoes. If flooding lasts for more than 48 hours, there is little chance vegetable crops could recover. Re-planting would be the only option left. On the bright side, the majority of vegetable fields have not been planted although fertilizers were applied and plastic was laid in several fields in the Southwest Indiana. In this scenario, the heavy rainfall did not directly affect plants, but we should caution that they may leach already applied fertilizers that would affect crops in the middle or late of the season. If field were flooded or ponded with water, they may not be replanted right away even after water recedes because of food safety concerns.

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Breeding behaviour of Pseudocereal Crop: *Amaranths*

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Introduction

India represents about 11 % of the world's flora in spite of having only just about 2.4 % of the total landmass. India has two biodiversity hotspots, namely, Eastern Himalaya and Western Ghat. Today 25–30 food-yielding species supply food to human of which only three-crop types viz. rice, wheat and maize, supply 60 % of food requirements for the world human population. Underutilized crops can be defined as a class of crop that once grown more rapidly and intensely but lagged behind the conventional major crops in terms of cultivation and use for variety of agronomic, genetic, economic and cultural reasons. Most of the underutilized crops are pseudocereal that is defined as fruits or seeds of non-grass species that are consumed in very similar way as cereals. The protein contents of pseudocereals like quinoa (Supergrain), *amaranthus* and buckwheat are much higher than cereals and the quality of proteins is much improved containing higher amount of lysine which is limiting in cereals. From the angle of digestibility, bioavailability, available lysine and net protein utilization, pseudocereal proteins are definitely better when compared to cereals. The nutritive value of pseudocereals is very much competitive to conventional crop, in most cases even better All India Coordinated Research Project (AICRP) on Underutilized crop (UUC) was initiated in 1982 with a headquarter at the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, with 15 main centres and 10 cooperating centres in different agricultural zones of the country.

Classes of *Amaranthus*

Amaranthus is a widely distributed herbaceous genus of herbs comprising approximately 70 species collectively called amaranths or pigweeds. Three species of *Amaranthus* are familiar for grain production –*A. hypochondriacus*, *A. caudatus* and *A. cruentus*. According to one school of thought, all the grain amaranths are of the New World origin, but other school of thoughts suggested that grain amaranths might have been cultivated in South Asia from prehistoric period and probably have domesticated there. Seeds of grain amaranths are very rich in crude protein with lysine and threonine. Seed oil contains squalene, trypsin inhibitor, tocotrienols, tannins etc. The tender plant of grain species *A. cruentus* is also consumed as leafy vegetable. Amaranth grain may be processed in various forms like flaked, popped, extruded and ground into flour and can be used as a substitute in porridge, stirred into soup. Grain amaranths have several health benefits like lowering of plasma cholesterol level, protection of heart, stimulation of immune system, anticancer activity, control of blood sugar level, improved condition of hypertension and anaemia, anti-allergic and antioxidant activity, etc., due to the presence of some bioactive components. Most of the molecular techniques used yielded a common inference that all the grain amaranths have evolved from weed progenitor *A. hybridus*.

Vegetable amaranths are the most popular vegetable crops in tropics especially in the tropical humid climate of Africa and Asia. Several species are known as vegetable amaranths of which two are most popularly grown, *A. tricolor* Green amaranths are rich source of lysine-rich protein, β-carotene, various vitamins, minerals and dietary fibres. Anti-nutrients like nitrates and oxalates are present in small amount that does not cause any nutritional problem under normal condition of consumption and another species *A. blitum*. Vegetable amaranths are considered as the most popular vegetable crops grown in the tropics for their protein, vitamin and mineral-rich leaves and stems. Vegetable amaranths are grown in the hot, humid regions of Southeast Asia, Africa, Southern China, India and Caribbean islands. Leaves of most *Amaranthus* species are edible, but few are very popular, e.g. vegetable amaranths such as *A. tricolor*, *A. blitum*, *A. dubius*, *A. cruentus* and *A. viridis*.

Approximately ten *Amaranthus* species are recognised as weedy member. These are either monoecious or dioecious species. Monoecious category comprises redroot pigweed (*A. retroflexus*), smooth pigweed (*A. hybridus*), Powell amaranth *(A. powellii)*, tumble pigweed *(A. albus)*, prostrate pigweed *(A. blitoides)* and spiny amaranth *(A. spinosus)* and dioecious category includes the common waterhemp *(A. rudis),* tall waterhemp *(A. tuberculatus),* Palmer amaranth *(A. palmeri)* and sandhills amaranth (*A. arenicola*). The notable weed *A. retroflexus* is considered one of the world's worst weeds.

Flower Morphology

Grain *amaranthus* are characterized with few salient features like apical, large to moderately large complex inflorescence comprising aggregates of cymes, unisexual flowers with five tepals, five stamens, circum scissile utricle, seeds with variable seed coat colour and well-defined flange. Due to variability in morphological features, accurate identification of amaranth genetic resources is not always possible. Flowers are small, green and unisexual and develop in numerous dense clusters. Each flower is subtended by 1–2 spinescent bracteoles, which are responsible for the overall increases in the density of the inflorescence. The ratio of male/female flower in inflorescence is very important in reproductive behaviour of the species. As per estimation, the ratio of male/female flowers in the inflorescence of *A. powellii* was 7.6 % and 9.7 % for *A. hybridus*. All monoecious species of Amaranthus are self-compatible and probably self-pollinating.

Cytogenetics Study

Three gametic numbers have been reported in the genus (n = 14, 16 and 17). Srivastava and Roy (2012) reported the chromosome number in *A. blitum* (2n=28), which is similar to the new basic chromosome number (x=14). This tribasic nature of the genus has supposed to originate from dysploidy or aneuploidy. Two hypotheses have been proposed regarding the origin of grain amaranths from their wild weed progenitor-monophyletic and polyphyletic. The monophyletic hypothesis based on plant and seed morphology suggests that all three-grain amaranths have originated from a single progenitor, *A. hybridus*. The polyphyletic theory based on phytogeography suggests that all the three grain amaranths have evolved independently. A third hypothesis suggests that all the three grain amaranths have originated from genetically differentiated population of *A. hybridus* through independent domestication event.

Breeding Objectives

Amaranths are characterized with remarkable germplasm diversity, adaptability to different growing conditions and unique matting behaviour ranging from obligate outcrossing (dioecious species) to greater outcrossing to greater self-pollination. The breeding mechanism in amaranths is variable due to variability and versatility of inflorescence, ratio and distribution of male and pistillate flowers in inflorescence. The major objectives in improving cultivars of grain amaranths are to raise yield, increase pest resistance and improve harvestability. Williams and Brenner (1995) emphasized three internationally recognized breeding objectives for grain amaranths, viz. reduced plant height and high yield, enhanced food quality and non-shattering of seed.

Conventional Breeding Methods

Conventional plant breeding involves three major steps: the screening of relatively large populations, utilization of genetic variability and selection of the desired genotypes. Three mutant varieties of amaranth have been developed viz. Centenario in Peru, New Asutake in Japan and Sterk in Russian Federation. Polyploids are shorter and thicker stemmed than normal diploid, and seed size increased by 42–159 % with polyploidy.

Wide Hybridization

The work on the genetic improvement of grain amaranths, especially in India, has been achieved through conventional selection methods from local collections of landraces available at different experimental stations. Research on amaranth breeding internationally located at North Central Regional Plant Introduction Station, Iowa State University. Murray (1940) was one of the first persons to classify interspecific hybridization within the genus *Amaranthus*. Two categories of plants were recognized-type I plants having male and female flowers intermingled with each other and type II plants having male flowers arranged at the apical part of inflorescence. He made a few crosses between and among type I monoecious species (*e.g. A. caudatus, A. hybridus, A. retroflexus* and *A. powellii*), type II monoecious species (*A. spinosus*) and dioecious species. Crossing involving *A. hybridus* and *A. caudatus* was among the most consistent with the weak prezygotic isolation indicating close affinity. One of the most widely used grain amaranth varieties in the USA is 'Plainsman'. The variety was derived from a cross between *A. hypochondriacus* and a Pakistani *A. hybridus* accession. Crop-wild hybrids have been developed to transfer non-dehiscence property of *A. powellii* to *A. cruentus* and *A. hypochondriacus* breeding lines in an effort to reduce grain shattering. Herbicide resistance evolved in *A. hybridus* has been transferred to elite breeding lines of *A. hypochondriacus* and *A. cruentus*. Most of the basic breeding works on amaranths have been done at the Organic Gardening and Farming Research Centre, PA, USA. Male sterility is available only in *A. hypochondriacus* but not in other *Amaranthus* species.

Molecular Breeding

A limited sequencing of the genome of *A. tuberculatus* has been done to understand the mechanism applied by the species to resist three herbicides. Sunil and co-workers in year 2014 reported a draft genome of amaranths genome *(A. hypochondriacus)*. Out of 411 linkages, SNPs derived from homozygous region of the grain amaranths, 355 SNPs (86 %) were reported to be present in scaffolds and 74 % of the 8.6 billion bases of the sequenced transcriptome map to the genomic scaffold. In case of Plant Tissue culture technique, there are not much published reports on the tissue culture of Amaranthus. On in vitro growth and morphogenetic first time reported in grain and vegetable amaranths (Flores et al., 1982).

Cultivars Released in Worldwide and India

Amaranth cultivars released worldwide are Montana-3, Montana-5, Amount, Plainsman, Pastevnyi-1, Turkestan, Ural and *A. cruentus* genotype Anden. In India six varieties for hill regions (Annapurna, Durga, VL Chua 44, PRA-1, PRA-2 and PRA-3) and for plains (GA-1, Suvarna, GA-2, GA-3 GA04 and BGA-2) has been released commercially for the farmers.

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Effect of Agrochemicals on Environment

Article ID: 31062

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The main effects will be on:
1. Soil
2. Water
3. Air

Soil Health

Soil health is the capacity of soil to function within ecosystem and land use boundaries to sustain productivity, maintain environmental quality and promote plant and animal health.

Physical	Chemical	Biological
Aggregation & Structure	PH	Macrofauna
Surface sealing	Soluble salts	Micro fauna
Compaction	Sodium	Micro organisms
Porosity	Nutrient holding capacity	Biological matter
Water movement	Nutrient availability	Organic matter

Negative Impacts of Agrochemicals on Soil Health

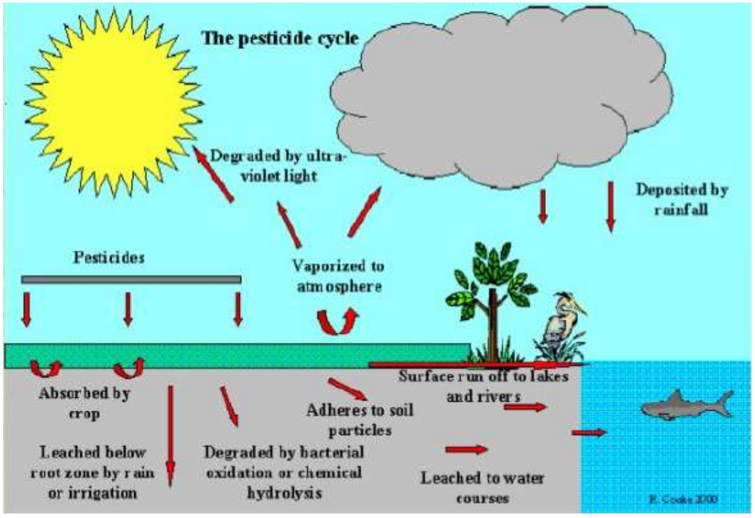
1. Kills beneficial organisms.
2. Increase in nitrate levels of soils.
3. Damage natural make up of soil.
4. Alters the PH.
5. Decrease soil quality.
6. Toxic to microbes.
7. Toxicity availability of nutrients.
8. Kills earthworms.
9. Growth regulators.
10. Residual effect.
11. Leaching of nutrients.

Effects on Water

1. Water become unfit for drinking.
2. The runoff of agrochemicals into streams, lakes, and other surface waters con increase the growth of algae.
3. Eutrophication- Change in quality and composition of aquatic ecosystems by accumulation of excessive chemicals in water bodies.
4. Polluted water leading to death of fish and other aquatic animals.
5. Excessive use of agrochemicals has led to the contamination of ground water.

Pesticide Pathway Entering Water

There are four major routes through which pesticides reach the water: it may drift outside of the intended area when it is sprayed, it may percolate, or leach, through the soil, it may be carried to the water as runoff, or it may be spilled, for example accidentally or through neglect. They may also be carried to water by eroding soil.



Effects on Air

1. Pesticides can contribute to air pollution.
2. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas.
3. Weather conditions at the time of application as well as temperature and relative humidity change the spread of the pesticide in the air.
4. Low relative humidity and high temperature result in in more spray evaporating.
5. The polluted air is inhaled by human's end with up with different diseases.

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Desert Locust, *Schistocerca gregaria*

Article ID: 31063

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What are Locusts?

Locusts are the swarming phase of the short-horned grasshoppers. These are species that can breed rapidly under suitable conditions and subsequently become gregarious and migratory. They travel a great distance and damage the crops extensively on their way.

Locusts Reported in India

1. Desert locust, *Schistocerca gregaria.*
2. Migratory locust, *Locusta migratoria.*
3. Bombay Locust, *Nomadacris succincta.*
4. Tree locust, *Anacridium* spp.

Desert Locust: *Schistocerca gregaria*

The desert locust is notorious. Found in Africa, the Middle East, and Asia. It inhabits 60 countries and can cover one-fifth of Earth's land surface. A desert locust swarm can be 1,200 square kilometres in size and pack between 40 and 80 million locusts into less than one square kilometre. Each locust can eat its weight in plants each day, so a swarm of such size would eat 192 million kilograms of plants every day.

Growth and Development

1. Stages: Egg, hopper and Adult Duration:

- **a. Egg stage:** 10-65 days.
- **b. Hopper:** 24-95 days (Avg. 36 days).
- **c. Adult:** 2.5 – 5.0 months.
- **d. Laying and fledgling:** 40-50 days.
- **e. Adult maturation:** 3 weeks to 9 months (Avg. 2-4 months).

2. Moults: 5-6 in *Solitarious* and 5 in gregarious.

Swarm Formation

Guaiacol is produced in the gut of desert locusts by the breakdown of plant material. This process is undertaken by the gut bacterium *Pantoea agglomerans*. Guaiacol is one of the main components of the pheromones that cause locust swarming. Serotonin enhances solitariness phase transition of migratory locust. Gregarious adults migrate in the direction of wind speed and cover a distance of up to about 150/km day. The direction and speed of wind determine the displacement of adults and swarms.

About 49,000 hectares (120,000 acres) of cotton, summer pulses and vegetable crops have been affected by locusts across six states of Rajasthan, Gujarath, Madhya Pradesh, Haryana, Uttatar Pradesh and parts of Maharastra. Swarms of desert locusts occur irregularly in North Africa, the Middle East and South Asia, usually when drought is followed by heavy rain. Normally, with the arrival of the monsoon, locust swarms enter the desert areas of India via Pakistan for breeding in June-July, but this year pink adult swarms were reported as early as April 30 in Rajasthan and Punjab.

This is in part because of the uncontrolled swarms in Pakistan that breed continuously. Swarms of pink adults fly high and travel long distances with strong winds coming from Pakistan. Most of them settle on trees during the night and mostly fly during the day. This is the second round of locust attack in India, the first one having occurred during December-February. In January, the biggest locust swarm to hit Gujarat in over a quarter of a century resulted in more than 25,000 hectares of wheat, rapeseed, cumin and potatoes being attacked, with at least a third of the crops damaged in 75% of the affected areas.

Management

1. Early warning and preventive control is the strategy adopted by locust-affected countries in Africa and Asia to try to stop locust plagues from developing and spreading.

2. The primary method of controlling desert locust infestations is with insecticides applied in small concentrated doses by vehicle-mounted and aerial sprayers at ultra-low volume (ULV) rates of application.

3. The desert locust has natural enemies such as predatory wasps and flies, parasitoid wasps, predatory beetle larvae, birds and reptiles. These may be effective at keeping solitary populations in check but are of limited effects against gregarious desert locusts because of the enormous numbers of insects in the swarms and hopper bands.

4. Farmers often try mechanical means of killing locusts, such as digging trenches and burying hopper bands, but this is very labour-intensive and is difficult. Farmers also try to scare locust swarms away from their fields by making noise, burning tires or other methods. This tends to shift the problem to neighbouring farms, and locust swarms can easily return to re-infest previously visited fields.

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Space Farming: An Overview of Alluring Search

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Keywords: space agriculture, closed system, veggie green house.

Abstract

Space farming research was started in late 1950s. With the advent of research and development in space science, space farming also has gained its momentum. Countries like Russia, USA, Japan, China, Mexico are now putting their focus in this area.

As the time passes, countries have started their long duration space missions and here the importance of space farming comes to provide nutritious and fresh food to astronauts in space.

In this article I have tried to give an overview starting from brief history regarding growing plants in space, the need of space farming, challenges faced by scientist, overall global status of space farming in a nutshell.

Introduction

Equivalent to agriculture on earth, space farming refers to growing of plants for food and other materials on off-earth celestial objects or in space. This area of research is now becoming necessary for providing food to astronauts in space stations and other long duration space missions.

The food which is provided to the space crews in a long duration mission must maintain its nutritional efficacy, safety and its viability for 3-5 years period. In order to achieve stability in food system in space crafts for maintaining heath of astronauts, the food under goes various processing for inactivating microbes.

This commercial sterility may provide a safe food system but the processing level can reduce nutritional content of food and acceptability (Cooper et al., 2011). Much of food supplied to astronauts are freeze dried or heat treated. A study in 2009 noted that, vitamin A, C and K along with thiamine and folic acid decreases significantly in less than one year of storage. Therefore, a mission to Mars for as long as 5 years would require new source of vitamins (Cooper et al., 2011).

Apart from food quality in space, the resupplying of food in long term space missions are very costly and impractical. To overcome this back drop, the existence of growing crop plants inflight is getting incredible importance.

The space farm would also be helpful for creating sustainable environment in space ship, as plants are able to generate oxygen, continuous purification of air, and also for recycling waste water (White paper. The space agriculture endeavour, 2016). The ability to grow food in space would improve the quality of astronaut's diet and provide fresh food with better taste and texture in a cost-effective way.

History of Space Farming

Agricultural system in space was discussed since the work of a Russian scientist, Tsiolkovsky. He was a Russian aerospace scientist described that how plants and humans might co-exist inside closed environment in space (Tsiolkovsky, NASA Translation, 1975, Wheeler, 2017).

After that, willy Ley proposed that if the space journey is too long then growing plants in space would be a good option for generating oxygen and purifying air based on discussion he had with a botanist (Wheeler, 2017). Since from last 50 years throughout the world many researchers are involved in the field of space agriculture and bio generative life support.

Initial studies in space farming begin with particular algae Chlorella sp. for oxygen production and carbon di oxide removal (Sorokin and Myers, 1953). At the same time when this study was conducted by NASA (National aeronautics and Space Administration) in US Russian scientist were also doing studies using algal bioreactors and plants to provide oxygen in closed habitat (Gazenko, 1967, Gitelson et al., 1975, 1976).

Crops Recommended for Space Farming

The selection criteria of a plant to be included in space mission were described in "Biologistics Symposium" held at Ohio in 1958. The plants should be able to grow in low light intensities, higher productivity, compact size and tolerant to osmotic stress from NaCl. This list included- lettuce, cabbage, cauliflower, kale, radish, turnip, sweet potato, Chinese cabbage, New Zealand Spinach (Gouleke and Oswald, 1964).

Technical Challenges

A variety of technical challenges are there in space agriculture. These includes change in pressure, reduced gravity, high irradiation and light etc. By constructing green house may solve these problems, but their construction is itself a technical challenge (Schubert, 2017).

Global Initiative for Betterment of Space Agriculture

During 1970-1980s, in Russia bio regenerative testing was flourished (Gitelson et al., 1975). Along with this, Institute for biomedical problems in Moscow also started their experiment regarding how agriculture might actually get started in space settings like the Mir space station or International space station (ISS). Similarly, NASA initiated CELSS (Controlled Ecological life support systems) in 1980s focussing on controlled environment production of potato, sweet potato, wheat, soybean. The findings of this experiment was used for conducting test in 20 m2 of atmospherically closed chamber located at Kennedy Space Centre (Fig-1), related experiments was also conducted in NASA's Johnson space centre in 1990s. Controlled Ecological Experiment Facility of Japan also carried out experiments in closed chamber with plants, animals, humans with waste recycling system. CEEF study provided that 150 m2 of plant growth area was able to provide near complete diet with air and water regeneration for two humans and two goats. The European space agency, A Canadian research team was also conducting experiments over space crop research. Most recently, China develops a closed life support facility (Lunar Palace 1) with 69 m2 agricultural module for air, water and food production for three humans (Wheeler et al., 2017). In this way novel technologies and findings were produced for space agriculture (Fig-2).

Ongoing Experiments

NASA's future mission ALINA (Luner lander mission) will also carry a small 'biosphere' chamber called Luner Plant Growth Experiment (LPX), where NASA will attempt to germinate and grow several plant types (Wadhwa, 2013). In 2019, Chang'e 4 mission of China carried the Lunar micro ecosystem, with 3 kg sealed 'biosphere' cylinder with insects' egg and seeds to test whether insects and plants could hatch and grow together in synergistic way (Tayag et al., 2019). The Veggie greenhouse will fit into an EXPRESS rack on the International Space Station for use with plant investigations in orbit (NASA). Lettuce plants in Veggie next year as a test run, because lettuce is well suited for this initial testing. Lettuce is a good first crop selection because it is a rapid growing plant, with a high edible content, and generally has a small micro flora content (Fig-3). (https://blogs.nasa.gov/ISS_Science_Blog/tag/plants/).

Conclusion

At last, the denouement is that intense experimentation is needed for exposing fundamental plant processes under various space programs and utilize that knowledge for the benefit of future mankind.

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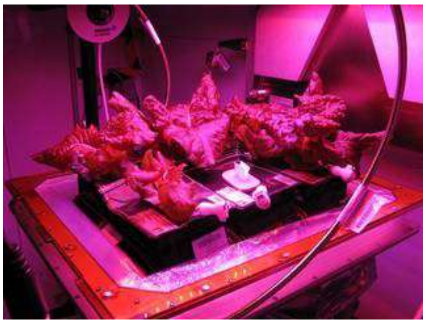

Fig-1. Orbital Technologies partnered with Kennedy Space Centre to create a plant growth system known as Veggie, now used on the International Space Station. The system employs LEDs, which are highly efficient and long-lasting and radiate hardly any heat. Credits: Orbital Technologies/NASA.

Fig-2 A leaf sensor developed to increase the efficiency of farming on long-duration space missions. Credits: AgriHouse Brands Ltd./NASA.

Fig-3 The Veggie greenhouse at ISS.

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Genetic Manipulation of Entomopathogenic Bacteria for Better Efficacy

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Introduction

Genetic improvement involves directed purposeful genetic alterations to enhance the efficacy of the natural enemies for the biological control. Entomopathogens can be improved for climatic tolerance, sex ratio, host finding ability, increased host range etc. Genetic improvement may be achieved by artificial selection, hybridization to achieve heterosis effect or the use of r-DNA techniques. Genetic manipulation of bacteria, fungi, virus or nematode through biotechnology is one of the alternative tools for chemical insecticide. Beside this it will enhance efficacy of biocontrol agents.

Entomopathogenic Bacteria

Narrow range of insecticidal activity. Bt exhibits its toxicity more towards lepidopteran insects and even among the lepidopteran it exhibits significant differences in sensitivity. It is affected by UV light. Low field persistence.

Molecular Approaches Towards Development of Novel *Bacillus thuringiensis* Biopesticides

1. Bt plasmid curing and conjugal transfer.
2. DNA technology (rDNA).
3. Encapsulation or non-living delivery system.
4. Recombinant Delivery of epiphytes and endophytes.
5. Transgenic plants.

Bt Plasmid Curing and Conjugal Transfer

It is occurring only in living organism. Transfer of plasmid between related Bacillus species (through mating). Improve the yield of crystal proteins from the sporulating cells of total weight (normal 30%). Sometime the cry protein ineffective against some species, at the time of plasmid exchange allows a greater amount of desired cry protein to accumulate in the strains of crystal. Cutloss ® increase the activity of *Bt subsp kurtaki*.

Synergistic effect-EG2424, an active ingredient of Foil® toxic to both lepidopteran and Coleopterans. Conjugal transfer of a toxin-coding Megaplasmid from *Bacillus thuringiensis* subsp. *Israelensis* to *Mosquitocidal Strains* of *Bacillus sphaericus* . Mosquitoes are the vectors of many disease, such as malaria, dengue fever etc.

Encapsulation or Non-Living Delivery System

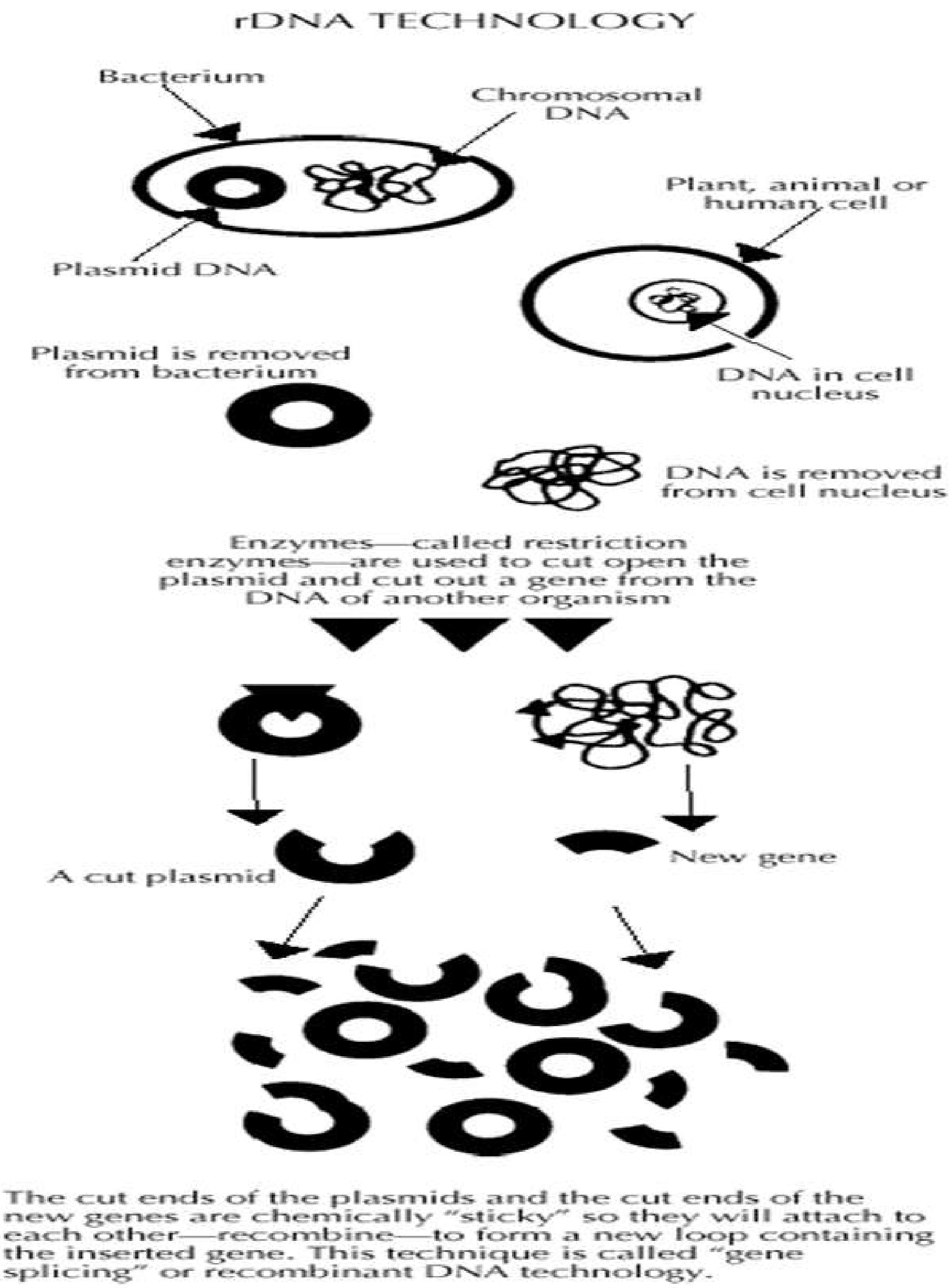
'Mycogen' has developed "Mcap" delivery system. The encapsulating Bt proteins with in a protective bacterial cell wall coat *(P. florescens)*. During fermentation the bacteria was killed. Dead bacterial ICP sprayed on the plant is more static to environment factor than other method. ICP protected from the UV lights.

A Genetically-Modified *B. thuringiensis* Product for the Control of Fall Armyworm on Corn

B. thuringiensis subsp kurstaki products have generally exhibited moderate to low effectiveness for controlling the Fall armyworm *S. frugiperda*. The EG2348 strain of Bt subspecies kurstaki, the active ingredient in the bioinsecticide "Condor". These products have shown improved toxicity for certain insects.

EG2348 utilizing natural processes for transfer of plasmids with genes encoding for production of specified insecticidal crystal proteins. Recombinant DNA technology has made it possible to improve Bt strains and recently Ecogen produced a rDNA modified variant (ECX9399) of EG2348 that was more toxic to FAW in laboratory tests.

Recombinant DNA Technology



Genetic Transformation of *B. thuringiensis* Insecticidal Toxic Genes to *E. Coli* Against *Spodoptra Littoralis* (Boisd.)

The aim of this work is to express the toxin protein genes from highly toxic B. thuringiensis isolates in a gram-negative *E. coli* strain to generate enhanced hybrid strains against *S. littoralis* larvae. The transformant strains proves to be useful in constructing new enhanced gram-negative hybrid strains which have toxin protein genes against *S. littoralis* larvae and other pest insects.

Delivery of Epiphytes and Endophytes

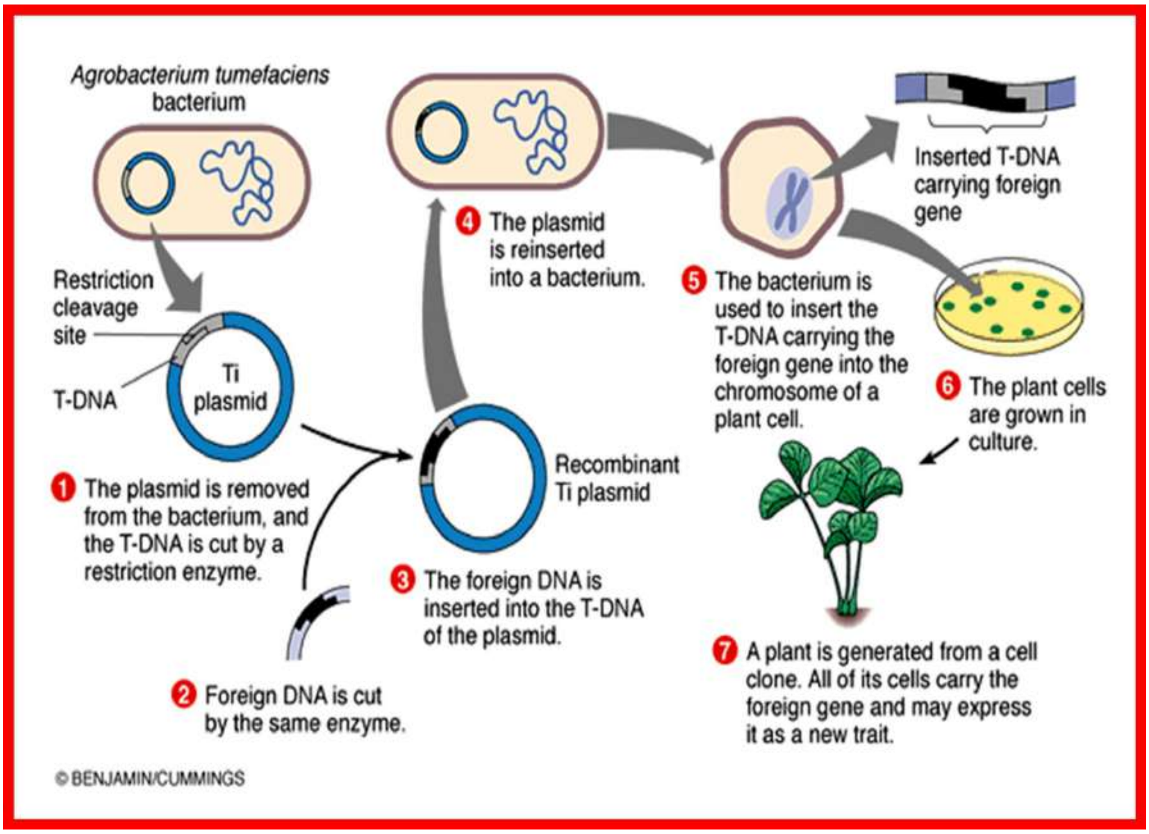
The GET allows the use of microorganism that multiply on or in the plants to produced insecticidal proteins. To reduce the insufficient coverage and long persistence.

Epiphytes

P. fluorescens, P. cepacia are plant associated bacteria. Mansanto using transposon Tn5, transferred a cry gene from *Bt subsp. kurstaki* HD-1 to a corn root-colonizing. *P. fluorescens* strain. The recombinant strain had pesticidal efficiency similar to *Bt subsp. kurstaki* HD-1. It was toxic to black cutworm *Agrotis ipsilon* but not adequately effective against corn root worm *Diabrotica sp.*

Endophytes

Inserting a Bt cry gene into the chromosome of *Clavibacter xyli subsp. Cynodontis. C. xyli* is coryneform bacterium that inhabits the xylem of the Bermuda grass *C. xyli* can be transformed to corn via seed treatment. After germination, bacteria colonize xylem and express Bt protein. It will protect the stem from damage by European corn borer *Ostrinia nubilalis.*



Conclusion

Genetic improvement involves directed purposeful genetic alterations to enhance the efficacy of entomopathogens can be improved for climatic tolerance, increased host range etc. Use of noval approaches like r-DNA technology will ultimately enhances the efficacy of bacillus thuringiensis. Besides the conventional insecticides for pest control genetic manipulation of entomopathogenic bacteria is useful and more efficient for pest control.

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Genetic Manipulation of Baculoviruses

Article ID: 31066

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Introduction

Baculoviruses are the major group of arthropod viruses well known due to their potential as agents of biological control of pests in agriculture and forestry. They are also widely used as expression vectors in biotechnology. Baculoviruses are composed of double stranded DNA and it attack insects and arthropods. They have species specific and narrow based insecticidal properties and are used as biological control agents. They do not have negative effects on plants, birds etc. So, these can be used in organic farming. Baculoviruses pesticides are ideal tools in integrated pest management programs as they are usually highly specific to their host insects; thus, they do not affect other arthropods including pest predators and parasitoids. They are also safe to vertebrates and plants and to the biosphere. Over 50 baculovirus products have been used against different insect pests worldwide. Beside this some limitations are there while using baculoviruses as tool for insect management viz, Slow speed to kill, poor persistence in the field, specificity confers the "bv" powerless against pest complex. To overcome these problems genetic manipulation is better tool.

Genetic Improvement

1. Gene deletion of Baculovirus from its genome.
2. The introduction of neurohormones into the NPV.
3. The introduction of enzymes into the NPV.
4. The introduction of insect-selected neurotoxins into the NPV.

Mutation

Ultra violet mutation – UV light, Chemical mutation – nitrosomethyl guanidine.

Natural Mutant

The mutant strain of AcNPV designated HOB produced a large number of OB in infected cells and had higher virulence in insect than the parent

Chemical Mutant

The spruce budworm virus was grown in the presence of the mutagen nitrosomethyl guanidine.

The survivors were cloned the cloned cells isolated and examined. Among one isolate CfNTG 29 was more virulent than the standard.

Deletion Mutant

Deletion of ecdysteroid UDP- glucosyl transferase (EGT) gene in NPV and also GV. It has been shown to increase the speed of kill by interfering with metamorphosis and moulting. The EGT gene was identified in several insect viruses including Ha and SlNPV.

Engineering NPVs

Nucleopolyhedroviruses (NPVs) are most commonly used for microbial insecticides for the control of lepidopteran insects. Approaches to engineer NPVs as improved biological insecticide include deletion of genes that encode products prolonging host survival, and insertion of genes that express an insecticidal protein during viral replication.

Deletion of an Endogenous Baculovirus Gene

Deletion of the ecdysteroid UDP-glucosyltransferase (EGT) gene of Autographa californica NPV(AcNPV) caused infected fall armyworm, Spodoptera frugiperda to feed less and die about 30% sooner than larvae infected with wild-type AcNPV.

Expression of Insect Hormone Genes

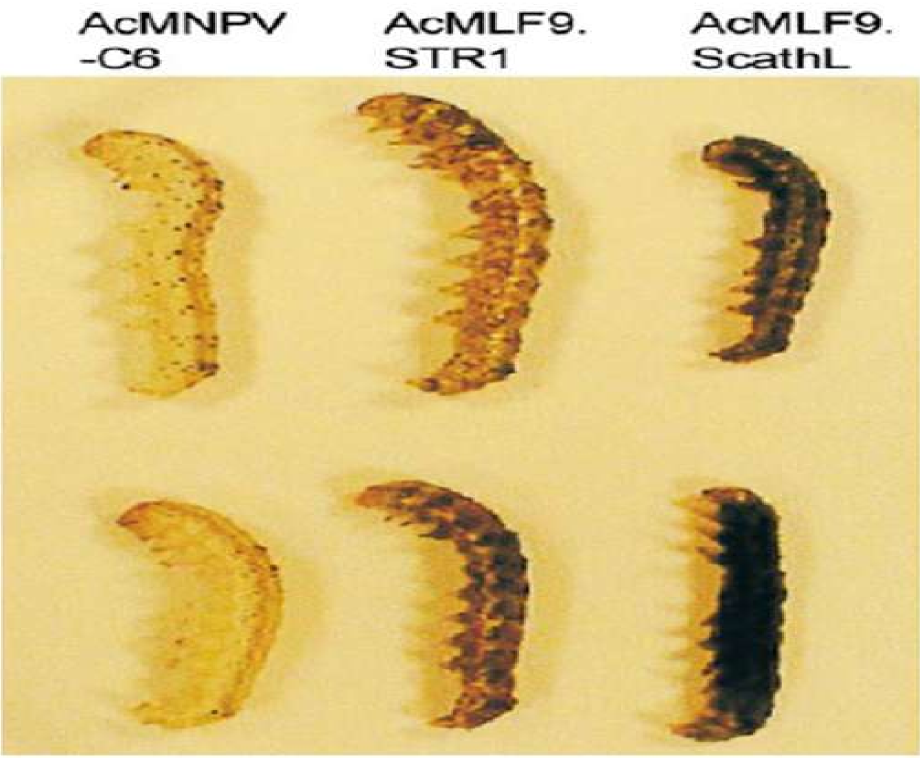
Expression of functionally active diuretic hormone (DH gene) in silkworm larvae using a recombinant Bombyx mori nucleo - polyhedrovirus (BmNPV) named BmDH35 causes 30% reduction in hemolymph volume & killed larvae 20% faster than wild-type BmNPV. Expression of other hormone like eclosion hormone (EH) & Prothoracicotropic hormone (PTTH) was tried by recombinant technology but significant improvement was not achieved for speed killing.

Expression of Insect-Selective Toxins

Engineer BmNPV having AaIT gene (encode highly potent insect-selective toxin) from scorpion *Androctonus australis* has proven successful in pest control in cotton.

Use of Proteases to Improve the Insecticidal Activity of Baculoviruses

1. Basement membrane: Potential barrier to baculoviruses movement.
2. 6 rDNA ACMNPV: RAT stromelysin-1, human gelatinase and flesh fly *(Sarcophaga peregrina) cathepsin L.*



Construction of Hybrid Virus In Vitro

A virus which can kill a pest complex comprising of two or three insects would be very useful tool. BmX and HaL93 cell lines, produced a hybrid virus between the NPVs of *Bombyx mori* and *H. cunea*. It had wide range including smaller tea tortrix Adoxophyes sp and the DBM.

Vertical Transmission

Selected a strain of virus with a higher rate of vertical transmission in *S. exigua*. When 5th instar of *S. frugiperda* were fed the median lethal concentration of the selected virus. The survivors transmitted NPV to 24% of their progeny, compared with 14% with the wild viral isolate. The selected NPV killed 58% of the infected progeny insects compared with 39% with the wild viral isolate.in the corn plant.

Conclusion

Use of genetic manipulation (biotechnological tool) for engineering the baculoviruses will ultimately enhances the efficiency of baculoviruses. It will enhance the climatic tolerance of NPVs, CPVs and GVs. Also enhances the speed killing of target pest.

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Gene Silencing in Insect - An Innovative Tool for Insect-Pest Management

Article ID: 31067

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Introduction

Gene silencing (GS) is defined as a molecular and very efficient reverse genetic tool which down-regulates the activity of specific genes (Dash et al., 2015). Broadly speaking, gene silencing is an epigenetic process of gene regulation and is used to describe the 'switching off' of a gene by a mechanism other than the modifications in the DNA sequence. The GS phenomenon is related to RNA activity within the cell. Transcription can be recalled as a process of synthesis of RNA from DNA. Genetic information which is carried by DNA is transferred in the form of RNA especially in the form of mRNA (messenger RNA). As soon as the different types of RNA are formed inside the nucleus, it passes through the nuclear pore to the cytoplasm. Becomes resistant to the different endo- and exo-nuclease activities present within cytoplasm of the cell. Synthesis of messenger RNA, initially pre-mRNA and thereafter called as the mRNA. After the formation of the mature mRNA, the genetic information which is present in the form of genetic code is decoded in the form of protein through an important molecular mechanism called as translation. The product of translation is the polypeptide chain or protein, the basic component of the enzymes or hormones which is reflected in the form of various metabolic pathways, function and phenotype of an organism. GS inhibits the expression of a gene thereby nullifying its harmful effect or by inhibiting the expression of a harmful or deleterious gene or sometimes an appropriate gene construct is made that contains a gene sequence to inhibit the function of a harmful gene and simultaneously introduce a beneficial gene also. Through research, it has been found that the key factor which induces the mechanism of gene silencing is the presence of double stranded RNA (dsRNA) in the cytoplasm (Fire et al., 1998). One of the most common and widely employed mechanisms of gene silencing is RNA interference. This RNAi approach has opened new avenues in the development of eco-friendly techniques for crop improvement as specific deleterious genes are made to be suppressed which otherwise cause stress and expression of novel genes for disease resistance (Younis et al.2014) and for other economical and agronomical traits as well. Gene silencing was initially reported in plants, where it was denominated as Post Transcriptional Gene Silencing (PTGS) (Napoli et al., 1990; Zhu., 2013; Morris et al., 2014).

RNAi (Interference) Technology

Cellular process by which an mRNA is targeted for degradation by a dsRNA with a strand complementary to a fragment of such mRNA. A selective gene knock-down phenomenon.

Main Component of RNAi Machinery for siRNA, miRNA and shRNA Generation

There are five components for siRNA, miRNA and shRNA generation:

1. Dicer: The dicer catalyzes the production of siRNAs from the long dsRNA and requires ATP for this function. It is a large (~220kDa) multi-domain protein and act as an anti-parallel dimer.

2. Drosha: Drosha that catalyses the nuclear processing of pri-miRNA in to pre-miRNA, the stem loop precursor of about 70 nucleotides which is further acted upon by dicer to generate miRNA.

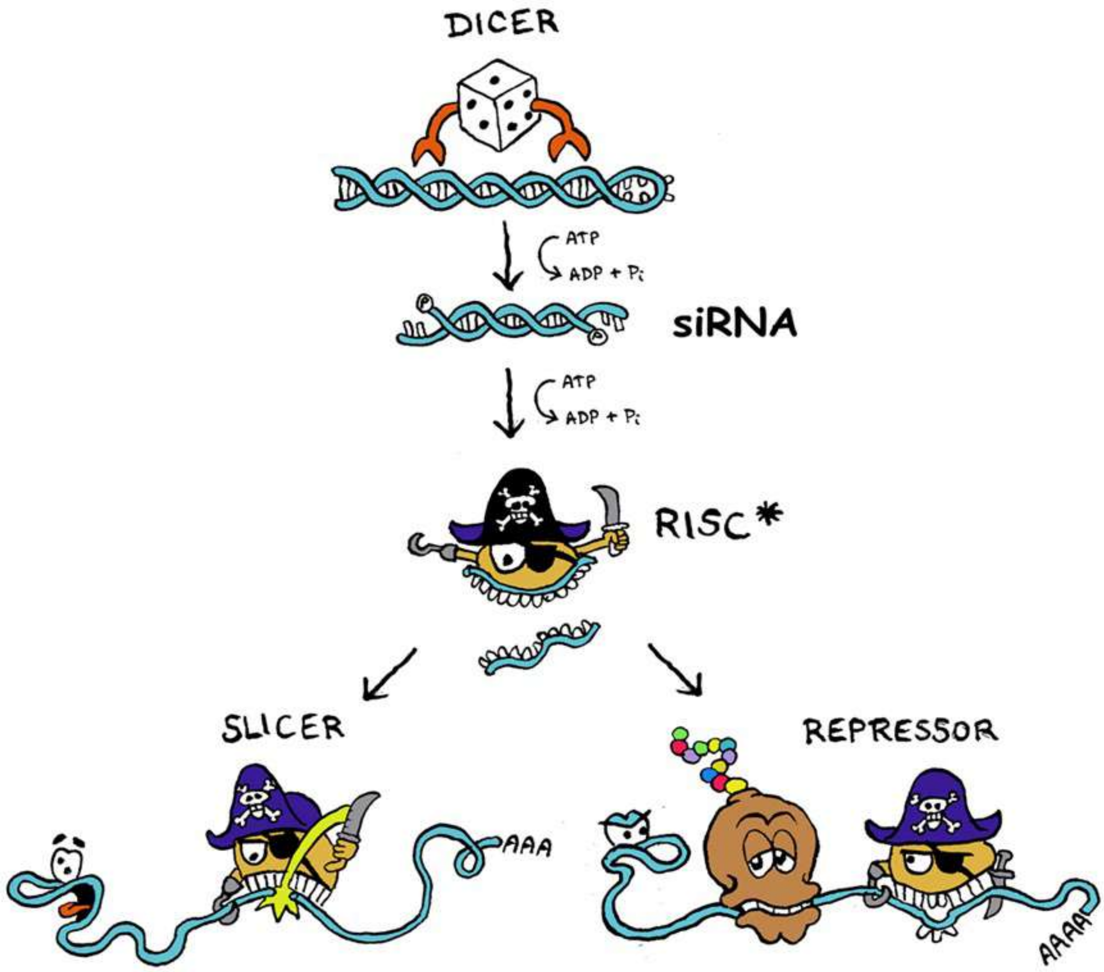
3. RNA-Induced Silencing Complex (RISC): RISC reaches at the target site, the endonuclease activity of the protein of Argonaute family chops that sequence and thus renders the target gene unexpressed.

4. Argonaute (Ago): Argonaute proteins constitute the catalytic unit of the RISC (RNA induced silencing complex). Argonaute proteins contain four conserved domains: The N- terminal, PAZ, mid and PIWI domains.

5. RNA-Dependent RNA Polymerase (RdRP): RdRp is primarily found in RNA virus where it catalyses its genome multiplication. RNA-dependent RNA polymerases (RdRPs) catalyze the formation of phosphodiester bonds between ribonucleotides in an RNA template-dependent fashion. RdRp is involved in the regeneration of dsRNA which is the key component in the gene silencing (Dalmay et al., 2000; Smith et al., 2004).

Gene Silencing In Insects

Mechanism of RNAi in insect:



Entomological aspects of RNAi: RNA interference (RNAi) allows for rapid and straightforward analysis of gene function. This parental RNAi effect made possible efficient genomewide functional screens in organism. Transfer across cell boundaries is an ancient feature of the RNAi pathway, and opens up new applications in functional genomics and in the study of developmental evolution. (Bucher et al., 2002).

Application of RNAi in Crop Protection

1. Protection from insect pests: Baum et al. 2007. showed that silencing of a vacuolar ATPase gene (V-type ATPase A gene) in midgut cells of western corn rootworm (WCR) led to larval mortality and stunted growth.

2. Nematode resistance: Huang et al., 2006. Showed that Arabidopsis plants expressing dsRNA for a gene involved in plant – parasite interaction (16D10) had suppressed formation of root galls by Meloidogyne nematodes and reduced egg production.

Future Prospects for RNAi-based Experiments in Insects

1. RNAi use to study - social behaviour, reproductive strategies and host-parasite interactions.
2. Systemic RNAi – genome wide screening is useful to identify genes involved at the whole animal level, e.g. in determination of life span and size, metabolic controls, ecdysis, etc.

3. Comparative studies for the function of a gene, or gene network, at species level.
4. More gene orthologs in different insects should be identified and their roles should be determined.

Conclusion

RNAi opened a new way for extending studies of functional genomics to many non-model insects. RNAi secures genome stability by keeping mobile elements silent. RNAi unveil the function of new genes, lead to discover the new function of old genes, and find the genes for old function. Some important factors influencing the success of RNAi application in insect studies: concentration of dsRNA, nucleotide sequence, length of the dsRNA fragment, persistence of the silencing effect, and life stage of the target insect. RNAi-like mechanisms repress protein synthesis and regulate the development of organism. Systemic RNAi has been used for studying a variety of functions related to development, reproduction, behaviour, immunology, and other complex biological patterns. RNAi-like mechanisms keep chromatin condensed, suppress transcription and inhibit translation. RNAi might be useful approach for sucking pests' control in future.

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IT Led Agriculture

Article ID: 31068

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Introduction

The term 'Agro-informatics' is a fusion of agriculture and information technology with innovative ideas, techniques and scientific knowledge. It is an application of information technology in agriculture which would benefit the students, researchers, organizations, entrepreneurs and also transform the livelihood of the farmers. Thus, Information Technology (IT) led agriculture is all about how to use information, compute and communicate agricultural information to the farming community.

Information technology which is a set of various practical tools and resources supports to communicate, transmit, deposit and handle information. It includes computer, internet, network devices, software, and satellites, broadcasting technologies like radio, television and telephony. Apart from this it requires services and tasks linked with it for example email, web portals, video-conferencing, SMS, etc. The role of information technology is to ensure that the users get the right information, in right form, in right time. Thus, information technology is helpful to communicate the knowledge.

In developing country like India transformation in agriculture with information technology is the need of hour as agriculture is the main source of national income. The generation and application of agricultural knowledge is progressively important, particularly for small and marginal farmers, who require relevant information in order to improve, sustain, and expand their farm enterprises.

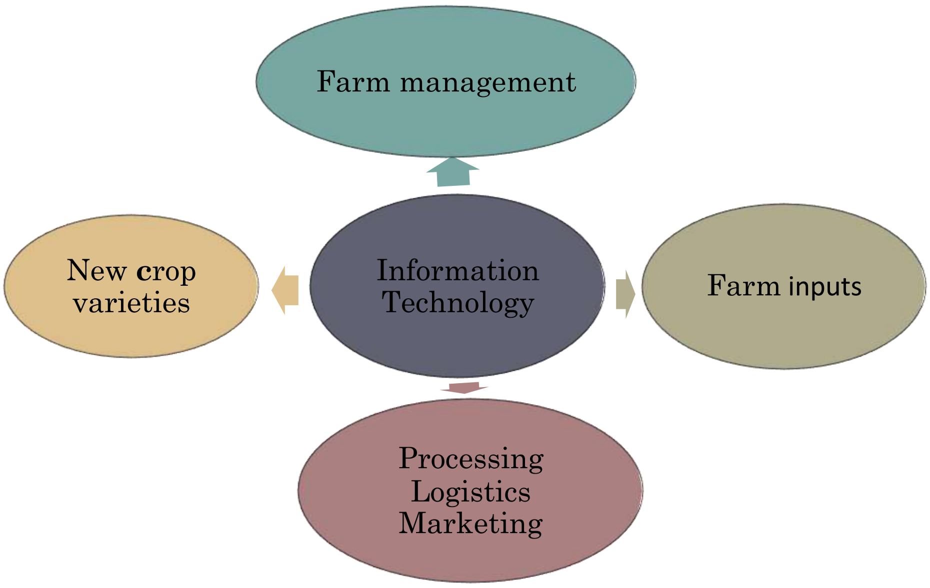

Figure1: IT led Agriculture

Needs and Objectives

With IT, farmers would have better exposure and pricing with less agricultural risks and enhanced income. The extension and advisory services added with information technology would benefit the farmers by making available the information round the clock.

Subsequently, information would be accessible to the farmers for optimizing their productivity and income. India's food production and productivity can be increased by effective use of information technology for agriculture.

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Table 1: Objectives of IT Led Agriculture

Pre-Sowing	Pre-Harvest	Post-Harvest	Market information
• Information on agri-inputs like seed, pesticides, fertilizers • Weather condition • Soil testing	• Good agricultural practices • Pest management • Techniques of harvesting • Packaging	• End-products storage, grading and management • Logistics • Market information	• Alternative market channels • Commodity prices • Mandi information • Consumer feedback

Thus, if IT tools are used effectively in agricultural sector, the farmers can produce quality products with higher yield and avoid post-harvest losses. Further, it helps to overcome technology dissemination loss and to provide direct access to farmers to improved expertise as well as products of technology. It also provides an opportunity to different divisions as well as the centres to have resource generation through sale of their technologies.

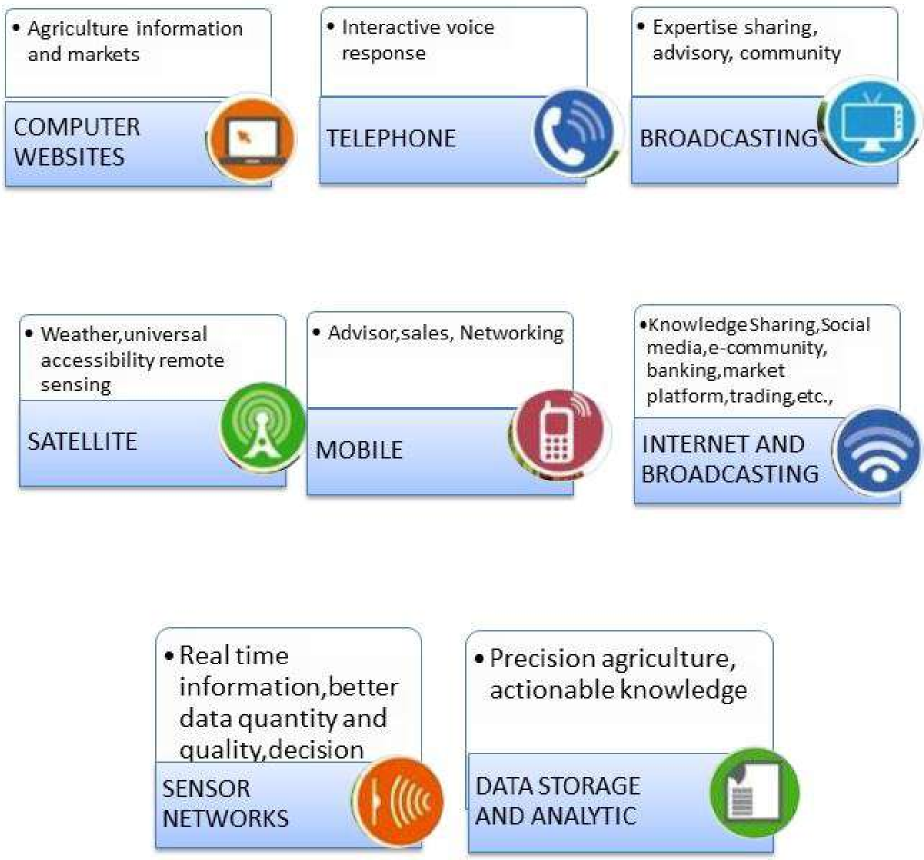

Figure 2: IT Tools for Agriculture

IT Led Agriculture Importance

1. Bridge the gap between agricultural researchers, extension agents and farmers, thereby enhancing agricultural production
2. Gain and improve access to climate-smart solutions with appropriate knowledge
3. Facilitates market access for inputs as well as product marketing and trade
4. Increase access to financial services for rural communities
5. Widen the reach of local communities and enhance the income of the farmers.
6. Assist in implementing regulatory policies, frameworks and ways to monitor progress.

Challenges of IT Led Agriculture

There is great potential for IT led agriculture in developing countries however application such as precision agriculture and e-commerce in agriculture can only work in an environment where there is good Information communication technologies (ICT) infrastructure.

Few areas require expensive advanced technologies, which are only feasible in intensive farming systems. Participation in e-commerce activities requires that both buyers and sellers have access to the internet and that they are able to use the required hardware and software effectively. Unfortunately, in most developing countries, there are many constraints blocking the development of IT led agriculture. These include:
1. Lack of sustainable ICT infrastructure.
2. Absence of appropriate skills among potential users of ICTs especially farmers, rural communities, extension staff and researchers.
3. Lack of appropriate content.
4. Lack of access to ICT facilities.

Thus, the rural digital gap must be linked in developing countries. Locally relevant digital content has to be developed or adapted and access to ICTs should be made affordable for rural populations. Otherwise IT for agriculture will remain beyond reach of rural communities and will merely aggravate the existing rural digital gap leading to an ever-widening knowledge gap between information and farming community.

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Move to Ban Pesticides in India: List and its Reason

Article ID: 31069

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Introduction

Pesticides are chemical compounds that are used to control pests, including weeds. Pesticides include herbicide, insecticide, nematicides, molluscicide, piscicide, avicide, rodenticide, bactericide, insect repellent, animal repellent, antimicrobial, and fungicide.

Pesticides are used from a longer period. As comparing from other ways like using bio pesticides, predators, parasites etc are very time taking and high cost while using pesticides it's a essay and quick method to get rid form pest in the field. But using pesticides having many drawbacks like they regard to be dangerous for humans and animals. As seeing these drawbacks, a draft order issued by the Ministry of Agriculture and Farmers Welfare called Banning of Insecticides order 2020. Government to ban 27 pesticides and insecticides in India by sub section 27 read with section 28 and sub- section(1) of section 36 of the insecticides Act, 1968.

Reason to Ban Pesticides

The order prohibits import manufacturing, sale, transport, distribution, and use of 27 types of pesticides. These include Acephate, Atrazine, Benfuracarb, Butachlor, Captan, Carbofuran, Cholorpyriphos, 2,4-D, Deltamethrin, Dicofol, Malathion, Mancozeb, Methomly, Oxyfluorfen, Pendimethalin, Quinalphos, and Sulfosulfuron. In 2013 there was a committee formed name Anupum Varma Committee for the long pending process of this notification of banning pesticides. Amit Khurana, Program Director Food Safety and Toxins, said that Monocrotophos and carbofuran are most used highly toxic pesticide in India. Chlorpyriphos and Quianalphos are other endocrine – disrupting chemicals. 63 countries like European Union, Argentina, Canada, South Korea, New Zealand, already banned these pesticides.

List of Banned Pesticides

The government has shortlisted 27 insecticides for prohibition on 14 May,2020:

S.No.	Pesticides	Decision of Central Government
1.	Acephate	Endocrine disruption in public domain, no report of resurgence could be traced in public domain, banned in 32 countries, toxic to honey bees etc.
2.	Atrazine	Incomplete bio-efficacy data submitted i.e. study on leaching, endocrine disruption in public domain, banned in 37 countries, toxic to aquatic organism including fish etc.
3.	Benfuracarb	Carcinogenic impurities, highly toxic via in- halatory exposure, reprotoxic effects observed in rat and rabbit, ground water contamination etc.
4.	Butachlor	Incomplete bio-efficacy studies submitted, prone for leaching, toxic to aquatic organism including fish etc.
5.	Captan	Endocrine disruptor, toxic to aquatic organism including fish etc.
6.	Carbendazim	Foetoxic and tetratogenic , it is a active component of Benomyl (already banned in country), toxic to pregnant women and presence of toxic impurities, resistance to many fungal sp. etc.
7.	Carbofuran	Extremely toxic, a red triangle pesticide belonging to class 1b, toxic to honey bees, aquatic organism and birds, its 50% formulation already been banned in country
8.	Chlorpyriphos	Product of organophosphate and is a neurotoxic and has been banned for household in USA and European Union, eco toxic, health hazard to children and infants etc.
9.	2,4-D	Conc. of dioxin content, as it is carcinogenic, etc.

10.	Deltamethrin	Comments for use in public health should be sought from national vector borne disease control programme (NVBDCP), Toxic to aquatic organism etc.
11.	Dicofol	Highly toxic to aquatic organism ,contamination of DDT and its metabolites etc.
12.	Dimethoate	It is a organ phosphorus compound and is highly toxic etc.
13.	Dinocap	No bio-efficacy and residue data has been submitted by stakeholders, tetratogenic concerns with the product, toxic to aquatic organism etc.
14.	Diuron	The product falls under category 2 of European union prioritization of endocrine disrupting chemicals , toxic to aquatic organism etc.
15.	Malathion	Falls under Category 2 of European union prioritization of endocrine disrupting chemicals , eco toxic etc.
16.	Mancozeb	Level of ETHYELENETHIOUREA, (ETU) is a concern from toxicity point of view, toxic to aquatic organism etc.
17.	Methomyl	Extremely toxic a red triangle pesticide, toxic to honey bees , silk worms birds and aquatic organisms, Falls under category 2 of European union prioritization of endocrine disrupting chemicals etc.
18.	Monocrotophos	Also, extremely toxic red triangle pesticides ,toxic to honey bees , silk worms birds and aquatic organisms, Falls under category 2 of European union prioritization of endocrine disrupting chemicals, banned in 112 countries etc.
19.	Oxyfluorfen	Alteration in blood parameters causes' anaemia haemolytic consequences and in liver, toxic to aquatic organism and carcinogen etc.
20.	Pendimethalin	Incomplete toxicity data submitted, causes thyroid follicular cell adenoma, toxic to aquatic organism etc.
21.	Quinalphos	High acute mammalian toxicity and is an organo phosphorus compound and highly toxic to aquatic organism etc.
22.	Sulfosulfuron	Development of resistance in the target weeds in Punjab, Haryana and Uttarakhand etc.
23.	Thiodicarb	Highly mammalian toxicity, Methomyl is a metabolite, toxic to aquatic organism and honey bees etc.
24.	Thiophanant emethyl	Carbendazim is an active component of Thiophanate Methyl and Benomyl, toxic to earthworm etc.
25.	Thiram	Metabolites M1 and NDMA is a concern, risk to birds, toxic to aquatic organism etc.
26.	Zineb	Falls under category 2 of European union prioritization of endocrine disrupting chemicals, Level of ETHYELENETHIOUREA, (ETU) is a concern from toxicity point of view, toxic to aquatic organism etc.
27.	Ziram	Also falls under category 2 of European union prioritization of endocrine disrupting chemicals, toxic to aquatic organism etc.

Conclusion

Pesticides are important substances for controlling the pests in the field condition so that we can get healthy crops and high production. By using pesticides which are highly toxic or more use of it can causes many major problems from crops, environment including human beings. So as concerning about benefit of all living organism and for our better eco-friendly future the government of India banned these pesticides. As these pesticides are banned in many countries and present alternatives of pesticides are also available in India.

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Review on Analysis of Groundwater Level and Fluctuation During Pre-Monsoon and Post-Monsoon Using GIS Application

Article ID: 31070

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Abstract
Groundwater trends are declining throughout the world due to the continuous increase of ground water withdrawal to meet the daily needs of growing population. The groundwater in the shallow aquifers gets replenished annually and therefore, the status of water levels and its fluctuation play a key role in the assessment of groundwater. The pre-monsoon and post-monsoon groundwater levels indicate the degree of saturation and extent of recharge in the hard rock aquifers. The spatial and temporal graphical analysis for the observation sites of the unconfined aquifer indicated that there is a good hydraulic connection of groundwater level with the rainfall. The aims of this study to evaluate the spatial and temporal changes in the groundwater level and fluctuation during pre-monsoon and post-monsoon.

Introduction
Ground water and surface water are in a continuous dynamic interaction. They interact in a variety of physiographic and climatic landscapes. The alteration or contamination of one commonly affects the other (Yang and Wang 2010; Sophocleous 2002; Winter et al., 1999). For instance, pumping of ground water can deplete the level of water in streams, lakes or wetlands; and surface water bodies also deplete the ground water (Chang and Anderson, 1993).

As part of the water cycle, some precipitation infiltrates the ground and percolates down until it reaches a depth where all the fractures, crevices and pore spaces are saturated with water. The upper surface of a zone of saturation is the water table. Water from beneath the ground has been exploited for domestic use, livestock and irrigation since the earliest times. Although the precise nature of its occurrence was not necessarily understood, successful methods of bringing the water to the surface have been developed and groundwater use has grown consistently ever since.

It is, however, common for the dominant role of groundwater in the freshwater part of the hydrological cycle to be overlooked. Water is drawn from the ground for a variety of uses, principally community water supply, farming (both livestock and irrigated cultivation) and industrial processes. Unlike surface water, groundwater is rarely used in situ for non-consumptive purposes such as recreation and fisheries, except occasionally where it comes to the surface as springs.

Consequently, ground-water is invariably directed towards factors which may lessen the suitability of pumped groundwater with respect to its potability and use in agriculture and industry (Palanichamy, 2017). Groundwater resources are explored in nature with the development of Irrigation activities, Industrialization and urbanization. The lowering of groundwater levels has resulted in reduction in individual well yield, growth in well population, failure of bore wells, drying up of dug wells and increase in power consumption (Imtiyaz and Rao, 2008).

Groundwater is often developed without proper understanding of its occurrence in time and space and is, therefore, threatened by over-exploitation and contamination. For that reason, groundwater management is the key to combat the emerging problem of water security. Knowledge of water table depth is a crucial element in many hydrological investigations, including agricultural salinity management, landfill characterization, chemical seepage movement, and water supply studies (Buchanan and Triantafilis, 2009).

Groundwater Level & Fluctuation: During Pre-Monsoon & Post-Monsoon
The ground water level fluctuation was analysed using Arc GIS software for long-term pattern in Tiruchchirappalli district of Tamil Nadu from1990 to 2011. It showed that during the pre-monsoon season the groundwater level varied from 4 metres to 12 metres in depth and during the post monsoon season the groundwater level was found to be from 3 metre to 9 meters (Palanichamy, 2017).

The investigated the ground water level and fluctuation using GIS application in between pre monsoon and post monsoon of 16-year data in the Patan block of Jabalpur district of M.P. India. The result showed that increase use of ground water for agriculture and the rise in agriculture area has leading ground water declination issue in study area (Pathak Rishi et al., 2017). To evaluate changes in the ground water table at spatial and temporal in the northwest (NW) Bangladesh for period 1991–2009. Trends analyses have been done by linear regression, Mann–Kendall Trend Test and Sen's slope estimator; and spatial analysis by Geographical Information Systems (GIS). The result showed that the change in ground water in dry condition is showed in magnitude where the rate of changes vary from 0.82 to 0.2 m/ year in dry season, from 0.67 to 0.2 m/year during monsoon season and 0.6 to 0.1 m/year in annual average time series (Rahman et al.,2016). The ground water fluctuation and depth in pre-monsoon and post-monsoon lies in upstream in the Bankeri block in M.P, India followed by Babai block and addressed to future for groundwater declination (Nema et al., 2017).

The spatial distribution of rainfall during pre-monsoon and post-monsoon in Chalk hills is located in northeast of Salem in Tamil Nadu, India. Frequency distribution analysis indicated that the ground water level was deep at Salem and Omalur rain gauge station and some place was shallow at Yercaud rain gauge station. The water levels remain stable only up to November but during January to May, the water level declines gradually due to water extraction for irrigation (Thilagavathiet al., 2014).To study the change in ground water level in pre-monsoon and post-monsoon season wells indcated lower and higher fluctuation at Badapur and Malkapur villages in the year 2008 at Jalnadistrict, Maharashtra, India (Rede, 2012).

Water Quality During Seasonal Rainfall

Pre- and Post-Monsoon Variation in Physicochemical Characteristics in groundwater quality of Bhopal, MP of India. Groundwater quality plays an important role in groundwater protection and quality conservation hence it is very much important to assess the groundwater quality not only for its present use but also a potential source of water for future consumption. In the present study an attempt has been made to identify the ground water quality of the city in Pre monsoon and Post monsoon phase in year 2007.

The physico-chemical parameters like pH, Electrical conductivity, Total hardness, Total alkalinity, Chloride, Sulphate, Sodium, Potassium, Mg and Nitrate were studied to analyze the potable ground water quality of the city. the study showed that during post-monsoon water quality was better but is conditon is reverse during monsoon.Extent of pollution occurred due to over exploitation of ground water, urbanization and anthropogenic activities (Jinwal and Dixit, 2008).To examine the spatial–temporal variations and factors influencing the management of groundwater along a section of the Bagmati river corridor in the Kathmandu valley (Nepal). The results showed that rural areas were less polluted than urban areas. In urban areas, the Biochemical Oxygen Demand (BOD), Total Nitrogen (TN) and Total Phosphorus (TP) concentrations ranged from 8.41 to 29.74 mg/L, 6.7 to 128.96 mg/L and 0.06 to 1.5 mg/L, respectively. In rural areas, the BOD, TN and TP concentrations ranged from 0.78 to 18.25 mg/L, 4.8 to 11.56 mg/L and 0.07 to 0.65 mg/L, respectively. The level of organics was higher in the pre-monsoon season, while the level of nutrients was higher in post-monsoon season (Kannel et al., (2008).

The quality of water from shallow wells in three districts in southern Malawi namely, Balaka, Chikwawa and Zomba districts from 2006 to 2007. water sample was collected from covered wells and open wells to analysed for chemical, microbiological and physical parameter using a portable water testing kit in time duration of two-year i.e.in August and October 2006 (dry season) and February and April 2007 (wet season). Microbiological data indicated that around 80 per cent of the samples, obtained from the covered wells, failed to meet safe drinking water limits, set by World Health Organisation guidelines and Malawi Bureau of Standards, of zero total and faecal colony forming units (cfu)/100 ml. Values in excess of 1000 cfu/100 ml were noted in 10 per cent of the samples, indicating gross contamination and the probability of pathogens being present. Contamination levels were higher during the wet season than the dry season in all three districts. Arsenic, ammonia, nitrate and sulphatewere all within the acceptable limits. Elevated levels of hardness, turbidity was noted in certain wells (Pritchardet al., 2008).

Conclusion

The fluctuation of in the level of underground water is depend on distribution and amount of rainfall and the quality of groundwater was much better in post-monsoon phase as compared to that of the pre-monsoon phase. Groundwater starts to replenish the shallow aquifers during NE monsoon season and reaches high during post-monsoon period when plants are dormant and evaporation rates are less. The study suggested that there is an evidence of decline of ground water levels due to increase in Agriculture area which ultimately had an impact on water inflow thus less recharge happened and similarly increase in Ground water withdrawal in agriculture production as well as growing population demand in area has also impacting the ground water declination in study area.

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Molecular Techniques for Detection of Insect Infestation in Stored Grain

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Introduction

From times immemorial there are many conventional methods for detection of insects in stored grain in large bulks in storage godowns where different techniques like acoustics which relies on sound produced by insects during feeding and movement on the grain bulks were used where in equipment used in this technique are Microphones and Piezoelectric sensors, another method is Near-infrared (NIR) spectroscopy which provides information based on the reflectance properties of different substances present in a product, based on the absorption of electromagnetic wavelengths in the range 780–2500 nm.

Disadvantages of Conventional Methods

Acoustics: Small insects, young larva are weak emitters of sound so it is difficult to detect the sounds made by initial instars, Very noisy operations of the instrument .

Carbon-dioxide measurement method: Higher levels of carbon-dioxide confirm the extent of spoilage-cannot detect lower levels of infestation, it implies that higher the level of CO_2, higher the insect activity. This method works only when higher amounts of CO_2 are emitted by the insects which indicates that half of the damage would already have been done by this time.

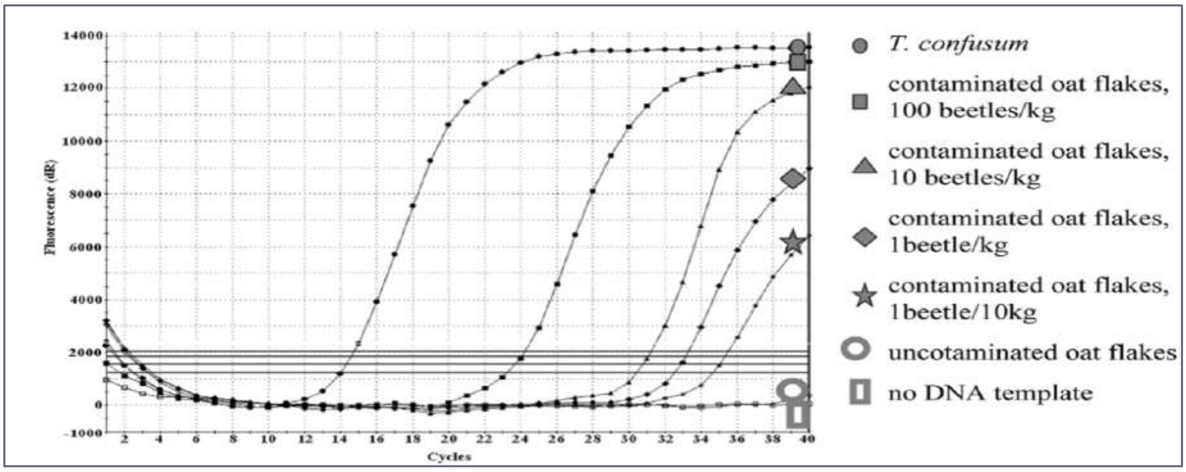
Near infrared radiation: Can't discriminate between dead and live insect.

Why Shift to Molecular Methods of Detection?

1. The essential aim of attempting to detect insects in stored food is to locate them in the early stage of infestation so that pests will not be present in consumer products, Conventional detection methods can prove less sensitive to low population densities.

2. However, conventional methods do not always meet the requirements of the modern large-scale food industry for rapid and inexpensive detection techniques.

Types of Molecular Detection



Detection of contamination by *Tribolium confusum* based on molecular biology techniques of standard and real-time polymerase chain reaction (PCR) was done where Sequences of internal transcribed spacer (ITS) fragment of rDNA and subunit I of mitochondrial cytochrome oxidase of *T. confusum* were chosen wherein DNA samples isolated from contaminated oat flakes and uncontaminated oat flakes were selected, This approach makes it possible to assess the presence of infestation with *T. confusum* quantitatively. The analysed samples and positive control and other contaminated samples gave positive results entering the logarithmic phase between 14 and 35 cycles of amplification ,with a cycle threshold (Ct) value of 24.71 The Ct is depended as the cycle at which PCR enters the exponential phase and the fluorescence emission exceeds the fixed threshold. It means more the number of insects; more will be the amount of fluorescence emitted with respect to the number of cycles.

Similarly, Randomly Amplified Polymorphic DNA markers are another technique for the identification of different strains based on polymorphic DNA revealing was investigated with grain insect species. The banding patterns observed from DNA extracts with different primers were compared between several grain insect species: *Sitophilus* spp., *Oryzaephilus surinamensis, Rhyzopertha dominica, Tribolium castaneum, Ephestia kuehniella, Plodia interpunctella,* and three bruchid beetles.The repeatability of the banding patterns was tested on: i)extracted DNA from pool samples of different stages and generations in the same strains; ii)Extracted DNA from individuals of the same species and strain. The differences observed in band profiles of the different species, the potential for RAPD-PCR technique to provide useful genetic data for the discrimination up to the population level of insects found in stored products .

Likewise, To establish species-specific restriction sites profile for 28S rDNA sequences of *T. castaneum* and *T. confusum,* restriction site analysis was made using PvuI endonuclease with unique sites after DNA extraction, PCR amplification and sequencing, Genetic differentiation analysis. PvuI was selected to achieve the species-specific pattern for distinguishing the two species. The recognition site of PvuI was CGATCG, and the amplified 28S rDNA fragments of *T. castaneum* and *T. confusum* had one and two recognition sites, respectively. If point mutations occurred within these recognition sites, the observed restriction patterns of 28S rDNA digestion with PvuI of *T. castaneum* and *T. confusum* should be changed. However, this can be avoided due to the high conservation of 28S rDNA region , PCR-RFLP assay successfully differentiated adult individuals of *T. castaneum* and *T. confusum* but the method can be used with larvae and pupae because genome DNA did not vary between adults and immature forms.

Conclusion

Molecular biology techniques used for detection have proved to be rapid and reliable and allow for large-scale analysis of multiple samples and are highly sensitive in detecting one insect per kilogram of infested grain.

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Artificial Intelligence May be Key to Better Weather Forecast

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Weather forecasting is a complex science. Several models are working to predict future weather. The accuracy of weather predictions has increased over time, but it is still not 100% accurate. Artificial Intelligence could be employed to improve the accuracy and reliability of weather forecasting.

Introduction

Weather forecasting is the application of science and technology to predict the conditions of the atmosphere for a given location and time. It helps people to prepare more meticulously in response to the possible natural disaster that might occur. It can help farmers make decisions about farming, like planting, harvesting and other agricultural operations. Weather forecasting is a complex science. It deals with massive data sets collected from thousands of weather satellites every day. Gathering the data, identifying patterns in the observations made, and then deducing results to get accurate weather predictions can be quite strenuous. Besides, almost all of this needs to be done in real-time. To prevent disasters, it is absolutely important that weather data is collected and analysed in real-time. Given the inherent complexity involved in weather prediction, scientists are now using AI for weather forecasting to obtain refined and accurate results, fast!

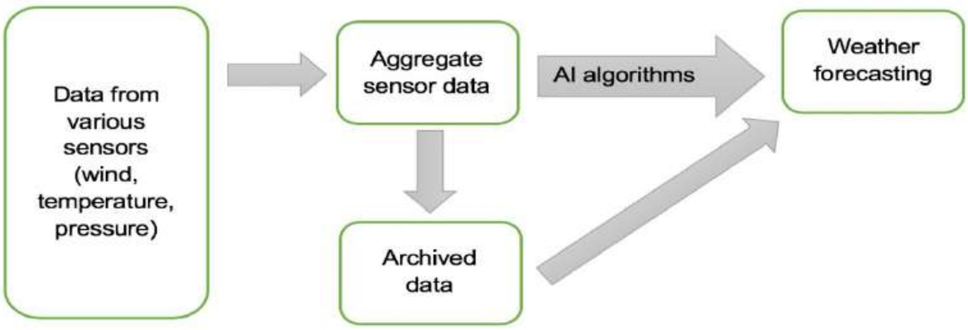
What is Artificial Intelligence (AI)?

The modern definition of artificial intelligence (or AI) is "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions which maximizes its chances of success (1).

Why AI is Necessary?

Weather forecasting is something of an educated guess. We cannot control the weather; the best meteorologists can do, is to use past and present data and patterns to attempt to predict the future. The traditional models of weather forecasting are based on statistical measures of numeric models, and it does not give answers in binary. As the atmosphere is constantly changing, estimates over long periods have proved to be very difficult to model and predict. The data collected can be from deep space satellites (e.g., NOAA's Deep Space Climate Observatory (DSCOVR), weather balloons, radar systems, now casting weather warnings and environmental analytics and sometimes from IoT based sensors. The accuracy of weather predictions has increased over time, but it is still not 100% accurate. But with ever-increasing data set, changing atmospheric conditions, the accuracy of the predictions may fluctuate, especially for more extended periods. But this is where AI could be employed to improve the accuracy and reliability of weather forecasting.

How is AI Being Employed to Help Predict the Weather?



The enormous data sets required and inherent unpredictability of the Earth's atmosphere makes predicting future events very tricky indeed. These include things like how the Sun heats the Earth's atmosphere; how pressure differences are affected wind patterns and how water-changing phases (ice to water to vapour) affect energy flow through the atmosphere. They also need to consider the Earth's rotation in space which helps churn the atmosphere throughout the day. Any tiny change in one variable can profoundly change future events.

The AI predictions are primarily based on machine learning algorithms. Machine learning can abet with other forecasts as well, including temperature, wave height, and precipitation. AI uses computer-generated mathematical programs and computational problem-solving methods on vast data sets to identify patterns and make a relevant hypothesis, generalizing the data. By using deep learning mathematical models, AI could learn from past weather records to predict the future.

One such popular model is the Numerical Weather Prediction (NWP). The model studies and manipulates vast data sets relayed from weather satellites, relay stations, and radiosondes to deliver short-term weather forecasts or long-term climate predictions. Other AI techniques for weather predictions are Artificial Neural Network, Ensemble Neural Network, Back propagation Network, Radial Basis Function Network, General Regression Neural Network, Genetic Algorithm, Multilayer Perceptron, and Fuzzy clustering (2).

Some Reviews

In 1996, IBM was one of the first companies to use computer systems to improve predictions about the weather. Now, after purchasing The Weather Company in 2016 and its properties, including weather.com, Weather Underground, the Weather Company Brand, and WSI, IBM plans to use Weather Company's extensive data set with IBM Watson's advanced cognitive computing capabilities and Cloud platform to transform the weather forecasting future. The result of this merger is IBM Deep Thunder. Deep thunder offers its' business customers hyper-local weather forecasts with a 0.2 to 1.2-mile resolution (3).

A researcher team at NOAA found that "applying AI techniques along with a physical understanding of the environment can significantly improve the prediction skill for multiple types of high-impact weather." This type of weather includes events like severe thunderstorms, tornadoes, and hurricanes. Last year another team of researchers at Penn State, AccuWeather, Inc., and the University of Almeria in Spain designed a computer model that can detect the movement of "comma-shaped" clouds in the satellite images. These clouds are hard to be noticed and are associated with cyclone formations. This model can forecast results with 99 percent accuracy, at an average of 40 seconds per prediction (3).

Google's AI forecast tool that is based on the UNET convolutional neural network (CNN) allows researchers to generate accurate rainfall predictions six hours ahead of when the precipitation occurs. CNN is a sequence of layers of mathematical operations arranged in an encoding phase. It takes the input satellite imagery and then transforms them into output images. The layers iteratively decrease the resolution of the images passing through them in an encoding phase, and the low-dimensional representations of the image created by the encoding phase are expanded back to higher resolutions in the following decoding phase (4).

Advantages of Using AI for Weather Forecasting

1. Reduction in Human Error.
2. Takes risks instead of Humans.
3. Available 24×7 Hours.
4. Helping in Repetitive jobs.
5. Digital Assistance.
6. Faster Decision.
7. Daily Applications.
8. New invention.

Disadvantages of Using AI for Weather Forecasting

1. High cost creation
2. Making Humans Lazy

3. No Emotions
4. Lacking out of Box Thinking.

Summary

The weather forecasting features of AI are multifold, from helping in disaster management to logistics and retail industry to agriculture. Someday we can use it for radar imagery to detect storm centres, high precipitation in the world and pest seasons. These are some advantages and disadvantages of Artificial Intelligence. Every new invention or breakthrough will have both, but we as humans need to take care of that and use the positive sides of the invention to create a better world. Clearly, artificial intelligence has massive potential advantages. The key for humans will ensure the "rise of the robots" doesn't get out of hand. Some people also say that Artificial intelligence can destroy human civilization if it goes into wrong hands. But still, none of the AI application made at that scale that can destroy or enslave humanity. But one should not forget that despite boosting the accuracy levels, weather forecasting can never be a hundred percent specific. The idea is to overcome the current shortcoming in the prediction and analysis process, which is where Artificial Intelligence is filling the gaps.

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Impact of Agronomic Practices on Carbon Sequestration

Article ID: 31073

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Introduction

The Fourth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) has reconfirmed that the global atmospheric concentrations of carbon dioxide (C02), methane and nitrous oxide, greenhouse gases (GHGs), have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The IPCC has projected that temperature increase by the end of this century is expected to be in the range of 1.8- 4.0°C (IPCC 2007a). For Indian region (south Asia), the IPCC has projected 0.5-1.2°C rise in temperature by 2020, 0.88-3.16 °C by 2050 and 1.56-5.44°C by 2080 depending on the scenario of future development (IPCC 2007b). Globally, carbon dioxide concentration increases from 316 ppm in 1960 to 411 ppm in 2019. Such global climatic changes will affect agriculture through their direct and indirect effects on crops, soils, livestock and pests. Increase in temperature, depending on the current ambient temperature, on the other hand, can reduce crop duration, increase crop respiration rates, affect the survival and distribution of pest populations, hasten nutrient mineralization in soils, decrease fertilizer-use efficiencies and increase evapotranspiration. Indirectly, there may be considerable impact on agricultural land-use due to snow melt, availability of irrigation, frequency and intensity of inter- and intra-seasonal droughts and floods, soil organic matter transformations, soil erosion, decline in arable areas (due to submergence of coastal lands) and availability of energy.

Carbon Sequestration (CS)

Carbon sequestration is the capturing and secure storage of carbon that would, otherwise, be emitted or remain in the atmosphere. Carbon dioxide is absorbed by plants through photosynthesis and stored as carbon in biomass in tree trunks, branches, foliage and roots and soils. Increasing soil carbon by 1 Pg through carbon sequestration is equivalent to reducing atmospheric CO_2 concentration by 0.47 ppm. (Lal, 2007).

Ways that Carbon Can Be Sequestered

1. Geological sequestration: Geologic Storage involves capturing anthropogenic CO_2 before it enters the atmosphere and injecting it into underground formations. Once CO_2 is injected deep underground (typically more than 800 meters) it is trapped in minute pores or spaces in the rock structure. Impermeable cap rocks above the storage zones act as seals to ensure the safe storage of CO_2.

2. Ocean sequestration: Carbon is naturally stored in the ocean via two pumps, solubility and biological and there are analogous man-made methods, direct injection and ocean fertilization, respectively. At the present time, approximately one third of human generated emission are estimated to be entering the ocean.

3. Terrestrial Sequestration: The process through which carbon dioxide from the atmosphere is absorbed through photosynthesis and stored as biomass and soils.

Why C-Sequestration Needed

1. Higher soil fertility status
2. Overall enhancements of soil quality (Physical, chemical and biological properties improved)
3. Increased crop yields and income of farmers
4. Rehabilitation of degraded land and reduced animal pressure on land
5. Benefits for global climate change (Reduced C losses from soil and increased CO2 uptake from the air)

Management Practices: Agronomic Practices to Enhance C-Sequestration

There are different strategies for improving carbon sequestration and those are described below:

1. Conservation till or no till: Conservation tillage is the collective umbrella term, commonly given to no-tillage, direct-drilling, minimum-tillage, and/or ridge-tillage, to denote that the specific practice has a conservation goal of some nature. Usually, the retention of 30% surface cover by residues characterizes the lower limit of classification for conservation tillage, but other conservation objectives for the practice include conservation of time, fuel, earthworms, soil water and nutrients.

2. Residue returns as mulch: Cropland offers a huge potential for sequestering C, especially when crop residues are managed properly. Permanent or semi-permanent crop/plant residue cover on soil, which can be a growing crop or dead mulch, has a role to protect soil physically from the sun, rain, and wind and to feed soil biota/microorganisms that take over the tillage function and soil nutrient balancing. It helps in water conservation through enhanced water infiltration, and reducing evaporation, and wind and water erosion.

3. Laser land levelling: This alters fields having a constant slope of 0-0.2% using laser-equipped drag buckets and gives a smooth land surface (± 2 cm). Large horsepower tractors and soil movers equipped with global positioning systems (GPS) and/or laser-guided instrumentation help to move soil either by cutting or filling to create the desired slope. Laser levelling provides a very accurate, smooth, and graded field, which helps in saving of irrigation water up to 20% and improves the use efficiency of applied N.

4. Bed Planting (Narrow/Broad Beds): In bed planting, crops are grown on the raised beds alternated by furrows. Beds are usually made at 0.6-1.0 m wide, and two to three rows of crops are sown on the beds. The furrow-irrigated raised-bed system (FIRBS) of wheat cultivation has been shown to result in saving of seed by 25-40%, water by 25-40%, and nutrients by 25%, without affecting the grain yield (Das, 2012).

5. Direct-Seeded Rice: Direct dry seeding of rice with subsequent aerobic soil conditions reduces overall water demand; saves labour, fuel, and time; and gives similar yield to transplanted rice, if weeds are effectively controlled. The technology does not affect rice quality and can be practiced in different ecologies such as upland, medium, and lowland and deep water and irrigated areas (Pathak et al. 2012).

6. Leaf Colour Chart (LCC): Leaf colour chart (LCC) is an easy-to-use and inexpensive tool for site-specific N management in crops/plants. Use of the LCC would promote timely and efficient use of N fertilizer in rice and wheat to save costly fertilizer and minimize the fertilizer-related pollution of surface and groundwater. It is a promising eco-friendly and inexpensive tool in the hands of the farmers.

7. INM: The common recommended management practices leading to improve soil C sequestration under integrated nutrient management include the use of manures, compost, crop residues, and biosolids, mulch farming, conversation tillage, agroforestry, diverse cropping systems, and cover crops (Lal 2004). All these practices have the potential to alter C storage capacity of agricultural soil. The addition of fertilizer on a regular basis leads to an increase in SOC and soil microbial biomass and also alters soil C and N dynamics.

8. Improved cultivars: Selection of improved varieties of different crops can improve both above and below ground biomass.

9. Restoring wetlands: Many wetland systems are degraded and in need of restoration. So, restoring mangroves, salt marshes and sea grasses would return in carbon benefit led to carbon sequestration.

Benefits of Carbon Sequestration

1. Improve structural stability and plant available water
2. Reduce soil erosion
3. Affecting thermal properties
4. Storing and cycling of nutrients
5. Sustaining biological activity, diversity and productivity
6. Increase agronomic productivity and brings sustainability in production system
7. Reduces atmospheric CO2 concentration thus helpful to mitigate the global warming issue.

Conclusion

Soil carbon sequestration is an important cost-effective tool in climate change mitigation program. Conservation agriculture, organic farming, agroforestry and biochar application can easily be adopted and these practices have positive impact on soil carbon sequestration and crop productivity. Crop diversification and intercropping could be a viable option for enhancing carbon sequestration in changing climatic scenario. For sequestering the atmospheric carbon and for maintaining sustainability, integrated nutrient management has a pivotal role. It requires knowledge, thorough understanding, proper channel to disseminate the technology, financial back up and govt. efforts.

Future Aspects

Long-term impacts of conservation agricultural practices on soil quality still need to be assessed. Standardized methodologies are required for estimating above and below - ground C stocks to improve the reliability of data Any single process cannot improve the carbon sequestration in soil. Therefore, there is need of multidisciplinary approach with scientist, farmers, and policy-makers to come together for mitigating this threat.

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Factors Influencing Nematode Population in Soil

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There is a complex relationship between plant parasitic nematodes, plants and soil climate and soil environment. Soil environment includes soil temperature, soil pH, soil texture, soil chemical composition, soil aeration etc. the spectrum of nematode population at a given point of time is the result of interactive ambient of abiotic and biotic factors. The principal characters in the soil environment are discussed below.

Abiotic Factors

1. Temperature
2. Moisture and Aeration
3. Texture
4. Osmotic Pressure
5. Chemicals
6. pH.

Biotic Factors

1. Host plants
2. Micro-organisms
3. Distribution.

Soil Temperature

1. Temperature plays an important role in nematode activities like hatching, reproduction, movement, multiplication, survival, feeding etc.
2. It affects the nematode activities like hatching, reproduction, survivability, movement, development of nematodes.
3. 5-150C – most of the nematodes remains inactive.
4. Most of the plant parasitic nematodes have optimum thermal requirements between 15-300C.
5. 30 – 400C- most nematode remains inactive.
6. But further extremes of lower and upper limits may be lethal.
7. By applying hot water at 180-degree F for 3 hrs all nematodes will die.
8. *M. hapla* survives well in <15°C for growth and development.
    Ex. *H. rostochiensis:*
    a. Invading host: 15 -160° C
    b. Cyst emergence: 21-250° C
    c. Development: 18-240° C

Soil Moisture

Agriculture soils are best with wide fluctuations in soil moisture.
1. Fluctuation in soil temperature due to rainfall or irrigation influence nematode population in the soil.
2. Soil aeration is inversely related to moisture content.
3. Nematodes require a thin film of water for their biological activities.
4. In *Meloidogyne incognita* flooding of the soil for 2 weeks regulate the nematode population. Due to the flooding, deficiency of oxygen and fatty acids are released.
5. Eggs of the most of the nematodes are well protected under desiccated condition. Due to the presence of gelatinous matrix it protects the egg from desiccation.

6. Excessive moisture tends to inhibit the locomotion of nematodes in soil. Lack of oxygen in saturated soil also adversely affects nematode population due to asphyxia.
7. Soil aeration mostly regulates the life processes of different organisms including the plant parasitic nematodes present in the soil.
8. It also depends on biological and chemical activities going inside the soil system.
9. Soil aeration depends on moisture content of the soil, particle size, pore space, soil texture, water holding capacity of soils, agricultural operations and other activities of organisms present in the soil.
10. Ex: *Hirschmanniella* spp. thrive well in flooded soils of rice field.

Soil Texture

1. The relative proportion of sand, silt and clay determines the soil texture.
2. In coarse texture soil there is high percentage of sand and large pore space which drains the soil very quickly than the fine texture soils.
3. Many of the cyst nematodes, root knot nematodes are found in coarse texture soil.
4. However sugar beet cyst nematode and some sps of lesion nematode, stunt nematode is heavy in clay soils.
5. Certain nematodes prove more pathogenic in light textured soil.
6. Ex: *Heterodera avenae* on wheat and barley.
7. *Rotylenchus reniformis* thrive well in fine and medium textured soils.

Soil Chemicals

1. The concentration of chemical constituents of soil fluctuates drastically depending upon soil moisture content.
2. The use of chemical fertilizer, organic manures, pesticides etc. further add to the dynamism of soil chemistry.

Soil pH

1. pH does not affect the nematodes directly.
2. Severely affects in hatching.
3. Variation in nematode activity is mainly due to soil pH.
4. They can exist within normal pH range (4-8) of agricultural soils, provided it safe for host plant growth.
5. Reduction in pH from 6 to 4 decreases the emergence of juveniles of *H. rostochinensis*.
6. *Pratylenchus penetrans* optimum pH: 5.5-5.8.

Osmotic Pressure

1. Osmotic pressure also plays role in influencing nematode population.
2. Most of the nematodes can tolerate up to 10atm.
3. Osmotic pressure acts as stimulating agents.
4. Ex- Juveniles of *Heterodera schachtii* shrink in concentration of Nacl solution.
5. More number of root knot nematodes are found in high saline soils.
6. Osmotic destruction occurs in nematodes.
7. Ex- *Meloidogyne Arenaria.*

Biotic Factors: Hosts Plants

1. Crops and cropping pattern influence plant parasitic nematode populations tremendously.
2. Some nematodes have wide host ranges while others parasitize only selected hosts.
3. The status of host is highly variable.
4. The multiplication rate of nematode species may be very high on a plant species (good host); while some other plant species (poor host) may not be very favourable for multiplication.

Organic Amendments

1. During decomposition of organic matter, microbial population of parasitic and predaceous fungi and also bacteria, nematodes, tardigrades, collembolan their population increase. They suppress the nematodes in soil system.

2. During decomposition it releases some toxic compounds which are nematocidal in nature. These compounds which have some rhizosphere effect.
3. The release of toxic compounds toxicates the soil water.
4. They have some direct effect on the nematode population.
5. The toxic materials release during decomposition interfere the nematodes physiology.
6. It helps in the improvement soil physical and chemical properties indirectly it suppresses.
7. For the management of root knot nematode the application of cellulose, chitin is quite effective. Both are source of organic matter.
8. The population of *Hirschmanniella mucronata* in deep water rice can be reduced by the application of water hyacinth if applied 7 days before transplanting.

Micro Organisms

1. Soil microorganisms in the rhizosphere influences nematodes in various ways.
2. The microorganisms are mostly antagonist to plant parasitic nematodes.
3. During decomposition process lot of gasses, organic acids like oxalic acids, fumaric acids, acetic acid and nitric acid are released.
4. These gaseous compounds are nematocidal in nature.
5. In flooded situation when anaerobic condition arises H2s gas are released to maintain the equilibrium.
6. The nature of damage by nematodes to plants may be drastically influenced by other plant pathogenic organisms (fungi, bacteria and virus) present in rhizosphere.
7. Nematodes actively interact with these organisms resulting in disease complexes which are common places in nature.

Distribution

1. The locomotion of nematodes per sec is very limited.
2. They can hardly move a few cm in a year by their own movement.
3. They can spread by various means.
4. Short distance spread is usually facilitated by irrigation, agricultural machinery, wind, livestock, etc.
5. Long distance occurs through plant propagating material, seedlings, saplings etc.

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Genetic Engineering and New Technologies in IPM

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Introduction

In recent years the area of genetic engineering has provided an altogether new approach for circumventing the use of chemical insecticides for controlling the insects and pests. This approach employs the techniques of molecular biology whereby genes coding for insecticidal proteins can be identified, isolated, mobilized and expressed in crop plants.

Such transgenic plants thus acquire the ability which is heritable to protect themselves from insect pest attack. Genes for insecticidal proteins like delta endotoxin, protease inhibitors, α-amylase inhibitors, lectins, cholesterol oxidases and vegetative insecticidal proteins have been identified against the insect pests.

Insect Resistance Cultivars

Insects cause heavy damage to cultivated crop plants. Production of proteinaceous inhibitors that interfere with the digestive biochemistry of insect pests is one of the naturally occurring defence mechanisms in plants. These proteins include lectins, arcelins and inhibitors of alpha amylases and proteases of various larvae pests.

Use of plant genes encoding effective inhibitors of major digestive enzymes, such as protease and a-amylase inhibitors of the target pest species is emerging as viable approach for the production of pest resistant transgenic crop plants.

Therefore, it is important to characterize proteins and their genes from our indigenous crops in order to strengthen and broaden our gene bank for pest control manipulations. The availability of diverse insecticidal proteins and their genes from different plant species will make it easier to use one or more genes in combination to develop resistant crop plants.

Cry Genes from Bacillus Thuringiensis

Transgenic crops modified by cry (Bt) genes (from bacterium *Bacillus thuringiensis*) are so far the only insect resistant transgenic crops grown commercially. Cry genes were also the firstly used insecticidal genes for plant transformation. *B. thuringiensis* (Bt) is a gram-positive bacterium producing highly insecticidal protein crystals also called Bt toxins during sporulation.

Spores and protein crystals of several strains of this bacterium have been used as bioinsecticide for many years. After ingestion by susceptible insects, toxins bind to specific receptors in the gut and are solubilized and activated by proteinases in the insect midgut epithelium. The activated toxins induce the formation of a lytic pore in the midgut epithelial membrane that results in cell lysis, cessation of feeding, and death of the larva Separate strains of Bt produce a variety of crystal toxins.

More than 400 genes encoding toxins from wide range of B. thuringiensis have been identified so far. Many of the identified cry genes (for example cry1Aa, cry1Ab, cry1Ac, cry1Ba, cry1Ca, cry1H, cry2Aa, cry3A, cry6A, cry9C, cry1F) have been engineered into plants. Most cry proteins, even within cry1A subfamily, have a distinctive insecticidal spectrum. While some crystal toxins are specific to, and affect, larvae of lepidopteran pests, some other are toxic to coleopteran, or dipteran pests.

Plants encoding Bt toxins have no need of protection with other insecticides, which results in less damage to the environment and prevents other negative effects of insecticide application. Alternative way to avoid or slow down development of insect resistance is steacking insecticidal genes with different mode of action against insects in transgenic plants. As it will be cleared hereinafter, many genes of a different origin are potential candidates for such stacking or for sole expression in order to confer resistance of transgenic plants.

Resistance Genes from Higher Plants

From a wide range of insecticidal plant secondary metabolites, genes for protein antimetabolites:
1. Proteinase inhibitors.
2. α-amylase inhibitors.
3. Lectins have been extensively used for plant transformation to confer insect resistance.

Proteinase Inhibitors

Insect proteinases are essential digestive enzymes that catalyse the release of amino acids from dietary protein to provide the nutrients required for larval growth and development. Whereas serine proteinases (trypsin-, chymotrypsin- and elastase like proteinases) are predominant in lepidopteran midgut, midguts of coleopteran species are rich in cysteine and aspartic proteinases.

The mode of PI action on insects is still under debate, and it remains to ascertain whether PIs' deleterious effects stem from an anti-digestive effect through proteolysis inhibition or from a toxic effect by inducing proteinases hyperproduction, leading to a shortage in amino acids. PIs can also affect the water balance, moulting and enzyme regulation of the insects. Consequences are reduced growth and development of insects but also death. PIs reduces proteolytic enzyme activity in vitro in a number of insect species.

α-Amylase Inhibitor

Protein α-amylase inhibitors are widespread and have been isolated from a variety of plant species and microorganisms. The physiological role of α-amylase inhibitors in plants is uncertain, but there is some evidence that they may act as protein reserve in seeds. α-amylase inhibitors function in a similar manner as proteinase inhibitors, interfering with insect nutrient utilization.

Lectins

Lectins are a group of proteins that are found in plants and they discourage predation by being harmful to various types of insects and animals that eat plants. The best-characterized family of plants lectins are *Fabaceae, Poaceae* and *Solanaceae*; especially some of leguminous seeds have a remarkable amount of lectin. Different food crops such as tomato, wheat, rice, potato, soybean and bean contain lectins.

The great majority of the plant lectins are present in seed cotyledons but a lot of them are also found in the protein bodies such as roots, leaf, stems, rhizomes, bark, bulbs, tubers, corms, fruits, flowers, ovaries, phloem sap, latex, nodule andNew Perspectives in Plant Protection even in nectar. Plant lectins function as storage proteins and they have been implicated in defence mechanisms against phytophagus insects.

Ribosome Inactivating Proteins

Ribosome-inactivating proteins (RIPs) are a group of plant proteins that are capable of inactivating eukaryotic ribosome's and accordingly are called ribosome-inactivating proteins, which play an important role in plant defence and hence can be exploited in plant protection. RIPs are subdivided on the basis of their molecular structure into three distinct groups.

Type-I RIPs is composed of a single polypeptide chain and endowed with a variety of activities including immunosuppressive/anti-mitogenic, anti-tumour/anti-proliferative, and anti-viral activities. Type-I RIPs has also entomotoxic activity toward Lepidopteran insects. Type-II RIPs is a heterodimer consisting of two polypeptide chains (A & B chains), which A-chain is linked through a disulfide bridge to a B-chain. The A-chain has an N-glucosidase activity of the ribosomal ribonucleic acid (rRNA) and B-chain contains carbohydrate-binding domains and is also regarded as lectin. They are defence proteins that directly targeted plants eating organisms.

Whereas, type-III RIPs have a single chain containing an extended carboxyl-terminal domain with unknown function. Ricin, abrin and modeccin are well known examples of RIPs, Some of these such as ricin (type-II RIPs) have high toxicity effect against a variety of insects, RIPs may be able to bind to specific sites on the cell surfaces; either exerting their toxic action at the membrane level or after uptake and internalization of the toxic polypeptide chain. Most RIPs specifically recognize galactosyl terminated glycoproteins on the cell surface and as such facilitate the entry of the RIPs onto the cell, where it can exert its enzymatic activity on ribosome or other cellular structures.

Cholesterol Oxidase

Screening of filtrates from microbial fermentation often reveals presence of certain proteins which attack some insects. Transgenic leaf tissues expressing cholesterol oxidase exerted insecticidal activity against boll weevil larvae.

Conclusion

This new technology is seen as an additional tool for the control of insect pest and could offer certain advantages over conventional use of insecticides, such as more effective targeting on specific insects, greater resilience to weather conditions, no question of seasonal application, operator exposure and most importantly eco-friendly system.

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Vermicompost: An Ideal Waste for Soil Fertility

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Introduction

Vermicomposting is a mesophilic bio oxidative process in which detritivorous earthworm interacts with microbes and soil invertebrates within decomposer community, strongly affecting decomposition process, accelerating the stabilization of organic matter and inhancing its physical and biochemical properties. Vermicompost is an odourless, stabilized, dark brown, finely divided peat-like material with a low C: N ratio, high porosity and high water-holding capacity bio product in which most nutrients are present in available forms for plant.

Also called vermicasts as they are expelled as casts from the earthworm gut. Vermicompost contain nutrients such as nitrates, exchangeable phosphorus, soluble potassium, calcium, and magnesium in plant available forms and have large particular surface area that provides many microsites for microbial activity and for the strong retention of nutrients.

The actions of the earthworms in this process are both physical and biochemical. The physical actions include fragmentation, turnover and aeration. Whereas biochemical actions include nitrogen enrichment, enzymatic digestion, transport of inorganic and organic materials. Soil volume, microflora and fauna influenced by earthworms have been termed as drilosphere.

Type of Earthworms

Ideal earthworms (Epigeic species) for vermicomposting *Eisenia foetida, Eudrilus eugeniae, Perionyx excavates*. *E. Foetida* is most widely used species in vermicomposting. Earthworms are classified into epigeic, aneceic and endogeic species based on definite ecological and trophic functions.

Aneceic earthworms are *Lumbricus terrestris, Lumbricus, Polyphemus Aporrectodea longa*. Epigeics and aneceics are harnessed largely for vermicomposting. Epigeics such as *Eisenia foetida, Eudrilus eugeniae, Perionyx excavates, Eisenia anderi* have been used in converting organic wastes into vermicompost.

Some others earthworms are as follows: *Dendrobaena rubida, D. veneta, Eudrilus hortensis, Eudrilus. Eugeniae, Eudrilus Andrei Amynthas diffringens, Eisenia fetida, A. morrisi, Lampito mauritii, Metaphire anomala, M. birmanica, Perionyx excavates, P. sansibaricus, Megascolex megascolex, Pontoscolex corethrurus, Octochaetona serrata, O. surensis, Pheritima elongata, P. posthuman*, *Bimastos parvus*. The quality of the end product differs with the species and ecological groups of earthworms.

Type of Biomass Used

A wide range of organic wastes used which are as follows:
1. Horticultural residues from processed potatoes, Mushroom wastes, Horse wastes, Pig wastes, Brewery wastes, Sericulture wastes, Municipal sewage sludge, Agricultural residues, Weeds, Cattle dung, Industrial refuse such as paper wastes, Sludge from paper mills and dairy plants, Domestic kitchen wastes, Urban residues and animal wastes.
2. Cow dung serves as bedding material for earthworms and also as a food supplement.
3. Materials should not use such as stones, plastic, glass, scented leaves, bitter taste leaves, colocasia, citrus leaves etc.

Microbial Diversity

Earthworm have the potential to increase plant nutrient availability by the activity of earthworm gut microflora. Vermicompost harbours so many microbes including bacteria, fungus, actinomycetes etc. Fungus species: *Aspergillus flavus*, *Aspergillus niger*, *penicillium;* yeast: Saprophyte, Cladosporium etc.

Actinobacteria and Gamma-proteobacteria were abundant in vermicompost while conventional compost contained more Alpha-proteobacteria and Bacteriodetes. Plant growth-promoting rhizospheric bacteria such as Pseudomonas, Rhizobium, Bacillus, Azosprillium, Azotobacter, etc. along with rhizospheric soil, and they might get activated due to the ideal micro-environment of the gut.

This bacteriospecific group stimulates plant growth directly by solubilization of nutrients, production of growth hormone, 1-aminocyclopropane-1-carboxylate (ACC) deaminase nitrogen fixation, and indirectly by suppressing fungal pathogens. Antibiotics, fluorescent pigments, siderophores and fungal cell-wall degrading enzymes namely chitinases and glucanases produced by bacteria mediate the fungal growth-suppression. Earthworm microbes mineralize the organic matter and also facilitate the chelation of metal ions.

Earthworms increased the number of microorganisms in soil as much as five times and the number of bacteria and 'actinomycetes' contained in the ingested material increased upto 1,000-fold while passing through their gut. Gut of *E. foetida* contained various anaerobic N_2-fixing bacteria such as *Clostridium butyricum*, *C. beijerinckii* and *C. paraputrificum*. Earthworms harbour 'nitrogen-fixing' and 'decomposer microbes' in their gut and excrete them along with nutrients in their excreta. Actinobacteria and Gamma-proteobacteria were abundant in vermicompost, while conventional compost contained more Alpha-proteobacteria and Bacteriodetes, the bacterial phylogenetic groups typical of non-cured compost.

Nutrient Content

Vermicomposts are rich source of available nutrients such as organic carbon 9.15-17.98%, total nitrogen 0.5-1.5%, available phosphorus 0.1-0.3%, available potassium 0.15%, calcium and magnesium 22.70 -70 mg/100 g, copper 2 - 9.3 ppm, zinc 5.7-11.5 ppm and available sulphur 128–548 ppm. Large particular surface area that provides many microsites for microbial activity and for the strong retention of nutrients (Shi-wei and Fu-zhen 1991). Earthworms lower down the pH and C: N ratio in manure.

Chemical analysis showed vermicompost had a lower pH, EC, organic carbon (OC), C: N ratio), nitrogen and potassium and higher amounts of total phosphorous and micronutrients compared to the parent material. Humic acid substances occur naturally in mature animal manure, sewage sludge or paper-mill sludge, but vermicomposting drastically increases the rate of production and their amount from 40–60 percent compared to traditional composting.

Vermicomposting increased the concentration of nitrate-nitrogen to 28fold after 17 weeks, while in conventional compost there was only 3-fold increase. The observed increase of total phosphorous in vermicompost is probably due to mineralization and mobilization of phosphorus resulting from the enhanced phosphatase activity by microorganisms in the gut epithelium of the earthworm.

The variability in the effects of vermicompost may depend on the cultivation system into which it is incorporated, as well as on the physical, chemical and biological characteristics of vermicompost, which vary widely depending on the original feedstock, the earthworm species used, the production process, and the age of vermicompost. Vermicompost has more available nutrients per kg weight than the organic substrate from which it is produced.

Biochemical Composition

Wormcasts contain higher activities of cellulase, amylase, invertase, protease, peroxidase, urease, phosphatase and dehydrogenase. Mucus, excreted through the earthworm`s digestive canal, stimulates antagonism -and competition between diverse microbial populations resulting in the production of some antibiotics and hormone-like biochemicals, boosting plant growth. Digestive enzymes like amylase, cellulase, protease, lipase, mannase, chitinase have also been reported from the alimentary canal of earthworms.

The maximum enzyme activities (cellulase, amylase, invertase, protease and urease) were observed during 21–35 days in vermicomposting and on 42–49 days in conventional composting. Four species of indian earthworms such as *Octochaetona* surensis, *L. mauritii*, *D. calebi* and *Dichogaster balaui* rich source of protease, amylase, cellulose, invertase and urease enzymes. Higher activity of amylase, cellobiase, endoglucanase, acid phosphatase and nitrate reductase found in the gut of *E. eugniae* and *E. fetida*.

Vermiwash

Vermiwash is a brownish-red liquid extract or leachate collected during vermicomposting of organic waste rich in macro and micronutrients. Utilized as bio-fertilizers and can be used crops such as rice, Kharif crops, okra, other vegetables etc. It can also serve as a valuable foliar spray whereby it acts as a pesticide in sustainable agriculture because it is composed of excretory products and mucus secretions from earthworms and micronutrients from the organic molecules in the soil.

Benefits

Influence the growth, productivity of plants, germination percent etc due to their micro and macro elements, vitamins, enzymes and hormones. Uptake of nitrogen (N), phosphorus (P), potassium (K) and magnesium (Mg) by plant enhanced when fertilizer was applied in combination. There are so many benefits which are as follows: Plant growth promotion, Oxalate degradation, Improved distribution of nodules on some leguminous plant, Increased root nodulation and nitrogen fixation in legumes, Antimicrobial activity, promote free-living N2 fixers, Plant growth promotion by nitrification, phosphate solubilisation and plant disease suppression, Antifungal activity, Antagonistic activity.

It is used by gardeners and landscapers as a soil amendment. Improve soil structure by enhancing soil porosity, aeration, and moisture holding capacity resulting in enhanced plant growth.

Conclusion

An ideal organic waste manure because it provides available nutrient in soil and also enhance the soil fertility by adding beneficial microbes, biochemical substances to soils. It is an attractive approach for the treatment of organic waste, particularly in areas where there is no functioning of organic waste management. A cost-effective tool for environmentally sound waste management.

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Gramin Krishi Mausem Sewa (GKMS): A Crop Saviour Scheme

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Weather is one of the most important factors affecting the agricultural production. Every phase of growth and development in plant is affected by weather. Among the various weather parameters, rainfall and its distribution fluctuate greatly as compare to the other parameters. Any variability in the rainfall during the crop season, such as delay in onset of monsoon, excessive rains and prolong dry spells would affect the crop growth and finally the quality and quantity of the produce. Adoption of the real time contingencies in crop management based on weather forecasts can minimize crop losses.

GKMS Project

Gramin Krishi Mausam Sewa project (GKMS), is a central govt. sponsored scheme in collaboration with India Meteorological Department, ministry of Earth Sciences (Mo ES) is a mechanism to apply relevant meteorological information to help the farmer make the most efficient use of natural resources.

It becomes more and more important to supply climatological information blended with seasonal climate forecasts before the start of the start cropping season as well as crop growing period. It was implemented in the year 2017. Farmers can register through the website of Agrimet Division (www.imdagrimet.gov.in) to utilize these services by visiting the following link:

http://imdagrimet.gov.in/farmer/FarmerRegistrationFrontpage/welcome.php. It issues advisories every Tuesday and Friday and under extreme weather conditions.

What is Agro-Meteorological Advisory Service (AAS)?

The Agro-meteorological Advisory Service (AAS) rendered by India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) is a mechanism to apply relevant meteorological information to help the farmer make the most efficient use of natural resources. It becomes more and more important to supply climatological information blended with seasonal climate forecasts before the start of the cropping season as well as crop growing period.

Purpose of GKMS Project

1. Improving agricultural production both in quantity and quality.
2. To help the framers in capitalizing prevailing weather conditions in order to optimize the resource use.
3. To minimize the loss due to aberrant weather conditions.

Benefits of GKMS

A typical Agromet Advisory Bulletin in GKMS scheme enables farmers to reap benefits of the benevolent weather and minimize or mitigate the impacts of adverse weather are:

1. District specific weather forecast, in quantitative term, for next 5-6 days for weather parameters like rainfall, clod, maximum/ minimum temperature, wind speed/direction and relative humidity, including fore warning of hazardous weather events (cyclone, hailstorm, heat/cold waves, drought and flood etc.) likely to cause stress on standing crop and suggestions to protect the crop from them.

2. Weather forecast based information on soil moisture status and guidance for application of irrigation, fertilizer and herbicides etc.

3. Advisories on dates of sowing/planting and suitability of carrying out intercultural operations covering the entire crop spectrum from pre-sowing to post harvest to guide farmer in his day-to-day cultural operations.

4. Weather forecast based forewarning system for major pests and diseases of principle crops and advises on plant protection measures.

5. Propagation of techniques for manipulation of crop's microclimate e.g. shading, mulching other surface modification, shelter belt, frost protection etc. to protect crops under stressed conditions.

6. Reducing contribution of agricultural production system to global warming and environment degradation through judicious management of land, water and farm inputs, particularly pesticides, herbicides and fertilizers.

7. Advisory for livestock on health, shelter and nutrition.

Adapting Measures Against Climate Change Taken by the Farmers through GKMS

1. Selection of suitable crop variety.
2. Adjustment of sowing/planting window.
3. Judicious use of fertilizer, herbicide, insecticide and fungicide.
4. Diversified cropping System- Crop rotation/ intercropping/ mixed cropping etc.

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Use of Alovera for Woman Beauty and its Use in Income Generation of Rural Woman

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Abstract
The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The aloe vera plant, its properties, uses for woman beauty and income generation in rural woman is briefly reviewed in this article.

Introduction
Aloe vera is a plant with height of almost 60–100 cm containing very short stem or stemless long leaves, and belongs to the family Liliacae. The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The name Aloe vera derives from the Arabic word "Alloeh" meaning "shining bitter substance," while "vera" in Latin means "true." 2000 years ago, the Greek scientists regarded Aloe vera as the universal panacea. The Egyptians called Aloe "the plant of immortality." There are over 550 species of aloe grown around the world (World Checklist of Selected Plant Families, Royal Botanic Garden Kew, 2013). However, only two species are grown today commercially, with *Aloe barbadensis* Miller and *Aloe aborescens* Miller being the most popular.

Anatomy
The plant has triangular, fleshy leaves with serrated edges, yellow tubular flowers and fruits that contain numerous seeds (Figure 1.0). Each leaf is composed of three layers:
1. An inner clear gel that contains 99% water and rest is made of glucomannans, amino acids, lipids, sterols and vitamins.
2. The middle layer of latex which is the bitter yellow sap and contains anthraquinones and glycosides.
3. The outer thick layer of 15–20 cells called as rind which has protective function and synthesizes carbohydrates and proteins. Inside the rind are vascular bundles responsible for transportation of substances such as water (xylem) and starch (phloem).

Active Components with its Properties
Aloe vera contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids.

1. Vitamins: It contains vitamins A (beta-carotene), C and E, which are antioxidants. It also contains vitamin B12, folic acid, and choline. Antioxidant neutralizes free radicals.

2. Enzymes: It contains 8 enzymes: aliiase, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, cellulase, lipase, and peroxidase. Bradykinase helps to reduce excessive inflammation when applied to the skin topically, while others help in the breakdown of sugars and fats.

3. Minerals: It provides calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium and zinc. They are essential for the proper functioning of various enzyme systems in different metabolic pathways and few are antioxidants.

4. Sugars: It provides monosaccharides (glucose and fructose) and polysaccharides: (glucomannans / polymannose). These are derived from the mucilage layer of the plant and are known as mucopolysaccharides.

5. Anthraquinones: It provides 12 anthraquinones, which are phenolic compounds traditionally known as laxatives. Aloin and emodin act as analgesics, antibacterials and antivirals.

6. Fatty acids: It provides 4 plant steroids; cholesterol, campesterol, β-sisosterol and lupeol. All these have anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties.

7. Hormones: Auxins and gibberellins that help in wound healing and have anti-inflammatory action.

8. Others: It provides 20 of the 22-human required amino acids and 7 of the 8 essential amino acids. It also contains salicylic acid that possesses anti-inflammatory and antibacterial properties.

Figure 1.0

Uses for Woman Beauty

Aloe vera has been used to enhance the beauty of skin, hair, nails, lips, and eyes. However, with the improvement in cosmetology, it has been proved that Aloe vera is a very important component of cosmetics. It contains almost 20 amino acids, minerals like calcium, magnesium and sodium in sufficient quantities, enzymes, vitamins, polysaccharides, nitrogen and other components that make it a miracle beauty herb. Some of the most important applications of Aloe vera for purpose of Cosmetology are being explained here briefly.

1. Pigmentation: Melanin is a pigment which is responsible for the colour of the human skin. Hyper pigmentation is a situation in which large amount of melanin is synthesized. This generally happens due to excess exposure of the skin to the sun. In reaction to UV rays in sunbeams, the skin cells called melanocytes initiate to synthesize melanin.

2. Skin Eruption: Aloe vera containing creams are beneficial for skin eruptions. Aloe vera gels have been proved to be the best remedy for burns and wounds. Actually, cellular regeneration, anti-bacterial and anti-fungal activities of Aloe vera make it useful for skin eruption. Sclap and other Skin Problems Aloe vera is very valuable for skin disorders.

3. Itching and Blisters: Aloe vera also provides relief from itching and also helps to treat blisters. Aloe contains vitamin B1, B2, B6, B12 and vitamin C that provide soothing and pleasing sensation to skin.

4. Skin Aging: Aloe vera initiates the synthesis of elastin as well as collagen. These proteins are essential for preventing the aging of the skin.

5. Acne: Aloe vera helps to eradicate acne scars by performing as an immune booster and an anti-inflammatory agent. Beauty products composed of Aloe vera may diminish the rigorousness of acne. It is also composed of the chemical ingredients which have the property to save the skin to initiate the acne.

6. Freshness: Aloe vera imparts the sensation freshness. It helps in increasing distribution of blood therefore providing easier oxygen exchange among the cells, hence giving them nourishment.

7. Sun-burns: Aloe Vera has an outstanding possession in diminishing the hurting of sunburn. For this purpose, it is rubbed directly on skin. The fresh fluid from the plant or Aloe vera containing after-sun creams may be used for sun-burns.

8. Moisturizing Agent: Aloe vera may also be used for softening and moisturizing the skin. There are so many products available in the market containing Aloe vera which may be used post-showering to obtain the skin in super soft shape. Aloe vera gel, cream or lotion applied on the face forms a delicious cover that helps to shield the skin from dust and other natural elements which may be injurious to the skin.

Source of Income Generation in Rural Woman

Aloe vera gel derived from the leaf pulp of the plant has become a big industry worldwide due to its application in the food industry. It is utilized in functional foods especially for the preparation of health drinks with no laxative effects. It is also used in other food products including milk, ice cream, confectionery, etc. Aloe vera gel is also used as flavoring component and preservative in some foods. The production process of aloe vera juice involves crushing, grinding or pressing of the entire leaf of the aloe vera plant to produce a liquid, followed by various steps of filtrations and stabilization (preserving the biological integrity of active ingredient to exert the reported physiological effect upon ingestion or topical application). The resulting juice is then incorporated in or mixed with other preparations or agents to produce a pharmaceutical, cosmetic or food product. In food industry, aloe vera has been utilized as a source of functional food drinks and other beverages including tea.

Aloe Vera farming in India is gaining popularity as aloe vera production profit per acre is much higher than normal agriculture and it can be done using much less water and effort. Aloe vera business can be done by selling the plant leaves or extracting and marketing the juice.

Aloe vera cultivation and marketing in India is not tough. Pharmaceuticals, therapeutic and cosmetic industries are major consumers of Aloe Vera. Farmers can go forward with contract farming with aloe vera buyers like Patanjali. Aloe products are mainly comprised of ointments, juices, creams, body lotions and shampoos. Ayurvedic and Unani system of medicines are using Aloe Vera since ancient time.

Conclusion

The article covers the about aloe vera plant, its properties, uses for woman beauty and income generation in rural woman is briefly reviewed in this article. The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. Aloe vera gel derived from the leaf pulp of the plant has become a big industry worldwide due to its application in the food industry. It is utilized in functional foods especially for the preparation of health drinks with no laxative effects. Aloe vera is widely known for its beauty benefits. It works wonder for skin and hair and is often the key ingredient in many beauty products. Moisturizing the skin and repairing damaged hair is one of the numerous benefits of aloe vera. As every like to look and be beautiful specially women in the world. Increasing demand for natural, herbal and ayurvedic beauty and personal care products over the years has led to heighten the competition in this area. The surge in demand for natural and herbal products has also helped to record rapid growth to several companies and entrepreneurs. Aloe Vera farming in India is gaining popularity as aloe vera production profit per acre is much higher than normal agriculture and it can be done using much less water and effort. Aloe vera business can be done by selling the plant leaves or extracting and marketing the juice.

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Nanotechnology: An Initiative Towards Plant Pathology

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Introduction

Nanotechnology can be considered as an emerging technology that contribute to sustainable competitiveness as well as enhancing industrial application efficiency of various tools, controlling systems to be engaged in overall sectors that might boost economic sectors in various ways of possibilities. Due to ultimate modifications of various instruments, higher surface area and cost effective it is trending as smart technology.

Nanodevices as Smart System for Disease and Pest Control in Plants

Nanotechnology has shown remarkable achievement in the field of plant protection by producing nanodevices like nanocapsules and nanoparticles range from 0.1 to 1000 nm. Nanocapsule has a shell that is occupied by chemicals for the protection of plants against various diseases and pests. The shell is made up of polymers, lipids, viral capsids or various clay materials and the shell is so made that it can protect the compound/chemical until unless it is released into the target site as well as improve its solubilities along with its penetration power into the plant tissues for maximum utilization and efficiency.

Nanoparticles are surrounded by different linkers and biomolecules and are having a solid core that can be composed by different metals or polymers. Due to its smaller surface area the reaction activities are faster than other materials. For example; use of nanodisks (bilayer of phospholipids containing amphotericin molecules inside) for delivering amphotericin B, which is an important antimicotic. The nanoencapsulated pesticides (e.g. mancozeb, carrbendazim etc) when applied they protect the active chemical the release slowly and protect from degradation for better application of pesticides than other pesticides applied normally.

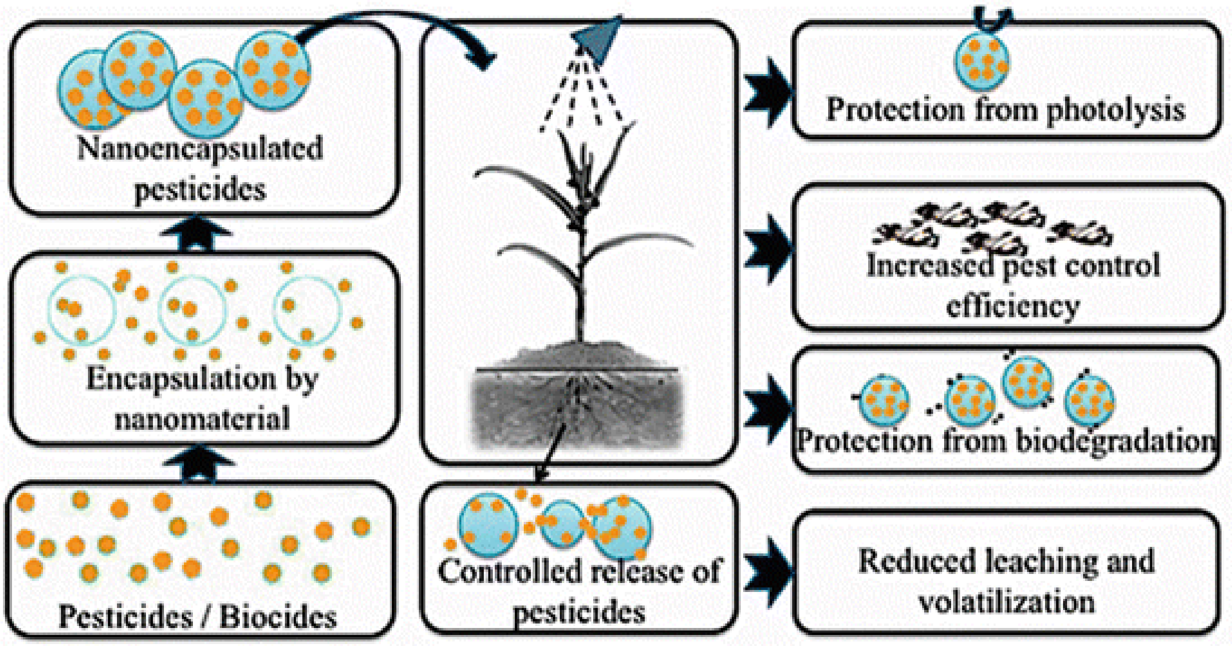

Fig-1. Nanoencapsulated pesticides application and its advantages (Bhattacharyya et al., 2016)

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The overall structure protect the amphotericin molecule is protected in this manner from external agents (pH, light etc).The product containing active compound should be prepared in such a manner that small scale application can cover many plants as well as formulations should be easily absorbed by plants either via roots (as nutrient uptake mechanism) or leaf. The nanoparticles have magnetic characteristics due to magnetic carbon coating that are detectable and this property help them for movement in plant tissues. The specific affinity between nanoparticles and biomolecules helps in target specificity and selectivity. Protection from external factors as well as quick solubility with extra protection is the advantages of these materials.

Genetic transformation and genetic manipulations are also possible by the use of nanotechnologies. Nanoparticles when carry nucleic acids with specific ligands when penetrated into plant cells enhance the development of new genetically modified plant species. Transgenesis method for gene manipulation is used. Specific plant part transformation or modifications are also possible.

Starch nanocontainers are improved technique for supplying nutrients into plant tissues at slower rate along with antibacterial compounds thus protect other nutrients like phosphorus and micronutrients (e.g. zinc, iron, manganese) in alkaline soils. Biostimulants are also supplied through nanocontainers for better plant growth.

Chitosan nanoparticles are used for seed treatment in agriculture in broad term and as biopesticide to fight back fungal diseases. Various technologies like carbon quantum dots are used for regular routine monitoring of different pathogens and beneficial microorganisms as may because of gene profiling of large number of microorganisms. Neem oil *(Azadirachta indica)* as nanoemulsion used in controlling larvae of various microorganisms (Anjali et.al., 2012).

Fig-2. carbon quantum dots

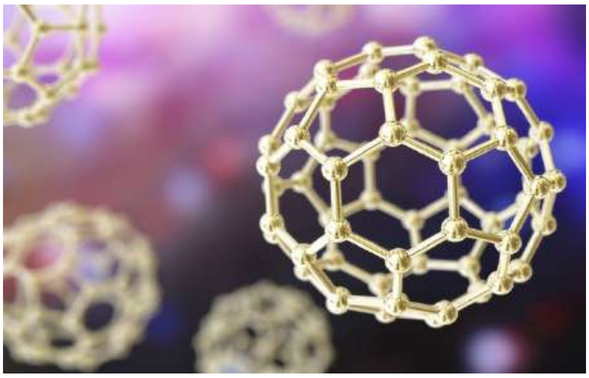

Fig-3. metallic nanoparticle

The Advantages of Starch Nanoparticles

1. Reduction of harmful substances, chemicals in soil as well as in crops.
2. High selectivity, better efficiency of active compounds used.
3. No phytotoxicity.
4. High quality and no harmful residues in final product.
5. Cost effective.

Conclusions

Nanodevices (e.g. nanoparticles, nanocapsules) provide structural advantages as smaller size (0.1-1000nm) thus increases surface area for better utilization of applied chemicals for plant disease and pest control, increases its solubility, protects from external factors for degradation. The cost-effective system of nanotechnology makes possibilities for its further uses in case of agriculture. Overall reduction of harmful substances and chemicals in soil, foods as well as genetic modifications, microbial monitoring are also being done by this technology. Encapsulated pesticides show more efficient utilization than other normally applied pesticides.

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Nutrient Management – A Crucial Factor for Crop Production with Higher Productivity for Food Security

Article ID: 31080

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Introduction

It is the science and practice directed to link soil, crop, weather, and hydrologic factors with cultural, irrigation, and soil and water conservation practices to achieve optimal nutrient use efficiency, crop yields, crop quality, and economic returns, while reducing off-site transport of nutrients.

It involves matching a specific field soil, climate, and crop management conditions to rate, source, timing, and place (commonly known as the 4R nutrient stewardship) of nutrient application.

Nutrient Management is Important for the Following Facts

1. Nutrient management helps to reduce contamination to waterways by plant nutrients.
2. Improve the soil fertility.
3. Enhance the plant productivity.
4. Reduce the cost of chemical fertilizers.
5. Providing balanced nutrition to crops.
6. Promotes carbon sequestration and prevents the deterioration of soil, water, ecology, and also leaching of nutrients from the soil.

Important Parameter for Nutrient Management

1. Fertilizer type: Important considerations are ratio of ammonium to nitrate-N, trace element charge, content of calcium and magnesium, and potential acidity or basicity. Ideally no more than 50 percent of the total nitrogen supplied to plants grown in soilless media should be in the ammonium form. Ammonium toxicity can occur in soilless media due to high levels of ammonium or urea fertilizer. The toxicity occurs on some plants when the soil is cool and waterlogged, when the ammonium is converted to ammonia.

2. Fertilizer rate: Traditionally fertilizer rate (ppm) has been the main focus of greenhouse fertilizer programs, but rate interacts with the other five factors on this list to determine the success of a fertility program.

3. Frequency of application: How many times water-soluble fertilizer is applied is often overlooked as a factor in developing a good fertilizer program. What does the term "constant liquid feed" (CLF) really mean - every watering, once a week, or twice a week? At a given ppm level, more frequent applications will lead to a higher fertility level simply because fertilizer is applied more often.

4. Volume of fertilizer solution applied: As the volume of water-soluble fertilizer increases the quantity of nutrients delivered to the plant also increases. Doubling the volume applied also doubles the amount of each nutrient potentially available to the plant.

5. Leaching fraction: Leaching fraction is the proportion of fertilizer solution or irrigation water applied that is lost from the plant container by leaching. The lower the leaching fraction, the greater the quantity of nutrients and salts retained in the growth medium. Leaching fraction is strongly affected by volume applied (i.e., factor 4). Avoiding excess leaching is critical to reducing both fertilizer costs and ground water contamination.

6. Plant growth rate and environmental conditions: In general, nutrient requirements of greenhouse crops are greatest during periods of rapid growth. Two major influences on growth rate are the inherent growth pattern followed by the plant and the environment in which it is grown. Too much fertilizer during slow growth periods may lead to excess soluble salts; failure to provide enough fertilizer during periods of rapid growth will lead to deficiency.

Potential Acidity and Basicity of Greenhouse Fertilizers

Fertilizers may raise or lower the pH of the growth medium. Fertilizers are rated as to their potential acidity or potential basicity. This value is determined largely by the amount and sources of nitrogen in a formula. Fertilizers that contain more urea and ammoniacal nitrogen are acidic in reaction, while those that contain primarily nitrate nitrogen are basic. The numbers used to express these potentials refer to the pounds of limestone (calcium carbonate) that it takes to either neutralize (potential acidity) or be equivalent in reaction to (potential basicity) on ton of that fertilizer. In theory, by alternating fertilizers, the medium pH should be able to be stabilized. In reality, the pH of the medium is a dynamic system and is influenced by many other factors such as irrigation water alkalinity, fungicide drenches and root exudates.

Important Nutrient Management Strategies: General Plant Nutrition

The 16 elements required by all plants are carbon (C), hydrogen (H), oxygen (O), phosphorus (P), potassium (K), nitrogen (N), sulfur (S), calcium (Ca), magnesium (Mg), iron (Fe), boron (B), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), and chlorine (Cl).The elements C, H, and O are supplied largely from air (carbon dioxide (CO_2) and oxygen), and water (H_2O). The nutrients N, P, K, S, Ca, and Mg are referred to as the macronutrients because they are required in larger quantities by the plant compared to the remaining elements. The other seven elements are referred to as micronutrients because they are required in small amounts, usually a few parts per million (ppm) in the plant tissue.

Phosphorus is absorbed as $H_2PO_4^{-1}$ or HPO_4^{-2} by an active energy-requiring process. P is very mobile in the plant. Deficiencies therefore show up on the older leaves of the plant because P is translocated out of these leaves to satisfy needs in the new growth. P deficiency shows up as stunting and a reddish coloration resulting from enhanced levels of anthocyanin pigments. Deficient leaves will have only about 0.1% P by dry matter. Normal most-recently-matured leaves of most vegetables will contain 0.25 to 0.6% P on a dry weight basis

Potassium is absorbed in large quantities by an active uptake process. Once in the plant, K is very mobile and is transported to young tissues rapidly. Deficiency symptoms for K show up first on lower leaves as a marginal flecking or mottling. Prolonged deficiency results in necrosis along the leaf margins and the plants can become slightly wilted. Deficient plant leaves usually contain less than 1.5% K.

Nitrogen can be absorbed by the plant in either the nitrate (NO_3) or ammonium (NH_4^+) forms. The NO_3 form is usually the preferred form in which to supply most N to greenhouse crops. The NH_4 form seems to be absorbed easier than NO_3 at cool temperatures (less than 55F). Uptake of $NH_4$is best at a media pH near neutrality with uptake reduced as pH is dropped.

Sulfur is absorbed mainly in the form of sulfate (SO_4). Sulfur is not very mobile in the plant so deficiency generally begins in the new growth. Deficiency symptoms consist of a general yellowing of the leaves. Deficiencies of N and S appear similar but N deficiency occurs on the lower leaves; S deficiency occurs on the upper leaves.

Calcium, unlike most elements, is absorbed and transported by a passive mechanism. The transpiration process of the plants is a large factor in the uptake of Ca. Once in the plant, calcium moves toward areas of high transpiration rate such as the rapidly expanding leaves.

Magnesium is absorbed by the plant in lower quantities than Ca. The absorption of Mg is also highly affected by competing ions such as K, Ca, or NH_4. Unlike Ca, Mg is mobile in the plant and deficiencies appear first on the lower leaves. Mg is usually found in concentrations of 0.2% to 0.8% in normal leaves. Conditions that lead to deficiency include poorly designed fertilizer programs that supply too little Mg or ones that supply excess K, Ca, or NH_4.

Iron can be absorbed by an active process as Fe^{2+} or from iron chelates which are organic molecules containing iron sequestered within the molecule. Uptake of iron is highly dependent on the iron form and adequate uptake depends on the ability of the root to reduce

Manganese is absorbed as Mn^{2+} ions and the uptake are affected by other cations such as Ca and Mg. Manganese is relatively immobile in the plant and symptoms of deficiency show up on the upper leaves. Deficiency of Mn resembles that of Mg; however, Mg appears on the lower leaves of the plant. Mn deficiency consists of interveinal chlorosis; however, the chlorosis is more speckled in appearance compared to magnesium deficiency. Normal concentrations of Mn in leaves ranges from 30 ppm to 125 ppm for most plants. High concentrations of Mn can be toxic to plants. Toxicity consists of marginal leaf necrosis in many plants. Concentrations of Mn on the order of 800 ppm to 1000 ppm can lead to toxicity in many crops. Excess Mn in the nutrient solution reduces uptake of Fe.

Zinc uptake is thought to be by an active process and can be affected by concentration of P in the media. Zn is not highly mobile in plants. Deficiency of Zn results in leaves with interveinal chlorosis. Sometimes Zn deficiency will lead to plants with shortened internodes. Normal leaves contain about 25 ppm to 50 ppm Zn. High concentrations of Zn can lead to toxicity where root growth is reduced and leaves are small and chlorotic. Zinc deficiency can be increased by cold, wet growing media or by media with a very high pH or with excessive P.

Copper is absorbed by plants in very small quantities. The uptake process appears to be an active process and it is strongly affected by Zn and pH. Copper (Cu) is not highly mobile in plants but some Cu can be translocated from older to newer leaves. The normal level of Cu in plants is on the order of 5 to 20 ppm. Copper deficiency of young leaves leads to chlorosis and some elongation of the leaves. Excess copper, especially in acidic media, can be toxic.

Molybdenum is absorbed as molybdate MoO_4^{2-} and the uptake can be suppressed by sulfate. Tissue contents of Mo are usually less than 1 ppm. A deficiency of Mo first appears in the mid leaves and the older leaves. The leaves become chlorotic and the margins roll. Unlike other micronutrients, Mo deficiency occurs mostly under acidic conditions.

Boron uptake by plants is not well understood. Boron (B) is not mobile in the plant and seems to have many uptake and transport features in common with Ca. Boron deficiency affects the young growing points first, e.g., buds, leaf tips, and margins. Buds develop necrotic areas and leaf tips become chlorotic and eventually die. Tomato leaves and stems become brittle. Normal leaves contain 20 ppm to 40 ppm B while high levels may lead to toxicity.

Chlorine deficiency is very rarely observed in crop plants. This is because Cl is needed in very small amounts and Cl is present in the environment in the fertilizers, water, air, and media.

Conclusions

It is here by conclude that the nutrient management is very much crucial important factor for crop production with higher productivity so there for proper nutrient source with good physical condition material are applied for higher productivity in crop production and govt imitative with subsidy are considerable factor also farmer awareness programme.

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Important Diseases of Cucurbits and their Managements

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Cucumber and squash Vascular Wilt

Erwinia tracheiphila

Symptoms: Symptoms of the disease first appear on a single leaf which suddenly wilts and becomes dull green. The wilting symptoms spread up and down the runner sometimes as a recurring wilt on hot, dry days. Soon infected runners and leaves turn brown and die. The bacteria spread through the xylem vessels of the infected runner to the main stem, then to other runners. Eventually the entire plant shrivels and dies. Less susceptible plants, such as certain squash varieties, may show dwarfing of growth before the wilt symptoms become apparent. Creamy white bacterial ooze consisting of thousands of microscopic, rod-shaped bacteria may sometimes be seen in the xylem vascular bundles of an affected stem if it is cut crosswise near the ground and squeezed. This bacterial ooze will string out forming fine, shiny threads (like a spider's web) if a knife blade or finger is pressed firmly against the cut surface, for cucumbers than for muskmelons. Fruit may also show symptoms. Small water-soaked patches form on the surface. These patches eventually turn into shiny decayed spots on the fruit.

Pathogen: It is a motile rod with 4 – 8 peritrichous flagella and capsulated. Agar colonies are small, circular, smooth, glistening white and viscid.

Mode of Spread and Survival: The bacteria apparently overwinter in cucumber beetles and they appear to multiply in the beetle. The bacterium is not seed borne or soil borne. Bacteria in stems can survive for one month. Beetles prefer to feed on plants with bacterial symptoms than on healthy plants. Beetle can remain infective for at least three weeks. Striped cucumber beetle and the 12- spotted cucumber beetle help in the spread of the bacterium.

Management: Larger plantings must be protected by insecticides. Some carbaryl (Sevin), malathion, or rotenone insecticides or combination products are registered to treat cucumber beetles. They will provide control of the beetles if applied when beetles first appear in the spring. Early control, beginning as soon as the plants emerge, is most important as a single beetle can introduce the bacteria. One to four generations of the beetle may occur on unprotected plants and applications of these insecticides at weekly intervals may become necessary.

Mosaic

PRSV/CMV

Symptoms: A virus distributed worldwide, affecting most cucurbits but rarely affecting watermelon. New growth is cupped downward, and leaves are severely mottled with alternating light green and dark green patches. Plants are stunted, and fruits are covered with bumpy protrusions. Severely affected cucumber fruit may be almost entirely white.

Mode of spread and survival: It is transmitted by mechanical inoculation and by insect vectors, Aphis gossypii and *Myzus persicae*.

Management: The virus is readily transferred by aphids and survives on a wide variety of plants. Varietal resistance is the primary management tool, and eliminating weeds and infected.

Fusarium Wilt

Fusarium oxysporum f. sp. *melonis* attacks muskmelon and *Fusarium oxysporom* f. sp. *niveum* attacks watermelon.

Symptoms: Both fungi contribute to damping-off of seedlings, but most significant losses occur after young plants are infected in the field. Plants infected early in the season often produce no marketable fruits. Plants that begin to show wilt symptoms at or near maturity produce fewer and lower quality fruits. The first symptoms of Fusarium wilt are wilting and chlorosis (yellowing) of older leaves.

The wilt is most evident during the heat of the day. Plants may appear to recover by morning, only to wilt again in the afternoon. Stem cracks and brown streaks often appear near the crown of the plant and are associated with a red-brown exudate. Fusarium wilt also causes vascular browning that is visible in stem cross-sections.

Mode of spread and survival: The wilt fungus is introduced to new areas on seed. It spreads by wind, equipment and workers. It can survive long periods in soil as chlamydospores and in association with melon plant residue.

Management: Planting resistant cultivars is the only reliable way to keep infested fields in production. Commercially acceptable resistant cultivars exist, but extremely high pathogen populations in the soil can overcome their resistance. Therefore, methods to reduce Fusarium populations in the soil also should be employed. These methods include extended rotations with crops other than cucurbits and fall plowing of severely infested fields.

Powdery Mildew

Erysiphe cichoracearum

Symptoms: It attacks muskmelons, squash, cucumbers, gourds, and pumpkins. It is evident as a superficial, powdery, greyish-white growth on upper leaf surfaces, petioles, and even main stems of infected plants. Affected areas turn yellow then brown and die. In dry seasons, powdery mildew can cause premature leaf drop and premature fruit ripening. Some early disease results from spores produced on over wintering cucurbit debris or weeds but the major source of disease inoculum is windblown spores from southern crops. Warm, dry weather conditions favour the development of powdery mildew.

Pathogen: The conidia measure 63.8 x 31.9-micron meter, the cleistothecia are globose which contain 10 – 15 asci. In each ascus, ascospores are two and are oval or sub cylindrical.

Mode of spread and survival: Perithecia developed on left over cucurbit crop in isolated areas serve as primary inoculum. Wild cucurbits harbour the conidial stage of the fungus and release conidia for primary infection to the spring or summer sown cucurbits. Conidia are spread by wind , thrips and other insects.
Management: Powdery mildew can be controlled by application of Wettable sulphur @ 0.2%.

Downy Mildew

Pseudoperonospora cubensis

Symptoms: It occurs on cucumbers, squash, muskmelons, and pumpkins and less frequently on watermelons. On cucurbits other than watermelons, small, yellowish areas occur on the upper leaf surface. Later a more brilliant yellow colour develops with the centre of the lesion turning brown. Usually spots are angular because they are restricted by leaf veins. When leaves are wet, a downy, white-grey-light blue fungus growth can be seen on the underside of individual lesions. On watermelons, yellow leaf spots may be angular to non-angular and turn brown to black. Spores produced on the lower leaf surface are readily spread by the wind. Rainy, humid weather favours the development of downy mildew.

Pathogen: It is an obligate parasite. The mycelium is coenocytic and intercellular with small ovate or finger likes haustoria. One to five sporangiophores arise through the stomata. Sporangia are greyish to olivaceous purple, ovoid to ellipsoidal, thin walled with a distal papilla. Zoospores are 10 – 13-micron meter. Oospores are not common.

Mode of spread and survival: The pathogen survives on the diseased plant debris. In warm and humid climates, transmission from old to younger crops takes place all the year round. Where warm and dry summers alternate with cooler and wet winters, year-round survival is possible on summer irrigated crops. They may overwinter as thick-walled oospores. Sporangia are disseminated by wind. Cucumber beetles are reported to carry the sporangia.

Disease cycle: *Pseudoperonospora cubensis* is an obligate parasite requiring living host tissue to survive. It does not live in debris in the soil. Occasionally, under optimum environmental conditions, the pathogen may develop thick-walled spores called oospores that are resistant to low temperatures and dry conditions. This is rare and not considered an important source of inoculum. Infections in greenhouses likely originate from another type of spore (sporangia) that enters the facilities from the outside. Local field infections are usually established by spores carried by moist air currents blowing northwards from distant warmer regions where the fungus can over winter on plant material. The periods of wetness needed for infection on cucumber leaves are about 12 hr at 10°c-15°c, 6 hr at 15°c-19°c, and 2 hr at 20°c. About 4-5 days after infection, new spores are produced and released into the air, primarily in the morning. Spores can quickly spread within the greenhouse via moist air currents, contaminated tools, equipment, fingers and clothing.

Management: Spraying with Metalaxyl 500 g or Metalaxyl + Mancozeb 1 kg/ha or Mancozeb 1 kg/ha.

Angular Leaf Spot

Pseudomonas lachrymans

Symptoms: Symptoms of the disease firsts appear as small, angular, water-soaked lesions on the leaves. When moisture is present, bacteria ooze from the spot in tear like droplets that dry and form a white residue on the leaf surface. Water-soaked areas turn grey or tan, die, and may tear away leaving irregular holes. Water-soaked spots may also appear on the fruit and are frequently followed by soft rot bacteria.

Pathogen: The bacterium is a rod with 1 – 5 polar flagella and forms capsule and a green fluorescent pigment in culture. The colonies on beef – peptone agar is circular, smooth, glistening, transparent and white.

Mode of spread and survival: Infected seeds may harbour the bacterium. They survive in soil or debris from diseased plants for two years. They spread by irrigation water.

Management: Angular leaf spot may be controlled by planting disease-free seed. Rotating with unrelated crops, keeping workers out of fields when foliage is wet and Spray 400ppm Streptomycin sulphate.

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Biochemical Defences of Plants (Pre-Existing and Post-Infectional Defences) Against Pathogens

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Introduction

As a result of continuous encounters by pathogens has led to development of defence mechanism in host plants. The resistance against parasites/pathogen is the heritable trait of plants by virtue of which they resist attack by parasites/pathogens or their activities. The defence mechanism(s) has ensured the survival of plants. Structural and biochemical defences are the two modes of defence mechanisms in plants. Among these two, biochemical defences are more effective than structural defences.

Biochemical Defences

Although structural defence mechanisms do prevent the attack of the pathogen, the defence mechanism also includes the chemical substances produced in the plant cells before or after the infection. Hence biochemical defences are classified into pre-existing and post-infectional defences.

Pre-Existing Biochemical Defences

1. Inhibitors released into its environment.
2. Inhibitory substances present in plant cells.
3. Lack of essential factors for growth of pathogen.

Post-Infectional Biochemical Defences

1. Toxic material produced in response to infection.
2. Induced synthesis of proteins and enzymes.
3. Formation of substrates resistance to enzymes of pathogen.
4. Detoxification of pathogen toxins and enzymes.
5. Biochemical alterations.
6. Hypersensitivity.

Inhibitors Released into its Environment

1. Plant generally exudes organic substance through above ground parts (phyllosphere) and roots (rhizosphere).
2. Some of the compounds released by some plants are known to have an inhibitory effect on certain pathogens during the pre-penetration stage.

For example:

a. Chemicals released by tomato and sugar beet prevent the germination of Botrytis and Cercospora.
b. Presence of phenolics like protocatechuic acid and catechol in scales of red onion variety inhibit the germination of conidia of *Colletotrichum circinans* on the surface of red onion.

Inhibitory Substances Present in Plant Cells

1. Inhibitors present in high concentrations in the plant cells also play an important role in defence of plants.
2. Presence of several phenolics, unsaturated lactones, tannins, saponins, and some fatty acid like compounds such as dienes in cells of young fruits, leaves or seeds afford them resistance to *Botrytis*.
3. Wilt resistant varieties of tomato contain high concentration of alkaloid 'tomatin'
4. The tubers of resistance vars of potato against potato scab disease contain higher concentrations of chlorogenic acid around the lenticels and tubers than the susceptible vars.

Defence Through Lack of Essential Factors

1. Lack of recognition between host and pathogen
2. Lack of host receptors and sensitive sites.
3. Absence of common antigen. For example:
   a. Varieties of linseed which have an antigen common to their pathogen are susceptible to the disease rust of linseed caused by *Melampsora lini*.
   b. Another example is leaf spot disease of cotton caused by Xanthomonas campestris pv. malvacearum.
4. Lack of nutrients required by the pathogens: Plant varieties or species which do not produce any of the chemicals essential for the growth of pathogen may act as resistant variety. For example: A substance present in seedling varieties susceptible to Rhizoctonia initiates hyphae cushion formation from which the fungus sends penetration hyphae inside the host plants. When this substance is not present, hyphal cushions are not formed and the infection does not occur.

Toxic Material Produced in Response to Infection

1. Phenolics:
   a. Derived from phenyl alanine (such as caffeic and ferulic acid), phenylpropanoid lactones (known as coumarins) and benzoic acid derivatives (such as vanillin and salicylic acid).
   b. The oxidized products of phenolics may detoxify the toxins or inactivate other weapons of the pathogen.
   c. The cotton phenolic pigment gossypol has repellent effects against numerous insects and is toxic to *Heliothis virescens* (tobacco bollworm), *Heliothis zea* (bollworm) and several other insects.

2. Phytoalexins:
   a. Muller and Borger (1940) first used the term phytoalexins.
   b. Low molecular weight antimicrobial compounds.
   c. Produced in healthy cells adjacent to damaged or necrotic cells.
   d. Phytoalexins are considered to stop the growth of pathogens by altering the plasma membrane and inhibiting the oxidative phosphorylation.
   e. It is considered that a metabolite of the host plant interacts with specific receptor on the pathogen's membrane resulting in the secretion of "phytoalexin elicitor" which enters the host plant cells and stimulates the phytoalexin synthesis.
   f. Phytoalexins have been identified in a wide variety of species of plants such as Soya bean, Potato, sweet potato, barley, carrot, cotton etc.

Defence Through Induced Synthesis of Proteins and Enzymes

1. Increased protein synthesis and enzymatic activities are found in many plants resistant to bacterial and viral diseases.
2. Enzyme, PAL, showed increased activity and protein synthesis in diseased tissues.
3. Key enzyme in the synthesis of phenols, phytoalexins and lignin.
4. Eg: Black rot of sweet potato *(Ceratocystis firbriate)* infected tissues showed marked changes in enzyme synthesis.

Formation of Substrates Resistant to Enzymes of Pathogen

1. Some hosts produce chemicals which neutralise the enzymes produced by pathogen, thus defending the host. Therefore, these substances help plants to defend themselves from the attack of the pathogen.
2. In bean plants, infection with *Rhizoctonia solani* causes necrosis. In resistant bean varieties, the entry of pathogen causes the separation of methyl group from methylated pectic substances and forms polyvalent cations of pectic salts which contain calcium.
3. The calcium ions accumulate in infected as well as neighbouring healthy tissues and because of the calcium accumulation, the pathogen fails to disintegrate middle lamella by its polygalacturonase enzymes.
4. Polygalacturonase enzymes are known to dissolve the middle lamella of healthy tissue in susceptible varieties.

Detoxification of Pathogen Toxins and Enzymes

1. In this case, the plants produce chemicals which deactivate the toxins produced by the pathogens.
2. For Eg, *Pyricularia oryzae* which causes blast disease of rice produces Picolinic acid and pyricularin as toxins.
3. Similarly in case of cotton and tomato wilts, the toxin fusaric acid produced by the pathogen gets converted into non-toxic N-methyl-fusaric acid amide in resistant varieties.
4. As in case of detoxification of toxins, the toxic enzymes produced by the pathogen is deactivated by phenolic compounds or their oxidation products.

Biochemical Alterations

1. It has been observed that infection of the host by the pathogen brings about biochemical changes in the host which may prove toxic to the pathogenic microorganisms and cause resistance to the pathogen.
2. Production of certain new enzymes and other compounds are synthesized and accumulated in higher concentration.
3. This add to the resistance of the plant by being toxic to pathogenic microorganisms.

Hypersensitivity

1. The hypersensitive response (HR) is a mechanism, used by plants, to prevent the spread of infection by microbial pathogens.
2. The HR is characterized by the rapid death of cells in the local region surrounding an infection.
3. The HR serves to restrict the growth and spread of pathogens to other parts of the plant.
4. The HR is analogous to the innate immune system found in animals.

HR Includes:

a. Oxidative bust (production of reactive oxygen species).
b. Disruption of cell membranes.
c. Opening of ion channels.
d. Cross linking of phenolics with cell wall component.
e. Production of anti-microbial phytoalexins and PR protein.
f. Apoptosis (programmed cell death).

Conclusion

It has now been established that biochemical defence mechanisms play more important role than the structural defence mechanisms. This has been supplemented by the fact that many pathogens entering non host plants naturally or artificially inoculated fail to cause infections in absence of any structural barriers. This does suggest that chemical defence mechanisms rather than structural mechanisms are responsible for resistance in plants against certain pathogens.

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Cultivation of Vegetable Using Hydroponic Techniques for Landless Farmers of Bihar

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Summary

Landless community is the poorest community in the state of Bihar where vegetables are hardly taken in their diet whereas the recommended per capita availability of vegetables in India is 300g. For nutritional security, these landless farmers may able to grow vegetables without soil in their surrounding with locally available used plastic bottles of mineral water/cold drinks, bamboo structure for supporting plants and hydroponics solution as nutrient feed for plants.

Introduction

Bihar is the third most populous state in India with over 100 million inhabitants. The state's economy is dominated by agriculture: it constitutes 19.2 percent of state's GDP and employs nearly 75 percent of the labour force. 92.8 percent of the farmers in Bihar are small and marginal (small holders), which is much higher than the all India average of 83.5 percent. Furthermore, Bihar's agriculture productivity is one of the lowest in India. With every sunrise fifty-five thousand new mouths opens for food in India. The ever-increasing population pressure has reduced per capita availability of land. For producing more food more agrichemicals are used injudiciously and as a result, there is increased incidence of several fatal diseases, which affected the quality of human life. Vegetable grows 30-50 percent faster in a hydroponic system and healthier. Because the water is nutrient rich, and the pH has been balanced, the plant roots don't have to work to find minerals from the soil, which allows them to grow quicker and produce more yield.

Landless community is the poorest community in the state of Bihar where vegetables are hardly taken in their diet whereas the per capita availability of vegetables in India is 300g. For nutritional security, these landless farmers may able to grow vegetables without soil in their surrounding with locally available used plastic bottles of mineral water/cold drinks, bamboo structure for supporting plants and hydroponics solution as nutrient feed for plants. Soil-less culture mainly refers to the techniques of Hydroponics'. The term Hydroponics was derived from the Greek words hydro' means water and ponos means labour. It is a method of growing plants using mineral nutrient solutions, without soil.

Vegetables Suitable for Growing in Hydroponics

Vegetables	Scientific Name (Family)	Major nutrient content
Peas	*Pisum sativum L.* (Leguminosae)	Protein, Fibre, Vitamin A and antioxidants
Spinach beet	*Spinacia oleracea var bengalensis L.* (Chenopodioideae)	vitamin A, vitamin C, vitamin K, magnesium, manganese, iron and folate and antioxidants
Lettuce	*Lactuca sativa* L. (Asteraceae)	Calcium, potassium, vitamin C, folate and antioxidants
Cucumber	*Cucumis sativa L.* (Cucurbitaceae)	Vitamin K, Magnesium Potassium and antioxidants
Cowpea	Vigna unguiculata (L.) Walp. (Leguminaceae)	Protein, fat and carbohydrates and it is a good source of vitamins and phosphorus
French bean	*Phaselous vulgaris* L. (Leguminaceae)	protein, carbohydrates, vitamin A, 11 mg vitamin C, Calcium
Bitter gourd	*Memordica charantia* L. (Cucurbitacae)	Iron, magnesium and vitamin to potassium and vitamin C

Sponge gourd	*Luffa acutangula* L. (Cucurbitaceae)	Vitamin A, Carbohydrate, Vitamin B5, Manganese, Potassium and very low in Lipid, fat, Protein, Sodium and Vitamin K.
Chilli	*Capsicum annum* L (Solanaceae)	Vitamin C. Vitamin B6. Vitamin K1, Potassium, Copper, Vitamin A.
Tomato	*Solanum lycopersicon* L. (Solanaceae)	Vitamin C, potassium, folate, and vitamin K.

Hoagland Solution

Hydroponic nutrient solution. Developed by Hoagland in 1933. The Hoagland solution provides every nutrient necessary for plant growth and is appropriate for supporting growth of a large variety of plant species.

Nutrients Required for Hoagland Solution

Components	Stock Solution	Components	Stock Solution
Macronutrients		**Micronutrients**	
KNO_3	202 g/L	H_3BO_3	2.86 g/L
$Ca(NO_3)_2 \cdot 4H_2O$	236 g/L	$MnCl_2 \cdot 4H_2O$	1.81 g/L
Chelated Iron	15 g/L	$ZnSO_4 \cdot 7H_2O$	0.22 g/L
$MgSO_4 \cdot 7H_2O$	493 g/L	$CuSO_4 \cdot 5H_2O$	0.08 g/L
Phosphate		$H_2MoO_4 \cdot H_2O$	0.09 g/L
KH_2PO_4	136 g/L	$Na_2MoO_4 \cdot 2H_2O$	0.12 g/L

Optimum Range of pH and EC Values for Hydroponic Crops (Sharma et al., 2019)

Crops	EC(dSm1)	pH
Bean	2.0 - 4.0	6.0
Cucumber	1.7 – 2.0	5.0 - 5.5
Lettuce	1.2-1.8	6.0-7.0
Spinach	1.8-2.3	6.0-7.0
Tomato	2.0-4.0	6.0-6.5

Vegetable Production Under Soil-Less Culture in India

Vegetables	Production (g/m2 /day)	Vegetables	Production(g/m2 day)
Carrot	56.5	Onion	56.5
Cucumber	226	Peapod	113
Garlic	57	Potato	56.5
Ginger	57	Salad greens	226
Leek	57	Tomato	113
Green Bean	113	Greens	113
Lettuce	226		

Source: Maharana and Koul (2011).

New Initiative at RPCAU, Pusa

An experiment was formulated, designed and tested for vegetable production in hi-tech horticulture unit of RPCAU, Pusa in 2018. Bamboo stand was made to arrange horizontally; ten used bottles joined to each other's by making a hole in the bottom and a 2" diameter hole in the body for setting a paper cup with cross cut in the bottom. Seedlings were grown in a portray in a mixture of vermicompost, sand and soil. 12-15 days old seedlings were transferred in the paper cup; keeping three fourth roots portion in nutrient solution of the plastic bottles. To avoid disturbance of plant roots with wind, waste foam from the nearby furniture market was used in seeding cup. A level of solution was maintained throughout the vegetable production.

Cowpea, French bean, bitter gourd, sponge gourd, spinach beet, Chilli and tomato were tested for growth and production; Cowpea performed better in terms of growth and yield followed by bitter gourd and sponge gourd in summer. Whereas French bean, spinach beet and tomato found better in winter season. The cost of production under this system is economical and affordable by landless farmers.

Advantages of Soil-Less Culture

There are many advantages of growing plants under soil-less culture over soil-based culture. These gardens produce the healthiest crops with high yields and are consistently reliable; gardening is clean and extremely easy, requiring very little effort. Here nutrients are fed directly to the roots, as a result plants grow faster with smaller roots, plants may be grown closer, and only 1/5th of overall space and 1/20th of total water is needed to grow plants under soil-less culture in comparison to soil-based culture. There is no chance of soil-borne insect pest, disease attack or weed infestation too. Overall soil-less culture provides efficient nutrient regulation, higher density planting, and leading to increased yield per acre along with better quality of the produce. It is also effective for the regions of the World having scarcity of arable or fertile land for agriculture.

Limitations of Soil-Less Culture

Despite of many advantages, soil–less culture has some limitations. Application on commercial scale requires technical knowledge and high initial investment, though returns are high. Considering the high cost, the soil-less culture is limited to high value crops. Great care is required with respect to plant health control. Finally, energy inputs are necessary to run the system.

Conclusion

In recent years hydroponics is seen as a promising strategy for growing different crops. As it is possible to grow short duration crop like vegetables round the year in very limited spaces with low labour, so hydroponics can play a great contribution in areas with limitation of soil and water and for the poorer and landless people. In India, the hydroponic industry is expected to grow exponentially in near future. In this regards, Dr. Rajendra Prasad Central Agricultural University, Pusa has taken a lead to develop low cost hydroponic technologies that reduce dependence on human labour and lower overall start-up and operational costs.



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Crop Rotation: A Way to Sustainable Production

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The primary goal of agriculture is to get good yields, by using sustainable methods. Nowadays, crop protection scientists and agronomists utilize various methods to increase productivity and environmentally friendly pest and diseases management practices to protect environment and food. Among different cultural methods, crop rotation is one of the most important part of any sustainable agricultural system Francis (1990).

What is Crop Rotation?

This concept means just what its name implies. Crop rotation involves planting different crops in the same area at different times of the year or in different years. This method improves soil health, optimize nutrients in the soil and reduces pesticide and herbicide use, which can bioaccumulate in species, especially predatory birds. Pesticide use is limited because pests cannot build up populations since they do not have a steady food source when the crops change from year to year. Pest reproductive cycles are also interrupted with the change in crops, preventing their numbers from growing rapidly.

History

Rotational cropping dates back to times immemorial. Benefits of crop rotation were noticed as early as in 6,000 BC by ancient Egyptians and were successfully used by the ancient Romans and Greeks as well. They noticed that planting crops in a certain sequence enhanced yields and improved soils, even though there were no chemical studies to explain this trick scientifically. One of the first evidence to teach how to implement the crop rotation system was the Bible.

The 3-cycle crop rotation was first introduced in Ancient Rome. The scheme could be represented by three key milestones: 'food, feed, fallow'. 'Food' stood for cereals like wheat that was grown for human needs. 'Feed' implied forage for domestic poultry and cattle. 'Fallow' meant leaving the land uncultivated to give it 'rest'. Besides, our ancestors understood that certain crops (like sunflower) heavily drain soils, so the fallow year was highly recommended.

Scope

Different crops have different nutritional needs and are susceptible to different pathogens and pests. Growing the same crop in the same place every year, as is common in conventional farming is known as Monoculture farming. This practice of a monoculture continually draws the same nutrients out of the soil which leads to the lack of nitrogen in soils if no legumes for long periods and allow weeds and insects to adapt and thrive. This makes them much more difficult to manage. Another minus is the soil erosion issue because tilled (cultivated) crops are likely to cause it. In terms of diseases and pests, monoculture requires continuous usage of the same chemicals to tackle the issue.

Benefits

Crop rotation also helps reduces fertilizer use, which often are in run-off from farms, and lead to eutrophication. When crops use up the nutrients in the soil, instead of adding artificial ones back in, crops like soybeans and other legumes are planted to naturally restore nitrogen and other nutrients. The practice also works to interrupt pest and disease cycles, improve soil health by increasing biomass from different crops' root structures, and increase biodiversity on the farm. Life in the soil thrives on variety, and beneficial insects and pollinators are attracted to the variety above ground.

Sustainable with Crop Rotation

Here are different ways practicing crop rotation helps us become more sustainable for our land, environment and future generations.

1. Introduces new nutrients and reduces emissions: Continually growing of one crop in the same field, it would keep pulling the same essential nutrients out of the soil. That would force us to spread fertilizer to add them back in. Because of taking different crops also return different nutrients back into the soil, can count on crop rotation to lighten the fertilizer load. For example, reduce amount of added nitrogen to support cotton growth because the peanuts in the ground before put some back because it is legume crop. To spread fertilizer, it takes equipment that produces fuel emissions, and the fertilizer itself expels greenhouse gas. Therefore, by reducing fertilizer use, we lower both fuel and greenhouse gas emissions.

2. Prevents erosion: Different plants have different root systems, either shallow or deep. They penetrate soils on alternative levels, thus improving soil porosity. Also, green leys cover lands and protect them from being exposed directly to winds and rains that destroy the land surface. Rotating crops adds diversity and brings a balance to soil profile. Certain crops that grow underground (peanuts, potatoes, sugar beets) are known for low post-harvest residue unlike maize (corn) or sugar cane. The first group of plants needs frequent cultivation and thus causes much erosion while the other does not.

3. Helps retain moisture: Incorporating crop rotation practice has allowed to practice alternative crops help keep water in deep soil layers. Plants will be able to use it in case of droughts. Crop rotation with no-till farming, that means we don't run a tractor through our fields to stir up the top soil before planting. This leaves residue from the previous crop on top of the soil. The leftover residue act as a kind of mulch covering the field. That mulch shields the soil from much of the heat and sunlight. This stop valuable moisture from evaporating. Keeping that moisture in the ground helps to manage water use and crops can sustain without irrigation.

4. Provides pest control: Certain species are attacked by certain pests, for example, potatoes are cut up by Colorado beetles. They are killed with target chemicals. When they are used for many years, excessive amounts pollute nature being harmful to all living beings. However, if you plant, for example corn or wheat, they will leave the field, as they don't destroy. Taking away that pest's access to the crop it needs to survive by rotating in different plants disrupts that cycle and controls the pest populations plaguing our fields. As an added bonus, this allows us to reduce the amount of pesticide we spray.

Conclusion

In near future cropping diversity and rotations will become more important to fulfil the dreams of sustainable agriculture. There is often a problem with continuous cropping of the same crop species in the same peace of land, it is becoming more susceptible to pest and diseases. It will lead to increase the utilization more chemicals to manage them, and it will not economic to farmer. Diverse crop rotations provide multiple opportunities through the year to apply manure and compost back in production fields. And it maximizes productivity and minimize negative impacts on the environment.

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Diseases of *Rauwolfia serpentine*, Causes, Symptoms and Management

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(*Rauwolfia serpentina*, Apocyanaceae, 2n = 22)

Sanskrit – Sarpagandha, Chandrika; Hindi – Chandrabhaga.

Sarpagandha (*Rauvolfia serpentine* Benth. Ex. Kurz family Apocynaceae) is growing in different parts of India and its adjoining countries. Its root contains many important alkaloids, like ajmalicine, ajmaline, isoajmaline, rauvolfinine, reserpine, serpentine, rescinnamine, tetraphylicine, yohimbine and 3 epi α-yohimbine (Snimolia et al., 1984). Sarpagandha roots are popular in Ayurveda, Unanifor different physical and mental ailments and also used for snake bite and insect stings. It also acts as a sedative in various disorders like anxiety states, excitement, maniacal behaviour associated with psychoses, insanity, insomnia and epilepsy(Dey et al.,2010).Mode of action of nearly all alkaloids secreted by Sarpagandha depends upon the targeted binding to a class of protein receptors called vesicular monamine transporters(VMATs) present at specialized secretory vesicles of presynaptic neurons (Lobay et.al.,2009).These alkaloids results in excessive or no release of neurotransmitters from the presynaptic neurons which aids intono promulgation of the nerve impulses(Gopalakrishnan et al.,2007).

Rauvolfia serpentine is susceptible to several disease caused by fungi and viruses, resulting in reduction of production of medicinally important products prepared from this plant(www.ars-grin.gov).

Blossom Blight

Causal organism: *Colletotricumcapsici*

Spread: Found in North Indian plains and caused drastic reduction in the production of healthy seeds (Shukla et al., 2006).

Symptoms: The disease incidence adversely affects the sarpagandha plantation because of severe infection on inflorescence leading to premature death of the infected flowers. The blossom blight also resulted in decapitation and prevented seed setting.

Control: Chemical control-Mancozeb was highly effective against conidial germination at lower concentrations but not against the mycelial growth. It gave promising protection from *C. capsici* infections in the field (Brijesh K.,2011).

Wilt

The wilt disease of R. *serpentina* was first observed in Jammu. Since, its first appearance the disease became more and more important, because it caused considerable damage to the crop.

Symptoms : Initial symptoms of the disease consist of wilting of branches followed by wilting the entire plant. In advance stages, collar region and the root portion below the ground level turned into dark colour. Two-year-old plants were affected mostly. The disintegration of root cortex was more prominent in the seedling and young plant (Janardhanan *et.al.*, 1964).

Causal organism: *Fusarium oxysporum* f. sp. *Rauvofii* (Schlecht) Janardhanan, Ganguly and Husain. Mycelium extentive and cottony, pinkish-white in colour, both macro and micro conidia present .The pathogen was found to produce significant number of hydrolytic enzymes *in vitro*. The host tissue stimulated the production of pectolytic enzymes (Janardhanan and Husai, 1969).

Powdery Mildew

The disease was found prevalent on *R. serpentine* in the plantation in India (Ganguly and Pandotra, 1962). The characteristic symptom of the disease was rolling of infected leaves enclosing the lower surface of the leaves which is covered with whitish growth of the fungus in patches, consisting of conidia and conidiophores.

Causal organism: *Leveillulataurica* (Lev) Atz.

Control: The disease can be controlled ny one application of any wettable sulphur preparation (0.3%) or Karathane WD 0.05% at the time of first appearance of the disease (Pandey,1995).

Leaf Blight and Bud Rot

A leaf blight and bud rot of *R. serpentia* was frequently observed in the experimental plants. The attack is more common on one-year old plants.

Symptoms: initially small brownish circular spots with yellowish margin on the ventral surface of the tender leaves appeared. These spots then enlarged forming large dark brownish circular lesions. The spots covered the entire leaf, resulting in blight symptom and subsequently leaves died and dropped.

Control: the disease can be controlled by spraying the infected plants with Dithane M-45 (0.3%) (Pandey,1995). Use of seed treatment with fungicides also reduced the infection to a great extent.

Leaf Spots

History: The leaf spots disease of R. serpentine was first reported by Mohanty and Addy (1957) and then by Chandra (1957).

Causal organism: *Cercosporarauvolfiae* Chupp and Muller (the conidiophores of the fungus occur in dense groups) and *Macrophominaphaseolina* (Tussi) Goid.

Symptom: The disease appeared as minute yellow spots which gradually increased in size and became dark brown patches. First purple coloured blotches appeared on the ventral surface of the leaves. In about a week's time the infected portions became dark brown in colour. The affected leaves dried and fell off (Mohanty and Addy, 1957).

Control: To control this Dithane M45 @ 0.2% is to be sprayed before the monsoon and repeated at monthly intervals until November.

Target Spot

Rauvolfiaserpentina was reported to suffer heavily due to target spot disease (Mohanty and Addy , 1958, Reddy et.al., 19571).

Symptoms: The leaves are attacked on both surfaces. The infection resulted in the appearance of small brownish spots which gradually enlarged into circular spots,2-20 micrometre with concentric zones due to which the disease is called as 'target spots'. The spots were dark brown on the upper and yellowish brown on the lower surface and are usually surrounded by a pale-yellow margin.

Control: Attempts were made to control the disease. Among the four fungicides tested in the field , application of 0.25% Captain at monthly intervals for six months effectively controlled the disease (Reddy et.al., 1971).

Anthracnose

Symptoms: The symptoms consist of numerous spots and the acervulli scattered all over the leaf . Infection is mainly confined to upper surface of the leaves. The spots enlarged into large circular patches and invaded the surrounding tissues. Severely infected leaves dried resulting in defoliation (Varadarajan, 1964).

Causal organism: *Colletotrichumgleosporioides* (Penz) Sacc.

Control: The disease is reported to be controlled by removing with fermate, Dithane Z-78 and Terlateis also recommended for the control (Varadarajan,1964).

Die-Back

Symptoms: Numerous tiny spots found on leaves and stem. Acervuli are scattered all over the surface. Smaller lesions coalesced to form large and circular necrotic patches. Severe infection resulted in drying, defoliation and decapitation (Lele and Ashram,1968, Varadarajan,1958).

Causal organism: *Colletotrichum dematium*: (Pers) Grove.

Control: The disease is reported to be controlled by spraying the infected with Dithane Z-78 (0.2%).Two to three sprayings a week with Bordeaux mixture for 4-6 weeks are reported to control the disease.

Phyllody

History and spread: Bunchy top disease of *R. serpentina* was first observed by Varadarajan (1967). He suggested the overwintering of the disease in Catharanthusroseus, Nicotianatabacum, Solanummelongena and Capsicum annum in Gujarat (India). A disease with similar symptoms was observed in 1964 in Jammu (Sastry,1973).

Symptoms: Characteristic symptoms of the disease were retarded growth, shortened internodes, phyllody of flowers. The leaves became small and pale in colour; the floral parts of the infected plants are modified to leaf like structures resulting into a cluster of small leaves in place of florescences and leading to complete sterility.

Yellow Vein Mosaic

History and spread: A yellow vein disease of *R. serpentinacaused* by a graft transmissible and whitefly (Bemisiatabaci) transmitted virus, was observed in the experimental plantation in Jammu.

Symptoms: The symptoms consisted of yellowing of young leaves and formation of yellow network in the back ground of green surface. A minor retardation of growth of infected plants was also observed.

Ring Spot

History and spread: A graft transmissible ring spot disease of R. serpentine was observed in the experimental plantations in Jammu.

Symptoms: leaves of infected plants showed characteristic concentric yellow rings of different sizes scattered all over the surface of the leaves. The rings gradually enlarged , coalesced and became gradually necrotic. In later stages, the entire infected leaves become necrotic resulting in defoliation. Infection adversely affected the quality of roots and their alkaloid contents (Sastry,973).

Root-Knot

Symptoms: The infected plants showed stunted growth, etiolation and smaller leaves. The disease was reported to be caused to be caused by a nematode, Meloidogyne incognita (Kofoid and White) Chitwood (Hasseb et.al.,1983).

Control: soil fumigation, adoption of proper cultural practices and development of resistant variates are useful methods for the control of disease caused by nematodes.

Yield and economics of cultivation per hectare: yield per hectare is 3,000 kg dried roots and 30 kg seeds. The average time for crop harvesting is 18 months (Subandi et.al.,2018).The average cost of selling 3,000kg roots @Rs140/kg is 4,20,000 and that of 30kg seeds @Rs400/kg is 12,000 resulting Rs 4,32,000 in gross returns. Expenses in maintenance and harvesting the crop accounts Rs 1,80,000 resulting into a net profit return of Rs 2,52,000(www.naturaldatabase.com).

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Minimum Support Price an Initiative Toward Doubling Farmer Income

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The Govt. has set a target of doubling the farmers' income by 2022 and constituted an Inter-Ministerial Committee under the chairmanship of Chief Executive Officer, National Rainfed Area Authority, Dept. of Agriculture, Cooperation and Farmers Welfare to inspect problems relating to doubling of farmers' income and suggested a plan of action to doubling of farmers' income in real terms by 2022. Giving a vital boost for the farmers' income, the Govt. has increased the Minimum Support Prices (MSPS).

Introduction

Minimum Support Price (MSP) is a type of market intervention by the Govt. of India to assure agricultural producers against decrease in farm prices. The MSPS are declared by the Govt. of India at the starting of the sowing season for certain crops on the basis of the recommendations of the CACP (Commission for Agricultural Costs and Price). MSP is price declared by Govt. of India to overcome the producer - farmers - against decrease in price during higher production years. The MSPS are a guarantee price for their product from the Government. The vital objectives are to protect the farmers from distress sales. In case the market price for the commodity decrease below the announced minimum price due to higher production and surplus in the market, Govt. agencies purchase the whole quantity offered by the farmers at the announced MSPs.

Crops Covered under MSPs: Govt. announces MSPs for 22 mandated crops and FRP(Fair and Remunerative Price) for Sugarcane. The mandated crops are 14 crops of the Kharif, 6 Rabi season crops and two other commercial crops. In addition, the MSPs of Toria and de-husked coconut are declared on the basis of the MSPs of Rapeseed/Mustard and Copra, respectively. The crops are as follows:

1. Cereal crops(7) - Rice, wheat, Barley, Sorghum, Pearl millet, Maize and Finger millet
2. Pulse crops (5) - Chickpea, Arhar, Moong, Urad and lentil
3. Oilseed crops(8)- Groundnut, Rapeseed/ Mustard, Toria, Soybean, Sunflower seed, Sesame, Safflower seed and Niger seed.
4. Raw cotton crop.
5. Raw jute crop.
6. Copra crop.
7. De-husked coconut crop.
8. Sugarcane crop (FRP).
9. VFC (Virginia flu cured) Tobacco crop.

Commodities	Varieties	MSP for 2019-20 (Rs per quintal)	MSP for 2020-201 (Rs per quintal)	Increase over previous year (Rs per quintal)
Kharif crops				
Paddy	Comman	1815	1868	53
	Grade 'A'	1835	1888	53
Jowar	Hybrid	2550	2620	70
	Maldandi	2570	2640	70
Bajra		2000	2150	150
Maize		1760	1850	90
Ragi		3150	3295	145
Arhar(Tur)		5800	6000	200
Moong		7050	7196	146

Urad		5700	6000	300
Cotton	Medium Staple*	5255	5515	260
	Long Staple**	5550	5825	275
Groundnut in Shell		5090	5275	185
Sunflower seed		5650	5885	235
Soybean		3710	3880	170
Sesamum		6485	6855	370
Nigerseed		5490	6695	755
Rabi Crops				
Wheat		1840	1925	85
Baeley		1440	1525	85
Gram		4620	4875	255
Masur(Lentil)		4475	4800	325
Rapeseed & Mustard		4200	4425	225
Safflower		4945	5215	270
Toria		3560	3900	340
Other Crops				
Copra(2020 crop season)	Milling	9521	9960	439
	Ball	9920	10300	380
De-husked coconut		2571	2700	129
Raw Jute (for 2010-20 season)			3950	-
Sugarcane$			275	-

*Staple Length (mm) of 24.5-25.5 and Micronaire value of 4.3-5.1.
**Staple Length (mm) of 29.5-30.5 and Micronaire value of 3.5-4.3.
$Fair and remunerative price.

Conclusion

The Government has raised the MSPs which is good initiative of the Govt. and it will give the boost to double the farmer income by 2022.

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A Study on Strategical Significance of South China Sea for India

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Abstract
This paper tries to explain the importance of South China Sea for India. Mainly secondary data has been used for analysing this paper. The ongoing disputes in the South China Sea (SCS) have been regarded as one of the most enduring and complicated regional conflicts in the Asia-Pacific. The disputes involve China along with several states in the region and encompass issues such as overlapping territorial claims and access to critical resources like energy and fisheries. Within this turbulent environment, India has been expanding its influence through implementing its Look East Policy (LEP). This has not been taken well by China, who has for years tried to curb New Delhi's growing involvement in the SCS. India's decision to involve itself in such a complex environment, even at the risk of provoking its giant neighbour, demonstrates the significance it places on the region and its sea lanes.

Introduction
The South China Sea is a marginal sea, which is part of the Pacific Ocean. It is surrounded by littoral states China, Vietnam, Malaysia, Singapore, Brunei, Philippines and Taiwan. Strait of Malacca connects South China Sea with Indian Ocean while Formosa Strait connects South China Sea with East China Sea. Geographically, it connects the Indian Ocean and the East China Sea via the Malacca Straits, which is one of the busiest sea lanes in the world. This important waterway serves as a vital economic artery for the South Asian state. Up to 97 percent of India's total international trade volume is sea-borne, half of which, passes through the straits. In addition, the Association of Southeast Asian Nations (ASEAN) constitutes one of India's largest trade partners, with total trade valued at $71 billion in 2016/2017.

South China Sea and ASEAN
Economies of South East Asian countries heavily depend on ports and free movement of goods and services through trade lanes in South China Sea. One-third of the world's shipping passes through South China Sea, carrying over $3 trillion in trade each year.

South China Sea has large reserves of oil and natural gas, fisheries, sea products and other minerals. All the littoral countries of this Sea want to explore these reserves for economic development.

USA and Development of Region
United States thinks highly of maritime predominance, freedom of navigation, and security commitments to regional states in South East Asia. American military presence has afforded ASEAN countries the opportunity to pursue economic prosperity without substantial increases in their own defence expenditures.

The Indo-Pacific has prospered under American hegemony for the previous 40 years. USA invested$328.8 billion in the Association of Southeast Asian Nations (ASEAN) in year 2017 alone. No group of nations has benefitted more from the presence of the US in the region than ASEAN.

Nine Dash Lines
The nine-dash line refers to the undefined, vaguely located, demarcation line used by China for their claims of the major part of the South China Sea. The contested area in the South China Sea includes the Paracel Islands, the Spratly Islands, Pratas Islands, the Maccles field Bank and the Scarborough Shoal. The claim encompasses the area of Chinese land reclamation known as the "Great Wall of Sand".

China's Claims Over South China Sea
On 1st January, 2013, China issued a new map, which for the first time marked in detail more than 130 islands, reefs, shoals in the South China Sea that Beijing claims within U shaped lines. China's claims over South China Sea and Chinese occupation in territorial waters and islands of neighbouring countries are in

violation of UNCLOS. China advances its claims base on the argument that the SCS and the islands within this body of water have been in the Chinese possession for centuries dating back as far as the Han Dynasty in the Second Century AD. Recently Vietnam, Indonesia and Malaysia have approached the UN expressing that China has no legal basis for the nine-dashed line region.

The alleged historical claims over South China Sea are not centuries old: they only go back to 1947. China uses fabricated 'evidences of history' as a tool for grabbing this region.

Chinese Aggression and ASEAN Economies

In the first half of 2020, Chinese naval forces have rammed a Vietnamese fishing boat, buzzed a Philippines naval vessel and harassed a Malaysian oil drilling operation all within their respective EEZs. At the same time, ASEAN overtook the European Union to become China's largest trading partner in the first quarter of 2020, and China is the third-largest investor ($150 billion) in ASEAN.

ASEAN countries need China especially in a post-COVID world where they are struggling to revive their economies.

ASEAN and US-China Rivalry

China is presenting a binary choice to Southeast Asia to choose between China and USA amid trade war between these countries. China is also aiming to create a sphere of influence through economic statecraft and military modernization.

ASEAN Expectation with India

While strategic partnerships and high-level engagements are important, ASEAN expects long-lasting commitments from India in the future. ASEAN wants to collectively encourage an increasingly powerful China to pursue strategic interests in a legitimate way, and on the basis of respect for international law, in the South China Sea, by involvement of India in Indo-Pacific affairs. ASEAN nations have taken the initiative time and again to involve India in Indo-Pacific affairs.

India's Interests in South China Sea

Sea-lane through South China Sea has been of great importance for India, for communication since the very beginning, and passage has been unimpeded over the centuries. India has historical rights established by practice and tradition to traverse the South China Sea without impediment. Nearly $200 billion of India's trade passes through the South China Sea. Thousands of Indian citizen's study work and invest in ASEAN, China, Japan and the Republic of Korea. Security and safety of Indian Diaspora and their investment in South China Sea region and East Asia is responsibility of Indian state. India have high stakes in the peace and security of this region in common with others who reside there, and freedom of navigation, as well as other normal activities with friendly countries, are essential for India's economic well-being.

India Must Consider the Following Factors While Calibrating its Approach

1. The South China Sea is not China's sea but a global common.

2. It has been an important sea-lane of communication since the very beginning, and passage has been unimpeded over the centuries.

3. Indians have sailed these waters for well over 1,500 years — there is ample historical and archaeological proof of a continuous Indian trading presence from Kedah in Malaysia to Quanzhou in China.

4. Nearly $200 billion of our trade passes through the South China Sea and thousands of our citizens study, work and invest in ASEAN, China, Japan and the Republic of Korea.

5. We have stakes in the peace and security of this region in common with others who reside there, and freedom of navigation, as well as other normal activities with friendly countries, are essential for our economic well-being. In short, the South China Sea is our business.

6. We have historical rights established by practice and tradition to traverse the South China Sea without impediment.

7. We have mutually contributed to each other's prosperity for two thousand years.

8. The proposition that nations that have plied these waters in the centuries past for trade and other peaceful purposes are somehow outsiders who should not be permitted to engage in legitimate activity in the South China Sea, or have a voice without China's say, should be firmly resisted.

Conclusion

Indian is a stakeholder in the South China Sea. What happens there have implications for us, so far, the U.S. played a major role in the prosperity and security of the Indo-Pacific, but after the COVID-19, it may be forced to reconsider its stand over the region. In such a scenario, India must form a partnership with other players in the region and should attempt to make China follow international laws and global order.

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Commercial Cultivation of Multivitamin Green (*Sauropus androgynus* Meeril.)

Article ID: 31088

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Introduction

Chekkurmanis (*Sauropus androgynus* Meeril.), belongs to the family Euphorbiaceae is a native of Malaya. It is commonly called as Multivitamin greens due its capability of having more load of vitamins. Its multiple upright stems can reach 2.5 meters high and bear dark green oval leaves 5–6 cm long.

It is one of the most popular leafy vegetables in South Asia and Southeast Asia and is notable for high yields and palatability.

The shoot tips have been sold as tropical asparagus. The leaves and tender shoots are mainly used as vegetable after frying. The tender shoots and leaves are trimmed and used in the preparation of fried and boiled items.

Nutrient Composition

It has high level of provitamin A carotenoids, especially in freshly picked leaves, as well as high levels of vitamins B and C, protein and minerals. The more the leaves mature, the higher the nutrient content of the leaves. The leaves are rich in protein (7.4% as compared to 3.2% in amaranthus), Vitamin A (47,500 IU/100g), Vitamin B, Vitamin C (100mg/ 100g).

Soil and Climate

It comes up well in all types of soils. The growth and yield are high when they are grown in rich, well drained sandy loam or semi-laterite soils.

A warm humid climate with good rainfall is best suited and its grows well in mild humid locations with equable temperature viz., the temperature is neither very high (40oC) nor too low (freezing or near freezing).

It grows very well at lower elevations at 500m above MSL though plants are found at higher elevations up to 1,200m above MSL. When the plants are raised under shade, it produces broader leaves.

Propagation

There are no distinct varieties have been identified in this crop. It is propagated by seeds and stem cuttings. Seed propagated plants come to harvest little later than cuttings. Rooting of stem cuttings can be fastened by dipping the cuttings in 50ppm IAA/ IBA before planting in polybag.

It takes 20-25 days for rooting. The stem (softwood and semi-hardwood) cuttings of 6-12 months old, 20-30 cm length are to be planted in May – June. These are usually grown on borders of kitchen garden; to check the height of the plant and to get frequent harvest the tips are clipped off intermittently.

Planting and Aftercare

The field is prepared to a fine tilth and form a ridges and furrows. Before planting add 20 t FYM/ha. The rooted cuttings are planted in the spacing of 60 x 30 cm or 45 x60 cm. Planting can be done during May-June. For planting a hectare area, about one lakh cuttings are required.

Soil should be supplied with major nutrients especially nitrogen fertilizers and irrigated. FYM @ 5-10 Kg/plant/year and N:P_2O_5:K_2O (7:10:5) mixture @ 30 gram/plant are recommended. The plants are reached about three feet high they are tipped to develop laterals.

If left untrimmed in this early age, the plant reaches the size of a small tree. It can be trained as hedge or even on bowers or on trellises. Pruning is essential for once in a year.

Pest

Scale insects and aphids are problematic which can be controlled by spraying Malathion @ 1 ml/lit. after clipping the leaves for green. Caution should be taken not to pluck the leaves and tender shoots immediately after spraying insecticide.

Harvest and Yield

The first clipping can be had 4 months after planting and subsequent cuttings at monthly interval. The annual productivity is 30-50 tonnes/ha with a per plant yield of 2- 5 Kg leaves /plant.

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Agricultural Marketing Infrastructures in India

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Abstract

Marketing infrastructure include apart from the Government institutions and organizations, roads, railways, warehouses, market yards, cold stores, processing units, research and training institutions, means of communication and transportation including air cargo, sea cargo etc. The basic rationale of any infrastructure is the sustenance it provides to production activity, income generation and social service supplies. It has also positive effect on income distribution because low per capita infrastructure limits the access of small and marginal farmers to the market.

Introduction

Agricultural marketing infrastructure includes all those facilities and amenities needed for the smooth conduct of marketing in the economy. The infrastructural facilities in development are as necessary as foundations of a building. The existence of adequate marketing infrastructure is important not only for the performance of various marketing functions and expansion of the size of the markets but also for the transfer of appropriate price signals leading to improved marketing efficiency.

The availability of different infrastructures affects the choice of technology to be adopted, reduces the cost of transportation, produces powerful impetus to production and also affects income distribution in favour of small and marginal farmers by raising their access to the market. The agriculture sector needs heavy investment for creation of basic infrastructures necessary for the overall economic development. In a developing country like India, marketing infrastructures play a pivotal role in fostering and sustaining the tempo of rural and economic development. Marketing is as critical to better performance in agriculture as farming itself.

Though the role of infrastructure is the key element of any development programme yet their role in distribution and marketing is the supreme. India's growth both as agriculturally and horticultural advanced country may get derailed if various marketing infrastructural constraints are not removed. Many of the regions of the country still suffer from the existence of infrastructural problems that they threaten to torpedo the region's agricultural and horticultural development efforts.

Marketing Infrastructure Facilities

1. Main Trading Facilities: It includes, common covered auction halls, common open auction platforms, common drying yards, traders' models coffee, auction hall, godown and retail shops.
2. Administrative facilities.
3. Farmers facilities.
4. Common facilities.
5. Ancillary Trading Facilities. It includes, Storage Godowns, Cold Storage, Weighing Equipment and Facilities, Processing Units, Grading equipment and Pledge finance.

Agriculture Produce Market Committee (APMC)

APMC were established by the state GOI for regulating the marketing of different kind of agriculture produce. The Maharashtra Agricultural produce marketing (regulation) act was passed in the year 1963 with view to regulate the marketing of agricultural produce in market areas. Which is implemented from 1967 onwards at present there are 295 main market and 609 sub-market in Maharashtra.

The Maharashtra Agricultural Produce Marketing (Regulation) Act was passed in the year 1963, with a view to regulate the marketing of agricultural and pisciculture produce in market areas. After giving due consideration to various committee's recommendations and study groups, some important changes have been made in this Act in the year 1987 and thereafter.

Agricultural Produce Markets

Actual buying and selling of agricultural commodities takes place in market yards, sub-yards and rural markets/ hats spread throughout the length and breadth of the country. Agricultural produce regulated markets have been playing a major role in the smooth distribution of food grains, oilseeds, fiber crops and fruits and vegetables to meet the supply and demand needs of the farmers, traders, processors and consumers of the State. The research studies revealed that farmers on an average gets 8 to 10 per cent higher price and higher share in the consumer's rupee by selling their produce in the regulated markets compared to rural, village and unregulated wholesale markets. The benefits got by the farmers by sale of agricultural produce in the regulated market varies from area to area because of the variation in the spread of regulated markets over the regions and the existence of necessary infrastructural amenities/ facilities in these regulated markets.

Storage Infrastructure

Storage facilities in the country, the Agricultural Produce (Development and Warehousing) Corporation Act was enacted in 1956. The State Governments also enacted the warehousing Acts during July 1957 to August 1958. The scheme of Warehousing, Rural Godowns and Cold storage's have been initiated in public, cooperative and private sectors in the country to meet the storage needs of the producers in different areas.

Processing Infrastructure

Strong and effective food-processing sector plays a significant supportive role in diversification and commercialization of agriculture. Processing function adds value to the products and enhances the income of the farmers in addition to generation of employment in the economy. A number of agro-processing units for processing of different agricultural products have been established in the country in recent past with the increasing consumer demand for processed products.

The processing capacity of the existing units has also been enhanced. Huge post - harvest losses of fruits and vegetables is there in absence of the processing units. Presently only 2.3 per cent of total production of fruits and vegetables is being processed in the country. Though the country offers vast potential for establishing agro-processing units like for oilseeds, food grains and sugarcane, yet their availability in the number of State is almost negligible.

Cleaning, Grading and Packaging

Grading and standardization of agricultural produce is done under the Agricultural Produce (Grading and Marking) Act, 1937. Grading is being undertaken at the traders and producers' level both for internal consumption and for export. To facilitate grading, grading centres have been established only in 1321 markets so far. The trend of the quantity of agricultural produce graded over time is a rising one. But the quantity graded at producer's level is still almost negligible. There is a need to create facilities for cleaning, grading and packaging at primary level and also in the villages from where produce is brought for sale. In the absence of such facilities at the village, the kind of congestion and pollution mounts at the market yard level.

Food Parks and Pack Houses

India is second largest producer of fruits & vegetables. With a view to tap export markets and catering to the need of bulk buyers, mechanical graded and packed house are required in the horticulture growing areas. Certain activities like cleaning, washing, grading, packaging, refrigerated transportation etc. are to undertaken in conformity to international trade. To address these problems, APEDA a implemented a scheme for catering Export Oriented Agri- Zones.

Market Information System (MIS)

Farmers need information to aid them in planning their operations right from the time they plant these seeds until the produce possess the hands in the market. Market information helps the farmers in comparing the prices offered by different firms in different markets and also in the selection of alternative outlets available. The MIS reduces business risks of farmer - sellers and traders.

Post-Harvest Technology

Post -harvest technology infrastructure especially for perishables, less perishables and non- perishable commodities is of critical importance to preserve their quantity and quality. A substantial quantity of produce is lost on account of poor post-harvest technology and careless harvesting, assembling, preserving, packaging and use of technology for quality control.

State Agricultural Marketing Board, Directorate of Horticulture and Post-Harvest Technology Centres established for specific crops by ICAR has initiated the process for promotion of Post-Harvest Technology in the form of providing of know-how on different aspects to the farmers and orchardists of the country.

In some of the States, State Agricultural Marketing Board offer services to the traders and processors in providing of technical consultancy, preparation of techno – economic feasibility report, quality control guidance, assessment of packaging necessity of different fruits and advisory services to fruits and vegetables processing units.

Marketing Education and Training

There is increasing need to provide market education and training to the farmer – producers, traders, marketing personnel, policy makers etc. on a continuous basis based on regular research studies. These improves know how and decision taking power of the farmers as to when, where and in what form to sell the produce. The Directorate of Marketing & Inspection, State Agricultural Marketing Board, State Marketing Department, Agricultural University and National Institute of Agricultural Marketing are engaged for helping the farmers and market functionaries in these areas. However, the available inputs in these areas are not sufficient to cater to the needs of all the growers and other stakeholder because of varied agro-climatic conditions.

Conclusion

From the above article it is concluded that there is a strong need for:
1. Creation of necessary infrastructural facilities in all the regulated markets of the country.
2. Regulation of all primary and secondary wholesale markets to minimize the variation in their spread.
3. Develop the periodic/rural markets with minimum necessary infrastructural facilities as these are the main contact points for sale of agricultural produce by the small size farm operators.

On storage front also there is need for:
1. Construction of more scientific storage structures especially in rural areas for protection of produced agricultural output.
2. Private sector involvement is necessary for creation of more storage structures and cold stores as it is highly capital-intensive marketing infrastructure.

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Plasticulture: An Inevitable Condition for Ongoing Agriculture

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Introduction

Plasticulture, which means the use of plastics in agriculture cultivation is fast becoming the most sought out technique to augment farm yields and consequent farm income. In India, it can come handy in realizing the overall aim of doubling of farmer's income domestically by 2022. This is more significant, mainly since agriculture contributes 14% of GDP of India, while more than 50% of the population is directly or indirectly dependent on it for livelihood. Moreover, the erratic nature of climate is a cause of worry for different crop growth parameters during kharif, rabi and zaid seasons and exposes risk of national income. Hence, it requires mitigation measures. India supports 18% of the global population with 2.4% of land area and 4% of water resources, thereby making judicious use of water even more paramount. Plasticulture applications are considered as indirect and valuable agriculture input which show effect in moisture conservation, reduction in fertilizer consumption, helps in application of precise inputs, plant protection through the use of nets, solarisation of soil and use of innovative packaging facilitates help in increasing shelf-life during collection, storage and transportation of fruits and vegetables.

History

While plastic itself has origins dating back to the 19th century. Agriculture plastics rose to prominence in the 1940s when E.M. Emmert, a horticulturist at the University of Kentucky, discovered plastic film. At first, agricultural plastic was mostly used as it was durable and a cost-effective way to replace glasses in greenhouse and tunnel siding. This helped to develop new greenhouse designs which are more efficient to capture more solar radiation while protecting crops from the elements. The greenhouses and poly houses are still being equipped with farm plastics, along with several other innovative applications.

Types of Plastics Used in Agriculture

A wide range of plastics is used in agriculture, including, Polyolefin, Polyethene (PE), Polypropylene (PP), Ethylene-Vinyl Acetate Copolymer (EVA), Poly-Vinyl Chloride (PVC) and less frequently, Polycarbonate (PC) and Poly-Methyl-Methacrylate (PMMA).

Why Do Farmers Prefer the Use of Plastics in Agriculture?

Plastics can play a major role in energy conservation. This requires considerably minimum energy in production and conversion to finished products. The farmers were well habituated with this plasticulture due to following reasons.

1. Higher-strength / weight ratio: Plastics tend to have a higher strength-to-weight ratio, as well as a higher strength-to-stiffness ratio. By this feature, farmers can easily carry the required material from place to place with his affordable means of transport without using heavy machinery.

2. Superior electrical properties: Plastic is a bad conductor of electricity unless until it made with an array of plastics with metallic or even superconducting properties.

3. Superior thermal insulation properties: Plastics are poor heat conductors because they have virtually no free electrons available for conduction mechanisms like metals.

4. Excellent corrosion resistance: Plastics have excellent corrosion resistance when compare to wood and iron. When compared to wood, durability of plastics is more and can efficiently use for various purposes.

5. Superior flexibility: The plastics can be folded as per our convenience and provide space for other things in a limited area.

6. Impermeability to water, gas, etc.: The Impermeability nature of plastics like water and gases can help the farmers to grow plants even in unfavourable conditions.

7. Less friction due to smoother surface: Less damage occurs during usage as there is no frictional losses or damages.

Where We Use Plastics in Agriculture?

1. Greenhouses and High Tunnels: Using plastic for greenhouses and high tunnels offer all sorts of benefits for crops and plants. Agricultural plastic can transfer more nourishing solar radiation to plants as they begin to grow, protect them from pests and the elements and maintain the perfect temperature to encourage growth at different stages in their maturity cycles. Keeping plants safe from extreme temperature fluctuations can also extend the growing season and even accommodate year-round growth.

2. Plastic mulch: Plastic mulch refers to a thin layer of plastic film that covers the crops to insulate their root system and prevent weeds as the crops begin to grow. It also limits the amount of water that evaporates from the soil, which is extremely helpful in dry regions or areas experiencing drought.

3. Irrigation: As this Farm plastic is resistant to rust and other forms of corrosion, it works well for plastic reservoirs and irrigation systems to manage water flow from different sources and supply in both large and small agricultural operations. It's also a durable material that can help avoid leaks that could waste precious water and impact crop growth.

4. General Supplies: Rather than wood that can rot and splinter, agriculture plastics can be used to create lightweight as well as handy crates for crop collection, or for displaying crops at farmers markets. They can also be used for netting to guard against hail and create shade when needed.

5. Silage: Even the small farmer performs silage practise with the help of plastic film at a low cost. Plastic film can be wrapped tightly around grains and straw used to feed farm animals, keeping them safe and fresh throughout the winter. Their airtight seal and resistance to the elements will prevent the food from going bad for years to come.

How We are Dealing with the Use of Plastics in Agriculture After their Applications?

Plastic products and packaging have become part of all aspects of modern farming. Much of it has been buried in landfills or burned in the field, generating dioxins and other pollutants. Single use plastic used for making silage and other purpose is the leading cause of damage and concern, as it doesn't bio degrade and is left discarded in the outskirts of the fields by farmers which leads to numerous problems explained below. On the other hand, polymer used in construction of greenhouse sheets are more resilient and last longer with proper care than even glass hence, making it a very desirable product. The options to recycle these used plastics have been neither robust nor sustainable for farmers.

What are the Damages Caused to the Soil by Using Plastics in Agriculture?

Dangerous toxins released from the polythene film can remain in the soil for centuries. Known as white pollution, polythene residue is becoming increasingly prevalent in treated soils at levels of up to 3300,000 grams/hectare. Over time, this decreases soil porosity and air circulation, alters microbial communities and compromises soil fertility. Polythene also releases carcinogenic phthalate acid esters into the soil which, together with other synthetic pesticides, can be easily absorbed by the crops. This is a significant risk to human health. What's more, the polythene films used in the coverings are low density by design, which makes the plastic extremely difficult to biodegrade. Any waste from this process is rarely accepted by recycling facilities and often ends up in landfills and oceans, wreaking havoc on ecosystems around the world.

Alternatives to Avoid Plastic in Agriculture

India hosts the World Environment Day for 2018 and has taken a slew of steps in recent months to ban the use of single-use plastics, mainly in the form of polythene bags and bottles. The use of plastics in agriculture could be the next big segment for plastic manufacturers to target, and that is going to be disastrous considering the effects on soil health, microbial communities, potential release of carcinogenic compounds into the food chain and also loss of commercial value to crops such as cotton.

There are alternatives. A recent UN Environment report discusses the use of:
1. Alternative natural materials obtained from plants and animals.

2. Newer generation bio-polymers which are plastics made from biomass sources.

Concerning agriculture, in particular, some of the solutions might come with a little more physical effort (using organic mulch) or others that come at a slightly higher cost (biodegradable materials).

Steps such as those taken by smart cities like Muzzaffapur and progressive states like Maharashtra in banning single-use plastics and enforcing penalties for non-compliance will undoubtedly help. But we need to go beyond just ban of plastic bags and address its use across all sectors if we are to make a difference to contamination of our soil, water, food and air.

Conclusion

The sustainable use of plastics in agriculture with the help of research based on alternative options as a paramount importance to maintain a healthy ecosystem and environment. Therefore, state and national policies must incentivize desirable and responsible behaviour. And while research help develop more alternatives as commercial options, the traditional resource management principles of reuse, reduce, recycle will continue to hold.

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Certification in Organic Farming

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Introduction

Generally, Organic farming is defined as a form of agriculture which excludes the use of synthetic fertilizers and pesticides, plant growth regulators, livestock feed. The perception of organic farming by common man is more from consumers' angle.

A common man always thinks that organic farming results into "PESTICIDE FREE FOOD". Hence most commonly accepted definition of organic farming the perception that farming should not have used any pesticides.

Modern definition of organic farming was proposed by global organization called IFOAM (International Federation for Promotion of Organic Agricultural Movement) as "Organic agriculture is a production system that sustains health of soil, eco-system and people, by relying on ecological process, bio diversity and natural cycles and adapted to local conditions than use of inputs with adverse effects".

Certification in Organic Farming

The production of organic goods necessitated an elaborate method of certification mainly because the organic products are sold more easily at a remunerative price only when they have a tag "ORGANIC". As the awareness towards consumption of organic goods improved globally, the consumer and marketing organizations insisted on organic tag to be sure that the concerned product is grown under organic management and be sure that it is free of pesticides.

The necessity to obtain the organic certificate arose also because most of the farms converted their chemical agriculture to organic agriculture and a certifying agency should ensure that synthetic chemicals are not included in cultivation of crops.

In this background, the concept of certification of organic goods commenced. EEC countries were pioneers in demanding the specific standards required under certification. Later on, certification standard was evolved in US and many other countries. Even in India number of third-party certification agencies has been identified to award the certificate with the tag organic.

As per the organic certification directory published by Grolink, there are 364 certification agencies across the world. They are unevenly spread, because 231 agencies are operating in Europe and North America and only 7 of them working in Africa.

IFOAM (International Forum for Organic Agriculture Movement) has even launched accreditation programme to seek the accreditation of different certification agencies. Despite many efforts to streamline the certification process, different countries required different certification programme of organic products even today.

In absence of such a global uniformity in organic standards and certification, the export of organic goods has been often affected for the reasons of certification. In the context of Indian organic agriculture, certification has remained mainly as a facility to export organic goods than to supply of pollution free food to domestic markets. For example, an Indian organic fruit producer needs to seek certification acceptable through European Union if he wants to export fruits to any country in Europe.

International Standards for Organic Certification

Although European Community fixed the standards of organic products for the purpose of importing them from producing countries, the international standards for organic agriculture were developed by IFOAM popularly called as IFOAM standards. They are valued and accepted by many countries for trading in organic products. In addition to IFOAM Standards, following standards are followed by different certifying agencies.

1. Joint commission of FAO and WHO was established in 1962 as inter-governmental body to evolve standards the name of Codex Elementarious Commission. It was successful in shaping the fundamental basis for certification of organic production as early as 1962.

2. EU regulations were established to evolve European organic standards in 1991 to give the details of production practices of organic crops. These were made applicable for both domestic producers and producers from exporting countries.

3. Demeter International is a worldwide network of international certification bodies in Africa, Australia and Europe. They developed standards for production of biodynamic preparations and organic production.

4. JAS standards were developed by Japan mainly to satisfy the needs of certification for organic products reaching Japan.

5. USDA's National Organic Standard Board was established under Organic Food Production Act of farm bill in USA. They defined the complete set of practices and residual levels of pollutants to be acceptable as organic products.

6. IFOAM also established international organic accreditation service in 2001 mainly to bring the global certifying agencies under one umbrella to maintain the uniformity of certification.

Steps in Organic Certification

Certification is offered to a farm and not to a product at production level. But certification is applicable to production, processing, packing, storage and even transportation. At every stage of handling, organic products certification insists on certain procedures and certain materials.

Although certification at production level considers the whole farm as a unit, in subsequent stages, the products and their handling are involved.

At a farm level, the certification is awarded to whole farm looking to various considerations regarding.

1. The source of seed material (seed must have been produced under organic conditions).
2. The source of manure or other organic inputs (the materials used to produce manure must have been originated from organic farm).
3. The feed given to animals; whose dung/urine is used to produce manures.
4. The soil and its physical, chemical and biological characters.

Following steps are followed in certifying a farm as organic and to allow the products of such farm to carry the tag 'ORGANIC'.

1. The farmer approaches a certifying agency with the prescribed fees for certification.

2. Depending on the standards followed by each certifying agency, they visit the farm and collect all basic information regarding soil, crops and cropping pattern, cultivation practices and chemicals/fertilizers used.

3. Usually soil, water, manure and produce samples are collected and analysed.

4. Then, the farmer is advised about "conversion to organic". Depending on the standards, they insist on the farmer to follow specify cropping pattern, specific set of inputs (obviously precluding the fertilizers and pesticides) as well as specific pattern of cultivation.

5. The farmer must follow these methods till end of second year from the commencement of conversion process. Third year is reserved for production of organic goods, which are rigorously tested.

6. Then the farm is awarded certification and is allowed to sell its products under `organic' tag-usually carrying logo of certifying agency/standard used.

7. If processing is involved, the products are sent for processing, which again should be certified under similar standards. Otherwise, the product is packed and transported according to stipulated standards.

Inputs Allowed, Banned and Restricted (India)

Allowed	Restricted	Banned

FYM, slurry, urine, poultry manure, vermi-compost, compost from residues, green manures, green leaf manures, bio-dynamic preparations, azolla, straw, mulches, kitchen wastes, coir pith, organic compost from tea/ coffee residues Mechanical traps, plant-based repellants, Azardactine, pyrethrin, tobacco and tea products etc.	Oil cakes, mill products, human exctrements: FYM, slurry urine, coir pith, sea weeds from uncertified farms, gypsum, limestone, magnesium rocks, rock phosphate, basic slag, mineral potassium, saw dust, products from food/ textile industry, fish Plant/ animal oils Other plant extracts.	All synthetic fertilizers, sewage sludge, all synthetic pesticides.

Conclusion

Practically, in organic farming, farmer is greatly benefitted by reduced cost of cultivation, as his net profit will rise, although gross returns may be similar or even less in most success stories of organic farming. Every waste on a farm is organic and recyclable. No waste is allowed to go really waste and is productively used in organic farming. Therefore, key rule of organic farming will be WASTE IS NOT A WASTE BUT WEALTH.

Organic farming also improves soil physical characters like water holding capacity or structure are of greater importance in terms of sustaining natural resources. Because, such a development will not only reduce erosion but promote better utilization of natural precipitation. Better moisture retention also helps in improved microbial activity which is the basis of improvement of soil fertility.

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Adoption of Direct Seeded Rice Over Transplanted Rice in Areas Having Water and Labour Scarcity

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Need of 'Direct Seeding of Rice' (DSR) in the Current Situation?

Due to unavailability of labour in this pandemic (Covid-19) situation, farmers are now being encouraged to adopt 'Direct Seeding of Rice' (DSR) in place of conventional method of transplanting. During lockdown, a technology that allows farmers to sow paddy seeds directly could be a solution to overcome transplantation problem due to shortage of migrant labourers. Besides this method has another advantage of saving water by not requiring flooding of fields.

Why DSR?

Major reason:

1. Water scarcity.
2. The rising cost and scarcity of labour at peak periods.
3. Adverse effects of Puddling.
4. Rising interest in conservation agriculture.
5. Best fit in the cropping system.

What is Direct Seeding?

Direct seeding includes either wet or dry methods, depending on the manner of crop establishment. Wet seeding refers to sowing of pre-germinated seed, either by broadcasting or by drilling onto puddled wet soil followed by flooding the land. Dry seeding refers to broadcasting or drilling of rice into dry soil followed by covering the seed. There is a need for less land preparation.

But weed control is also important. It is essential to replace puddle transplanting with direct seeding in order to save water and labour and also to promote conservation agriculture (CA), with no/reduced tillage. In South Asia, DSR is being practiced on terraced and sloppy lands of Bangladesh, along the coastal and Western Himalayan region of India (Gupta et al., 2007). It is reported that productivity of DSR is 5-10% more than the yield of transplanted rice.

Table 1. Classification of Direct-Seeded Rice (DSR) System

System of direct Seeding	Seed bed condition and environment	Sowing method practiced	Suitable ecology/environment
Direct seeding in dry seed bed	Dry seeds are sown in dry and mostly aerobic soil	Broadcasting, Drilling or sowing in rows at depth of 2-3 cm	Mainly adopted in rain fed area, sometimes followed in irrigated areas with precise water use
Direct seeding in wet bed	Pre-germinated seeds sown in puddled soil, may be aerobic or anaerobic	Broadcasting, Drilling or sowing in rows at depth of 2-3 cm	Mostly favourable for rainfed lowlands but also suited for irrigated areas with good drainage facility
Direct seeding in Standing Water	Dry or Pre- germinated seeds sown mostly under anaerobic condition in standing water	Broadcasting on standing water of 5-10 cm depth	In areas with red rice or weedy rice problem and in irrigated lowland areas with good land levelling

Source: (Joshi et al., 2013).

How is DSR Different from Normal Transplanting of Paddy?

Transplanted Paddy:	Direct Seeding of Rice (DSR):
Seeds are first sown and raised into seedlings.	In DSR, the pre-germinated seeds are directly drilled into the field by a tractor-powered machine.
The area required for nursery seedbed is 5-10% of the total area to be transplanted.	There is no need of nursery preparation or transplanting in this method.
These seedlings are then uprooted and replanted 25-35 days later in the puddled field.	Uniform broadcasting of 60–80 kg seeds by hand or sowing in furrows in an area of 1 ha of field.
	Shallow furrows are made along the prepared field by passing a furrower.
	After broadcasting, cover the seeds with soil with the help of spike-tooth harrow.

Time of Sowing

This is a critical point to achieve the success in DSR crop in the main rice growing season (kharif). The sowing of crops should be accomplished before 10-15 days of onset of monsoon.

Selection of Varieties

Table 2.Varieties suitable for direct seeding of rice in different states in the Indo-Gangetic plains:

State	Varieties
West Bengal	Southern region: Nilanjana, MTU 7029 (Swarna Mahsuri), and CR group Northern region: N K3385, IET 15847
Bihar	Early sowing: Pusa 2-21 and Prabhat Medium sowing: IR 36 and Rajendra Dhan 201 Late sowing: Super mahsuri, Smbha mahsuri and Swarna mahsuri
Uttar Pradesh	Early sowing: Narendra 97 and Narendra 118 Medium sowing: Sarjoo 52, NDR 359, Sugandha 3 and Sugadh 4 Late sowing: Sambha mahsuri, Swarna mahsuri, Scented: T3, Pusa Basmati 1, Kasturi
Haryana and Punjab	Scented: Pusa Basmati 1, Haryana Basmati 1, Basmati 370, Kasturi and Tarawadi Basmati

Source: Tewari et al. (2011).

Water Management

Precise water management, particularly during crop emergence phase (first 7-15 days after sowing), is crucial in direct seeded rice (Balasubramanian and Hill, 2002).

Sl No	Phenological stages	Irrigation (times)
1	Pre-sowing	1 time
2	Emergence of seedling (7-10 days)	1 time
3	Tillering (30-45 DAS)	1 time
4	Panicle initiation to grain filling	1 time

Source: (Joshi et al., 2013).

Different Weed and their Management

Table 3. Important weeds associated with direct seeding rice crop in the Indo-Gangetic Plains:

Weed group	Weed species
Grassy	*Echinochloa colona, E. Crusgalli, Digitaria sanguinalis, Dactyloctenium aegyptium, Leptochloa chinensis, Eleusine indica, Cynodon dactylon, Paspalum distinchum, Ischaemum rugosum*
Broad-leaved	*Trianthema monogyna, Commelina benghalensis,Caesulia axillaris, Sphenoclea zeylaica, Marsila minuta, Ludwigia spp., Monochoria vaginalis*
Sedges	*Cyperus rotundus, Cyperus iria, Fimbristylis littoralis, Cyperus difformis, Scirpus juncoides.*

Source: Gupta et al., (2006) and Tewari et al., (2011).

Table 4. Recommended rates and time of application of selected herbicides in direct seeded rice:

Herbicide	Dose (kg a.i. ha-1)	Time of application	Target weed
Paraquat	0.5	1-2 DBS	All type of weeds
Glyphosate	1.2-1.6	7-15 DBS	All types of weeds
Pendimethalin	1.0	1-2 DAS	Grasses, broadleaved
Pretilachlor + safener z	1.5	1-2 DAS	All type weeds
Ethoxysulfuron	15	10-15 DAS	Sedges, broadleaved
2,4-D	0.5	20-25 DAS	Sedges, broadleaved

DBS, days before sowing; DAS, days after sowing (Source: Tewari et al., 2011).

Advantage with Direct Seeding of Rice

1. Water savings.
2. Less numbers of labourers required.
3. Saves labour cost.
4. Reduce methane emissions due to a shorter flooding period and decreased soil disturbance compared to transplanting rice seedlings.

Drawbacks of Direct Seeding of Rice

1. Non-availability of herbicides.
2. The seed requirement for DSR is also high, 8-10 kg/acre, compared to 4-5 kg/acre in transplanting.
3. Further, laser land levelling is compulsory in DSR. This is not so in transplanting.
4. The sowing needs to be done timely so that the plants have come out properly before the monsoon rains arrive.

Conclusion

DSR followed with suitable conservation practices has potential to produce slightly lower or comparable yields as that of TPR and appears to be a viable alternative to overcome the problem of labour and water shortage. Despite some controversies comparable yield may be obtained from DSR compared with TPR if managed properly. If not managed efficiently weeds problem arises which leads to partial or complete failure of DSR crops.

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Controversies, Opportunities and Status of GM Crops in India

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Introduction

Population, Poverty and hunger, shrinking area of agricultural land, Climate change in agriculture, Deterioration in soil quality, New pest and disease outbreak, diminishing water resources, Inadequate labour and inputs, Low agricultural production are the major problems faced by the farmers in India. Genetically modified organisms (GMO's) refer to plants and animals containing genes transferred from other species to produce certain characters such as resistance to pest, disease and drought etc.

Genetic modification done in two major ways:
1. Introduce one or a few well-characterized genes into a plant species and
2. Introduce genes from any species into a plant.

GM Crops Indian Scenario

GM crops commercially started grown during 1996. (GEAC) – Genetic Engineering Approval Committee look over the issues regarding GM crops in India. The commercialization of Bt Cotton was in the year 2002. The approval for Bt Brinjal (1st GM food crop) in the year 2009 and later announced a moratorium on the release of Bt Brinjal. The Indian government revalidated 10 GM-based food crops and allowed field trials for them, including wheat, rice, and maize (March, 2014). Supreme Court technical expert committee commended an indefinite moratorium on the field trials of GM crops till the government comes out with a proper regulatory and safety mechanism (TOI, July, 2013). The Indian government allowed field trials for GM crops, including wheat, rice, and maize (March, 2014). India doesn't allow commercial cultivation of genetically modified (GM) crops but Indians may be consuming GM processed food - knowingly or un-knowingly (Parliamentary panel, March, 2014).In GM foods consumption, Americans stands first in consuming GM foods. About 70 per cent of processed food products in the United States have ingredients derived from GM crops (Cornell CES, 2003).

GM Foods Consumption

Nowadays, consuming GM foods were increasing largely practice all around the world. The first GM crop was produced by Calgene and approved for marketing by the US Food and Drug Administration (FDA) in 1994.FlavrSavr tomato helped the United States consumers to accept genetically modified foods (Cornejo et al, 2006).The Americans stands first in consumption of GM foods. About 70 per cent of the processed foods ingredients in the United States have derived from GM crops (Cornell CES, 2003). An average of 87.5 Kilograms of GM foods was consumed per person per year. This 87.5 Kg accumulates 31 Kg of Sugar beet products, 27 Kg of Maize products, 17 Kg of Soya and Oil products and 13 Kg of Sorghum products (ISAAA, 2011). There are countries do not allow the production of GM plants but they do import and allow it for consumption. For example, Europe imported 23 million tonnes of soy meal and 12.6 million tonnes of soybeans from South America. China imported 45 million tonnes of soybean and 2.4 million tonnes of soya oil from South America. India also imported 1.1 million tonnes of soybean oil. Kenya imports GM maize from South Africa (ISAAA, 2011).

Nutritional Security (Golden Rice)

Nutritionally improved GM foods could overcome the human deficiencies among the malnutrition inhabitants.

Rice is the basic staple crop for half of mankind, yet rice is lacking micronutrients, such as beta-carotene (pro-vitamin A), which makes this predominant food source the main cause for vitamin A deficiency (Potrykus, 2008).

Golden Rice has been genetically engineered to produce beta-carotene in the endosperm of the grain. It could improve the vitamin A status of deficient food consumers, especially women and children in the developing world. Ingo Potrykus and his collaborator Peter Beyer, with financial support from the Rockefeller Foundation, led the effort to develop a variety of rice that contains beta-carotene, the plant pigment that is the precursor of Vitamin A. This rice, called "golden" rice because the inserted beta-carotene turns the grain a golden yellow colour, could supply enough beta-carotene in a typical serving to supply 10% of the daily requirement for Vitamin A (Hessler et al, Lowa state university).

Golden Rice Strategy have shown that Golden Rice can reduce VAD related mortalities and diseases at less cost than alternative strategies. According to their calculations, the delay over the last 10 years has caused losses of at least 1,424,680 life years for India, ignoring indirect health costs of VAD (Wesseler and Zilberman, 2014). The genetically modified Golden Rice can indeed improve the vitamin A status of a rice-eating population to an extent that it has a considerable impact on this population's burden of VAD. In this case Golden Rice would further contribute to a sustainable and permanent solution of micronutrient malnutrition (Stenin et al, 2006).

The purpose of developing GR is not to substitute for other interventions such as food fortification, supplementation, or dietary education programmes. Rather, the technology should be seen as a complementary tool in the fight against VAD.

Genetically modified (GM) food has raised controversy among scientists, environmentalists, and economic activists. Some Bt genes are known to cause toxic or allergic reactions in humans(ISP 2003). However, GM technology can also be used to prevent food allergies by deleting the major allergen, such as the case with soybean developed by Pioneer International (Mills 2005).

The Centres for Disease Control recently concluded a study in which it found no connection between a processed food that contained a GM product and claimed allergic reactions (Pollack, 2001).

Summary and Conclusion

Public attitudes are considered an important factor influencing both the use of GM technology and its development. Factors considered highly important for consumer acceptance are free consumer choice and a high quality of information, as well as consumer benefits and the absence of risk issues related to health and the environment. Feeding the world population adequately would also mean producing the kinds of foods that are lacking to ensure nutrition security. Nowadays the risk opposed society will accept anything only if it is totally harmless. At a distance from risk there are numerous rewards by using GM foods. The delay over the last 10 years has caused losses of at least1,424,680 life years for India, ignoring indirect health costs of VAD (Wesseler and Zilberman, 2014). GM foods have the potential to solve many of the world's hunger and malnutrition problems. Yet, there are many challenges ahead for us and governments, especially in the areas of safety testing, regulation and food labelling.

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Cookies from Jamun Seed Powder

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Jamun, botanically named as *Syzygium cumini*, belongs to family Myrtaceae. Its fruit is generally acknowledged to be very high quality for its curative function chiefly against diabetes because of its effect on pancreas. Jamun holds anti-hypercholesterolemic properties and helps in regulating the blood lipid profile due to presence of bioactive component.

Studies accomplished in last twenty years have explored that jamun have got good complex of naturally present antioxidant compounds.

Recently, studies have shown that jamun fruit and seed contain significant quantity of antioxidant compounds such as phenolic acids, flavonoids and anthocyanins. These bioactive compounds are helpful in preventing different metabolic syndromes .The present research was carried out to evaluate the anti-hyper glycaemic properties of jamun fruit and seed.

A full Jamun consist of its edible part, seed coat and kernel. The edible part of whole Jamun fruit is around 75%. 83.7% moisture, 0.7% protein, 0.3% fat, 0.9% crude fibre, 14% carbohydrate and 0.4% ash were found in edible part of Jamun (Chaudhary and Mukhopadhyay, 2012). The Jamun seed contains 6.63% protein, 0.66% lipid, carbohydrate 75.4% and insoluble dietary fibre 1.32%.

Jamun seed powder is good sources of vitamin-C and vitamin-B complex as well as dietary fibre, potassium, iron and they are low in fat and cholesterol. It also contains some essential minerals such as potassium, calcium, sodium, magnesium and phosphorus (Priyanka and Mishra, 2015).

The results of instant research depicted that both seed and fruit extracts reduce the blood glucose level significantly and also regulate the insulin levels in hyperglycaemic rats. It was noted that jamun fruit extract attenuated serum glucose levels to 5.35% and 12.29% in normal and hyperglycaemic rats, respectively; while insulin levels were improved by 2.82% and 6.19%, correspondingly. Whereas, jamun seed extract reduced glucose to 7.04% & 14.36% and showed 3.56% & 7.24% higher insulin levels in normal & hyperglycaemic rats, respectively.

Jamun fruits are universally accepted to be very good for medicinal purposes especially for diabetes because of its effect on the pancreas (Joshi, 2001). The fruit, its juice and the seed contain a biochemical called ‘Jamboline’ which is believed to check the pathological conversion Jamun seed powder supplemented cakes 600 of starch into sugar in case of increased production of glucose.

Jamun seeds are known for their medicinal characters to cure diabetes, diarrhoea, dysentery and blood pressure (Chopra et al., 1 WF and JSP blends in the preparation of functional cookies to improve the quantity and quality of protein, carbohydrate, and fibre content. They recommended that cookies can be produced by incorporating JSP in WF up to 20% to get suitable colour, flavour, texture and overall acceptability.1956).

Although wheat flour is a good source of calories and other nutrients, but the price of wheat flour is increasing day by day due to multipurpose uses. Mixing of JSP with WF, which increases nutritional quality, shelf life and also the excellent taste of preparing cake could be a good alternative to WF.

Only Jamun flesh is utilized but large amount of Jamun seed being discarded every year. So, it will be a unique technique to prepare different value-added products by mixing JSP and other ingredients for cakes, cookies, biscuits preparation. It can be used to develop nutritionally enriched bakery products.

Standardized Recipe for Jamun Seed Powder Cookies (Per Kg)

Ingredient	Amount
Wheat flour	200 gm
Refined wheat flour	140 gm

Jamun seed flour	150 gm
Sugar	100 gm
Oil	100 gm
Rose Flavour	10 gm
Milk powder	10 gm
Baking powder	20 gm
Baking soda	10 gm

Photographs While Preparing the Cookies from Jamun Seed Powder

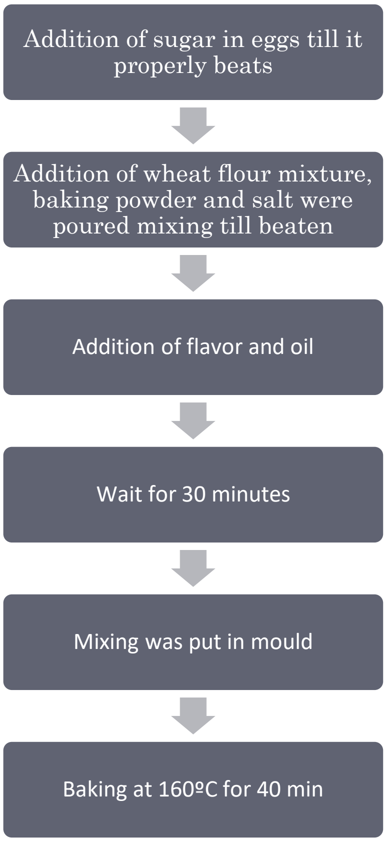
Jamun seeds

Drying of Jamun seeds for 7-10 days

Preparation of jamun seed powder after grinding

After baking preparation of jamun cookies

Standardized Flow Chart for Making the Preparation of Cookies from Jamun Seed Powder with the Help of Wheat Flour



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Impact of Climate Change on Plant Pathogens and Crops

Article ID: 31095

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Introduction

A plant disease is the result of interaction between a susceptible host plant, virulent pathogen, and the environment. Human activities (i.e., agronomic practices, fungicide treatments, movement of plant material in the global market, etc.) and the presence of microbial antagonists to the pathogen may also play roles in the development of a disease. Because the environment significantly, directly or indirectly, influences plants, pathogens, and their ntagonists, changes in environmental conditions are strongly associated with differences in the level of losses caused by a disease, and environmental changes are often implicated in the emergence of new diseases (Anderson et al. 2004). For these reasons, the changes associated with global warming (i.e., increased temperatures, changes in the quantity and pattern of precipitation, increased CO2 and ozone levels, drought, etc.) may affect the incidence and severity of plant disease and influence the further co evolution of plants and their pathogens.

Impact of Climate Change on Crops

The environment may affect the availability, growth stage, succulence, and genetic susceptibility to diseases of plants (Agrios, 2005). Therefore, agricultural production is extremely susceptible to climate change. According to the IPCC (2007), climate change will reduce yields in the XXI century. However, the effects of climate change will be highly variable and dependent on the region. Climate change will affect temperature, precipitation, CO2 levels and frequency of extreme weather events, so these will have a significant effect on agricultural production and the temporal and spatial distribution of pests and diseases (Peng et al., 2004, Ghini et al., 2008.

Impact on Plant Pathogen

Predicted climatic changes are expected to affect pathogen development and survival rates and modify host susceptibility, resulting in changes in the impact of diseases on crops. The effects of these climatic changes will differ by pathosystem and geographical region. These changes may affect not only the optimal conditions for infection but also host specificity and mechanisms of plant infection. Climate plays an important role and is crucial part of disease triangle so that successful invasion and multiplication, colonization of pathogen can occur. They are adapted to specific climate but now climate change has made great impact on their occurrence, virulence, specificity and multiplication. The same trend is also seen in their management practices. Now minor pest is becoming major one as they are causing significant economic losses as they are crossing their threshold level. Climate change affects crop pests and disease susceptibility which in turn affects crop health, and these changes cause deviations in farming practices as to cope with the effects of these changes and to prevent a decline in productivity. Climate elements like (temperature, rain, humidity etc.) play important role in primary and secondary dispersal of pathogen. Moreover, effect of UV rays has affected host range as pathogen has developed resistance or they are able to defend themselves from plant defence mechanism.

Changing abiotic conditions will also affect the microclimate surrounding plants and the susceptibility of plants to infection. These changing conditions are expected to affect microbial communities in the soil and canopy pathosystems, possibly altering the currently observed beneficial effects of these communities. Because both pathogens and host plants will be affected by the changing climate, dramatic changes in the magnitude of disease expression in a given pathosystem, the geographical distribution of particular plant diseases, the economic importance of particular diseases in a given location, and the set of diseases that challenge each crop are expected. These changes will affect the measures farmers use to effectively manage disease.

Conclusion

Climate affect crop, pathogen and their interaction that have great impact on their disease occurrence, physiology, virulence, host range and affect the management practices. So, changing climate in present scenario is a very big and burning issue for crop, its productivity and food supply.

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Celery (*Apium graveolens* L.) – A Profitable Crop

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Introduction

Celery is a main member of the family Apiaceae and native to Coastal Australia and New Zealand. It has a long fibrous stalk tapering into leaves. Depending on location and cultivar, either its stalks, leaves or hypocotyl are eaten and used in cooking. Celery seed is also used as a spice and its extracts have been used in herbal medicine.

Uses

It is a salad vegetable. Both leaf and stem are eaten. Dried leaves are used in native Australian spice mixes. It tastes much the same as celery and is used to flavour soups.

Medicinal Properties

1. Celery's young leaves and stem contain mineral vitamin and protein content (6.3%), Vitamin C(62mg/100 g), Calcium (230mg/100g), Iron(6.3 mg/100g), ß-Carotene (3.99 mg/100g) and Riboflavin (0.11 mg/100g) and also used as one of the important medicinal plants.
2. The oil is made from celery has great fragrance. This aromatic oil helps the human brain to work effectively.
3. It is the best medicine for rheumatoid arthritis such as under rheumatoid arthritis.

Varieties

Gaint Pascal, Emperor of Jeen, Standard Bearer, Wright Grove Gaint are a few introductions found promising.

TNAU Ooty - 1

Characteristics of celery:

1. Ooty Horticultural Research Station maintained 6 vatieties, from which this Ooty – 1 was choosen.
2. This type of celery will grow by an average of 72.3 cm height. It is a short-term crop. The 115 days of age. It has a potential yield. The average yield of 30.5 t/ha. Grown in the Nilgiris district, 30.3 per cent more yield than the local type of offer. The seed yield of 1.40 t/ha. Smaller seeds. Color is brown.
3. 1.71 percent of the oil present in the seeds. The seed oil is only 0.56 per cent of the local type. It has good fragrance so it used as spices material. The longitivity of leaves is higher.
4. In mountainous areas, it can be kept upto 8 days, so it is optimized to carry to distant markets.
5. The 100g leaves contain high level of protein content (1g), carbohydrate (3 g), sodium (88 mg), calcium (4 per cent) and iron (1 per cent). Leaves with dark green colour, excellent cooking quality.
6. From this instant soup and instant spice powder, curry, Channa Masala and Vegetable curry can be prepared. This variety is resistant to leaf spot disease.
7. It has root nematode, white fly and aphid insects resistant. It can be cultivated throughout the year. Nirpokam (February - April), karpokam (April – June) kadaipogam (August - October). It is cultivated all mountainous, which has a height of 900 meters above Mean Sea Level.

Soil and Climate

It is a cool season crop. Good fertile well drained soil is very suitable for the crop and grown in hills. With high amounts of organic material rich in laterite soil pH of 6 to 6.5 is very suitable for the cultivation of the crop. If the soil pH is less than 4, may be applied of dolomite 2.5 t/ha to the soil 5 months before cultivation.

The ideal temperature is 15 – 21oC. When temperature goes very high bolting occurs and leaves become bitter also.

Season

It can be cultivated in three seasons, i.e., Neerbogam (February - April), Karbogam (April –June) and kadaipokam.

Propagation

It is a transplanted crop. To raise seedling to plant one hectare an area 50 m2 will be sufficient. About 1.5 -2.0 Kg of seeds are soaked in water overnight and then broadcast on the beds or sown in lines and covered by a thin layer of top soil. Celery propagated by seeds. The seeds are very small, so mixed with ten times more sand and be sown in the nursery bed.

Nursery

Prepare the field to get a fine tilth.

Seed Rate

The seed rate is 1.25 kg of seed per hectare. To produce seedlings per hectare required a 100-square-foot nursery.1 m Width, 15 cm height and length required to set up the raised beds. The seeds are soaked in a 3% Panchagavya solution, dry it in a shade and sow. While preparing the field, apply for one square meter 20kg farm yard manure, 5kg vermicompost, 10 kg bio compost manure, 200g Mycorhiza root internal fungus, 200 g Azospirillum and 200 g phosphobacteria can be applied. Take the weeds in the nursery and should be kept clean. Watering should be done once in two days. 3 weeks after planting the seeds will germination. After 75 days obtained good quality seedlings. Sowing is done during July – September in plains and January – March in hills.

Land Preparation

Applied 30 t/ha of well decomposed farmyard manure. Along with farmyard manure, 5-ton bio compost manure, 5 ton vermicompost, 10kg Metarizium, 10kg Azhospirillum, 10kg phosphobacteria, 10 kg Mycorhiza root internal fungus, 1.25 tonnes neem cake, 2.5 kg Pseudomonas fluorescence and 2.5 kg Trichoderma viride can be applied. Plough the land well and then, 75 g composted cow manure, 1.5 kg cow dung herbal manure with 40 Litres of water mixed and spread as a large droplet to the ground and spray.

Planting

Planting made during the rainy season. Good quality seedlings should be planting 4-5 cm row to row and 15 cm plant spacing or 60 x15 cm are followed.

Fertilizer

Top dress application of N-140 Kg, P-55Kg and K-220 Kg/ha.

Irrigation

Proper and rapid irrigation for required for crop development. Need water once a week.

Post Treatment

The land must be maintained free from weeds. 4-5 times to remove the weeds for good growth of the crop.

Crop Growth Regulators

1. Panchagavya 3% solution to be spray 4 times at intervals of 15 days.
2. Pre harvest spray10% earthworm infusion 4 times at 15 days interval.
3. Horn silicamanure 2.5g mixed with 50 litres of water spray 15 days before harvest.
4. Spray bio-herbal manure 5 kg / ha mixed with 200 litres of water (45, 60 and 75 days).
5. Pre-harvestapply 3%Dasakavya solution 4 times at 15 days interval as foliar spray.
6. Spray 5% Manchurian tea extract 3 times in 15 days interval.

Crop Protection

This variety is resistant to pests and fungal diseases.

Harvesting

Celery preparing harvest in 115 days. The external thick stems are used to prepare soup, and internal stems are very young so used to prepare salad.

Crop Duration

4-5 months

Yield

Celery yield of 30.5 t/ha.

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Access to Agricultural Information and Use of Modern Technology, the Real Game Changer for Doubling Farmer's Income

Article ID: 31097

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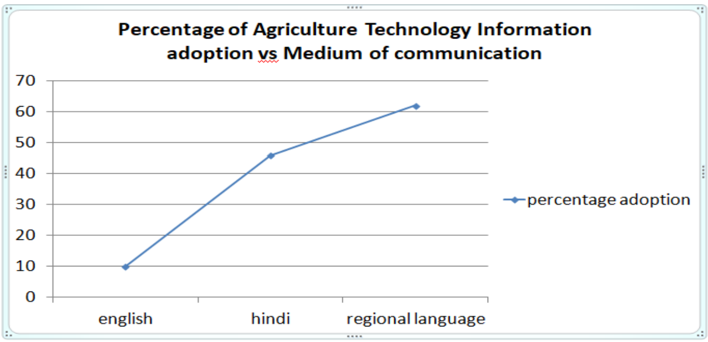
Summary
Agriculture sector of developing nations are often plagued by several natural and man -made exigencies. To combat the same, technology enabled dissemination of Agricultural Information is required. If a farmer gets right information at the right time to sell his/her marketable surplus, the problem of information lag can be solved. Agricultural Information being quintessential for a farmer, the need of the hour is to make it technology enabled. Exploitation of the application of Information Communication Technology can be a real game changer in Agriculture Domain, especially when India is focussing on Doubling Farmer's Income.

Role of Regional Language
For a farmer to be an adopter, he has to understand the message conveyed by the source. But normally, message distortion occurs due to a plethora of factors. One such poignant issue confronted by farmers is lack of access to Agricultural Information in regional languages. Most of the mobile applications available are either in English or Hindi. This has to de deftly managed as, farmers feel more confident to adopt practices which they have read in their regional languages.



Source: Agropedia

Table 1

Table 1 shows the percentage adoption of agricultural practices communicated to farmers in English, Hindi and regional languages (the average of ten regional languages has been included). Thus, 62% adoption of information communicated in regional languages shows the credibility and need for Agriculture Information to be in farmer's own language.

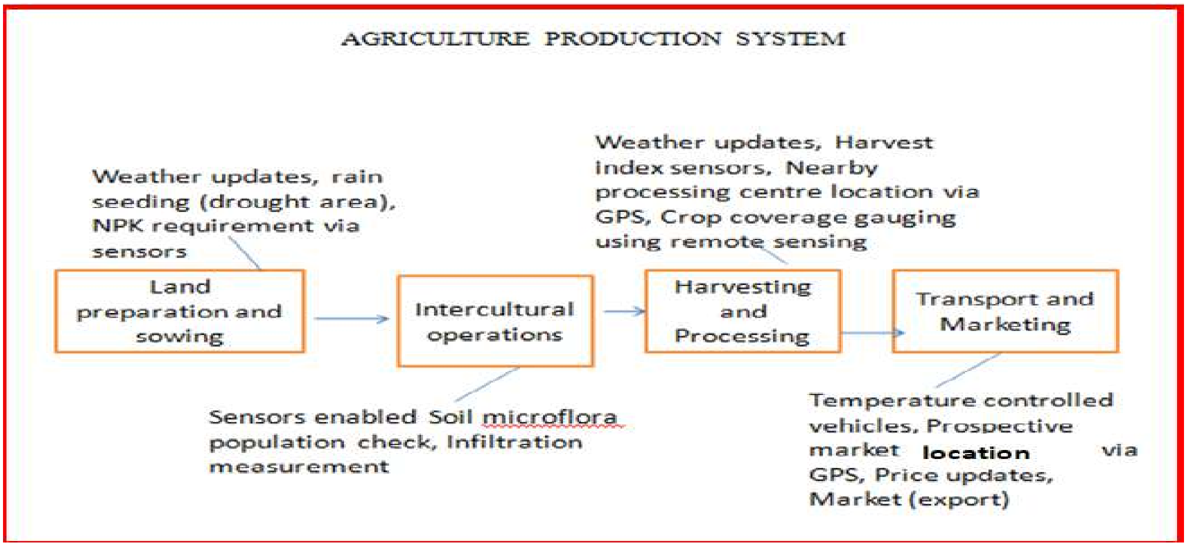
Multidimensionality of ICT
Several works conducted in the arena gave cognizance of the fact that multi-dimensionality of ICT should be applied in Agriculture. There are a plethora of potential areas where ICT can be applied to increase the efficacy of Agricultural production system, thereby enhancing farmers' income. Albeit the idea of Artificial Intelligence and Big Data analytics seem utopian, several countries have put them into agricultural use. For instance, a researcher team developed an AI that can identify diseases in cassava plants. By a technique known as transfer learning, this team, teach the AI to recognize crop diseases and pest damage. They used Tensor Flow, a Google's open source library to build a database of AI 2,756 images of cassava leaves from plants in Tanzania. Eventually, AI was able to identify a disease with 98% accuracy. In Indian scenario, farmers being marginal and small create intensified agricultural practices unpragmatic. But the situation can be approached in different angle.

Information Communication Networking is one such tool that can be employed so as to put domain knowledge in user's language. Efficient accessing and distribution of content are two advantages of the ICN approach. Communication is driven by users requesting content/data/information, namely named data objects (NDOs) such as web pages, videos, songs, photos, documents, streaming and interactive media, or other pieces of information. Senders make NDOs available to users by publishing the objects. Similar networking needs to be chalked out in agricultural production, processing and marketing fronts (Singh. S. et al, 2017). Information communication networking can work both for homophilous and heterophilous populace of farmers. For instance, in developing nations, larger chunk of farming population is small and marginal while in developed nations the same is dominated by large farmers. The penetrative power of ICT is such that it can cater to former and latter.

Efforts Unleashed by Government of India

Approximately 45 per cent ICT projects of the whole world have been implemented in India and also maximum number of information kiosks has been employed in rural India. Nevertheless, it was found that majority of the ICT projects in agriculture were put into action in socio- economically developed states of South and North India , while deprived states are not benefitted by ICT initiatives (Adhiguru, P. and Devi, S.V, 2012). Albeit several efforts have been unleashed by GOI and other private agencies to digitally aid farmers such as several mobile applications, e-NAM, kiosks, e-choupals etc, lot more to be done.

Nevertheless, the uses of drones and satellite-based technologies in Agriculture have been gaining momentum. The incorporation of Remote Sensing in Pradhan Mantri Fasal Bheema Yojana for gauging crop loss is a welcome step. Innovative satellite-based technologies such as navigation systems, GIS combined with automation control systems, sensor networks, and ICT can pave the way towards sustainable and efficient agricultural production systems. Innovative satellite technology can be used in right from the initial stages of crop production. As far as India is concerned, Indian Regional Navigation Satellite System (NAVIC) can aid in the process. A schematic diagram below shows how satellite technology can augment the efficiency of Agricultural Production System to enhance farmer's income.



In Indian perspective, similar efforts have to be strengthened by GOI to realize the aim of doubling farmer's income. Unless ICT has been rigorously been put into use, there would always be an information gap between the scientific faculty and farmers. For farming has to be remunerative farming methods have to be strategically planned and technologically linked.

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Eco-friendly Areca Palm Leaf Plates: An alternative to Plastic plates

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Introduction

Environmentally friendly and sustainability were not a determining factor in our purchases until the end of the last decade. But now we've begun to realize the devastating effects of plastic products and become more environmentally conscious day by day. Consumption has changed in the way people think. We want to keep the plastic contaminants away from our planet.

So, we want to make a more environmentally friendly choice over wasteful choices. Eco-friendly disposable plates can be easily handled and disposed of after application. Although there are many environmentally friendly goods, this article will concentrate more on the areca palm leaf plates and benefits.

Areca is a commercial crop and is cultivated primarily in the Karnataka, Kerala, Tamil Nadu, Assam and Andaman & Nicobar Islands states. Areca palm sheaths Areca sheath is currently used to make plates/cups, fuel and compost. One Areca palm tree sheds 5 to 6 leaves per year. Such leaves were considered an agro-waste and were simply thrown away or burned.

But now the sheaths have acquired significant significance in the company of the areca leaf plates. After the sheath is trimmed, the sheath gets into the manufacture of areca leaf plates. The leaf goes into the composting process. You can get up to 3000 sheaths of an areca palm tree from one acre.

Drying Areca leaf sheaths. Picture Courtesy: Author.

Farmers gather the sheaths, bundle them and send them to nearby manufacture of areca leaf plates. In the manufacturing unit, the primary step is to assort the sheaths and thoroughly clean them. In the freshwater, the sheaths get wet. A soft brush is used to scrub the dust and the sand particles. The sheaths are then allowed to drain the water and dry for removal of the moisture.

Why are Palm Leaf Plates the Best?

1. Areca Leaf Plates Are 100% Natural: Products from Areca are 100 per cent natural. It is FREE from chemicals, glue and binders. During processing, there is no additional coating added to plates to preserve the texture. That way, serving food on the Areca leaf plate becomes the most compelling reason.

2. Easy Handling: When the food weight in the plate increases, the shape of the Paper and Plastic plates will be distorted. Moreover, in the case of Areca leaf dishes, they can stay in shape and will keep up the food and no need to worry about spilling. They can be easily held by hand and the dish can be enjoyed while in standing also.

3. Different Styles: Areca leaf plates come in many different shapes and sizes, and for the occasion, you can choose the plates or bowls according to the dishes that are expected to service. You can test the different shapes and sizes of the Areca plates with your manufacturer and pick the one you think would fit your dishes best. 4-inch Round bowl, 4-inch Square bowl, 12-inch Round plate, 10-inch Square plate are the most

desirable shapes and sizes of areca plates.

Picture Courtesy: Author

4. Microwavable: It is important to realize that when you microwave the food in a plastic and foam plate there is a high likelihood that it will be melted and that it will be able to come into contact with the contaminated food.

5. Make It Memorable: The guests will remember it forever and will be happy if you use Areca plates to serve food at weddings and parties for having a "green" gathering. You will make a super hit for your party and that will make you a happier host.

6. Getting Rid of Plates: The main reason people started using Areca plates is that it's environmentally friendly and getting rid of it is very quick. After your session, simply collect the dishes, dig a small hole, and dump the soiled plates. That's it, in 90 days it will be decomposed and ultimately this will enrich the soil.

Waste Sheaths

The remaining portions in the areca leaf sheath after turning the sheath into plates are called agro-waste, after turning the sheath into plates. Units producing vermicompost take and compost these leftover areca palm sheaths into vermicompost.

Picture Courtesy: Author

Areca Plates Usage Occasions

Areca Leaf Plates are can be used for various occasions to serve all kinds of food - Hot, Cold, Oily, Dry, Greasy. Areca leaf plates are the best alternatives to any other disposable plates in following occasion and places like Wedding, Parties, Family Get Together, Corporate Meeting, Picnic, Restaurants, Coffee Shop, Food parcel packing, All Religious functions, College Functions, Festivals, etc.

Conclusion

Environmentally friendly and sustainability were not a determining factor in our purchases until the end of the last decade. But now we have started to see the negative environmental impacts of plastic disposables. Areca leaf plates are the ideal solution to products based on plastics/polymer and even paper-based products that affect the entire world. Lastly rethink twice before picking up plastic plates, while the Areca leaf plates can be the best choice to make earth-friendly parties for you.

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Seed Production Feasibility in Off Season and Seed Storage in Soybean (*Glycine max* (L.) Merrill)

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Summary

Soybean seed has to be stored without loss of viability and vigour from the day of harvest to next planting season and also for carryover purpose. In India, seed is stored in ambient storage condition. Seed germination is the major problem in soybean. Adverse climatic conditions especially continuous rainfall during crop harvesting in kharif season resulted in failure of seed production programme coupled with lower seed quality.

In rabi and summer season climatic conditions especially average temperature range is not suitable for optimum crop growth and yield. Seed yield is low in rabi and summer seasons as compare to kharif season but seed quality is superior in rabi and summer season. (Dandagi et al., 2012).

Introduction

Soybean [*Glycine max* (L.) Merrill.] is an important oilseed crop belonging to family Leguminosae, sub family Papilionaceae and the genus Glycine max L. Soybean contains Protein (40-42%), Carbohydrates (26%), Oil (18-25%), Minerals (4%), Phospholipids (2%), poly unsaturated fatty acids (60 %) with calorific value of 452 calories per 100 g.

In recent decades area under soybean in our country is increasing year after year but productivity is not considerably increased and has remained almost stagnant for the past several years There are several reasons for low productivity such as low seed germination, lack of seed vigour, poor plant stand, low seed quality and deterioration of seed quality in seed storage.(Deshmukh, S. D. 2013) Seed viability is a major factor in crop stand establishment and subsequent productivity in many parts of the India.

As per minimum seed certification standard, minimum seed germination in soybean should be 70%. Losses in seed quality occur during storage if they are exposed to high temperature and humidity. Further rainfall during seed harvesting also reduce seed germination considerably. (Meena et al., 2017).

Main Body

Seed is to be stored from harvest to next sowing season. As soybean seed comes under large volume, low price seed category it is economical not viable to stored seed under controlled conditions. Under tropical conditions ambient storage condition and rainfall during harvest are the major causes to lower seed germination. Seed germination capacity has been reported to drop sharply after two months of storage at ambient conditions. (Kandil et al., 2013) and (Krittigamas et al., 2001).

In India seed is stored in ambient storage conditions where summer season temperature ranges from 40oc to 45oc. If storage temperature goes above 40oc, moisture content in seed decreases below 08 % which adversely affect seed germination. Thin seed coat and exposure of embryo outside is the main cause of seed deterioration.

Therefore, increase storability period of soybean seeds without decrease in seed quality parameters and biochemical activities viz., α-amylase and Dehydrogenase enzymes. As far as storage is concern seed is to be stored in polyline gunny bags with six stacking bags and ample aeration (Hossein et al., 2014).

In kharif season, if rainfall occurs during harvesting and seed germination is adversely affected than off season seed production programme is to be undertaken in rabi season and sowing is to be completed before 15 December. If sowing is delayed than increased temperature adversely affected physiological growth and yield of crop. In kharif season seed yield was higher than rabi season. However, rabi season seed quality was superior than kharif season. (Deshmukh et al., 2018).

Conclusion

If kharif season seed germination was found below minimum seed certification standard i.e. 70% than corrective seed production programme is to be undertaken in rabi season and seed to be stored in polyline gunny bags with six stacking having ample aeration.

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Herbal Management of Brown Plant Hopper in Paddy

Article ID: 31100

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Introduction

Rice (*Oryza sativa* L.) belonging to the family Gramineae is the staple food for one third world's population and occupies almost one fifth of the total land area covered under cereals. Rice is a high energy or high calories food and of high biological value of the proteins. More than 100 species of insect have been recorded to infest the paddy crop but out of these 20 insect pests are of major economic significance.

The most damaging pest is brown plant hopper, *Nilaparvata lugens* (Stal.) suck the plant sap from the phloem vessels through their proboscis, due to this plant starts wilting with outer most leaves drying first and then the entire plant dries up. Under severe cases field gives a burnt appearance in concentric circles known as "hopper burn".

Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellency, antifeedance, insect growth regulatory activities against pests of agricultural importance. In fact, botanical pesticides are in use in Indian agriculture for over a century to minimize losses caused by pests and diseases. (Prakash et al., 1997 and Parmar and Devkumar,1993).

Treatments Details

Tr. No.	Treatments
T_1	*Metarrhizium anisopliae* (1x108 cfu/ml) (dose 4 gm/lit of water)
T_2	5 % neem oil (dose 5ml/lit of water)
T_3	5 % NSKE
T_4	5 % bitter gourd *(Momrdica charantia)* leaf extract
T_5	5 % custard apple (Annona squamosa) leaf extract
T_6	5 % garadi *(Cleistanthus collinus)* leaf extract
T_7	5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract
T_8	Control (water spray)

Preparation of Bitter Gourd Leaf Extract, Custard Apple Leaf Extract and Garadi Leaf Extract

Freshly collected tender leaves (50 g/litre) were washed thoroughly under tap water. The washed leaves were rewashed with distilled water and drained out excess water and the excess moisture on leaves was removed by using muslin cloth which further allows to shade dry. The leaves were completely dried without any trace of moisture. These dried leaves were taken and prepared into fine powder by means of mixture and kept for 16 hours in water. The crude extract slurry was prepared and the concentrated pure leaf extract thus obtained through a sterilized a Whatman no.1. filter paper was used for spraying of required dose (Fiaz et al., 2012).

Methodology

Blanket application of all treatments except M. anisopliae was undertaken at 15 DAT, subsequently all treatments application was applied on 30, 50, 70 and 90 DAT. The knapsack sprayer was used for spraying operations. After every treatment, sprayer nozzles, pipes were washed twice thoroughly with clean water. In case of hoppers populations, number a hopper one day before (1DB) and 3 days after each application (3DAA) on ten random hills were recorded.

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Effect of Different Treatments on the Population of Brown Plant Hopper on Paddy

Pooled analysis showed that the treatment of 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (2.42 nos./hill) was found significantly superior in reducing the population of brown plant hopper over other treatments and followed by 5 % garadi leaf extract (3.11 nos./hill), neem oil (3.23 nos./hill), M. anisopliae (3.62 nos./hill), 5 % custard apple leaf extract (3.69 nos./hill) , 5 % bitter gourd leaf extract (3.76 nos./hill) and 5 % NSKE (3.97 nos./hill). However, highest population of brown plant hopper was recorded in control (4.92 nos./hill)

Effect of Different Bio-Pesticide, Botanicals and Herbal Extracts on Population of Brown Plant Hoppers on Paddy

Tr. No.	Treatments	Brown plant hoppers (no./hill)											
		1st Spraying		2nd Spraying		3rd Spraying		4th Spraying		5th Spraying		Pooled	
		BT	AT	BT	AT	BT	AT	BT	AT	BT	AT	BT	AT
		14 DAT	18 DAT	29 DAT	33 DAT	49 DAT	53 DAT	69 DAT	73 DAT	89 DAT	93 DAT		
T_1	*Metarhizium anisopliae* ($1x10^8$ cfu/ml) @ 4 g /litre of water	0.00 (0.00)	0.00 (0.00)	0.10 a (0.32)	0.43 a (0.66)	0.20 a (0.45)	3.67 b (1.91)	4.30 (2.07)	4.67 c (2.16)	4.40 (2.10)	5.70 b (2.39)	2.25 (1.50)	3.62 c (1.90)
T_2	Neem oil @ 5 ml/litre of water	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.57 a (0.75)	1.27 b (1.13)	3.33 b (1.83)	3.13 (1.77)	4.93 c (2.22)	3.80 (1.95)	4.43 b (2.18)	2.09 (1.45)	3.32 b (1.82)
T_3	5 % NSKE	0.00 (0.00)	0.00 (0.00)	0.23 b (0.48)	0.73 b (0.86)	1.20 b (1.10)	4.23 b (2.06)	3.47 (1.86)	5.23 c (2.29)	3.77 (1.94)	5.67 b (2.38)	2.17 (2.00)	3.97 c (1.99)
T_4	5 % bitter gourd (*Momrdica charantia*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.13 a (0.37)	0.83 b (0.91)	1.20 b (1.10)	4.23 b (2.06)	3.20 (1.79)	4.63 c (2.15)	3.47 (1.86)	5.33 b (2.31)	2.00 (1.41)	3.76 c (1.94)
T_5	5 % custard apple (*Annona squamosa*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.20 a (0.45)	0.70 b (0.84)	1.53 b (1.24)	3.73 b (1.93)	5.13 (2.27)	5.03 c (2.24)	3.53 (1.88)	5.30 b (2.30)	2.60 (1.61)	3.69 c (1.92)
T_6	5 % garadi (*Cleistanthus collinus*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.73 b (0.86)	1.57 b (1.25)	3.03 a (1.74)	5.00 (2.24)	3.80 b (1.95)	3.83 (1.96)	4.87 b (2.21)	2.64 (1.63)	3.11 b (1.76)

T_7	5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.60 a (0.77)	1.63 b (1.28)	2.23 a (1.49)	4.37 (2.09)	3.17 a (1.78)	3.33 (1.83)	3.67 a (1.91)	2.38 (1.54)	2.42 a (1.55)
T_8	Control (water spray)	0.00 (0.00)	0.00 (0.00)	0.43 b (0.66)	1.00 c (1.00)	2.23 c (1.49)	5.37 c (2.32)	3.57 (1.89)	6.70 d (2.59)	3.87 (1.97)	6.60 c (2.57)	2.53 (1.59)	4.92 d (2.22)
	'f' test	NS	NS	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig	NS	Sig
	SE (±M)	-	-	0.05	0.04	0.12	0.10	-	0.05	-	0.07	-	0.04
	CD at 5%	-	-	0.14	0.13	0.37	0.30	-	0.16	-	0.21	-	0.13
	CV (%)	-	-	18.15	8.62	19.10	9.09	-	4.37	-	5.36	-	3.93

BT- one day before treatment, AT-3days after treatment.
Sig – Significant, NS- Non-Significant,
**Figures in parentheses are corresponding values of square root (n) transformation, n= Brown plant hoppers (no./hill).

Conclusion

5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract was found effective in management of brown plant hopper

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New Technologies of Locust Management

Article ID: 31101

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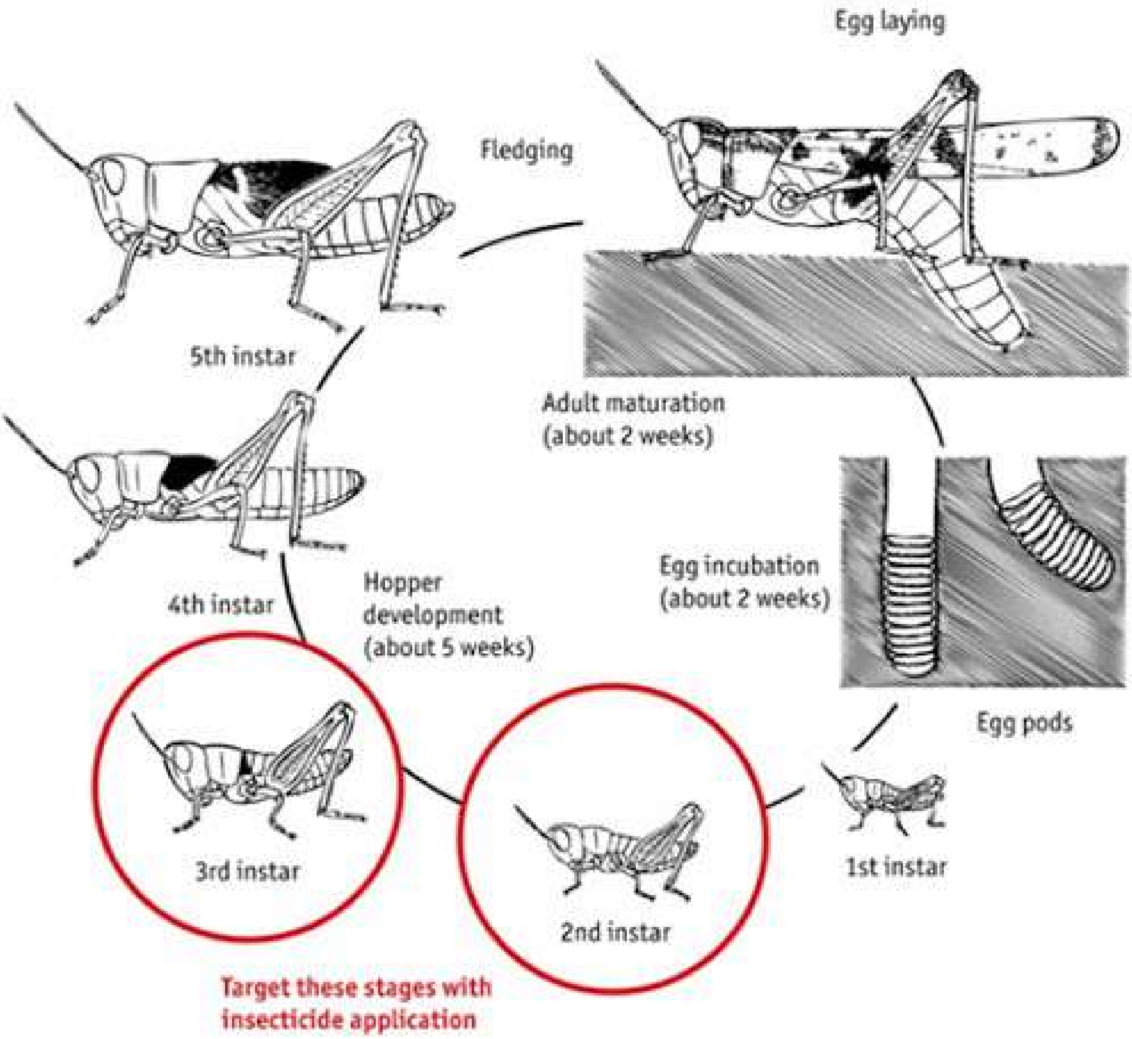
Introduction

Locusts (Orthoptera: Acridoidea) are among the most dangerous agricultural pests. Locust invasions are dramatic, cover large areas in a short period and almost all green in their path is destroyed. It is the destructive which is dreaded as locusts come so suddenly in such large numbers and swarm across international boundaries and due to this reason locust invasion attract so much public attention and cause international concern. Locusts are invertebrate animals with highly migratory habits, marked polymorphism and voracious feeding behaviour. They are able to take rapid advantage of the climate and geography can survive in temperature range from 0 degree to 60 degree and can speed up or slow down their life cycle. Desert Locust are now better controlled, since the middle of the 60's, thanks mainly to more efficient chemical pesticides, improved application methods, better knowledge of locust ecology and implementation of a preventive control strategy supported by FAO, the Food and Agriculture Organization of the United Nations.

Life Cycle of Locust



The desert locust (*schistocerca gregaria* forskal) The life cycle of the desert locust consists of three stages: egg, hopper and adult and duration of the life is 2-6 months on an average. The eggs are laid by females in pods in the moist sandy soil at a depth of about 10 cms.

Egg pods are laid at intervals of 7-10 days. Gregarious females usually lay 2-3 egg pods, each with about 60-80 eggs. Solitarious females mostly lay 3-4 times. Each pod contains 100-160 eggs. There are five instars in gregarious population and 5-6 instars in solitarious individuals.

In each instar there is growth of nymph and the colour of the solitarious hopper is green throughout all instars but the gregarious hoppers have characteristic colouration of black and yellow. After this there is no further moulting and the adult cannot grow in size but gradually increase in weight. Fledglings gradually become hard and able to fly.

Locusts in this condition are called immature adults, the adults may mature in 3 weeks. On maturation adults become bright yellow. Males mature before females but oviposition usually commences within two days of copulation.

The desert locust exhibit two distinct behavioural phases – the solitary phase – when individual actively avoid one another and – the gregarious phase – when they form marching hopper bands (mass aggregations of flightless nymphs) and swarms (adult aggregations with high mobility). (Anil Sharma, 2014).

Management Strategy of Locust

The current management strategy for locust control is preventive in that the aim is to keep locusts at lower densities, so that migration is much reduced and crop and pasture damage minimized.

In many areas, the reeds favoured by locusts have been replaced with non-host plants such as *Robinia pseudoacacia* L. (false acacia) or *Ziziphus jujuba* Miller (Chinese date) or non-host crops like alfalfa or cotton.

Studies have shown that in areas where non-host trees have been planted, locust densities have declined by more than 90%. In the past, almost all treatments were by chemical pesticides but in recent years, non-chemical control forms an increasingly important part of locust and grasshopper management in China (Zhu et al. 2013).

There has been substantial use of the naturally occurring fungus *Metarhizium acridum* (Driver and Milner) and the microsporidian Paranosema locustae (Canning) (formerly, Nosema locustae).

While such products were used in only 5% of treatments during 2004, their use has increased to over 30% in recent years, which amounts to more than 100,000 ha per year sprayed with these products.

These applications of bio pesticides against locusts are more than all of the rest of the world combined. Local production of these bio pesticides has meant their price is almost the same as that of chemical pesticides and while mortality is slower than with chemicals, a high level of mortality can be obtained both with Metarhizium (Zhang and Hunter 2005, Zhang 2011) and with Paranosema (Gong et al. 2003,).

The major advantages of using bio pesticides, which include specificity to locusts and grasshoppers, preservation of natural enemies (Zhang and Hunter 2005), as well as avoiding chemical residues both in agricultural products and in environmentally sensitive areas such as near water, mean that the credibility of having bio pesticides as part of management programs is being recognized (Hunter 2010).

Some other methods which are used for control of the desert locust adult by the farmers are as follows:
1. Beating or trampling on the hoppers.
2. Digging up egg pods or ploughing fields infested with egg pods.
3. Scattering straw over roosting sites and then burning it.
4. Lighting fires or making noise to prevent swarms from settling in crops
5. Driving hoppers into trenches and burning, drowning, or crushing them
6. Use of flame throwers.

The Cotton bollworm Nuclear Polyhedrosis Virus (NPV) causes high mortality of locusts when viral DNA is mixed with nano-particles (Liu et al. 2016). In recent years, there has been the development and testing of new more precise monitoring and spraying methods, which are being incorporated into the preventive management program.

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Importance and Agro-Technology of Garden Cress (*Lepidium sativum* Linn.)

Article ID: 31102

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Introduction

Lepidium sativum Linn. commonly called garden cress, is a fast-growing annual herb belonging to the Brassicaceae family that is native to Egypt and West Asia. It is also found in various parts of Europe, including Britain, France, Italy, and Germany. In India, it is mainly cultivated in Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, and Madhya Pradesh. Seeds, leaves, and roots are considered important parts of this plant which are used for treating various ailments. The seeds hold significant anti-inflammatory, antipyretic, analgesic, and coagulant activities and also useful in treating asthma, cough, and bleeding piles. The powder made from garden cress seed along with sugar can be taken to treat diarrhoea, indigestion, and dysentery. The seeds are also considered rubefacient and are applied as a poultice for hurts and sprains. The leaves possess antiscorbutic, diuretic, stimulant properties and also used as a spice, and sprouts of garden cress are important ingredients of salads and sandwiches. The roots are considered bitter, acrid and are useful in treating secondary syphilis, tenesmus, and also used as a condiment. In the Ayurvedic system of medicine, this plant is known to have several pharmacological activities such as galactogogue, aphrodisiac, and have found to destroy Vata (air) and Kapha (phlegm). The seeds as well as leaves are reported to possess diuretics, aperient, and aphrodisiac properties, and are used against inflammation, bronchitis, rheumatism, and muscular pain in the Unani system of medicine (Sharma and Agarwal, 2011). The seed oil of garden cress is rich in alpha linolic acid and omega-3 fatty acid, which is effective in curing different kinds of cancers. The decoction made from seed along with a tablespoonful of honey is given to increase the production of breast milk in animals as well as human beings and also enhance the sexual stamina.

Why to Cultivate Garden Cress?

1. It can be cultivated in different types of soil with few requirements.
2. Economic return can be obtained within a short period of 4-5 months.
3. This crop requires less inputs viz., fertilizer, pesticides, water and provide comparatively better yield.
4. The seed has relatively high oil contents and tolerance of fallow lands.
5. The garden cress grows very rapidly that doesn't allow the weeds to come up in the field.
6. It is not easily attacked by insects and pests as well as the grazing animals.

Agro-Technology

1. Mode of propagation: Garden cress is propagated through seed.

2. Climate: It can grow in any type of climate from tropical to temperate regions with fewer requirements. It can also develop well in semi-shade (light woodland) or even without any shade.

3. Soil: It can grow in a wide range of soil conditions. However, it prefers light (sandy), medium (loamy), and heavy (clay) soils. It requires moist soil and also some shade during the summer to prevent from desiccation effect of heat reaching directly to seed.

4. Selection of seed: The seeds which are healthy, bolder, and free from any disease and pest infestation should be selected for cultivation.

5. Field preparation: The garden cress doesn't require much field preparation activities. The field is ploughed 3 to 4 times and then the soil is thoroughly mixed with the required quantity of farmyard manure

or fertilizer and beds of 4x3 m size are prepared for sowing the seeds. Seeds can also be sown in the field without preparing the beds.

6. Planting out: Sowing is done from September to February in the plains and on the hills from March to September (Falana et al., 2014). Seeds are sown in the prepared field at the rate of 8-10 kg/ha. Line sowing can be done with 15 to 20 cm spacing between the lines or rows. Seeds can also be sown by broadcasting in the properly prepared field with or without beds.

7. Intercultural operation: The application of irrigation in the summers is helpful since the seedlings are lightly rooted which can dry up due to high temperature (Wadhwa et al., 2012).

8. Harvesting: The growth of garden cress is very rapid and the crop becomes ready to harvest in 4-5 months after sowing when its colour turns yellow. The yellowish plants are cut with the help of equipment and cut plants are then dried till it produced crinkling sound upon pressing. After that seeds are extracted by rubbing the fruits with hands or by beating with the help of sticks.

9. Yield: Seed yield of 12-16 q/ha and 50-52 q/ha of dry aerial biomass can be obtained in one growing season.

Conclusion

Considering the economic importance complemented with its medicinal usage, the cultivation of this crop is being undertaken in several parts of the country. However, there is very little information about its genetic diversity which is a prerequisite for any crop improvement program. Therefore, more research should be taken up focusing on exploring its genetic diversity. Being a short duration crop, economic return can be realized within a short period of 4-5 months.

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Management Strategies of Apple Scab Disease Caused by *Venturia inaequalis*

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Introduction

Apple scab occurs wherever apple is grown and may be a very serious disease on susceptible varieties. Apple is the one of the most important fruit of J&K. Directly or indirectly half of population of Jammu and Kashmir is involved in apple production and trade business in the state and provides means of employment generation (Bhat and Lone 2017). Apples are affected by a number of diseases caused by fungi, bacteria, viruses, viroids and phytoplasmas (Abrol, 2015). In India it was first reported from Kashmir valley on the native cultivar Ambri in 1935.

The large scale damage and spread of apple scab created an alarming situation and the problem managed to engage the attention of the Indian Council of Agricultural Research (ICAR), Directorate of Plant Protection, Quarantine and Storage (DPPQS) and the Govt. of India (GOI) and it was promptly declared as one of the five main problems of national importance in India (Abrol, 2015). Apple scab is the major disease affecting apples grown in temperate climates throughout the world (Sheikh, 2017). This disease can have a significant economic impact as diseased fruit are not marketable.

The disease negatively affects fruit size and quality (due to blemishes and poor ripening). Over time, repeated defoliation from the disease reduces tree vigour, growth and yield. This outrageous disease leads to premature leaf/fruit fall that results in 74% yield loss and even complete loss is also possible, if steps are not taken in the orchard to reduce infection (Ogawa and English 1991).

Symptoms

The disease may affect leaves, petioles, fruit and twigs. The early lesions of scab are defined with dark green velvety spots, seen on lower surfaces of leaves. Leaves and fruits are highly susceptible to apple scab when they are young and growing. Mature leaves and fruits gain resistance as they age. During the main growth period in early spring, there is more susceptible tissue available for infection and therefore, greater risk of disease than later in the season. Apple scab generally does not kill the trees but it can cause defoliation, which will weaken the tree and influence its survival during winter conditions. On leaves, young scab lesions are pale, irregular, and small. As they age, they become circular and olive-coloured with a velvety texture. Early infections can lead to abnormal growth and fruit drop. If the fruit is infected late in the summer or just before harvest, black, circular, very small (0.1 – 5 mm diameter) lesions called 'pin-point scab' will appear during storage (MacHardy,1996).

Causal Organism

This disease caused by the fungus *Venturia inaequalis,* belongs to subdivision Ascomycota, class Loculoascomycetes, order Pleosporales and family Venturiaceae and genus Venturia. Saprophytic (sexual state *Venturia inaequalis* (Cke) and parasitic (asexual state *Spilocaea pomi* Fr) are the two states of this fungus (Bowen, 2011).

Venturia inaequalis overwinters mostly on dead leaves, in which small microscopic flask formed black fruiting bodies, called pseudothecia, are developed. Ascospores start maturing in early spring and when temperature and moisture are suitable these spores are released forcibly in air. In the spring during the rainy season, fungal spores are released from the infected leaves that remain from the previous year and are carried by the wind to newly emerging leaves and fruits of healthy trees.

Once primary infection occurs, secondary spores (conidia) are formed, allowing a tree to continually re-infect it or neighbouring trees as long as environmental conditions are favourable. The disease progresses rapidly and causes severe infections if plants remain continuously wet for at least a six-hour period with temperatures around 19 - 26°C (Holb, 2004).

Disease Management

The apple scab disease management requires an integrated disease approach that depends on the grower's goals and such approach combines resistant cultivars, cultural practices, biological agents and fungicides. Through cultural practices, disease can be minimized, or even prevented, by good horticultural practices like selecting sites that provide more than six hours of sunlight per day, spacing trees adequately following proper pruning practices to open the tree canopy, sanitation in orchards to prevent pseudothecial formation in overwintering apple leaves, applications of 5 percent urea to autumn foliage to increase leaf decomposition, thereby reducing the amount of fungus that will survive the winter (MacHardy, 2001).The scab-resistant cultivars, including Freedom, Shireen, Firdous, Jonafree, Liberty, Prima and Redfree is essential if growers wish to produce organically grown fruit, as most organic fungicides will not provide adequate control against this disease in most years (Ellis, 1998). Biological control is often seen as a strategy that recently emerged from microbial biotechnology, but, in fact, research on biological control of apple scab has been conducted for per 50 yr. The nature of life cycle of *V. inaequalis* has lent itself to studies that aim to interrupt overwintering of the perfect stage or else to control infection of leaves during the spring and summer. Regardless of a cultivar's susceptibility, fungicide applications are an essential component of effective scab management. For disease-resistant cultivars in particular, the most critical step of the process is controlling primary infection by ascospores in the spring (Poleatewich, 2010). These spores are the "offspring" of the previous year's infection and have the potential to infect even scab resistant cultivars if they contain the right combination of genes. Using fungicides on scab-resistant cultivars can help prevent infection by any newly virulent strain of the fungus, protecting the tree from primary scab and any successful secondary scab. Throughout the season different fungicides are Captan 70% + Hexaconazole 5%, Hexaconazole, Mancozeb, Trifloxystrobin 25% + Tebuconcazole 50%, Metiram55% + Pyraclostrobin 5% used to control apple scab disease. Spray of any Protectant/systemic fungicide should continue after walnut size fruit if secondary infection is still anticipating (Sajad 2018).

Conclusion

The apple scab disease causes huge losses to apple industry throughout the world, hence there is a need to develop an ideal system that prevents these losses and is eventually acceptable to consumers. In order to control such menace caused by apple scab, proper prediction and forecasting systems are need of the hour to prevent apple scab disease well in advance and also understanding the host pathogen interaction, which can provide new insights for effective management of this disease.

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Small-Scale Farming of Edible Insects

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Increasing World Population & Increasing Demand for Animal-Based Protein

1. FAO estimates: 70% increase of food production to feed 9 billion by 2050.
2. Animal feed production increasingly competing for natural resources with human food, fuel production & urbanization.
3. Limits of conventional livestock production (e.g. land conversion), decrease of people active in agriculture
4. 70% of agricultural land used directly/indirectly for meat production.
5. Inter-linkages between agricultural/livestock production & climate change.
6. Prevailing food & nutrition insecurity (62% of world 's undernourished live in Asia).

Worldwide 2 Billion People Eat Insects - 1,900 Edible Insect Species

Why Promote Eating of Insects?

1. They are tasty 2 billion people love to eat them!
2. Health:
   a. Healthy & nutritious: rich in protein, fat & micronutrients.
   b. 64.5 mill. ppl. undernourished in SEA.
   c. Micronutrient deficiencies: 40% of children <5 yrs. anaemic & vitamin A deficient in Laos.
3. Environment:
   a. Climate friendly & land-independent production.
   b. Efficient food conversion.

Barriers to Insect Consumption

1. Limited availability of wild insects:
   a. Most edible insects collected from nature.
   b. Dependent on season.
   c. High demand.
   d. Environmental factors.
2. Limited accessibility of wild insects:
   a. Time: Women involved in household, childcare & other duties.
   b. Insects are expensive.

3. Utilization issues related to wild insects:
    a. Chemical risks: pesticides, heavy metals & other toxins.
    b. Parasitical risks: intestinal flukes in water insects & beetles (raw consumption).

Insect Farming: A Sustainable Livelihoods Activity

1. Economically sustainable:
    a. Low capital input.
    b. Frequent income within short time.
    c. Potential for value-added products.
2. Socially sustainable:
    a. Culturally accepted: insects already part of traditional diets.
    b. Inclusive: pro-poor, suitable for vulnerable groups, urban & rural.
3. Environmentally sustainable:
    a. Climate-friendly production.
    b. No land conversion/degradation.
    c. Preservation of wild insect populations.
4. Climate change considerate:
    a. Prevention: complementary protein supply.
    b. Adaptation: less impacted by climate-related events.
    c. Mitigation: shorter-term availability of nutrients as compared to other agricultural activities (45 days).

Insect Farming for Food & Nutrition Security

1. Increased availability:
    a. Sufficient number of insects the whole year.
    b. Enables production of insect-based products.
2. Increased accessibility:
    a. No need to buy; often gifted to relatives/friends; sold at lower price in rural areas.
    b. No need to collect (women).
    c. Insect-based products & fortified foods reach wider range of consumers.
    d. Income generation: more money available to buy food.

Conclusions & Recommendations

1. Pilot studies to address knowledge gaps:
    a. Suitable insect species & rearing techniques.
    b. Low-cost alternative to commercial chicken feed (e.g. Moringa).
    c. Value-added products suitable for village production
2. Explore options for food fortification.
3. Investment & Support:
    a. Development of village production facilities (grants, investment, suitable public SME development programs).
    b. Marketing support.
4. Knowledge exchange: Set up communities of practice & share best practices/lessons learned.
5. Promote benefits of insect farming for local communities: Ensure that food/nutrition security for poorer people are kept in focus & not become secondary to promoting export & feed production for livestock.

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Application of Expert System for Pest Management in Indian Agriculture

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Crop name	System name	Description
Paddy, Fruits, Vegetables	AGREX	Centre for Informatics Research and Advancement, Kerala has developed an expert program called AGREX to help farmers get timely and reliable advice and use in fruit, vegetable, paddy and postharvest technology in the areas of fertilizer application, crop protection, irrigation scheduling and disease diagnostics.
Tea	TEAPEST	It is a rule-based, object-oriented expert system that identifies major insect pests of tea and suggests appropriate control measures.
Jute	JAFexpert	JAFexpert is a web-based expert system developed by ICAR-Central Research Institute for Jute and Allied Fibres (ICAR-CRIJAF) for proper identification and management of harmful organisms and abiotic damages for jute and allied fibre crops.
Mango	AMRAPALIKA	This expert system is used to make diagnosis of particular disease of mango. The system's knowledge base includes knowledge of the symptoms and remedies of 14 Indian mango tree diseases that occur during the fruiting and non-fruiting seasons.
Rice	Rice crop doctor	This expert system was developed by the National Institute for Agricultural Extension Management (MANAGE) to diagnose rice pests and diseases and to recommend preventive / cure measures.
Rice, Wheat	AGPEST	The system is intended for the diagnosis of diseases caused by pests in rice & wheat plants respectively. It also facilitates decision support module with an interactive console base user interface for diagnosis made against the queries related to particular disease symptoms.

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Invasive Insect Pests of India- Current Scenario

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Introduction

India is the seventh largest country and a total area expanse of 3.28 million sq.km. (approx.) with richest flora and fauna in the world. The country has 15 agro-climatic zones comprising of mountains, plateaus, river, lakes, deserts, oceans and grasslands. Apart from that 21.54 per cent of the total area is covered by dense forests. Hence, the complex topography, diversified climate and vegetation make India the favourite habitat to the alien species.

Furthermore, India being one of the fastest-growing economies with an export of 330.07 billion dollar to as many as 190 countries around the world. On the other hand, the import statistics reveal an importation of 462.9 billion dollar from around 140 countries. Therefore, large scale trade among the nations has made an opportunistic target for the entry of the invasive species. Invasion of species (IAS) are considered as a major threat to agricultural biodiversity, human and animal health, livelihoods, forestry and biodiversity which results in huge economic losses (Singh et. al., 2019).

Invasive insect pest is one which becomes established in natural or semi natural ecosystems or habitat, and threatens native biological diversity (International Union for Conservation of Nature and Natural Resources -IUCN). Damage by crop pests which include insects, diseases, nematodes and rodents are recognized as the major constraints in food production. Apart from these elements the agricultural economy is vulnerable to exotic pests/diseases which act as the bottle neck in reducing yield. Current status of invasive insects in India are 173 species, including 54 terrestrial plants, 56 aquatic organisms, 23 insect pests and 61 organisms having microorganisms and island ecosystem.

Climate change results in increased temperature which ultimately influence the ecology and biology of insect pests and diseases. This in turn causes migration of insect species towards higher latitudes, while in tropics the higher temperatures might adversely affect specific pest species. Likely impacts of any change in climate on population of pests are manifold. In India, the Directorate of Plant Protection, Quarantine and Storage is responsible for implementation of Plant Quarantine (Regulation of Import into India) Order, 2003 to prevent entry, establishment and spread of exotic plant pests into India to safeguard agriculture, horticulture and forest tree plants.

Mode of Invasion

Invasion of alien species can be divided into four steps viz., a). Introduction, b). Establishment, c). Spread, d). Naturalisation (Sujay et. al., 2010).

Introduction

Non-native species are imported either intentionally or unintentionally for economic purposes in shipping containers, wood imports, infesting fruits carried by tourists, unsuspecting travellers and hidden in soil of imported ornamental plants. In order to get established in a new locality, beyond the natural ranges, first the insect must have to move or get itself from its current habitat. This mode of transport is very common and difficult to control.

For the examples, timber beetles (Cerambycidae) in Antarctica was predicted to be introduced through transported logs. Invasive insects themselves have an inherent capacity to migrate long distances. Hence any deviations from the favourable condition make them migrate from that place. Fall armyworm, *Spodoptera frugiperda*, is one of the recent invasive insect pests in India.

Spreading

Invasive species overcome barriers to dispersal within the new region from where they get introduced and can cope up with the abiotic environment and biota. Usually the non-native species appear to first colonize in a disturbed habitat and some gets spread into seminatural communities and they overcome resistance posed by different factors.

Naturalisation

Naturalisation occurs when the alien species adapts itself to the new environment by overcoming the abiotic and biotic stress and when they start their regular reproduction.

Invasive Insects in India

The economically important invasive pests in India are listed below (Gupta et. al., 2018; Bisht and Giri, 2019).

S. No.	Common Name	Scientific Name	Year of Introduction
1.	Woolly apple aphid	*Eriosoma lanigerum* (Hausmann)	1889
2.	San Jose scale	*Quadraspidiotus perniciosus* (Comstock)	1911
3.	Lantana bug	*Orthezia insignis* (Browne)	1915
4.	Cottony cushion scale	*Icerya purchasi* (Maskell)	1921
5.	Potato tuber moth	*Phthorimaea operculella* (Zeller)	1937
6.	Diamond back moth	*Plutella xylostella* (Linn.)	1914
7.	Pine woolly aphid	*Pineus pini* (Macquart)	1970
8.	Subabul psyllid	*Heteropsylla cubana* (Crawford)	1988
9.	Serpentine leaf miner	*Liriomyza trifolii* (Burgess)	1990
10.	Coffee berry borer	*Hypothenemus hampei* (Ferrari)	1990
11.	Spiraling whitefly	*Aleurodicus disperses* (Russell)	1993
12.	Coconut eriophid mite	*Aceria gurreronis* (Keifer)	1997
13.	Silver leaf whitefly	*Bemisia argentifolii* (Bellows)	1999
14.	Papaya mealy bug	*Paracoccus marginatus* (Williams & Granara de Willink)	2005
15.	Erythrina gall wasp	*Quadrastichus erythrinae* (Kim)	2005
16.	Cotton mealy bug	*Phenococcus solenopsis* (Tinsley)	2006
17.	Blue gum chalcid	*Leptocybe invasa* (Fisher & La Salle)	2006
18.	South American tomato leaf miner	*Tuta absoluta* (Meyrick)	2014
19.	Rugose spiraling whitefly	*Aleurodicus rugioperculatus* (Martin)	2016
20.	Fall armyworm	*Spodoperda frugiperda* (J.E. Smith)	2018
21.	Woolly whitefly	*Aleurothrixus floccosus* (Maskell)	2019
22.	Neotropical whitefly	*Aleurotrachelus atratus* (Hempel)	2019

Conclusion

The impact caused by invasive pests on the environment and agricultural production is tremendous. Increase in international agricultural trade because of globalisation, increased the movement of seeds and planting material which ultimately enhanced the risk for introduction of invasive pest in India. Certain reformative measures have to be improved to narrow down these losses.

To control the introduction of invasive species the steps such as identification, preliminary risk assessment, planning for eradication programme, risk assessment review and monitoring of the status of the pest followed should be strengthened.

To manage the invasive insects, suitable natural enemies of native origin should be explored, cultured and released. There is a need for interdisciplinary coordinated work among scientists, in identifying invaded organisms and in assessing their ecological problems, environmental concerns in different ecosystems, economic damage and methods of control.

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Hardships of Covid-19 on Indian Farmers

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Abstract

The worst thing that human civilization could encounter after a health crisis would be a famine and it is quite obvious that this could happen if it is not acknowledged and acted upon quickly. Each and every aspect of our lives is going to be affected by this pandemic. Despite the more resilience seen in the agriculture sector in a short span of time, it is also not far away from the different levels of impact due to several factors like migration of labours, transportation industry, market shut downs to name a few. Agriculture holds a share of about 14% in GDP of India and employees about 43% of population of India (Statista, 2020). The substantial decline of growth in this sector may leave the biggest impact of covid-19 in this world.

Keywords: Agriculture, COVID-19, economy, GDP, government, farmers, India, transport.

Problems Faced by Agriculture Sector Due to Covid-19

Introduction: The outbreak of novel Corona virus officially named as COVID-19 (WHO), has created a situation of pandemic which has left all the nations hanging in the curb of crisis. Despite all the efforts taken by the representatives, impact of this huge health crisis will surely leave its impact for a longer period than expected. "India stays in village" this saying of Mahatma Gandhi is still not an exaggeration, and an agrarian economy like India where more than 70 per cent of its rural population depends, agriculture and its allied sectors are going to be one of the worst affected areas in the long run. The forced migration of labours, disruption in supply chain, transportation restrictions and the threat of infection on top of all, lead to a phase where our farmers are facing hardships. The amends made by the government of India, may or may not be useful for every sector directly or indirectly dependant on agriculture.

Impact on Farmers: The untimely announcement of lockdown caused many labours to remain stranded in cities away from their native places without any work or means of survival which led to a forced migration of workers in huge numbers. This led to a loss of human resource for day to day jobs on farms like weeding, spraying of insecticides and harvesting etc. as very less field workers were available which shifted the equilibrium of labour availability towards scarcity, causing demand of higher wages than usual. Apart from this, the farmers were short on agricultural inputs such as chemicals, fertilizers and seeds as the supply chain was heavily affected. The marketing of harvested products faced issues due to a halt on transportation facilities, APMCs and lack of proper storage facilities in remote areas. Predominance of small and marginal farmers in India restricts mechanization of farms because of which manual and animal power is still dominating in our country. India needs to increase the utilization of mechanical farm power from 2.02 kw per ha up to 4 kw per ha to meet the demands of ever-increasing populations (NABARD, 2018). This situation became worse at such an extent that farmers had to burn or dump the perishable products as they were not delivered on time which caused a huge loss to our farmers. Also, bad impacts of weather at the time of harvest were aggravated due to non-availability of labours at crucial periods. The poultry industry also suffered a lot as demand for fish, eggs, chicken declined both in direct to consumer as well as processing industries market (ICRISAT, 2020).

Impact on Post Harvest Industries: The agricultural produce processing industries in India account for a total of Rs 18.55 lakh crore (US$ 265.51 billion) holding a share of 32 percent of the country's total market. These agriculture-based industries are responsible for 8.80% in manufacturing and 8.39% in agriculture share to Gross Value Added (GVA) (APEDA, 2020). These industries suffered a complete shutdown phase due to shortage of labours, hinderance in supply chains and restrictions on transport and export caused by the nationwide lockdown which led to a decline in demand of agricultural harvest. According to Devendra Pant, chief economist at India Ratings and Research, supply chain disturbances and labour-related issues could exacerbate the situation [Figure -2].

"More than the lockdown, manufacturing growth would depend on how quickly supply chain disturbances are resolved. It would largely depend on labour-related issues also," Pant said. "If migrant labourers are not back, the production process will be hit and it will impact manufacturing growth."

Impact on export of agricultural produce: The World Food Programme (WFP) along with UN has issued warning for an acute shortage of food in near future due to pandemic. Due to restrictions on movement from one country to another the curve for number of commodities exported has also flattened. Many countries which are not self-sufficient in terms of agriculture are in danger of severe food crisis. The countries like Russia and Kazakhstan which are major wheat exporters have restricted exports of wheat to other countries. Vietnam, world's largest producer of rice has stopped exporting to other nations and India along with Thailand has given priority to the food security of their own countries. Due to shortage of labour, resulting in fewer exports declined production, the prices of agriculture goods are stipulated to soon rise and lead to extreme malnutrition and food crisis not only for human being but also for livestock in many countries including India.

Steps for Amendments by GOI

1. Immediately after the nationwide lockdown, GOI announced a package of 1.7 trillion INR, keeping in mind the farmers, daily wage workers and weaker sections of our society which also included transfer of Rs. 2000 into the bank accounts of farmers through district beneficiary transfer (DBT).

2. Pradhan Mantri Gareeb Kalyan Yojna was announced (Prime minister's scheme for welfare of the poor).

3. Increment in daily wages of the workers under NREGS act was announced along with the distribution of grains on regular basis.

4. The Indian Council of Agriculture and Research (ICAR) formulated special guidelines to be followed by farmers for successful completion of operations like harvesting, storing and selling of farm products.

5. RBI has granted a moratorium of three months for agriculture terms and crop loans (upto 31st may) with interest subvention of 3% on interest rates.

6. With a recent amendment in Essential commodity act of 1955, farmers are now allowed to sell their produce anywhere in the country i.e. across the state borders.

7. Eight-point agricultural reforms were announced in the Atma Nirbhar Bharat Package keeping in mind the micro food enterprises, fishermen, animal husbandry sector and post-harvest management.

8. One nation one ration card allows the migrant workers to get ration through public distribution system which will check the forced migration to their native place. Thus, this will help in supplying human capital for agriculture as well as industrial sectors.

Conclusions

Before the announcement of complete lockdown, over the country, economy was already facing a huge downfall as the GDP of last quarter of 2019 was as low as 3.1% (Prachi Mishra, Chief economist, India)[Figure-1]. Asian development bank has further projected a contract in Indian economy by 4% in this financial year. The impact of this downfall will be more severe on the weaker sections of our society. Agriculture has suffered huge losses due to restrictions imposed by pandemic. Farmers are now coping with this situation by trying to sell their products direct to consumers. The reforms announced by the government are not enough and it should be made sure that these amends don't just stay in paper. History teaches us a lot as after the Ebola virus disease (EVD) outbreak, agriculture suffered severe complications. According to a report published in JRC science and policy reports, after the EVD outbreak, food availability was less than average, households had less access to food, farmers were unable to sell their produce, labour was short and people faced malnutrition due to imbalanced diet. Besides this, cereal grains stored in warehouses of Food Corporation of India has been damaged in open weather due to due to dysfunctional transportation facilities over the territory. The UN also slashed the growth of India's economy to 1.2% and global economy to 3.2% which is worse than the recession of 1930s.

"When the government announced the lockdown, perhaps they did not visualize that agriculture is not an industry where you pull down the shutters today and restart in a few weeks," says Devinder Sharma, a food economist. "The crop will ripen, the cow will give milk, harvesting has to be done at a proper time."

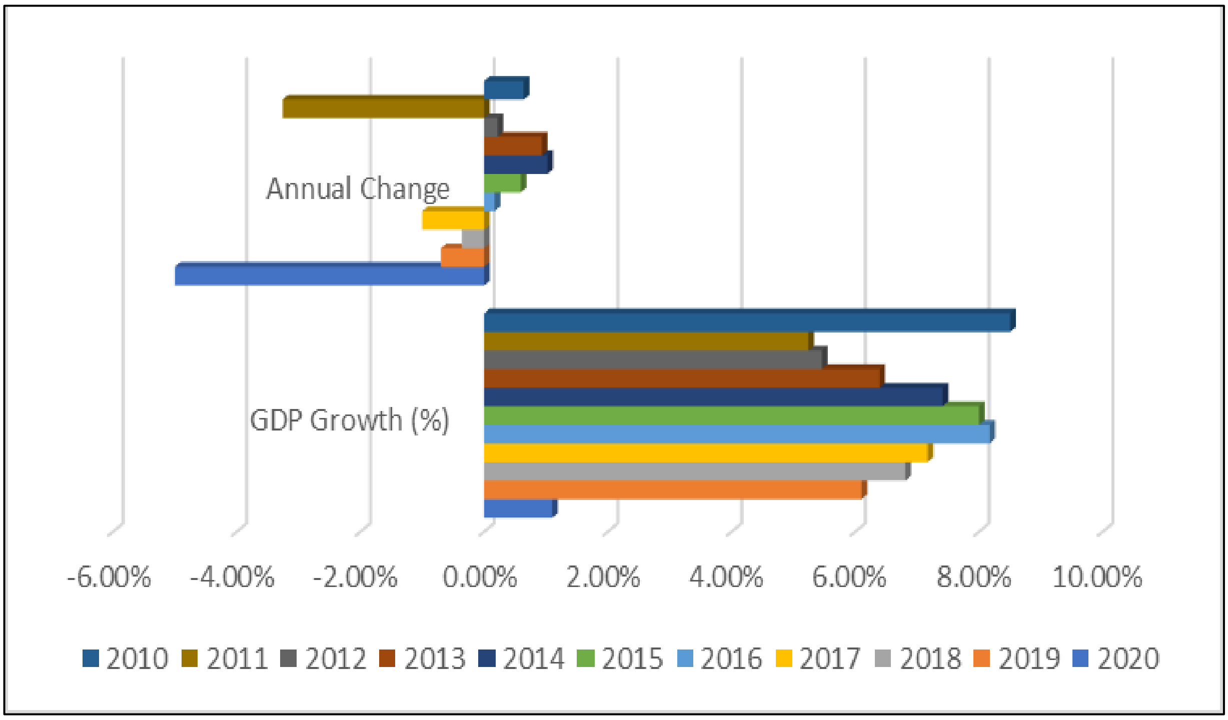

Fig. 1 : GDP trends of India (2020 predicted) (World Bank).

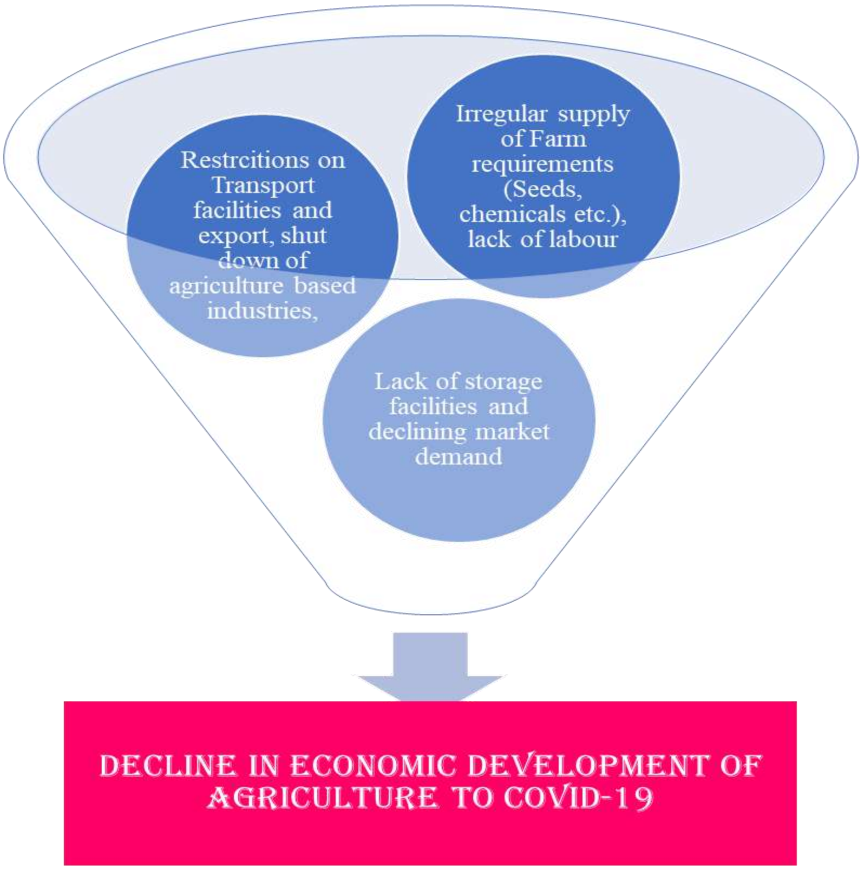

Fig. 2: Factors affecting Agriculture during COVID-19

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Agro-Tourism

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People have become more interested in how their food is produced. They want to meet farmers and processors and talk with them about what goes into food production.] For many people who visit farms, especially children, the visit marks the first time they see the source of their food, be it a dairy cow, an ear of corn growing in a field, or an apple they can pick right off a tree. Farmers and ranchers use this interest to develop traffic at their farm or ranch, and interest in the quality of their products, as well as awareness of their products. While revenue and education are often primary drivers for farmers to diversify and invite guests onto their property, safety isn't always a top priority. Accidents involving tractors, wagon rides, trips, falls, and traffic occur at agritourism operations on a regular basis. Data and specific cases of agrotourism-related injuries are tracked and stored by researchers and scientists. Some of this data is available at publicly accessible sites such as AgInjuryNews.org.

Agricultural tourism has become a necessary means for many small farms' survival. By diversifying business operations, farm operators are able to ensure a more stable income. This is because agritourism activities can occur during times of the year that crops may not be in season, and by providing a completely separate stream of income. Some studies have found that agritourism operations often benefit their surrounding communities by drawing tourists to the area. The economic boost by the increase in traffic can be beneficial to rural areas in need of diversified streams of income. Agricultural tourism has become a necessary means for many small farms' survival. By diversifying business operations, farm operators are able to ensure a more stable income. This is because agritourism activities can occur during times of the year that crops may not be in season, and by providing a completely separate stream of income. Some studies have found that agritourism operations often benefit their surrounding communities by drawing tourists to the area. The economic boost by the increase in traffic can be beneficial to rural areas in need of diversified streams of income. Agricultural tourism has become a necessary means for many small farms' survival. By diversifying business operations, farm operators are able to ensure a more stable income. This is because agritourism activities can occur during times of the year that crops may not be in season, and by providing a completely separate stream of income. Some studies have found that agritourism operations often benefit their surrounding communities by drawing tourists to the area. The economic boost by the increase in traffic can be beneficial to rural areas in need of diversified streams of income operations often benefit their surrounding communities by drawing tourists to the area. The economic boost by the increase in traffic can be beneficial to rural areas in need of diversified streams of income.

Scope of Agri Tourism in India

Agri Tourism is to experience the real rural life, taste the local genuine food and get familiar with the various farming tasks. Agriculture is the backbone of Indian Economy. Around 75% of the population is directly or indirectly dependent on Agriculture and almost 26 percent of India's GDP comes from Agriculture. 90 million farmers are dwelling in 6.25 lack villages producing food grains for feeding the country. More than a profession or a business, agriculture is India's culture. Hence, adding additional income generating activities to existing agriculture would certainly increase contribution of agriculture in the national GDP. Serious efforts need to be made in this direction and Agri-Tourism is one such activity.

Tourism is termed as an instrument for employment generation, poverty alleviation and sustainable human development. During 1999-2000, direct employment created by tourism was 15.5 million. Besides, tourism also promotes national integration, international understanding and supports local handicrafts and cultural activities. During 2000, the number of foreign tourists that visited India was 26.41 lacks.

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 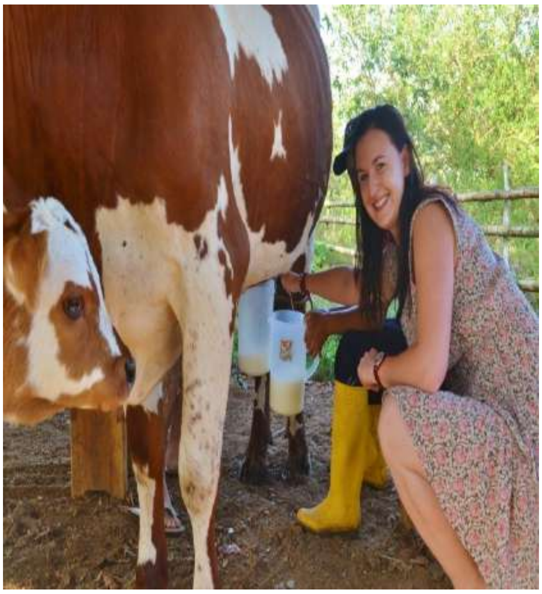

India's share in world tour market is just 0.38 percent. With this meagre share, foreign exchange earned is Rs.14, 475 crores. Turnover in domestic tourism is much more than this. To promote domestic tourism, thrust areas identified by Government of India are development of infrastructure, product development and diversification, development of eco-adventure sports, cultural presentations, providing inexpensive accommodation, streamlining facilitation procedures at airports, human resource development, creating awareness and public participation and facilitation of private sector participation. In this process, important stakeholders are State and Central Department of Tourism, Indian Institute of Tourism and Travel Management, Tourism Development Corporations, Foreign Embassies, Travel Agents Association of India (TAAI), Indian Association of Tour Operators (IATO), Tourists, Transport Operators Association, Indian Convention Promotion Bureau and Pacific Asia Travel Association (PATA).

 

What is Agri Tourism?

Agri tourism is where agriculture and tourism meet to provide us with an amazing educational experience, whether it is a tour of a farm or ranch, a festival or cheese-making class. Farmers turn their farm lands into a destination and open their doors to the public in order to teach more about what they do.

Why Agri Tourism?

Mother Nature is open door school without brick walls! If observed carefully one can learn something or the other, moreover India is Agriculturist's Country, it is expected that we should know the information related to agriculture. Today urban children's world has become limited in the closed-door school, classes, cartoon programs on the television, video games, chocolates, soft drinks, spicy fast food, computer, internet and so on, they see mother nature only on television screen.

Now it has become very necessary that children know the traditional way of agricultural farming activities and other businesses dependant on agriculture. Here children come very close to Mother Nature and learn many new things in life for a sustainable living.

Why is Agri Tourism Important?

As commercialism and mass production become the standards by which we live, agri tourism has given people who work in the agricultural and horticultural sectors a chance to share their work with the masses. Some agri-tourism experiences allow guests to buy food products grown on the farm or hand-crafted products made by the farmers' families; purchasing these goods helps provide farmers who rely on their land with another source of income. Home and consumer education have given way to technology courses in middle and high schools and many children grow up without ever really knowing what the countryside is or what it's like to interact with live farm animals. Agri tourism, therefore gives parents the opportunity to introduce their children to something other than the city life.

Agri Tourism Farms

Agri tourism is a style of vacation that normally takes place on a farm, either domestically or abroad. Many people are growing more interested in how their food is produced or how the population of a foreign country produces food. Agri tourism farms in India offer tours to allow a person to view the growing, harvesting and processing of locally grown foods, such as corn, coconuts, sugar cane and pineapple. Often the farmers provide a home-stay opportunity and general education on the workings of the farm. Children who visit the farms often have not seen a live duck or Rabbit and have not picked an apple right off the tree. This form of expanded agri tourism has given birth to what are often called entertainment farms. These farms cater to the pick-your-own crowd, offering not only regular farm products, but also food, mazes, open-pen animals, train rides, picnic facilities and pick-your-own produce.

Agri Tourism Benefits

The potential benefits of agri tourism development extend to farmers, rural communities, and tourism operators.

Benefits for Farmers: For Farmers Agri Tourism is a Potential Way

1. Expanding farm operations.
2. Using farm-based products in new and innovative ways.
3. Improving farm revenue streams.
4. Developing new consumer market niches.
5. Increasing awareness of local agricultural products.
6. Increasing appreciation of the importance of maintaining agricultural land.
7. Channelling additional on-farm revenues directly to family members.
8. Improving farm living conditions, working areas & farm recreation opportunities.
9. Developing managerial skill and entrepreneurial spirit.
10. Increasing the long-term sustainability for farm businesses.

Agri Tourism Information

Agri tourism travel information includes listings of local convention and visitors' bureaus for helping people to plan their Agro tourism vacation. Agri tourism blends entertainment, education and tourism together to provide a fun, exciting and memorable get-away for school trips and family outings. Agriculture and tourism together present unique opportunities for farmers to diversify and expand.

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Green Ear Disease of Bajra and its Management

Article ID: 31109

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Introduction

Bajra (*Pennisetum glaucum* L.) is one of the vital crops that feed poor people inhabiting in semi-arid and arid tropics of Asia and Africa and provide basic sustainable living (Nutsugah et al., 2002). It is usually cultivated as a food, fodder and fuel crop in regions that are too hot, too dry and / or have soil constraints that prevent economic production of other staple food grain crops (Hash and Witcombe, 2002). Long recognized by rural people in India for its nutritional value, the crop is now considered a "nutra-cereal" because it contains high levels of energy and protein, a more balanced amino acid profile than maize or sorghum, and relatively high densities of iron and zinc (Yadav et al. 2012).The green ear disease of Bajra is a common disease and has been reported from several countries including India, Iran, Israel, China, Fiji, Japan and the countries wherever Bajra crop is grown. The state of Rajasthan, followed by Maharashtra, Gujarat and Uttar Pradesh, account for an estimated 90% of the acreage planted in pearl millet (Yadav et al. 2012). However, Butler (1907) first reported this disease in India in a sporadic form. Mathur and Dalela (1971) and Nene and Singh (1976) have estimated the loss as much as 26-33%. An outbreak of the disease on an unprecedented scale has been evidenced in Karnataka and Maharashtra during the 'Kharif' season of 1975 and a loss of almost 100% has been recorded.

Symptoms of Green Ear Disease

Two stages of symptoms are recorded. One, the downy mildew stage which is predominant on the leaves and the other, the green ear stage affecting the inflorescence. However, the downy mildew stage on leaves is not as conspicuous as the green ear stage on inflorescence. In downy mildew stage, the infected leaves start showing chlorotic streaks on their upper surface and, just opposite to the streaks on the lower surface, one can see a fine downy growth of the pathogen. After sometime, the chlorotic streaks turn brown and, in advance stages, the infected leaves become distorted, wrinkled, and tend to split along the veins (Kenneth, 1998). In green ear stage, the symptoms of which are more pronounced and considered the principal one, the whole or part of the ear (inflorescence) is transformed into twisted leafy structures. This imparts the ear an appearance of green leafy mass and hence the name "green ear". The transformation of floral parts into leafy structures is due to over-development (hypertrophy and hyperplasia) of the concerned tissue.

Causal Organism of Green Ear Disease

The pathogen is an obligate parasite. Amongst various diseases affecting Pearl millet crop, green ear diseaSse [*Sclerospora graminicola*, (Sacc).Schroet] is a highly destructive and widespread disease in most bajra growing areas of Asia and Africa. The hyphae are coenocytic, intercellular and send small bulbous haustoria inside the host cells to obtain nutrients. Though hyphae are reported almost in all parts of affected plants due to systemic nature of infection, they collect in the form of tufts in the air spaces beneath the stomata and produce sporangiophores which emerge in clusters through stomata. The important point to note is that the sporangiophores are produced only on infected normal leaves, never on the inflorescence.

Each sporangiophore is a long, stout hypha, with many upright branches near the tip region which are slightly swollen and bear sterigmata. These are the sterigmata on which hyaline, broadly elliptical (sometimes broadly cylindric) sporangia are produced, which are slightly pointed or papillate at the free-end. Since the sporangiophore is of determinate growth, the sporangia are produced nearly at one time and also fall off simultaneously leaving the sporangiophore free of sporangia. Sporangia soon germinate producing bi-flagellate, reniform zoospores (3-13).

The sexual stage, the oosporic stage, of the pathogen is the most common and predominant stage in India. Unlike sporangiophores, the sex organs (antheridia and oogonia) are produced in both the infected leaves and the leafy structures formed as a result of transformation of floral parts of the inflorescence. After fertilization through fertilization tube, oospores containing thick and warty wall are formed inside oogonia.

The oospores remain scattered in the intercellular spaces of the infected host tissue. They do not germinate readily and are reported to have a prolonged resting period.

Green Ear Disease Cycle in Bajra

1. Perennation: The disease is mainly soil-borne but some believe that it is seed-borne too. In the first case, the oospores fall down on the ground along with infected plant debris wherein they enjoy prolonged resting period and overcome the unfavourable environmental conditions. In the second case, however, the pathologists claim traces of mycelium present in the embryo of bajra seeds collected from partially transformed ears and advocate their role in perennation.

2. Primary Infection: After the favourable conditions return, the oospores present in soil germinate and cause primary infection of the underground parts of the host plant. The infection spreads upwards systemically therefrom along with growing plant and the symptoms manifest on the leaves and on the inflorescence. However, the susceptibility of the underground part decreases with the advancing age of the host plant. The primary infection results in the production of sporangiophores and sporangia on the infected leaves, which serve as the source of secondary infection during the same growing season.

3. Secondary Infection: Secondary infection in the growing season occurs through zoospores produced by germination of sporangia formed during primary infection. These sporangia are disseminated by wind, water and insects, and reach susceptible parts of the host whereupon they germinate producing zoospores. The zoospores germinate by germ tube and cause secondary infection. Since the sporangia are considered to germinate early in the morning when there is enough dew present on leaf surface and, their germination ceases when dew dries (after about 7.30 a.m.), the chances of considerable secondary spread of disease look very poor. Towards the end of the growing season the pathogen enjoys sexual course of reproduction and produces oospores within all infected parts. The oospores represent resting structures of the pathogen and serve as source of primary infection during the next growing season.

Agri Tourism Farms

Agri tourism is a style of vacation that normally takes place on a farm, either domestically or abroad. Many people are growing more interested in how their food is produced or how the population of a foreign country produces food. Agri tourism farms in India offer tours to allow a person to view the growing, harvesting and processing of locally grown foods, such as corn, coconuts, sugar cane and pineapple. Often the farmers provide a home-stay opportunity and general education on the workings of the farm. Children who visit the farms often have not seen a live duck or Rabbit and have not picked an apple right off the tree. This form of expanded agri tourism has given birth to what are often called entertainment farms. These farms cater to the pick-your-own crowd, offering not only regular farm products, but also food, mazes, open-pen animals, train rides, picnic facilities and pick-your-own produce.

Predisposing Factors

Abundant air supply heavily charged with oxygen, low percentage of moisture in soil and a temperature range between 20 – 25°C are considered most favourable conditions for the germination of oospores in the soil. If the soil enjoys high moisture content, the seedlings emerge before the oospores germinate and thus escape the primary infection.

Management of Green Ear Disease

1. Cultural practices play important role. Early planting, avoidance of ratooning, rouging and gap filling, deep ploughing, sun-exposure to ploughed soil, removal of infected crop debris, avoidance of monoculture, crop rotation, and avoidance of water-logging reduce the incidence of the disease.

2. HB-5, NHB-10 and NHB-14 are the commonly cultivated varieties, which are resistant in Indian conditions. Open pollinated varieties WC-C 75 and ICPT 8203 have shown durable resistance in our country. ICMH 451 and Pusa 23 are the varieties that have remained free from the disease for seven years hence recommended. Hybrid ICMH 88088 produced by ICRISAT shows high level of resistance to downy mildew and yields better than all other available cultivars.

3. Since the seeds are considered to carry part of infection, their treatment with 0.1% Agrosan-GN + 0.4% Thiram has resulted in about 50% reduction in disease incidence. Ceresan and Captafol are also recommended for seed treatment. Seed treatment with Ridomil (8 g/kg of seed) followed by one spray of

0.1% Ridomil 20 days after plantation is recommended. Some pathologists report that seed treatment with crude extracts of *Vinca rosea, Ocimum sanctum, Allium sativum, Datura stramonium, Azadirachta indica, Thuja sinensis,* and *Parthenium hysterophorus* reduces disease incidence and increases crop yield.

4. Rouging of disease bearing plants within a month of sowing followed by Dithane M-45 spraying also helps controlling the disease.

Conclusion

Increased population necessitated increased food production. But demand growth for pearl millet is expected to exceed projected increase in pearl millet production as the production is growing slowly in India. Disease resistance is the only dependable source of disease management. The host resistance against downy mildew has been exploited to a large extent and the resistant varieties are now being used by the farmers. Metalaxyl has proved effective in controlling downy mildew when used as a seed treatment. However, in case of ergot, the control measures are not available.

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Alternate Wetting Drying (AWD): A Water-Saving Technology Under Rice Cultivation

Article ID: 31110

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Introduction

Rice is one of the most important cereal crops occupying second position in global agriculture. It is widely grown in India due to its wider adaptability. To safeguard and sustain the food security in India, it is necessary to enhance the productivity of rice with restricted resources, particularly land and water. As per the principles of water foot print and virtual water 3000 to 5000 litres of water is needed to produce one kg of rice. Being a water-intensive crop, cultivation of rice has been a big drain on water resources. The water required for rice production is becoming scarce and costly because of the more demand for water from the ever-growing population and industries (Choudhury et al., 2007). Bouman et al. (2007) quoted that by 2025 nearly 2 million hectares of Asia's irrigated rice fields may suffer from water shortage because of extreme consumption of water in lowland rice, which consumes 70 to 80 per cent of the irrigated water resources in the major part of the rice growing regions in Asia including India. Rice is often called as a water hungry crop and abundant consumer of water compared other cereal crops like wheat and maize (IRRI, 2009).

Rice is typically grown in bunded fields that are continuously flooded up to 7−10 days before harvest. Continuous flooding helps ensure sufficient water and control weeds. Total seasonal water input to rice fields varies from as little as 400 mm in heavy clay soils with shallow groundwater tables to more than 2000 mm in coarse-textured (sandy or loamy) soils with deep groundwater tables. Irrigated rice receives an estimated 34−43 % of the total world's irrigation water, or about 24−30 % of the entire world's developed fresh water resources. Worldwide, water for agriculture is becoming increasingly scarce. Due to its semi-aquatic ancestry, rice is extremely sensitive to water shortages. Continuous flooding of water generally provides the best growth environment for rice. After transplanting, water levels should be around 3 cm initially, and gradually increase to 5−10 cm (with increasing plant height) and remain there until the field is drained 7−10 days before harvest. Lowland rice is extremely sensitive to water shortage (below saturation) at the flowering stage. Drought at flowering results in yield loss from increased spikelet sterility, thus fewer grains.

In case of water scarcity, apply water-saving technologies such as Alternate Wetting and Drying (AWD) to effectively and efficiently use water and maximize rice yields. Alternate Wetting and Drying (AWD) is a water-saving technology that farmers can apply to reduce their irrigation water consumption in rice fields without decreasing its yield. In AWD, irrigation water is applied a few days after the disappearance of the ponded water. Hence, the field gets alternately flooded and non-flooded. The number of days of non-flooded soil between irrigations can vary from 1 to more than 10 days depending on the number of factors such as soil type, weather, and crop growth stage.

Principle AWD

1. Introduce periods without ponded water before re-irrigation during periods without ponded water.
2. No continuous percolation.
3. No continuous seepage.
4. Less evaporation.

How to Implement AWD?

A practical way to implement AWD safely is by using a 'field water tube' ('pani pipe') or 'bouman tube' to monitor the water depth on the field. After irrigation, the water depth will gradually decrease. When the water level has dropped to about 15 cm below the surface of the soil, irrigation should be applied to re-flood the field to a depth of about 5 cm. From one week before to a week after flowering, the field should be kept flooded, topping up to a depth of 5 cm as needed. After flowering, during grain filling and ripening, the water level can be allowed to drop again to 15 cm below the soil surface before re-irrigation.

Safe AWD

Moreover, time of irrigation is key factor for success of AWD. There is a specific type of AWD called “Safe AWD” that has been developed to potentially reduce water inputs by about 30 per cent, which maintain yields under flooded rice (Bouman et al., 2007). In safe AWD method, the ponded water on the field (also called “perched water”) is allowed to drop to 10 - 15 cm below the soil surface before irrigation is applied. AWD can be started a few weeks (1−2 weeks) after transplanting. When many weeds are present, AWD should be postponed for 2−3 weeks to assist suppression of the weeds by the ponded water and improve the efficacy of herbicide. Local fertilizer recommendations as for flooded rice can be used.

The Field Water Tube (Pani Pipe)

The field water tube can be made plastic pipe or bamboo, and should have a diameter of 10−15 cm so that the water table is easily visible, and it is easy to remove soil inside. Perforate the tube with many holes on all sides, so that water can flow readily in and out of the tube. Hammer the tube into the soil so that 15 cm protrudes above the soil surface. Take care not to penetrate through the bottom of the plot pan. Remove the soil from inside the tube so that the bottom of the tube is visible. When the field is flooded, check that the water level inside the tube is the same as outside the tube. If it is not the same after a few hours, the holes a probably blocked with compacted soil and the tube needs to be carefully re-installed. The tube should be placed in a readily accessible part of the field close to a bund, so it is easy to monitor the ponded water depth. The location should be representative of the average water depth in the field (i.e. it should not be in a high spot or a low spot).

Impact of Alternate Wetting and Drying (AWD) Technique in Paddy

An investigation on “Productivity and water use efficiency of rice (Oryza sativa L.) cultivars under different irrigation regimes and systems of cultivation” was conducted at Indian Institute of Rice Research (IIRR) formerly Directorate of Rice Research (DRR), Rajendranagar, Hyderabad, Telanagana during kharif seasons of 2017 and 2018. The treatments consisted of two irrigation regimes viz., Alternate wetting and drying and Saturation as main plot treatments, three establishment methods viz., System of Rice Intensification (SRI) with spacing of 25 cm x 25 cm, Drum Seeding (DS) with spacing of 20 cm x 10 cm and Normal transplanting (NTP) with spacing of 20 cm x 15 cm as sub plot treatments and four Cultivars namely DRR Dhan 42, DRR Dhan 43, MTU-1010 and NLR-34449 as sub-sub plot treatments laid out in split-split plot design with three replications.

Field water tube was placed in each main plot of AWD practice, to measure the depth of standing water and water tables in the field, either above the surface or below the surface. Two different irrigation regimes based on water levels below the surface were practiced using this tube. Irrigation was given whenever the water depth goes below the surface up to 5 and 10 cm. Water level depth in the tube was measured by simple measuring scale. The subsequent irrigations were given to re-flood the field up to a depth of 5 cm as per the respective treatments. Irrigation was withheld 15 days ahead of harvest. (Bouman et al., 2007).

Measurement of Water Level in Perforated Pipes

In the experimental field, PVC pipes were used to measure the water level below the ground level in the field. The diameter and the length of the PVC pipe was 15 cm and 60 cm, respectively, having perforations

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at 2 cm away from each other. The pipe was installed in the field keeping 40 cm above the soil surface and the remaining portion (20 cm) inserted below the soil. After irrigation, water will be entered in to the pipe through small perforations and the water level inside the pipe was the same as that of outside field. After wards whenever the water level goes below the ground level the water level was measured by the scale. Thus, irrigation water was applied whenever the water level inside the pipe reached a predetermined position as per treatment.


Bouman tubes (field water tube)

Installation of Bouman tubes (field water tube) for AWD irrigation.


A field tube in flooded field

Water at 15 cm below the soil surface: Time to irrigate the field again

Conclusions for AWD

1. An average water savings of about 20% was attained in both deep well and shallow tube well systems.

2. Irrigation regime of alternate wetting and drying produced higher growth parameters, yield attributes, grain yield, straw yield, nutrient uptake and NUE as compared to saturation. The irrigation water productivity and water use efficiency were significantly higher

3. Community benefits: more water available for irrigation and less social tension when water is scarce!

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Water Hyacinth: A Unique Sustainable Materials

Article ID: 31111

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Pollution of soil is a major environmental problem in field and day by day its increase due to over use of fertilizer in farm land. Most conventional remediation approaches do not provide acceptable solution to pollution problem. *Eichhornia crassipes*, commonly known as (common) water hyacinth, is an aquatic plant native to the Amazon basin, and is often a highly problematic invasive species outside its native range. Day by day growth of water hyacinth is increased in maximum amount and it is a big challenge to control it. As per observation, it is clear that actual application of water hyacinth is useful in a number of the sector but no one can study its adverse effect on the environment. There is no. of research was carried out on that still it is not stated that how it will affect in the environment. The solution is water hyacinth is use as dry organic manure and liquid fertilizers in field crop. So, avoid use of chemical.

In brief, it is the free-floating aquatic plant and grow on river, tank or any other place where water is stagnated. It has highest growth in short time, higher percent of nitrogen content and higher percent of protein, also contain palmitic acid and stigmasterol. It has lost of Medicinal properties.

Whenever use, its 100% natural, free from artificial chemical, nontoxic, environmentally friendly and ecologically compatible. It does not have harmful residue and does not cause problem of pollution. Supply macro and micro nutrients to the plant. It helps in improving soil structure like physical and chemical condition of the soil and improves soil fertility. And one other use is Phytoremediation- to clean the pollution in water and improve the water quality. It has been tool for treatment of the municipal waste. Its absorb the heavy metal, its add some acid to increase decomposition process in river.

Water hyacinth is best source of nitrogen, phosphorus and potassium, organic carbon and other amino acid, humic acid, falvic acid. It's very usefully to plant growth (Nesic and Jovanovic.,1996).

Water hyacinth has been used in aquatic systems for wastewater purification for many years worldwide. The role of water hyacinth *(Eichhornia crassipes)* species in polishing nitrate and phosphorus concentration from municipal wastewater treatment plant effluent by phytoremediation method was evaluated. The objective is to determine the removal efficiency of water hyacinth in polishing nitrate and phosphorus, as well as chemical oxygen demand (COD) and ammonia. Water hyacinth is considered as the most efficient aquatic plant used in removing a vast range of pollutants such as organic matters, nutrients, and heavy metals (R. M. Kutty. et al, 2009).

Jayaweera and Kasturiarachchi (2004) Water hyacinth *(Eichhornia crassipes)* is an aquatic biomass species that exhibits prolific growth in many parts of the world. It has been suggested as a strong candidate for the production of methane because of high biomass yield potential and also those biomass use in agriculture sector for organic fertilizers, not environment pollution and supply macro or micro nutrient to plant.

Conclusion

As per above discussion, it is clear that there is a number of applications of water hyacinth used for a different area. As water hyacinth is used for water purification process and removal of heavy metals from waste water. Sometimes it is also clear that phytoremediation techniques are reported to be cost effective compared to other methods. Various contaminants like total suspended solids, dissolved solids, electrical conductivity, hardness, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, nitrogen, phosphorous, heavy metals, and other contaminants have been minimized using water hyacinth.

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Innovations in Horticulture for Nutritional Security and Economic Development

Article ID: 31112

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Horticultural crops are an important gradient of our diet as they are nutritionally rich as compared to other foods. Fruits and vegetables are rich sources of vitamins, minerals, carbohydrates, salts and proteins and are now becoming an important part of average household's daily meals. Their importance in providing balanced diet and health security has been realized world over. Thus, need of hour is to improve nutritional quality of fruits, vegetables and other horticultural crops.

Introduction

With a population of 1.35 billion, India is the second most populous country and by 2050 it is likely to be the most populous country in the world. Thus, ensuring food and nutritional security is a major goal for India and to feed the ever-increasing population, food production must increase by 70%. In order to achieve its true potential and play the role as a global superpower, India will need to focus on eradication of malnutrition so as to coming generations are physically fit, intellectually enriched & having higher work potential.

Maternal and child under nutrition is of major concern for the current government and to combat such problem government has taken extensive measures such as announcement of the National Nutrition Mission (NNM) and its targets are to reduce the level of stunting, under nutrition, anemia and low birth babies. On March 8, 2018; the Prime Minister launched Poshan Abhiyan-PM's Overarching Scheme for Holistic Nourishment. Fruits and vegetables are not only a good source of calories but also of natural vitamins, proteins and fibres (Kulshrestha 2018). Horticultural not only uplifts the Indian economy, improves farmer's income but also provides raw material to many agro-based processing industries.

Many agro-industries are based on horticultural products like rubber, coir (coconut) and sago (tapioca) industries. India is steadily making advancements in flower production particularly cut flowers, which have a high potential for exports. Horticultural crops also provide gainful employment for small farmers and agricultural labour throughout the year and thus it contributes to national wealth.

Biofortification

It refers to the idea of breeding crops to increase the nutritional value either by conventional breeding approach or via genetic engineering. It has many advantages like it improves the plant or crop quality, increases the nutritional quality in daily diets, over comes malnutrition in human beings and would benefit farmers by increasing their income in the long term. It is seen as an upcoming strategy for dealing with deficiencies of micronutrients in the developing world. Crop biofortification is an effective means of delivering micronutrients in diets (Bouis and Saltzman, 2017). Its objective is to develop vegetable crops such as biofortified sweet potato and cassava which have highly available micronutrients such as iron, zinc and vitamin A for preventing global deficiency of these nutrients.

Protected Cultivation Technique

It is an innovative technique of growing horticultural crops under partially or fully controlled environment with efficient use of resources for getting higher productivity and quality of horticultural produce. It offers several advantages to grow high-value crops with improved quality even under unfavourable and marginal environments. It can increase the yield manifold per unit area and the crops can also be grown round the year, including off season with increased profitability.

It is the most contemporary approach to produce highly productive and high value crops, to conserve water and land, to provide protective environment and to yield higher as well as quality produce during on and off-season or round the year. Low cost protected technologies like plastic low tunnels or walk in tunnels and insect proof net houses can be used for safe vegetable cultivation. Drip irrigation and low-cost nursery raising technology can also be replicated among the resource poor and tribal farmers to ensure their livelihood security.

Grafting Technique

This technique has been already in use in various fruits crops viz. litchi, pomegranate etc. but now it is becoming popular especially for greenhouse cultivation of vegetable crops. Apart from obtaining better yield and quality it is especially successful in cucurbits like melons for resistance against diseases and pests. It can also help to avoid or reduce yield losses caused by salinity stress in high yielding genotypes belonging to *Solanaceae* and *Cucurbitaceae* families. Important examples are watermelon grafted on squash and bottle gourd using cleft and tongue approach grafting, cucumber grafted on squash and fig leaf gourd and tomato grafted on wild species of tomato using splice and tongue approach grafting.

Hydroponics and Aeroponics Technique

Hydroponics is the art and science of growing crops without soil and its applications. It is a technique in which plants are grown in nutrient solution, instead of soil. Since the nutrients are available for plants, the root system of plants is compact and plants grow healthier. It is generally used for tomatoes and seedless cucumbers cultivation. Aeroponics refers to the technique when the nutrient media is sprayed to the plants by high pressure pumps. It has various benefits like it gives grower an effective control over the environment, yields are very predictable, budgeting is easier, root zone aeration as well as adequate porosity of medium is ensured and it also saves water.

Breeding Approach

To combat the problem of climate change as well as to ensure higher return to farmers, plant breeding procedures are adopted to evolve superior cultivars having desired attributes. The methods include conventional breeding, heterosis breeding, mutation breeding, biotechnology including genetic engineering etc. Varieties developed by heterosis breeding have higher yield (watermelon, squash, pumpkin), uniformity in size and maturity (onion), better resistance to drought (watermelon, sweet corn), better disease resistance (tomato, cucumber), better fruit quality (tomato, muskmelon, watermelon) and better adaptability to environmental conditions (sweet corn). The varieties evolved using mutation breeding method include drought tolerant PKM-1 (Brinjal), uniformly ripening Pusa Lal Meeruti (Tomato), fruit borer tolerant EMS-8 (Okra) and PKM-1 variety of ridge gourd having tolerance to pumpkin beetle, fruit fly as well as leaf spot.

PGR's Applications

Growth regulators can be used for reducing flower drop and improving fruit set in tomato, eggplant and chilli, to regulate sex expression in cucurbits like increased number of female and hermophroditic flowers in watermelons using TIBA (Tri-iodobenzoic acid) & gibberellic acid (GA), to retard yellowing and abscission of cauliflower, in sprout inhibition and storage quality of carrots and onion, in enhancing shelf life of okra, in increasing yield of cassava by using CCC, also for improving seed germination.

Value Addition

Horticulture produce can be processed to fetch higher price in market like dehydrated eggplant, pickled cucumber, sago from cassava, French fries and chips from potato, sauce and ketchup from tomato etc. Cucumber is the most important vegetable for commercial and home preservation for pickling and also preserved by brining. Dipping turnips in hot melted paraffin wax gives a glossy appearance and it helps in reducing moisture loss during handling.

Post-Harvest Management

Crop harvesting at right time and then cool chain management of horticultural produce with proper packaging (CAP & MAP), storage (CAS & MAS) and transport conditions not only reduce damage but also fetch higher remuneration for the produce in the market. Post-harvest treatment with fungicides can slow rot development. Sulphur dioxide fumigation can be used as a post-harvest treatment to reduce browning. Poor transport conditions are a major problem in Asia. Fruits are often damaged when baskets are overfilled or dropped so padding and strapping the baskets can restrict movement during transport.

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Conclusion

In nutshell cultivation of horticultural crops ensure health security by providing essential nutrients required for growth and development of human body as well as cure many nutritional disorders and degenerative diseases. Horticultural crops play a vital role in the prosperity of a nation and are directly linked with the health and happiness of the people. Thus, continuous innovations and interventions in cultivation techniques of horticultural crops are necessary to increase their production & productivity, to manage pests and diseases and to mitigate the climate change.

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KUSUM Scheme

Article ID: 31113

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The Ministry of New and Renewable Energy has formulated a Scheme 'Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM)'. The Scheme is currently under the process of seeking approval.

The Proposal on KUSUM Scheme Provides for

1. Installation of grid-connected solar power plants each of Capacity up to 2 MW in the rural areas.
2. Installation of standalone off-grid solar water pumps to fulfil irrigation needs of farmers not connected to grid.
3. Solarisation of existing grid-connected agriculture pumps to make farmers independent of grid supply and also enable them to sell surplus solar power generated to DISCOM and get extra income.

Objective of the Scheme

The main aim of this Kusum Yojana is to provide farmers with advanced technology to generate power. These solar pumps have double benefits as it will assist farmers in irrigation and will also allow farmers to generate safe energy. As these pump sets comprise of an energy power grid, farmers can sell the extra power directly to the government which would also increase their income.

Benefits of Kusum Yojana

The following are the list of benefits under Kusum Yojana:

1. Farmers will be provided with the option to sell the extra power directly to the government that would help the farmers with additional income.
2. The government has also taken the initiative to construct plants, that would generate solar power. As per the draft, these plants are capable of generating a total of 28,250 MW power.
3. Apart from the solar power plants, the government work towards the new solar pumps with the diesel pumps that holds the capacity of 720 MW.
4. This scheme also provides farmers with the opportunity to earn extra money by installing solar pumps. The amount of energy generated extra, can be sold to the government.
5. Every farmer will be getting a huge subsidy on this new and improved solar powered pump. The farmers will have to raise only 10 per cent of the total cost for this purpose.
6. The central government will be providing 60% subsidy to the eligible farmers on the total cost of the solar pump, and the remaining 30% of the cost will be provided as credit by the banks.

7. The increased use of solar power and electricity from solar plants will lower the pollution level in the farm.

Subsidy for Farmers

The cost distribution for setting up of pumps and tube-wells is as follows:
1. Central Government: 60% of the total cost as Subsidy.
2. Banks: 30% of total cost as Loans to Farmers.
3. Farmers: 10% of the total Cost.

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Water Pollution and their Management

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Introduction

Water is an important element for life. Water is generally present in two forms on earth that is marine water and fresh water. Marine water is containing 97% of the total water it's found in sea or ocean and fresh water comprises 3% of the total water on earth. Only a small percentage (0.01%) of water is available for human use (Hinrichsen and Tacio, 2002). Normally water is never chemically pure it contains various impurities like suspended and dissolved. Water pollution is the form of environmental degradation due to the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater) when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. There are found several classes of water pollutants. The first part of water pollutants are disease-causing agents (bacteria, viruses, protozoa and parasitic worms) that enter sewage systems and untreated waste. A second part of water pollutants is oxygen-demanding wastes; wastes that can be decomposed by oxygen-requiring bacteria. Regular monitoring of water quality is a key part of identifying existing problems or issues that could be emerge in the future.

Causes of Water Pollution

There are found various classifications of water pollution. The two chief sources of water pollution are Point and Non-Point source. Point source refer to the pollutants belong to a single source. An example that is emissions from factories into the water. Non-Point source is referring to the pollutants emitted from multiple sources. An example that is contaminated water after rains that has travelled through several regions. Many substances are regarded as active water pollutants and are classified into different classes. All these substances exceed a threshold value and cause severe health problems in humans and other organisms in the ecosystem.

1. Industrial waste: Industrial effluents are one of the most important agents of water pollution. Most Indian rivers and other water sources are polluted by industrial wastes or effluents. Industries produce huge amount of waste which contains toxic chemicals and pollutants which is cause air pollution and damage to us and our environment. They contain various pollutants like lead, mercury, sulphur, asbestos, nitrates and many other harmful chemicals. Many industries drain the waste in the fresh water which goes into rivers, canals and later in to sea because lack proper waste management system. The toxic chemicals have the capability increase the amount of minerals, also known as Eutrophication, to change the colour of water, change the temperature of water and create serious hazard to water organisms.

2. Sewage and waste water: The sewage is the water borne waste whose sources are domestic waste and animals or food processing plants. The sewage water carries harmful chemicals and bacteria that can cause serious health problems. Many microorganisms and pathogens in water are known to be causes of very deadly diseases and become the breeding grounds for other individuals that act as a carrier. These carriers cause these diseases via various forms of contact onto an individual. Because sewage is the excellent medium for growth of pathogens and several pathogenic microbes comes from the wastes and spreads water borne diseases like viral hepatitis polio (viral), cholera, typhoid, dysentery, diarrhoea (bacterial), amoebiasis (protozoal) etc.

3. Mining activities: Water-pollution problems caused by mining include acid mine drainage, metal contamination and increased sediment levels in streams. Mining is the process of crushing the rock and extracting coal and other minerals from underground. These elements when extracted in the raw form contains injurious chemicals and can rise the number of toxic elements when mixed up with water which may result in health problems. Mining activities discharge several metal waste and sulphides from the rocks and is harmful for the water.

4. Marine dumping: Each household produce garbage in the form of paper, aluminium, rubber, glass, plastic and food it collected and dumped into the sea. This is called "garbage dumping" and is one of the world's prominent causes of ocean pollution. These items take from 15 days to 200 years to decompose. When such type of items enters the sea, they not only cause water pollution but also harm animals in the sea.

5. Accidental Oil leakage: Oil spill pose a massive anxiety as huge amount of oil enters into the sea and does not dissolve with water; there by opens problem for local marine wildlife such as fish, birds and sea for e.g.: a ship carrying large amount of oil may fall oil if happened with an accident and can cause varying damage to species in the ocean depending on the amount of oil spill, toxicity of pollutant and size of ocean.

6. Burning of fossil fuels: Fossil fuels like coal and oil when burnt produce huge amount of oxides of nitrogen and sulphur into the atmosphere which contribute to the creation of smog and acid rain. Rain water fall in different water bodies like river, sea, lakes etc. Thus, acid rains contribute water pollution. Also, carbon dioxide is released from burning of fossil fuels which outcome in global warming.

7. Chemical fertilizers and pesticides: Chemical pesticides and fertilizers are used by farmers for the plants growth and to protect crops from bacteria and insects. However, when these chemicals are mixed up with water pass into food chain and finally enter into animal and human bodies and cause harmful effect. Also, when it rains, the chemicals mix up with rainwater and flow down into canal and rivers which cause serious damages for aquatic animals. The chemical fertilizer and pesticides disturb the natural ecosystem of the top soil. Since the chemical fertilizers contains only few minerals, it impedes the uptake of other minerals and imbalance the entire mineral pattern of plant system like excessive potassium cause carotene and ascorbic acid deficiency and excessive use of nitrogen fertilizer cause deficiency of potassium in plants.

8. Leakage from sewer lines: A small leakage from the sewerage lines can pollute the underground water and make it flabby for the people to drink. Also, when not repaired on time, the leaking water can come on to the surface and become a breeding ground for mosquitoes and insects.

9. Global warming: Global warming is a process where the average earth global temperature increases due to the greenhouse gasses effect. An increase in water temperature cause the death of many aquatic organisms and disrupt many marine habitats which later results in water pollution.

10. Radioactive waste: Using nuclear fusion or fission produced nuclear energy. The element Uranium is used in production of nuclear energy which is highly toxic chemical. The nuclear waste that produced by radioactive material cause nuclear accident so needs to be disposed nuclear wastes to prevent any nuclear accident.

11. Urban development: Rapid urbanisation during the current decades in India given a number of environmental problems such as water supply, waste water generation and its collection, treatment and disposal. Increasing population, as a result the demand for housing, cloth and food is increasing. To full fill the demands more cities and towns are developed, increase use of fertilizers to produce more food, increase in construction activities and increase in chemicals from industries to produce more materials.

All these sources of water pollution, i.e. industrial and domestic wastes and agricultural practices, not only contribute toxic chemicals to water but they also cause widespread bacteriological contamination which results in frequent occurrence of water-borne diseases. In addition, they also result in an increase in parameters like chemical oxygen demand (COD), total dissolved solids (TDS), biological oxygen demand (BOD), total suspended solids (TSS), and salinity and thus fade the water quality and make it flabby for drinking and other purposes.

Effects of Water Pollution

1. Groundwater adulteration from pesticides causes reproductive damage within wildlife in ecosystems.

2. The self-purifying ability of water is lost.

3. Sewage, agricultural and fertilizer run-off contain organic materials discharged into water increase the growth of algae, which causes the reduction of oxygen. The low oxygen level upset the natural ecological balance in rivers and lakes.

4. Swimming and drinking in contaminated water causes skin rashes and health problems like cancer, typhoid fever, reproductive problems and stomach sickness in humans.

5. Industrial chemicals and agricultural pesticides in aquatic environment collect in fish that are later eaten by humans. Fish are easily poisoned by metals. Mercury is particularly poisonous to women and small children. Mercury has been found to affect with the development of the nervous system in foetuses and young children.

6. Water pollution origins flooding due to the accumulation of solid waste and soil erosion in streams and rivers.

7. Oil spills in the water causes animal to die when they ingest it. Oil does not dissolve in water so its origins suffocation in fish and birds.

8. Radioactive wastes destroy the biological immune system. If radioactive wastes present in water causes cancer, DNA breakage, eye cataract and carcinoma in man.

9. Sediment reduce the light penetration and lowers the photosynthetic activity of aquatic plants.

Control Measures of Water Pollution

The following recommendations are made which may help to regulate the problems of deteriorating water quality.

1. There should be continuous monitoring of drinking water throughout the country both in urban and rural locations.

2. Local authorities should be provided facilities for purification and monitoring of drinking water.

3. There is a need to shift from an irregular water supply to a continuous water supply system to avoid the contamination produced by irregular water supply.

4. There should be a renewal of rusty and old pipelines of the water distribution network.

5. There should be enough distances between drinking water supply lines and sewage lines to avoid cross contamination

6. Industrial wastewater removal should be strictly monitored and all industries should be forced to adapt wastewater treatment measures.

7. There is a need to implementation of strict laws with no compromise on quality of public drinking water.

8. Public attentiveness campaigns should be launched to educate the population about the importance of pure drinking water.

9. The public should be guidance to adapt safety measures for stored water inside the houses.

10. The farmer community needs to be educated about the safe handling and proper application of fertilizers and pesticides to minimize the contribution of agricultural wastes in water pollution.

Conclusion

The current scenario has led to awareness about water preservation and efforts are being made on several levels to transfer our water resources. Factory and industries set-ups are restricted near the water bodies to avoid contamination. People are investing in rain water harvesting projects to collect rainwater and preserve it in wells below ground level. Water needs to be preserved and respected today, for us to live a tomorrow.

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Improved Production Techniques in Wood Apple

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Introduction

Wood apple (elephant apple, monkey fruit, curd fruit), *Feronia limonia*, of the family Rutaceae, native of India and Sri Lanka is one of the hardy fruit trees of arid and semi-arid regions. It is slow growing erect tree. The fruit is a hard- shelled many seeded berries with its pinkish brown aromatic sour sweet pulp being the edible portion the seeds embedded in it. The pulp represents 36% of the whole fruit.

Nutritional Value

The pulp contains 18.1% carbohydrate, 7.1% protein, 3.7%, fat, 5.0%, fibre and 1.9% mineral matter. The pulp is a rich source of calcium (130 mg/100g), phosphorus (110mg/100g) and iron (0.48 mg/100g). The vitamins supplied by one hundred grams of pulp are carotene - 61 µg, riboflavin - 0.17 mg, niacin - 0.8 mg, thiamine - 0.04 mg and vitamin C - 3 mg. The seeds contain a bland, non-bitter, oil high in unsaturated fatty acids.

Uses

The ripe is consumed a fresh along with sugar, fruit pulp makes excellent chutney. It is used as an adjunct in jelly preparation along with the pulp of guava due to its higher pectin content (3% to 5%). The fruit used in Indian medicines to treat liver and cardiac problem. Unripe as an astringent means of halting diarrhoea and dysentery and effective treatment for cough, sore throat and disease of the gums. The pulp is poultice onto bites and stings of venomous insects, as with the powdered rind. The fruit shell is fashioned into snuffboxes, small containers and in dry flower making. It is utilizing as a substitute for adulterant of gum Arabic and is also used in making artists atercolors, ink, dyes and varnish. The wood is heavy, durable and valued for construction, pattern making, agricultural implements, rollers for mills, carving, rulers and other products. It also serves as fuel.

Climate and Cultivars

Wood apple can be grown in dry tracts of tropical and sub-tropical regions upto 1500 m above MSL. It is adapted to a wide range of soil conditions including degraded soil and light soil. It can also tolerate salinity to certain extent. It is an ideal tree to be exploited for growing in wasteland. No named cultivars are available. There are 2 forms viz., fruit with large, sweetish fruits; fruit with small, acid fruits. High yielders with big sized and sweet tasting fruits should be selected for propagation through vegetative means.

Propagation

The seedlings will not bear fruit until at least 15 years old. Budded plants are dwarf and precocious in bearing. In dry regions where irrigation potential is limited, in situ budding has to be done on established seedling.

Planting and Aftercare

In wasteland, then pits can be dug at a spacing of 8m x 8m each pit with a size 1 m3. Planting should be done at the onset of monsoon after filling the pit with 20 kg FYM, sand and top soil it will help in increasing fruit size and quality. It is a crop of dry region and once the plants had established, they hardy need any irrigation. Nevertheless, conservation of runoff rain water in rhizosphere will enhance the productivity of this crop.

Inter-culture

Wood apple trees are allowed to grow along a central leader. The trees require no pruning except removal of cris-cross branches. Intercrops can be taken during rainy seasons for the first 5 years. In the post monsoon season, the basins can be mulched with dry leaves. Every year 25 kg of FYM is to be applied for each tree at the beginning of the monsoon rains to improve yield and quality. Irrigation is done during summer will be beneficial. Being a member of citrus family, it is attacked by the leaf-eating caterpillar of citrus which completely defoliate the plant. Spraying of any contact insecticide should be done after hand picking and destruction of larvae.

Harvest

Budded plants come to bearing 3-4 years after planting. But to reach optimum productivity it will take about 10 years. It flowers from February to May. In India, the fruit ripens from early October through March. The fruit is tested for maturity by dropping onto a hard surface from a height of 1 ft (30 cm). Immature fruits bounce, while mature fruits do not. After harvest, the fruit is kept in sun for 2 weeks to fully ripen. A well grown tree will give 200-250 fruits/year.

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Paramparagat Krishi Vikas Yojana

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"Paramparagat Krishi Vikas Yojana" is an elaborated component of Soil Health Management (SHM) of major project National Mission of Sustainable Agriculture (NMSA). Under PKVY Organic farming is promoted through adoption of organic village by cluster approach and PGS certification.

Expected Outcomes

The Scheme envisages:
1. Promotion of commercial organic production through certified organic farming.
2. The produce will be pesticide residue free and will contribute to improve the health of consumer.
3. It will raise farmer's income and create potential market for traders.
4. It will motivate the farmers for natural resource mobilization for input production.

Programme Implementation

1. Groups of farmers would be motivated to take up organic farming under Paramparagat Krishi Vikas Yojana (PKVY).
2. Fifty or more farmers will form a cluster having 50-acre land to take up the organic farming under the scheme. In this way during three years 10,000 clusters will be formed covering 5.0 lakh acre area under organic farming.
3. There will be no liability on the farmers for expenditure on certification.
4. Every farmer will be provided Rs. 20,000 per acre in three years for seed to harvesting of crops and to transport produce to the market.
5. Organic farming will be promoted by using traditional resources and the organic products will be linked with the market.
6. It will increase domestic production and certification of organic produce by involving farmers.

Components and Pattern of Assistance

Adoption of Participatory Guarantee System (PGS) certification through cluster approach:
1. Mobilization of farmers / local people to form cluster in 50 acres for PGS certification.
2. Conducting of meetings and discussions of farmers in targeted areas to form organic farming cluster @ Rs. 200 / farmer.
3. Exposure visit to member of cluster to organic farming fields @ Rs. 200 / farmer.
4. Formation of cluster, farmer pledge to PGS and Identification of Lead Resourceful Person (LRP) from cluster.
5. Training of cluster members on organic farming (3 trainings @ Rs. 20000 per training).

PGS Certification and Quality Control

1. Training on PGS Certification in 2 days @ Rs. 200 per LRP.
2. Training of Trainers (20) Lead Resource Persons@ Rs. 250 /day/ cluster for 3 days.
3. Online Registration of farmer @ Rs.100 per member cluster x 50.
4. Soil sample collection and testing (21 samples/year/cluster) @ Rs. 190 per sample for three years.
5. Process documentation of conversion into organic methods, inputs used, cropping pattern followed, organic manures and fertilizer used etc., for PGS certification @ Rs.100 per member x 50.
6. Inspection of fields of cluster member @ Rs. 400 /inspection x 3 (3 inspections will be done per cluster per year).
7. Residue analysis of samples in NABL (8 samples per year per cluster) @ Rs. 10, 000/ sample.
8. Certification Charges.
9. Administrative expenses for certification.

Adoption of Organic Village for Manure Management and Biological Nitrogen Harvesting through Cluster Approach

1. Action plan for Organic Farming for one cluster:
   a. Conversion of land to organic @ Rs.1000/acre x 50.
   b. Introduction of cropping system; Organic seed procurement or raising organic nursery @ Rs.500/acre/year x 50 acres.
   c. Traditional organic Input Production units like Panchagavya, Beejamruth and Jeevamruth etc. @ Rs.1500 /unit / acre x 50 acre.
   d. Biological Nitrogen Harvest planting (Gliricidia, Sesbania, etc) @ Rs. 2000/acre x 50 acre.
   e. Botanical extracts production units (Neem cake, Neem oil) @ Rs.1000/unit/ acre x 50 acre.

2. Integrated Manure Management:
   a. Liquid Biofertilizer consortia (Nitrogen fixing / Phosphate Solubilizing/ potassium mobilizing biofertilizer) @ Rs. 500/acre x 50
   b. Liquid Biopesticides (Trichoderma viridae, Pseudomonas fluorescens, Metarhizium , Beaviourie bassiana, Pacelomyces,verticilliu m) @ Rs. 500 /acre x 50
   c. Neem Cake/ Neem Oil @ Rs.500/acre x 50
   d. Phosphate Rich Organic Manure / Zyme Granules @ Rs. 1000/acre x 50
   e. Vermicompost (size 7'x3'x1') @ Rs.5000/ unit x 50

3. Custom Hiring Centre (CHC) charges:
   a. Agricultural implements (As per SMAM guidelines) - Power tiller, Cono weeder, Paddy thresher, Furrow opener,Sprayer, Rose can, Top Pan balance.
   b. Walk-in tunnels for horticulture (As per guidelines of MIDH).
   c. Cattle shed / poultry / piggery for animal compost (As per Guidelines of Gokhul Scheme).

4. Packing, Labeling and Branding of organic products of cluster:
   a. Packing material with PGS logo + Hologram printing @ Rs. 2500 / acre x 50
   b. Transportation of organic produce (Four-wheeler, 1.5 tone load capacity) @Rs. 120000 max. assistance for 1 cluster
   c. Organic Fairs (maximum assistance will be given @ 36330 per cluster).

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Agricultural Water Management in Jharkhand: Issues and Strategies

Article ID: 31117

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Introduction

Sustainable access to clean fresh water resources is a major concern to support intensification and diversification of farming systems, improve incomes for farm families and provide a buffer against climate aberrations. Agriculture in different agro-ecologies of Jharkhand is heavily dependent on the monsoon as a source of water, the failure of which causes water shortage and below-average crop yields. Many of the agro-ecologies in the state are characterised with low investment, low productivity, mono-cropping, low productivities and marginal annual returns per unit of land. The available surface and ground water resources in the state are estimated at 25.88 and 4.29 BCM, respectively (Fig.1). Stage of groundwater development is 15.0% implying that about 85% of the groundwater is still unutilized and there is good scope to increase the groundwater utilization in agriculture.

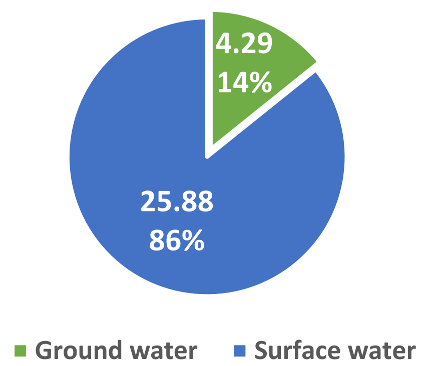

Fig.1 Surface and ground water resources of Jharkhand

The cultivable area is 3.8 million ha and only 12% of cropped area is under irrigation. Although, most of the cropped area is covered with rice during kharif, major portion of it remains uncropped during succeeding seasons. Despite good rainfall, the cropped area and cropping intensity are low. After withdrawal of monsoon, the residual soil moisture determines the opportunity for the succeeding crops during the succeeding seasons. Access to irrigation water being the prime reason, there are number of technological, social and policy constraints that limit multiple cropping within the state. The level of technology adaptation is also poor leading to lower productivity.

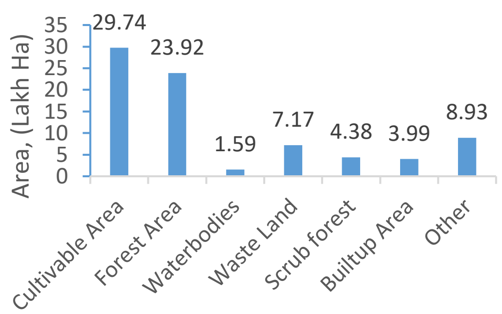

Fig.2 Land use pattern of the Jharkhand State

The undulating topography combined with well-developed network of streams leads to quick disposal of runoff from watersheds (Fig. 3) (GOJ, 2020). The region consists of a series of hillocks with drainage lines and low-lying areas near streams, collectively classified as lowlands, where paddy has traditionally been cultivated. In areas represented by the present study, lowlands extend about 60-150 m horizontally with a local relief of 2-3 m above the drainage line. These areas remain waterlogged for prolonged periods after the end of the monsoon season. The soils drain and become workable in the month of January. The area midway between lowlands and relatively planer uplands is categorized as midlands (Fig. 3), which have local topographic relief of about 2-7 m above the drainage line (Singh et al., 2019). Much of the original hill slope area (midland) has been terraced and bunded to convert it to paddy fields. The upper non-terraced and non-bunded planer areas generally have shallower, light-textured soil. Local water resources are not available to support irrigation in uplands. Uplands typically lie at an elevation range >7m above drainage line. There are some village 'fringe areas' on the stream banks which are marginal uplands having high slope, rocky terrain with high runoff. These are not used for agricultural production. Groundwater recharge mainly occurs in the uplands and the midlands (bunded paddy fields) while the low lands are the major discharge areas.

Storage of surface runoff is very limited and people depend on irrigation from groundwater even during dry spells within the monsoon season. Low levels of groundwater development on account of limited electrification and poor technology adoption further exaggerate the problems of irrigation in rice-fallow areas. Traditional methods of water application are still extensively used by majority of the farming community leading to over use of irrigation water and reduced water productivities. The remedy for improving water productivities and reducing future water use lies in efficient use of available water resources through adoption of improved technologies at farm scale. This also calls for revision in existing policies on irrigation infrastructure such that items provided under subsidy schemes match the needs of advanced irrigation technologies as well as farming community.

This paper attempts to provide critical analysis of the present status of agricultural water management and puts-forth the key technological interventions and policy changes required to achieve efficient water use in agriculture of the Jharkhand state.

Issues and Strategies

1. Promotion of drip irrigation: need for fallow up and feedback collection: Just like other Indian states, traditional methods of water application viz. flooding, border and furrow are widely used methods of water application in the state of Jharkhand. Water supplied from these methods is often unmetered and quantity of water application is largely governed by the understanding of the farmer. Water application is always in access to the water holding capacity of the soil and deep percolation losses are unavoidable. This not only leads to loss of precious irrigation water but also the reduced water productivities. Under such circumstances, drip and sprinkler irrigation offers great potential to make efficient use of available water by minimizing the water loss simultaneously reducing the labour and time requirement. Integrating drip irrigation with fertigation has been found promising in increasing the crop yields and in reducing the fertilizer requirements. Application of weekly fertilizer dose in specific patterns as per the crop growth stage has shown increased yields in tomato (Mali et al., 2016) and chilli pepper (Mali et al., 2019). Placement of drip laterals below the soil surface is referred to as 'Sub-surface drip'. Sub-surface drip with 10 cm depth of lateral placement and application of 150:120:120 kg NPK per ha has been recommended as an optimum practice for improving yield and water productivity of bitter gourd (Mali et al., 2017).

Fig. 4 Well maintained drip irrigation system in Onion and Brinjal crops

Although government of Jharkhand is extensively promoting the micro irrigation systems (MIS) through its subsidy based micro irrigation schemes, this needs to be supported with widespread training programs for the farming community. The responsibility of the government should not end once the system is delivered to the farmers. Many a times farmers purchase the MIS out of lucrative subsidies, but fail to continue its usage on account of lack of knowledge. Increasing the level of follow-up monitoring after the installation of subsidised drip irrigation system is of utmost importance to understand the problems and difficulties faced by the farming community. This should be combined with providing on-site solutions and periodical maintenance of drip irrigation system on payment basis to the farmers. This will not only increase the longevity of the systems but will encourage farmers to adopt the drip irrigation systems on larger area.

2. Promoting small scale drip irrigation systems: Present ceiling of area for disbursing subsidies is one acre, implying that farmers with area of greater or equal to one acre will be eligible to get the subsidy. Further, there is also a condition that the proposed one-acre land should be at one place as a single plot. Rather than facilitation, this is more of a limitation for the agro-ecological setup prevailing in the Jharkhand state. Large numbers of farmers in the state of Jharkhand are of 'small' and 'marginal' category with fragmented land holdings scattered over multiple locations. Small scale drip irrigation systems suitable for fields of 500-2500 m2 area offer great potential to increase the area under drip irrigation systems. Making subsidy provisions for small scale drip irrigation systems is the need of time. Subsidies on small scale drip systems will make these systems affordable to large number of farmers and will enable the small and marginal farmers to realize the potential benefits of the micro irrigation systems. Provision of subsidies on small scale drip systems will act as an entry point to large scale adoption of micro irrigation systems in the state.

Fig. 5 Small scale gravity drip systems suitable for small farmers

3. Promoting Drip with polyethylene mulch: Advantages of drip irrigation system over traditional irrigation practices have been well established. It reduces water loss and applies water with greater uniformity and achieves irrigation efficiency up to 90-95%. Recent research has shown that the use of drip irrigation in conjunction with bicolour polyethylene mulch is performing better in terms of crop productivity, water productivity and economic water productivity (Jha et al., 2019). Mulch enriches and protects the soil and it provides a better growing environment to the crop. Use of bi-colour plastic mulch (i.e., silver-black) has shown promising results in terms of weed control, moisture conservation, soil temperature regulation and has been found effective in reducing the labour cost.

Fig. 6 Use of polythene mulch on the raised beds

The mulches regulate the soil temperature by acting as insulating barrier between the soil and the air. Plastic mulches placed on raised beds may last for two to three seasons depending on the thickness (25, 30 or 50 micron) of the plastic mulch. After harvest of first crop, the second crop is planted in the same holes with some loosening of the soil. Likewise, a third crop can also be planted using the same polythene and raised beds. Plastic mulches are easier to spread on the soil surface. So, there is need to promote drip irrigation with mulch technology in Jharkhand for better yield, water productivity and economic water productivity.

4. Groundwater lift irrigation systems: Groundwater resource in the state is grossly underutilized. Over the last two decades use of pumps in irrigation has increased many folds, due to a subsidy offered initially to farmers on kerosene, which also popularized its use in agriculture. These pumps offer access to groundwater but their use is constrained due to limited suction lifts. Because of their low suction heads, these pumps became practically useless in farms located in the uplands and midlands where water table depths are below the suction lifts of these pumps. The groundwater resource available in the lowlands can be effectively tapped by using submersible pumps of appropriate capacity and suction heads. Such pumping systems can supply water to adjoining uplands and midlands during rabi and summer seasons, leading to improved cropping and better livelihoods to the farmers. In case the ownerships of lowlands, uplands and midlands are different, the water market can be established so that farmers in midlands and uplands can rent the water from the groundwater lift irrigation schemes located in the lowlands.

Fig. 7 Groundwater lift irrigations systems in lowlands and midlands

5. High discharge Vs high-head pumps: In the context that Government is promoting the use of drip and sprinkler irrigation systems through its subsidy schemes, it is important that these systems should have a matching pump to generate required pressure to operate these systems. Since, irrigation pumps are not covered in subsidy scheme on micro-irrigation, farmers have to depend on the existing pumps which are of low-pressure ratings. These pumps may not meet the pressure requirement of the micro-irrigation systems. Even if these pumps can operate the system, the application uniformity may be very poor. The mismatch between system and pump, at times, is uneconomical since low application uniformity in water application may lead to spatial variation in crop yields. Many a times the micro-irrigation system procured by the farmers under subsidy scheme goes unutilized on account of lack of suitable pump set. It would be promising to combine the subsidy schemes on micro-irrigation system and pumps to have the synergic effect of these to schemes. Government should either make a provision of matching irrigation pump in its subsidy scheme on micro-irrigation or can make it mandatory for the farmers to get the two subsidy schemes simultaneously. This would avoid the system-pump mismatch and can ensure the effective use of government schemes through synergies.

Fig.8 Low head high discharge pump in operation

6. Solar powered irrigation pumps: Given the context that electricity supply is erratic and diesel operated pumps incur heavy maintenance costs, solar lift irrigation can provide a much-needed sustainable push to the irrigated agricultural in the state. At present adoption rate of solar pumping systems is very low because of the initial investments the farmers have to make. Government of Jharkhand is taking substantial efforts in promoting the solar systems in every district of Jharkhand and people have started realizing the potential of these systems. Only concern is the size of the pumps provided under subsidy schemes. Most of the pumps are of 'high discharge and low pressure' type. This limits the applicability of these pumps in pressurised systems like drip and sprinkler. Working out optimal size of the pumps to suite the variety of cropping patterns, water sources and pressure requirements of the micro irrigation systems is a challenging task. The agencies and officials involved in prescribing pump sizes for farmers can make use of the android app "Saur Shakti" developed by ICAR. This is an app with user friendly interface which works out optimal pump size depending on water source, crops cultivated and method of water application. In the subsidy schemes on solar pumps, the government needs to focus on providing high pressure pumps in contrast to high discharge pumps. Provision of suitable pumps having comparatively higher-pressure heads will enable farmers to use their drip and sprinkler systems continuously without depending on electricity or liquid fuel. Combining drip and solar pumps will not only save precious water resource but will ensure effective use of on-farm irrigation infrastructure.

Fig. 9 Solar irrigation systems for drip irrigation

7. Improving water holding capacity of soils: Low water holding capacity, poor soil fertility and soil crusting in upland and waterlogging in lowlands are the major constraints of the soils in Jharkhand. Soon after the rainfall, the uplands of Jharkhand suffer from soil crusting on account of low soil organic carbon content (0.34%) which hinders the crop germination (Naik et al. 2015). Application of organic matter improves the aggregate stability of soil and helps in stabilizing soil structure. Application of liming material in acid soils of Jharkhand improves the soil pH and improves soil structure, water holding capacity and reduces crust formation.

Fig. 10 Growing tephrosia on bunds for use as mulch material

The biomass yielding plants like tephrosia (Tephrosia candida) can be grown on field bund by sowing seeds in strip during July. The lopping of biomass can be done in September and March. The leaf biomass can be used for mulching as well as reclaiming acid soils. Farmers's participatory research confirmed that application of 10 t/ha of dry biomass supplements 120kg/ha calcium (equivalent to 300 kg lime/ha), 70 kg/ha magnesium (equivalent to 292 kg lime/ha; lime equivalent of 1 kg magnesium carbonate =1.19). Organic mulches consist of organic plant and/or animal residue or by-products. They are generally spread over the ground surface around established plants or over the entire growing area in 2 to 5-inch thick layer. Application of organic mulch reduces the impact of high intensity rainfall on sheet erosion and surface sealing and thereby improves the water holding capacity. As the organic mulch decomposes, humus is added to the soil, which increases its water holding capacity.

8. Rural electrification: Jharkhand has made significant progress on grid connectivity over the last few years, still large population has no access to regular electricity supply as the duration of supply in most villages' averages to two hours per day. Recent survey data from Jharkhand reveals that 13 percent of the state's rural households still lack access to electricity. Electricity is the critical input in agriculture, particularly in irrigation water supply. This is the most critical and limiting factor in achieving inclusive growth in the agriculture of the state. Farming community cannot afford the irrigations using diesel pups manly because of its higher running and maintenance costs and the use of electric pumps is restricted because of erratic electricity supply. Rural electrification can play a great role in realizing the twin goals of achieving improved livelihoods and efficient utilization of rice-fallow areas.

9. Publishing of subsidy schemes in media: Recognizing that television is the most effective way of communication, there is need to promote the micro-irrigation, subsidy schemes, solar pumps and other agriculture schemes through television advertisements. We see number of advertisements regarding health schemes, education schemes etc. but the subsidy schemes are completely missed out. The procedure to get subsidy are often felt complicated which precludes farmers from visiting government offices for subsidy. Therefore, explaining the procedures and documentation required for getting subsidy should also be the integral part of such promotions. It is high time that government should take lead in promoting improved agricultural technologies and subsidy schemes using print and electronic media so that the benefits of such schemes can reach out the farming communities in remotest villages of Jharkhand.

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Pests of Sapota, Guava and Pomegranate

Article ID: 31118

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Pests of Sapota

1. Chickoo moth or leaf webber: Leaves are webbed together in a bunch and the chlorophyll scrapped by the larva. Cluster of dried leaves is hanging from the webbed shoots. Flower buds and tender fruits are bored, become withered and shed. Larva is pinkish in colour with three dorso-lateral brown stripes on each side. Adult moth is greyish with hairy brown forewings or black spots and semi hyaline hindwings.

2. Budworm: Floral buds and flowers are webbed together and shed. Larva is small, slender, pinkish brown in colour with black head and yellowish-brown prothoracic shield. Adult is grey coloured moth with black patch on wings.

3. Fruit fly: Semi–ripe fruit show decayed spots and fruits drop later. Maggot is yellowish. Adult fly is light brown with transparent wings.

4. Hairy caterpillar: Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth. Male is with pectinate antenna and chocolate brown patch in the middle of forewings. Female is bigger in size than male and has wavy transverse bands on wings.

Pests of Guava

1. Fruit borer: Infected fruits are with boreholes plugged with anal segment of the larva. Severe infestation results in fruit rotting and dropping. Larva is dirty dark brown, short and stout built covered with short hairs. Adult is bluish brown butterfly. Female is with „V" shaped patch on forewing. Fruits are with boreholes. Adult is metallic red coloured butterfly.

2. Tea mosquito bug: Corky scab formation on fruits is the symptom of damage. The infestations caused by the nymphs and adults caused by the nymphs and adults include inflorescence blight, terminal drying of young shoots and water-soaked lesions followed by brownish spots at the feeding sites. Nymphs and adults are reddish brown, elongate bugs with black head, red thorax and black and white abdomen.

Pests of Pomegranate

1. Fruit borer: Infested fruits are with bore holes plugged with anal segment of the larva. Severe infestation results in fruit rotting and dropping. Larva is dirty dark brown, short and stout built covered with short hairs. Adult is bluish brown butterfly. Female is with „V" shaped patch on forewing.

2. Fruit fly: Rotting of fruit is the symptom of infestation. The maggots feed on the pulp of the fruits and the symptoms of damage include of brown resinous fluid from fruits, distorted and malformed fruits premature dropping of fruits and unfit for consumption. Maggot is white and apodous. Adult is with hyaline wings or brownish with pale yellow band on 3rd tergite.

3. Shoot and fruit borer: Larvae make holes on fruits. Larva is pale greenish with pinkish tinge and fine hairs with dark head and prothoracic shield. Adult is medium sized and pale yellowish moth with small black spots on the wings.

4. Mealy bug: Cluster of white mealy bugs on the lower-side of the older plants cause yellowing and drying of leaves. Adults are small, oval, soft bodied and covered with white mealy wax.

Pests of Banana

1. Borers Rhizome weevil: The grub causes death of unopened pipe and withering of outer leaves. Grubs bore into the rhizome and cause death of the plants. Grub is apodous and yellowish white with red head. Adult is dark coloured weevil.

Pseudostem borer: The grub makes bore holes and tunnels in the pseudostem and causes wilting of the plant. Grub is apodous and creamy white with dark head. Adult is robust reddish brown and black weevil.

2. Sap Feeders:

a. Banana aphid: Nymphs and adults are vectors of bunchy top disease. They are seen in colonies on leaf axils and pseudostem. Nymphs and adults are dark

b. Banana aphid: Nymphs and adults are vectors of bunchy top disease. They are seen in colonies on leaf axils and pseudostem. Nymphs and adults are dark in colour. Winged adults are with black veined wings.

c. Tingid: The infested leaves are with greyish yellow spots and stunted growth. Presence of white, transparent adults is dull coloured nymphs on the lower surface of leaves. Nymphs and adult are dull coloured bugs with transparent shiny lace-like reticulate wings.

d. Thrips: Leaf thrips - Cause yellowing of leaves. Adults are with fringed wings. Fruit rust thrips - Cause leaf yellowing and rusty growth over fruit. Adult is yellowish white with shaded wings. Flower thrips - Cause corky scab on fruits and flowers.

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Pests of Mango and Citrus

Article ID: 31119

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Pests of Mango

1. Pests of Inflorescence/Fruit:

a. Mango hoppers: Nymphs and adults cause withering and shedding of flower buds and flowers. Presence of small drops of honeydew on lower leaves followed by development sooty mould. Clicking sound due to movement of jassids amidst leaves is a common phenomenon.

i. *I. niveosparsus* - Three spots on scutellum and white band across the wing.
ii. *clypealis* - Two spots on scutellum and dark spots on the vertex
iii. *atkinsoni* - Two spots on scutellum.

b. Aphid: The infestation results in drying of inflorescence and tender shoots and appearance of sooty mould. Aphids are brown coloured.

c. Flower webber : Larvae web the inflorescence and tunnel the stalks. Larva is greenish yellow light brown head and prothoracic shield. Adult female moth is with grey wings and male is with purplish pink wings.

d. Gall midges: *Procystiphora mangiferae* - Causes malformation of flowers and droppings of flower. Maggot and adult are orange coloured. *Dasineura amaramanjarae* - Causes damage to flower buds and dropping of bud. *Erosomyia mangiferae* - Results in stunting and malformation of inflorescence. Maggot is yellowish.

e. Fruit fly: Semi-ripe fruits are with decayed spots and droppings of fruits. Maggot is yellowish. Adult fly is light brown with transparent wings.

f. Nut weevil: The infestation results in dropping of fruits at marble stage and tunnelled cotyledons. Ovipositional injuries and eggs are seen on marble sized fruits. Grub is fleshy, yellowish and apodous. Adult is brownish with short snout and papillate scales.

2. Leaf Feeders:

a. Shoot webber: Larvae cause webbing of terminal leaves and defoliation. Larva is pale green with brown head and prothoracic shield. Adult is brownish moth with wavy lines on forewings.

b. Castor slug: Larva irregularly feeds on the leaves and causes defoliation. Larva is slug like, ventrally flat, greenish body with white lines and four rows of spiny scoli tipped red or black. Adult is green moth with a brown band at the base of forewings.

3. Sucking Pests:

a. Whitefly: Nymphs and adults cause yellowing of leaves in patches and the presence of white flies on the ventral side of leaves. Nymphs are greyish white, found in-groups. Adult is dull white in colour.

b. Scale insect: Nymphs and adults cause yellowing of leaves. They are white elongate hard scale.

c. Mealy bug: Severe infestation results in drying of leaves and inflorescence. Nymphs and adults are pinkish and undergo diapause in soil during winter.

d. Eriophyid mite: This worm like mites are found in growing tips, sucking the sap and injecting toxic substances, kill the buds and cause resetting of shoot.

4. Borers:

a. Stem borer: The grub causes drying of terminal shoots in early stage of attack. Wilting of whole tree damage occurs at the main stem. Grub is linear, fleshy and apodous. Adult is greyish beetle with two pink dots and lateral spine on the thorax.

b. Shoot borer: Larvae bore through the downwards from the growing tip to a depth of 5 or 6 inches. Whole seedling remains stunted with individual twigs showing a peculiar terminal bunchy appearance. Larva is dark pink with conspicuous dark brown prothoracic shield. Adult is greyish moth with dark grey wings having wavy designs.

Pests of Citrus

1. Internal Feeders:

a. Orange borer: The grubs cause drying of terminal shoots in the early stages, followed by wilting of thicker branches and main stem. Grub is creamy white with flat head. Adult is dull metallic green to dark violet or shiny blue beetle with yellow band across the middle of the elytra.

b. Citrus leaf miner: The infestation by the larva results in leaves with serpentine mines and distortion of the leaf lamina. Larva is minute, reddish or yellowish and apodous. Adult is minute moth with a black spot at the tip of the forewing.

2. Leaf Feeder:

Citrus butterfly: The larva causes defoliation of tender leaves. Larva in its early stage resembles bird dropping. Grown up larva is cylindrical, stout and green with brown lateral oblique bands. Adult is dark brown swallow tail butterfly with numerous yellow markings.

3. Sap Feeders:

a. Fruit sucking moths: Adult moths pierce the fruit and suck the juice resulting in rotting at the feeding site and dropping fruit. Larva is semilooper with orange blue and yellow spots on its velvety dark speckled body, which feeds on the weed host. Adult is stout-built moth with grey and orange coloured wings. There are 3 black spots on the forewings. *Otheris fullonica* - Presence of tripod black marks in the forewing and curved marking in the hindwing. *O. ancilla* - Presence of white band in the middle forewing.

b. Psyllid: Nymphs and adults infest terminal tender twigs and desap causing curling and drying of twigs. Transmit citrus greening virus. Nymph s are orange in color; adults are brownish males are shorter than female. Wings are memberaneous and semitransparent, wings extend beyond the body.

c. Citrus white fly: Nymphs and adults suck sap from leaves causing curling over and fall off. Nymph is pale yellow with purple eyes

d. Black fly: The symptoms of damage are yellowing of leaves in the early stage of attack followed by honeydew deposition on the lower leaves and sooty mould of development. Severe infestation leads to defoliation. Nymph is shiny black scale like and spiny with white markings at the edges.

e. Scale insects: Suck sap from branches, inject toxic substances. Females are light grey in colour; males are smaller than females.

f. Rust mite: Feeding by adults and nymphs causes silvery, scaly of rusty to black discolouration on the fruits. The affected fruits are smaller and the rind of injured fruits is thicker.

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Pests of Cashew, Grapevine and Coconut

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Pests of Cashew

1. Borers:

a. Cashew tree borer: The grub by internal tunnelling causes wilting of branches and then the tree as a whole (Fig. 80). It also infests trunk and root. Grub is elongated, creamy white brown head. Adult is reddish brown longicorn beetle.

b. Bark feeder: Zig-zag galleries and silk webbed masses comprising of chewed material and excreta of larvae are seen. Larva is stout and dirty brown. Adult is pale brown with forewings having brown spots and streaks.

c. Apple borer: Presence of bore holes on the tender cashew (or) apple. Larva is dark pink in colour. Adult is medium sized moth with dark forewings and pale hindwings.

2. Inflorescence Feeders:

a. Shoot and blossom borer: The larva causes webbing of tender leaves and inflorescence. Larva is reddish brown with yellow and pink lines. Adult male is dark fuscous. Female is pale and olive green.

b. Shoot tip and inflorescence caterpillar: The infestation results in webbing of terminal leaves and inflorescence and boring of shoot tip. Larva is yellowish brown. Adult is a dark and tiny moth.

c. Tea mosquito bug: The infestations by the nymphs and adults include inflorescence blight, terminal drying of young shoots and water-soaked lesions followed by brownish spots at the feeding sites.

3. Leaf Feeders:

a. Leaf miner: Mining of tender leaves in whitish blotches is the symptom of damage. Larva is reddish brown and minute. Adult is silvery grey moth with fringes of hairs on the wing margins.

b. Wild silk moth: The larvae feed on leaves, which results in complete defoliation. The infestation is indicated by the presence of golden coloured pupae on the trunk. Larva is stout, dark brown with prominent warts all over the body. Adult is pale yellowish- or reddish-brown moth with three clear moths on forewings.

c. Hairy caterpillar: Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth.

d. Leaf miner: Mining of tender leaves in whitish blotches is the symptom of damage. Larva is reddish brown and minute. Adult is silvery grey moth with fringes of hairs on the wing margins.

e. Wild silk moth: The larvae feed on leaves, which results in complete defoliation. The infestation is indicated by the presence of golden coloured pupae on the trunk. Larva is stout, dark brown with prominent warts all over the body. Adult is pale yellowish- or reddish-brown moth with three clear moths on forewings.

f. Hairy caterpillar: Larva feeds on leaves irregularly and causes defoliation. Larva is greyish brown, stout and hairy. Adult is stout greyish brown moth. Male is with pectinate antenna and chocolate brown patch in the middle of forewings. Female is bigger in size than male and has wavy transverse bands on wings.

g. Leaf twisting weevil: The grub rolls leaf terminal, results in drying. Grub is yellowish and apodous. Adult is reddish brown weevil.

h. Looper: The larva damages the leaf margins. It is a green looper. Adult is green with grey brown markings.

4. Sap Feeders:

a. Aphids: The infestation results in drying of inflorescence and tender shoots and appearance of sooty mould. Aphids are brown coloured.

b. Red banded thrips: The damage results in crinkling, discolouration and leaf drop. Nymph is greenish yellow with red cross band across first two and last abdominal segments.

c. Thrips: This species causes silvery white patches on leaves with excreta. Yellowing and withering are due to severe infestation. Nymph is reddish in colour. Adult female is dark brown with yellow legs and antennae. Male is with yellow abdomen.

Pests of Grapevine

1. Stem girdler: The grubs and adults cause wilting of branches and then the entire vine. Adult is medium sized and grey coloured with a white spot in the centre of each elytron.

2. Chafer beetle: The adults cause complete defoliation of the leaves. Adults are brown coloured beetles.

3. Ground beetle: The adults cause defoliation of the leaves. Adults are brown coloured beetles.

4. Flea beetle: The adults bite small holes on tender leaves and the root is damaged by the grubs. Adult is reddish brown, shiny beetle with six spots on elytra.

5. Leaf roller: The larva causes rolling of leaves. Larva is pale green with short hairs. Adult is brownish moth with wavy line.

6. Thrips: Leaf thrips - Cause yellowing of leaves. Adults are with fringed wings. Fruit rust thrips - Cause leaf yellowing and rusty growth over fruit. Adult is yellowish white. Flower thrips - Cause corky scab on fruits and flowers.

7. Blackfly: Yellowing of leaves is the symptom of damage caused by the nymphs and adults. Nymph is oval in shape, scale like fringes. Adult is minute, delicate insect.

8. Mealy bugs: Nymphs and adults cause crinkling and yellowing of leaves and rotting of berries.

9. Berry plume moth: Larvae cause feeding injury on berries. Larva is small, pale green or pink with median red line. Adult is a small moth.

10. Castor semilooper: Adult causes fruit rotting and dropping. Larva in varying shades of colour. Head is black with black and red spot on the 3rd abdominal segment and red tubercles on the anal region. Adult is pale reddish brown with black hind wing with a median white and 3 large white spots on the outer margin.

Pests of Coconut

1. Coconut Rhinoceros beetle: Damage is caused by adult beetles which burrow the leaf sheaths near the crown and cut across the leaf in the folded condition. The damaged leaves show characteristic clippings or holes in the leaflets. The infestation will result in stunting of trees and death of growing point. Adult beetle is stout, black, about 5 cm long and has a long horn projecting dorsally from the head in male, a short horn in female. The grubs feed on decaying vegetable matter and in manure pits at a depth of 5-30 cm. damaged leaves show characteristic clippings or holes in the leaflets. The infestation will result in stunting of trees and death of growing point. Adult beetle is stout, black, about 5 cm long and has a long horn projecting dorsally from the head in male, a short horn in female. The grubs feed on decaying vegetable matter and in manure pits at a depth of 5-30 cm.

2. Red palm weevil: A few small holes with protruding chewed fibrous material and oozing out of a brown liquid from such holes indicate early infestation. In advanced stage of attack the central shoot shows sign of wilting and on large mass of grubs, pupae and adults are seen inside trunk. The reddish-brown weevil has six dark spots on thorax and in the male a conspicuous long snout has a tuft of hairs.

3. Black headed caterpillar: The larvae live on the under surface of leaflets within galleries of silk and frass material and feed by scrapping the green matter. The caterpillar is greenish brown with dark brown head and prothorax, and reddish mesothorax.

4. White grub: The grubs feed on roots and cause stunting and delayed flowering. Adult beetles emerge after monsoon showers.

5. Termite: Termites damage coconut seedlings.

6. Scale insect: The under surface of leaflets is infested by scale insects in large numbers causing yellowing in patches.

7. Lace wing bug: The nymphs and adults of the lacewing bug feed by sucking the sap from the under surface of leaflets causing white spots on the upper surface.

8. Perianth mite: The mite infests and develop on the meristematic tissues under the perianth. Initial symptoms exhibit as triangular pale white or yellow patches close to the perianth. Continuous feeding results in necrosis of tissues leading to formation of brown colour patches, longitudinal fissures and splits on the outer surface of the husk; oozing of brown gummy exudation; reduced nut size and copra content and malformation of nuts. The mite is vermiform, elongate body with 2 pairs of legs in the anterior and of the body ; head with piercing and sucking mouth parts.

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Pests of Coffee and Tea

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Pests of Coffee

1. Borers White borer: Presence of ridges on the stem, yellowing of leaves, wilting of branches and occasional drying of plants are the symptoms caused by the grub. Grub is white or yellowish, anterior and broader and tapering towards tail end. Adult is black, elongate beetle with grey pubescence on the head, thorax and elytra and characteristics white markings on the elytra.

a. Red borer: The larvae cause wilting of branches or plant. Boreholes often are plugged with excreta at the base of the plant. Larva is orange red and smooth, Adult is with dirty white bands and black or steel blue spots on the wings.

b. Shot hole borer: Adult and grub make small holes on the under surface of young succulent branches between nodes which result in withered and dead branches with shot holes. Grub is milky –white and apodous. Adult is reddish brown to dark brown beetle with a short cylindrical body.

c. Coffee bean beetle: Infested berries are with small holes, black in colour and shrunken. Grub is milky-white and apodous. Adult is pale grey, elongate oval and slightly flattened tapering anteriorly. Entire body is clothed with hairs.

d. Berry borer: Infestation by the grubs and adults' results in dropping of tender berries. There are many small round holes in the nodal region of developed berry. Damage is often caused to endosperm by making small galleries near the main tunnel. Female adults' tunnel into berries. Grub feeds on beans. Grub is white in colour. Adult is black beetle and the males are wingless.

2. Leaf Feeder:

Leaf miner: The maggots often mine the leaves. Maggot is small and apodous. Adult is very small and brown coloured fly.

Pests of Tea

1. Leaf Feeders Looper: Larva causes defoliation of leaves. Larva is grey or dark green in colour. Adult is straw coloured moth. Wings are grey with light brown markings and wavy lines.

a. Bunch caterpillars: The larvae cause defoliation of leaves. Larva is smooth and hairless and grey in colour with brown patches. Adult is golden brown moth.

b. Lobster caterpillar: Defoliation of leaves is the symptom of damage by the larva. Larva is brown with white band and elongated legs.

c. White grub: Grubs feed on roots and rootlets resulting in drying of young plants. Adults are leaf feeders. Grub is fleshy and „C" shaped. Adult is a brown coloured beetle.

d. Tea tortrix: Caterpillar makes leaf nest by webbing the leaves. Adult is greenish with black prothorax or brown coloured bell-shaped moth. Male is smaller than female. Larva is greenish with black prothorax.

e. Tea leaf roller: Second instar larva mines the tender and reaches leaf margin. Fourth instar larva rolls the leaves from the tip downwards. Larva is yellowish. Adult is microlepidoptera. Antenna is longer than the body with golden iridescent patches in forewing and abdomen.

f. Flush worm: Larvae web the tender leaves enclosing the bud; feed on upper epidermis of leaves and apical portion of the bud. Larva is brown coloured and 1 cm long; adult is less than 1 cm in size blackish brown in colour.

g. Nettle grubs: The caterpillars are the nuisance to the workers because of their stinging hairs besides scrapping the leaves.

h. Faggot worm: Larva defoliates order leaves and also feeds on bark. Adult male is reddish brown and winged. The female is wingless and grub like.

2. Sap Feeders:

a. Red spider mite: Feeding by nymphs and adults causes the leaves to become bronzed dried and crumpled. Nymph and adult are brick red in colour and rounded.

b. Scarlet mite: The infestation results in brownish leaves. Large number of miles are seen near the petiole and along in the midrib. Nymph and adult are orange and flattened ovate mite.

c. Purple mite: This species causes brown or coppery brown or smoky discoloration of leaves. Adult mite is dark purple to pink in colour with characteristic white sides running along the back.

d. Pink mite or orange mite: Continuous decamping causes the leaves turn pale and curl upward. Under severe infestation, leaves become leathery and brown. Damages are often to top 10-15 cm tender leaves. Assam type of tea is susceptible. Nymph and adult are microscopic orange coloured mite and its body is carrot shaped with two pairs of legs.

e. Yellow mite: The damage is restricted to top two to three leaves and the bud. Leaves become rough and brittle. Corky line or patches appear on the lamina Inter node gets shortened, stunted and deformed. Mites are pale yellow in colour. Male is shorter than female with tapering abdomen and a sucker. Fourth pair of legs is provided with a curved tooth and a pair of whips. They carry female on their back. Female is bigger than male with two pairs of whips.

f. Thrips: Opened leaves show a parallel brown streaks on either side of midrib. Leaf surface becomes uneven. Nymph is creamy white and adult is with fringed wings and brown abdomen.

g. Tea mosquito bug: Brownish patches are seen in the tender shoots, buds and stem. Curling of leaves and drying of shoots are caused due to severe attack. Adult is black and red elongated insect with long legs and a dorsal process on the scutellum.

h. Scale: There are many hemispherical brown scales seen along the midrib and tender stem followed by sooty mould on lower leaves. Vegetative propagated clones are susceptible. Nymph is white, adult is winged and female is sedentary.

i. Tea jassid: The symptoms of damage include yellowing, marginal browning and cupping of leaves. Severity is more in North Eastern India. Nymph and adult are green coloured and wedge shaped.

j. Tea aphid: Dark brown colonies of aphids infest tender shoots and suck sap causing leaf curl and stunted shoot growth.

3. Borers:

a. Shoot hole borer: Grubs and adults make round shot holes in primary branches, which result in the mortality of buds and die-back symptoms in branches. Circular or longitudinal tunnels are seen inside the stem. Adult male is wingless and female is winged.

b. Red borer: The larvae cause wilting of branches or plant. Bore holes often are plugged with excreta at the base of the plant. Larva is orange red and smooth, Adult is with dirty white bands and black or steel blue spots on the wings.

c. Hepialid stem borer/Sapling borer: The larvae leave chewed tissue at the collar region. The tunnel mouth is covered by a thick mat of bark, wood and frass particles held together by silk, Sapling break-off at the point of injury. The larva is pale yellow in colour, pencil thick, 6-10 cm long and larval duration is around 10 months.

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Preparation of Jams, Jellies and Marmalades

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Preparation of Jams

Jam is a product made by boiling fruit pulp with sufficient quantity of sugar to a reasonably thick consistency, firm enough to hold the fruit tissues in position. Apply, sapota, papaya, plums, mango, grapes, jack, pineapple, banana, guava and pears are used for preparation of jam. It can be prepared from one kind of fruit or from two or more kinds. In its preparation about 45% of fruit pulp should be used for every 55% of sugar. The FPO specification of jam is 68.5% TSS, 45% of fruit pulp and 0.5-0.6% of acid (citric acid) per 100 gm of the prepared product.

1. Selection and preparation of fruit: Select good quality ripe fruits. Wash the fruits well in cold water. Peel the fruits and remove the stones and corers present. Cut the peeled fruit into small pieces with a stainless-steel knife. If the fruit is hard, it should be cut into very small pieces. Pulp the fruits by using pulper.

2. Addition of sugar and acid.

3. Cooking: Cook the mixture slowly with occasional stirring. The fruit pulp should be crushed with a ladle during cooking. Continue cooking till the temperature of the mass reaches 105.5°C.

Sheet (or) Flake Test

A small portion of jam is taken out during boiling in a spoon or wooden ladle and cooled slightly. It is then allowed to drop. If the product falls off in the form of a sheet (or) flakes instead of flowing in a continuous stream (or) syrup, it means that the end point has been reached and the product is ready. Otherwise boiling is continued till the sheet test is positive.

Packaging

Fill the hot jam into clean dry sterilized jars. Allow the jam to cool and fix the sterilized lid to the jar. Store in a cool place.

Process 1

Ripe firm fruits → Washing → Peeling →Pulping (Remove seed and core) → Addition of sugar and acid → Boiling (with continuous stirring) → Judging of end point by further cooking up to 105oC (or) 68% TSS (or) by sheet test → Filling hot into sterilized bottles → cooling → Sterilized bootles → cooling → Waxing → Capping → Storage (at ambient temperature). ning fruit extract, free from pulp, after the addition of sugar and acid. A perfect jelly should be transparent, well set but not too stiff, and should have the original flavour of the fruit. It should be of attractive colour and keep its shape when removed from the mould. It should be firm enough to retain a sharp edge but tender enough when it is pressed. It should not be gummy, sticky or syrupy or have crystallized sugar. The product should be free from dullness with little (or) no syneresis (weeping) and neither tough nor rubbery. The FPO specification for jelly is the final product should have 65% solids, 45% fruit extract and 0.5-0.75% acid.

Guava, sour apple, plum, karonda, wood apple, papaya and jack fruit are rich in pectin and generally used for preparation of jelly. Pineapple, strawberry grapes etc. can be used but only after addition of pectin powder, because these fruits have low pectin content. Preparation of jelly is similar to that of jam.

Process 2

Fruit (Firm, not over ripe) → Washing → Cutting into thin slices → Boiling with water (1 ½ times the weight of fruits for about 20-30 min) → Addition of citric acid during boiling (2 g per kg of fruit) → Straining of extract → Pectin test (for addition of sugar) → Addition of sugar → Boiling → Judging of end point (sheet

/ drop / temp test) → Removal of scum (or) foam (one teaspoonful of edible oil added for 45 kg sugar) → Addition of colour and remaining citric acid → Filling hot into clean sterilized bottles → Waxing (paraffin wax) → Capping → Storage at ambient temperature.

Important Considerations in Jelly Making

Pectin, acid, sugar (65%) and water are the four essential ingredients. Pectin test and determination of end point of jelly formation is very important for the quality of jelly.

Preparation of Marmalade

This is a fruit jelly in which slices of the fruit (or) its peel is suspended. The term is generally used for products made from citrus fruits like oranges and lemons in which shredded peel is used as the suspended material. Citrus marmalades are classified into:
1. Jelly marmalade.
2. Jam marmalade. The FPO specifications for marmalade are TSS- 65% and fruit juice - 45% of the prepared product.

Ingredients

1. Pectin extract - 1 litre.
2. Sugar - 750 gm.
3. Shredded peel - 62 gm.
4. It prepared from the clarified pectin extract.

Process

Ripe fruits → Washing → Peeling outer yellow portion (Flavedo) thinly → Cutting yellow portion into fine shreds (1.9 - 2.5 cm long and 0.8 – 0.12 cm thick) -0.45 cm Cutting of 0.3 thick slices of peeled fruit (or) crushing into pulp in a greater → Boiling (in 2-3 times its weight of H2O for 40-60 min.) Straining the extract t) → Addition Testing for pectin content of sugar (as required) Cooking to 103-105oC (Continuous stirring) Addition of shreds (shredded peel boiled for 10 to 15 min. in several changes of water for softening and removing bitterness and added @ about 62 g per kg of extract) Boiling till (continuous stirring) -88oC Testing for end point with continuous stirring) Flavouring Storage at ambient temperature.

Jam Marmalade

The method of preparation is practically the same as that for jelly marmalade. In this case the pectin extract of fruit is not clarified and the whole pulp is used. Sugar is added according to the weight of fruit, generally in the proportion of 11. The pulp – sugar mixture is cooked till the TSS content reaches 65%.

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Preparation of Chutneys, Pickles

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Preparation of Chutneys, Pickles

A good quality chutney should be palatable and appetizing. Mango chutney is an important food product exported from India to many countries. Apple and apricot chutneys are also very popular in the country. The method of preparation of chutney is similar to that for jam except that spices, vinegar and salt are added. The fruits / vegetables are peeled, sliced or grated or cut into small pieces and cooked in water until they become sufficiently soft. The quality of chutney depends to a large extent on its cooking which should be done for a long time at a temperature below the boiling point. To ensure proper thickening, cooking is done without a lid even though this results in some loss of volatile oils from the spices. Chopped onion and garlic are added at the start to mellow their strong flavours. Spices are coarsely powdered before adding. Vinegar extract of spices may be used instead of whole spices. Spices and vinegar are added just before the final stage of cooking, because prolonged boiling causes loss of some of the essential oils of spices and of vinegar by volatilization. In mango and apricot sweet chutneys, where vinegar is used in large quantity, the amount of sugar added may be reduced, because vinegar itself acts as a preservative. These chutneys are cooked to the consistency of jam to avoid fermentation.

Sweet Mango Chutney

1. Recipe: Mango slices (or) shreds – 1.0 kg, sugar (or) gur – 1.0 kg, salt – 45 g, onions (chopped) – 50 g, garlic (chopped)-15 g , ginger (chopped) – 15 g, red chilli powder – 10 g, black pepper, cardamom, cinnamon, cumin – 10 g each, cloves – 5 nos. and vinegar – 170 ml.

2. Process: Mature mangoes → washing → Peeling →Grating (or) slicing → cooking with a little water to make highly soft → Mixing with sugar and salt and leaving for an hour → Keeping all ingredients (except vinegar) in cloth bag, tied loosely, putting in mixture and cooking on low flame →During cooking, spice bag pressed occasionally \ Cooking to cons is tency of jam (up to 105oC) with stirring occasionally → Removal of spice bag after squeezing → Addition of vinegar → Cooking for 2-5 min. → Filling hot into bottles → Sealing (airtight) → Storage at ambient temperature.

Preparation of Pickles

The preservation of food in common salt (or) in vinegar is known as pickling. It is one of the most ancient methods of preserving fruits and vegetables. Pickles are good appetizers and add to the palatability of a meal. They stimulate the flow of gastric juice and thus helps in.

Preservation by Salt (NaCl2)

Sodium chloride is an indispensable component of food. At lower concentrations it contributes significantly to the flavour. At higher concentrations it exhibits an important bacteriostatic action. Salt is easily available and not expensive.

Pickling Process

Pickling is done in two stages (1) By curing (or) fermentation with dry salting (or) fermentation in brine (or) salting without fermentation (2) By finishing and packing. Pickling is the result of fermentation by lactic acid forming bacterial which are generally present in large numbers on the surface of fresh vegetables and fruits. Theses bacteria can grow in acid medium and in the presence of 8-10% salt solution whereas the growth of a majority of undesirable organisms is inhibited. Lactic acid bacteria are most active at 30oC, so this temperature must be maintained as far as possible in the early stage of pickle making. When vegetables are placed in brine, it penetrates into the tissues of the farmers and soluble material present in them diffuses into the brine by osmosis. The soluble material includes fermentable sugars and minerals.

The sugars serve as food for lactic acid bacteria which convert them into lactic acid and other acids. The acid brine thus formed acts upon vegetables tissues to produce the characteristics taste and aroma of pickle. There are two methods for pickling:

1. Dry salting method: Alternate layers of vegetables and salt (20-30 gm of dry salt/kg vegetables) are kept in a vessel which is covered with a cloth and a wooden board and allowed to stand for about 24 hrs. During this period, due to osmosis, sufficient juice comes out from the vegetables to form brine. The amount of brine required is usually equal to half the volume of vegetables. Brining is the most important step in pickling. The growth of a majority of spoilage organisms is inhibited by brine containing 15% salt. Lactic acid bacteria, which are salt tolerant can thrive in brine of 8- 10% strength though fermentation takes place fairly well even in 5% brine. In a brine containing 10% salt, fermentation proceeds somewhat slowly. Fermentation takes place to some extent up to 15% but stops at 20% strength. It is therefore, advisable to place the vegetables in 10% salt solution for vigorous lactic acid fermentation. As soon as the brine is formed, the fermentation process starts and Co2 begins to evolve. The salt content is now increased gradually, so that by the time the pickle is ready, salt concentration reaches 15%. When fermentation is over, gas formation ceases. Under favourable conditions fermentation is completed in7-10 days. When sufficient lactic acid has been formed, lactic acid bacteria cease to grow and no further change takes place in the vegetables. However, precautions should be taken against spoilage by aerobic microorganisms, because in the presence of air, pickle sum is formed which brings about putrefaction and destroys the lactic acid. Properly brined vegetables keep well in vinegar for a long time.

2. Fermentation in brine: Steeping of the vegetable in a salt solution of pre-determined concentration for a certain length of time is called brining. This type of treatment is adopted in the case of cucumbers and similar vegetables which do not contain sufficient juice to form brine with dry salt. Brine can be prepared by dissolving in common salt in water and filtering it through the cloth to remove insoluble impurities. The remaining process is similar to that of dry salting method.

Raw Materials Used in Pickling

1. Salt: Free from impurities, and salts such as lime (CaO), iron (blackening), magnesium (results bitter taste) and carbonates (makes the pickle soft in texture).

2. Vinegar: Vinegar of good quality should contain at least 4% acetic acid. Synthetic vinegar (or) low quality vinegar is not suitable for pickle preparations. Usually malt (or) cider vinegar is used. In order to ensure good keeping quality pickle, the final concentration of acetic acid in the

pickle should not be less than 2%. Acetic acid (commercial) is also used because it is highly concentrated.

3. Sugar: Used in the preparation of sweet pickles should be of high quality.

4. Spices: Spices are added practically to all pickles, the quantity added depending upon the kind of fruit (or) vegetable taken and the kind of flavour desired. The spices generally used are bay leaves, cardamom, chillies, cinnamon, clove, coriander, dill herb, ginger, mace, mustard, black pepper, cumin, turmeric, garlic, mint, fenugreek, asafoetida etc.

5. Water: Only potable water should be used for the preparation of brine. Hard water contains salts of Ca, Na, Mg etc., which interfere with the normal salt curing of the vegetable. If hard water is to be used, a small quantity of vinegar should also be added to the brine the neutralize its alkalinity. Iron should not be present in the water in any appreciable quantity as it causes the blackening of the pickle.

6. Cooking utensils: Metallic vessels should be non-corrodiable. Vessels made of iron (or) copper are not suitable. Glass -lined vessels, and stainless-steel vessels are preferred. The ladles, spoons and measuring vessels should also be masde on non-corrodible materials. At present, pickles are prepared with salt, vinegar, oil (or) with a mixture of salt, oil, spices and vinegar. These methods are discussed below.

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Preparation of Sauces / Ketchups

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Preparation of Sauces / Ketchups

There is no essential difference between sauce and ketchup. However, sauces are generally thinner and contain more total solids than ketchups. Tomato, apple, papaya, walnut, soybean etc. are used for making sauces. The FPO specifications of sauces are TSS – 25% and acidity – 1%.

Sauces are of two kinds:
1. Thin sauces of low viscosity consistency mainly of vinegar extract of flavouring materials like herbs and spices.
2. Thick sauces that are highly viscous. Sauces / ketchups are prepared from more or less the same ingredients and in the same manner as chutney, except that the fruit or vegetable pulp or juice used in sieved after cooking to remove the skin, seeds and stalks of fruits.

Vegetables and spices and to give a smooth consistency to the final product. However, cooking takes longer because fine pulp (or) juice is used. Some sauces develop a characteristic flavour and aroma on storing in wooden barrels. Freshly prepared products often have a raw and harsh taste and have, therefore, to be matured by storage. High quality sauces, are prepared by maceration of spices herbs, fruits and vegetables in cold vinegar or by boiling them in vinegar. Thickening agents are also added to the sauce to prevent sedimentation of solid particles. Apple pulp is commonly used for this purpose in India but starch from potato, maize, arrow root (cassava) and sago are also used. A fruit sauce should be cooked to such a consistency that it can be freely poured without the fruit tissues separating out in the bottle. The colour of the sauce should be bright. Sauces usually thicken slightly on cooling. By using a funnel hot ketchup is filled in bottles leaving a 2 cm head space at the top and the bottles are sealed or corked at once. The necks of the bottles when cold, are dipped in paraffin wax for airtight sealing.

Apple Sauce

1. Recipe: Apple – 1.0 kg, sugar – 250 g, salt – 10 g, onion (chopped) – 200 g, ginger (chopped) – 100 g, garlic (chopped) - 50 g, red chilli powder – 10 g, cloves – 5 Nos. cinnamon, cardamom – 15 g (each), vinegar – 50 ml, sodium benzoate – 0.7 g/kg of finished product.

2. Process: Apples → Washing → Peeling → Removal of core and seeds → Making into fine pulp → Straining of pulp → Cooking pulp with one third quantity of sugar → Putting spice bag in pulp and processing occasionally → Cooking to one - third of original volume of pulp → Removal of spice bag (after squeezing in pulp) →Adding remaining sugar and salt → Cooking to one – third its original volume → Addition of vinegar and preservative → Filling hot into bottles → Crown corking → Pasteurization at 85-90oC for 30 min. → Cooling → Storage at ambient temperature.

Preparation of Puree and Paste

Tomato pulp without skin or seeds, with or without added salt, and containing not less than 9.0% of salt free tomato solids, is known as medium tomato puree'. It can be concentrated further to heavy tomato puree which contains not less than 12.0% solids. If this is further concentrated so that it contains not less than 25% tomato solids, it is known as tomato paste, on further concentration to 33% or more of solids it is called concentrated tomato paste. Tomato pulp is prepared from ripe tomatoes in the same manner as tomato juice. Cooking for concentration of the pulp can be done either in an open cooker or a vacuum pan. In the former most of the vitamins are destroyed and the product become brown. On the other hand, use of vacuum pans, which are extensive, help to preserve the nutrients, and also reduce the browning to a great extent. In vacuum pans the juice is boiled at about 71oC only. While cooking in an open cooker, a little butter or edible oil is added to prevent foaming, burning and sticking. After cooking, the total solids content of the juice is higher than required, more juice is endpoint of cooking puree and paste can be determined either with a hand refractometer or by measuring the volume.

Process

Tomato juice (strained) → Cooking to desired consistency (open cooker / vacuum pan) → Judging of endpoint for puree (or) paste → Filling hot into bottles or cans (82-88o C) → Sterilization in boiling water for 20 min. →Cooling → Storage at ambient temperature.

Preparation of Syrup

This type of fruit beverage contains 25% fruit juice (or) pulp, 65% TSS, 1.3 to 1.5% acidity and 350 ppm of So2 or 600 ppm of KMS. It is diluted before serving, Fruits like aonla, jamun, pomegrante, grape, lemon, orange and sometimes ginger can be used for the preparation of syrup. It is also prepared from extracts of rose, sandal almond etc.

Synthetic Syrups

Heavy sugar syrup of 70-75 per cent strength is used as the base of all synthetic syrups and they are flavoured and coloured with artificial essence/flavours and colours. They never contain fruit pulp/juice. A large proportion of these syrups can, however, be replaced by real fruit juices, squashes and syrups which are more nutritious. Large quantities of synthetic syrups (orange, lemon, pineapple, strawberry) are manufactured and sold in various countries. These can be prepared by using 1.5 kg of sugar, 500 ml of H2O and 15 g of citric acid. Different colours and flavours are added as required. Among colours, orange red, lemon yellow, green, raspberry red etc. are mostly used, while artificial essence/flavours of rose, orange, pineapple, strawberry, lemon etc. are added as flavouring substances.

Preparation of Fruit Juices

1. Selection of fruit: All fruits are not suitable because of difficulties in extracting the juice or because the juice is of poor quality. The variety and maturity of the fruit and locality of cultivation influence the flavour and keeping quality of its juice. Only fully ripe fruits are selected. Over ripe and green fruits, if used, adversely affect the quality of the juice.

2. Sorting and washing: Diseased, damaged (or) decayed fruits are rejected or trimmed. Dirt and spray residues of arsenic, lead etc., are removed by washing with water or dilute hydrochloric acid (1-part acid 20 parts water).

3. Juice extraction: Generally, juice is extracted from fresh fruit by crushing and pressing them. Screw type juice extractors, basket presses or fruit pulpers are mostly used. The method of extraction differs from fruit to fruit because of differences in their structure and composition. Before pressing, most fruits are crushed to facilitate the extraction. Some require heat processing for breaking up the juice – containing tissues. In case of citrus fruits, the fruit is cut into halves, and the juice extracted by light pressure in a juice extractor or by pressing the halves in a small wooden juice extraction. Care should be taken to remove the rind of citrus fruits completely otherwise it makes the juice bitter. Finally, the juice is strained through a thick cloth or a sieve to remove seeds. All equipment's used in the preparation of fruit juices and squashes should be rust and acid proof. Copper and iron vessels should be strictly avoided as these metals react with fruit acids and cause blackening of the product. Machines and equipment's made of aluminium, stainless steel etc. can be used. Extracted juices should not be unnecessarily exposed to air as it will spoil the colour, taste and aroma and also reduce the vitamin content.

4. Deaeration: Fruit juices contain some air, most of which is present on the surface of the juice and some is dissolved in it. Most of the air as well as other gases are removed by subjecting the fresh juice to a high vacuum. This process is called deaeration and the equipment used for the purpose is called a deaerator. Being a very expensive method, it is not used in India at present.

5. Straining (or) Filtration: Fruit juices always contain varying amounts of suspended matter consisting of broken fruit tissue, seed, skin, gums, pectic substances and protein in colloidal suspension. Seeds and pieces of pulp and skin which adversely affect the quality of juice, are removed by straining through a thick cloth or sieve. Removal of all suspended matter improves the appearance but often results in disappearance of fruity character and flavour. The present practice is to let fruit juices and beverages retain a cloudy or pulpy appearance to some extent. In case of grape juice, apple juice and lime juice cordial however, a brilliantly clear appearance is preferred.

6. Clarification: Complete removal of all suspended material from juice, as inlime juice cordial, is known as clarification which is closely related to the quality, appearance and flavour of the juice.
The following methods of clarification are used:

a. Settling.
b. Filtration.
c. Freezing.
d. Cold storage.
e. High temperature.
f. Chemicals such as gelatin, albumen, casein, mixture of tannin and gelatin.
g. Enzymes such as pectinol and filtragol.

7. Addition of sugar: All juices are sweetened by adding sugar, except those of grape and apple. Sugar also acts as preservative for the flavour and colour and prolongs the keeping quality. Sugar based products can be divided into 3 groups on the basis of sugar content.

a. Low sugar – 30 per cent sugar or below.
b. Medium sugar – sugar above 30 and below 50%.
c. High sugar – 50% sugar and above.

Sugar can be added directly to the juice or as a syrup made by dissolving it in hot water, clarifying by addition of a small quantity of citric acid or a few drops of lime juice and filtering.

8. Fortification: Juices, squashes, syrups etc. are sometimes fortified with vitamins to enhance their nutritive value, to improve taste, texture or colour and to replace nutrients lost in processing. Usually ascorbic acid and Beta-carotene (water – soluble form) are added at the rate of 250-500 mg and 7-10 mg per litre, respectively. Ascorbic acid acts as an antioxidant and beta-carotene
imparts an attractive orange colour. For a balanced taste some acids are added. Citric acid is often used for all types of beverages and phosphoric acid for cola type of drinks.

9. Preservation: Fruit juices, RTS and nectars are preserved by pasteurization but sometimes chemical preservatives are used. Squashes, crushes and cordials are preserved only by adding chemicals. In the case of syrup, the sugar concentration is sufficient to prevent spoilage. Fruit juice concentrates are preserved by heating, freezing or adding chemicals.

10. Preservation by Bottling: Bottles are thoroughly washed with hot water and filled leaving 1.5-2.5 cm headspace. They are then sealed either with crown corks (by crown corking machine) or with caps (by capping machine).

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Preparation of Candied Fruits / Vegetables

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Preparation of Candied Fruits / Vegetables

A fruit /vegetable impregnated with cane sugar (or) glucose syrup and subsequently drained free of syrup and dried is known as candied fruit / vegetable. The most suitable fruits for candying are amla, kranda, pineapple, cherry, papaya, apple, peels of orange, lemon, grape fruit and ginger etc. The FPO specifications for candied fruits are TSS -75%, total sugar-70% and reducing sugar-25%. The process for making candied fruit is practically similar to that for preserves. The only difference is that the fruit impregnated with syrup having a higher percentage of sugar – 75obx.The syrup left over from the candying process can be used for candying another batch of the same kind of fruit after suitable dilution, for sweetening chutneys, sauces and pickles and vinegar making.

Preparation of Crystallized Fruits / Vegetables

Candied fruits /vegetables coated with crystals of sugar, either by rolling in finely powdered sugar or by allowing sugar crystals from dense syrup to deposit on them are called crystallized fruit / vegetable. The candied fruits are placed on a wire mesh tray which is placed in a deep vessel. Cooled syrup (70% TSS) is gently poured over the fruit so as to cover it entirely. The whole mass is left undisturbed for 12-18 hrs during which a thin coating of crystallized sugar is formed. The tray is then taken out carefully from the vessel and the surplus syrup dried off. The fruits are then placed in a single layer on wire mesh trays and drained at room temperature or at about 49oC in driers.

Preparation of Glazed Fruits / Vegetables

Covering of candied fruits / vegetables with a thin transparent coating of sugar, which imparts them a glossy appearance is known as glazing. Cane sugar and water (21 by weight) are boiled in a steam pan at 113-114oC and the scum is removed as it comes up. Thereafter the syrup is cooled to 93°C and rubbed with a wooden ladle on the side of the pan when granulated sugar is obtained. Dried candied fruits are passed through this granulated portion of the sugar solution, one by one, by means of fork and then placed on trays in a warm dry room. They may also be dried in a drier at 49°C fir 2-3 hrs when they become crisp, they are packed in airtight containers for storage.

Preparation of Preserves

A mature fruit / vegetable (or) its pieces impregnated with heavy sugar syrup till it becomes tender and transparent is known as preserve. Aonla, apple, pear, mango, cherry, karonda, strawberry, pineapple, papaya, carrot etc. can be used for making preserves. FPO specifications for preserve is TSS 68obx and fruit pulp - 55%.

General Considerations

Cooking of fruit directly in syrup causes shrinking of fruit and reduces absorption of sugar. Therefore, the fruit should be blanched first to make it soft enough to absorb water, before steeping in syrup. However, highly juicy fruits may be cooked directly. Fruits may be cooked in syrup by three processes as given below:

1. Rapid process: Fruits are cooked in low sugar syrup. Boiling is continued with gentle heating until the syrup becomes sufficiently thick. Soft fruits such as strawberries, grapes which require very little boiling for softening. Unlike hard fruits like apples, pears and peaches, which require prolonged heating. Rapid boiling should, however be avoided as it makes the fruit tough, especially when heating is done in a large shallow pan with only a small quantity of syrup. The final concentration of sugar should not be less than 68% which corresponds to a boiling point of 106oC. This is a simple and cheap process but the flavour and colour of the product are lost considerably during boiling.

2. Slow process: The fruit is blanched until it becomes soft. Sugar, equal to the weight of fruit, is then added to the fruit in alternate layers and the mixture allowed to stand for 24 hrs. During this period, the fruit gives out water and the sugar goes into solution, resulting in a syrup containing 37-38% TSS. Next day, the syrup is boiled after removal of fruits to raise its strength to about 60% TSS. A small quantity of citric acid (1 to 1.5 g/kg sugar) is also added to invest a portion of the cane sugar and thus prevent crystallization. The whole mass is then boiled for 4-5 min. and kept for 24 hrs. On the third day, the strength of syrup is raised to about 65% TSS by boiling. The fruit is then left in the syrup for a day. Finally, the strength of the syrup is raised to 70% TSS and the fruits are left in it for a week. The preserve is now ready and is packed in containers. This method is usually practiced.

3. Vacuum process: The fruit is first softened by boiling and then placed in the syrup which should have 30- 35% TSS. The fruit-syrup blend is then transferred to a vacuum pan and concentrate under reduced pressure to 70% TSS. Preserves made by this process retain the flavour and colour of the fruit better than by the other two methods. In all these processes, the fruit is kept covered with syrup during cooking as well as afterwards otherwise it will dry up and the quality of the product would be affected. The product should be cooled quickly after the final boiling to prevent discolouration during storage. The fruits are drained free of syrup and filled in dry containers or glass jars. Freshly prepared boiling syrup containing 68% TSS is then poured into the jars /containers which are then sealed airtight. In the commercial scale production, however, it is better to sterilize the cans to eliminate any possibility of spoilage of product during storage.

Process

Mature fruits → Washing → Preparation of fruit for sugar treatment → Keeping fruit and sugar in alternate layers (1.0 kg Fruit: 1 kg Sugar) (or) steeping fruit in syrup of 40% TSS for a day → Removal of fruit → Increasing consistency of syrup to 60% TSS by boiling S teeping of fruit for a day →Repeating the process and raising strength of syrup by 5% TSS to 70% on alternate days – Steeping in 70% TSS for a week → Preserve – Draining – Filling in jar (or) container → Covering fruit with freshly prepared sugar syrup of 68% TSS Sealing (airtight) – Storage.

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Pests of Brinjal, Tomato and Cucurbits

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Pests of Brinjal

1. Borers:

a. Shoot and fruit borer: General symptoms of damage are withered terminal shoots, bore holes on shoots plugged with excreta, shedding of flower buds, drying of leaves due to boring on petioles by larvae. Larva is pink in colour. Adult is medium sized moth with fore wings having black and brown patches and dots. Hind wings are opalescent with black dots.

b. Stem borer: Stunted growth, withering and wilting of plants. Bore holes on stem and leaf axils are covered with excreta; Infestation caused by larva. Larva is yellowish or light brown with red head. Moth greyish brown, forewings with transverse lines and white hindwings.

c. Bud worm: Larva causes shrivelling and shedding of flower buds. It is pale whitish with pink tinge. Adult moth is small with fringed wings.

2. Leaf feeders:

a. Spotted beetle (or) Hadda beetle: Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in colour and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytra.

b. Leaf roller: Leaves are folded from tip to downwards followed by withering and drying up of leaves. Purple brown larva is ornamented with yellow spots and hairs. Adult is with brown fore wings and an olive-green triangular patch on outer area.

c. Ash weevils: Adults cause notching of leaf margins. Grubs feed on roots resulting in wilting of plants. Grub is small and apodous. Adults are greenish white with dark lines on elytra or brownish weevil or brown with white spot on elytra or small and light green in colour.

3. Sap feeders or Leafhopper: Symptom of damage is yellowing of leaves followed by crinkling and downward curling leading to bronzing and hopper burn. Nymph is light green and translucent. Adult is green in colour.

4. Aphid: Curling and crinkling of leaves, stunted plants with honeydew secretion and sooty mould are the symptoms of damage. Large number of aphids are seen on tender/apical shoots. Nymph is greenish brown or yellow in colour. Adult is yellowish green to dark green in posterior side.

5.Root feeders:

Termites: *Trinervitermes biformis, Microtermes* spp: Nymphs and adults gnaw the roots below the ground level, tunnel upwards through the stems and eat inner tissues. The affected plants wither and dry especially in light soils.

Pests of Tomato

1.Borer Fruit Borer: Young larva feeds on tender foliage and from fourth instar onwards infests fruits. They make circular holes and thrust only a part of their body inside fruit and eat inner contents.(Fig. 69) Young larva is yellowish white but gradually becomes green. Full-grown larva is apple green in colour with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

Stem borer: Stunted growth, withering and wilting of plants, stem and leaf axils covered with excreta covering boreholes are symptoms of infestation caused by the larvae. Larva is yellowish or light brown with red head. Moth is with greyish brown fore wings having transverse lines and white hind wings.

2. Leaf Feeder:

a. Leaf miner: Leaves are often with serpentine mines followed by drying and dropping of leaves due to infestation. Larva is orange yellowish and apodous. Adult is pale yellow fly.

b. Tobacco caterpillar: Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown fore wings and white hind wings with a brown patch along its margin.

c. Green semi looper: Leaves are with holes and skeletonisation and defoliation represent severe damage. Larva is slender, attenuated anteriorly and green in colour with light wavy lines and a broad lateral stripe on either side. Adult is stout moth. Head and thorax are grey in colour. Abdomen is white with basal tufts ferruginous and grey wavy forewings with a slender Y– mark.

d. Spotted beetles: Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in colour and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytra.

3. Sap Feeders:

a. Green peach aphid: Leaves get curled and crinkled coated with honey dew and sooty mould. Plants remain stunted. Nymphs occur in different colour forms viz., yellow, green and red. Yellow forms are dominant. Both winged and wingless adults are common.

b. Fruit sucking moth: Adult sucks the juice by piercing the fruits. Infested fruits will shrink, shrivel, rot and ultimately drop down. Semi looper is with orange blue and yellow spots on its velvety dark speckled body. Stout built moth is with grey and orange coloured wings. Forewing are Gray with white patches and a tripod black mark in the centre of each. Hind wings are yellow bearing black patches on the outer margin and curved patch in the middle. The larvae feeds on the leaves of the creeper weed *Tinospora vordifolia*.

Pests of Bhendi

1. Borers:

a. Stem weevil: The grub causes gall like swellings on the stem near the base. Grub is white and apodous. Adults feed on leaves, buds and tender terminal shoots. Grub is creamy yellow and apodous. Adult is dark greyish brown with pale cross bands on elytra.

b. Shoot weevil: Grubs bore into stem and petioles causing gall like swellings. Adults feed on leaves, buds and tender terminal shoots. Grub is creamy yellow and apodous. Adult is dark greyish brown with pale cross bands on elytra.

c. Shoot and fruit borer: Symptom of attack is withering and drying of tender shoots in the early stage. Larva bores into flowers and flower buds causing withering and dropping of the same. Fruits with bore holes are seen often and sometimes deformed. Larva is stout , spindle shaped, dark brown in colour and with white patches on the dorsum. *Earias vitella*: small buff coloured. Forewings with a wedge-shaped green patch in the middle. *E. insulana*: entire forewing is green.

d. Stem fly: The maggot bores into tender shoots and petiole of leaves resulting in drying of leaves and seedlings. Maggot is yellow in colour. Adult is a small black fly.

e. Fruit borer: Young larva feeds on tender foliage and from fourth instar onwards attack fruits. They bore circular holes and thrust only a part of their body inside fruit and eat inner contents. Freshly hatched larva is yellowish white but gradually become green. Full-grown larva is apple green in colour with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

2. Leaf Feeders:

a. Leaf roller: Young larvae feed on the epidermis, roll the leaves, feed within and eat away the rolled portions. Larva is bright green with dark head and prothoracic shield. Moth is with yellowish fore and hindwings with brown lines and distinct markings.

b. Semilooper: The caterpillar completely feeds on the leaves (defoliation). *Anomis flava*: Larva is green in colour with 5 white longitudinal lines. Adult is brown and medium sized moth. Acontia

(=Xanthodes) graellsii: Larva is green in colour with horse-shoe-shaped black markings on each segment. Moth is yellowish with black markings all over the wings. *Tarache nitidula*: Larva is green in colour and resembles bird's droppings. Adult is white with grey markings.

c. Tobacco caterpillar: Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the sub-marginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings are having a brown patch along its margin.

Pests of Cucurbits

1. Fruit flies: The maggots feed on the pulp of the fruits and the symptoms of damage include oozing of resinous fluid from fruits, distorted and malformed fruits premature dropping of fruits and unit for consumption. Maggot is white and apodous. Adult is with hyaline wings or brownish body with brown oval spot on either side of 3rd tergite.

2. Snake gourd stem weevil: Grub bores into the stem/petiole and causes withering of leaves. Adult is small black weevil and feeds on leaves.

3. Stem gall fly: Maggot bores inside the distal shoot and induces galls. Adult is slender and dark brown mosquito like fly.

4. Stem borer: Larva bores into the stem of snake-gourd and produces gall. Adult is dark brown moth with transparent wings.

5. Leaf miner: Leaves are often with serpentine mines followed by drying and dropping of leaves due to infestation. Larva is orange yellowish and apodous. Adult is pale yellow fly.

6. Snake gourd semilooper: Larva cuts the edges of leaf lamina, folds it over the leaf and feeds from within the leaf roll. Larva is whitish green and the body is with black warts, off-white longitudinal stripes and a hump on its anal segment. Stout dark brown adult has shiny brown forewings.

7. Pumpkin caterpillar: The caterpillars lacerate and feed on chlorophyll of foliage; later fold and web the leaves together and feed within. They may also damage ovaries of flowers and boring into young developing fruits. Larva is elongate, bright green with two narrow longitudinal stripes dorsally. Adults are medium sized; wings are white and transparent with broad brown margin. Female has tuft of orange hairs at the anal end.

8. Pumpkin beetle: Grubs feed on the roots, stem and fruits that spread over the soil. Adults feed on leaf and flower. Grub is creamy yellow. Adult is grey black with black or blue colour with glistening yellow red border.

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Pests of Crucifers, Moringa and Tuber Crops

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Pests of Crucifers

1. Leaf Feeders:

a. Diamond back moth: Young caterpillars because small yellow mines followed by scrapping of epidermal leaf tissues producing typical whitish patches. Full-grown larvae bite holes in the leaves. Larva is pale yellowish green in colour, pointed at both ends with fine erect black hairs scattered over the body. Adult is small, green brown with pale whitish narrow wings. At rest a dorsal median patch of 3 diamonds shaped yellowish white spots are clearly visible by joining both forewings. Hindwings have a fringe of long fine hairs.

b. Cabbage borer: Larvae web the leaves and bore into the stem, stalk or leaf veins. Larva is pale whitish brown with 4-5 purplish brown longitudinal lines. Adult is pale greyish brown with 4-5 purplish brown longitudinal lines. Adult is pale greyish brown moth with forewings having grey wavy lines. Hindwings are pale dusty.

c. Leaf webber: Young larvae feed gregariously on leaves, later web together the leaves and feed. Larva is with red head, brown longitudinal stripes and rows of tubercles with short hairs on its pale violaceous body. Adult is small with brown forewings having distinct wavy spots. Hindwings are semi-hyaline.

d. Cabbage semilooper: Damaged leaves are with holes initially and the severe damage is represented by skeletonization. Larva is green colour with light wavy lines and broad lateral stripes on either side. Adult is stout moth. Head and thorax are grey in colour and the abdomen is white with basal tufts. Head and thorax are grey in colour and the abdomen is white with basal tufts. Grey wavy forewings are with a slender „y‟ mark.

e. Cabbage butterflies: The caterpillar feeds on leafy vegetation irregularly (defoliation). Sometimes bores into the heads of cabbage. Larva is velvety bluish green in colour with yellow dorsal and lateral stripes are covered with black hair. Adult is with snow white forewings and black apical spots; hind wings are pure white.

f. Tobacco caterpillar: The caterpillar damages leaves and heads of Cabbage, Cauliflower, Radish and Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the sub marginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings with a brown patch along its margin.

g. Mustard sawfly: Caterpillar like grubs nibble the tender margins of tender leaves and later bite holes on the leaves. Adult is with dark head and thorax, orange coloured abdomen and smoky wings with black veins. Female has a strong saw-like ovipositor.

2. Sap Feeders:

a. Thrips: Nymphs and adults suck the sap from leaves. Nymph is pale yellow and the adult has fringed wings.

b. Mustard aphid: Nymphs and adults suck the sap from the under surface of the leaves. Nymph is light yellowish green and adult is darker than nymph.

c. Cabbage aphid: Nymphs and adults cause crinkling and cupping of distorted primordia. White cast skins are present at the base of the plant. Adult is yellowish green with wavy white filament over the body.

d. Painted bug: Nymphs and adults desap the leaves, shoots and pods. Adults are small black bugs with red and yellow lines.

Pests of Moringa

1. Moringa Bud worm: Larvae bore into flower buds and causes shedding. Larva is dirty brown with mid-dorsal stripe and black head with prothoracic shield. Adult is small with dark brown forewings and white hindwings with a brown border.

2. Bud midge: Feeds on internal content of flower bud and causes shedding. Adult is small brownish fly.

3. Leaf caterpillar: Larva remains in a silken web in the undersurface of leaf and feeds on the leaflets reducing them into papery leaf. Larva is with brown head and without prothoracic shield. Adult is bigger than bud worm.

4. Moringa hairy caterpillar: Larvae are seen in groups in tree trunks and feed gregariously, scrap the bark and gnaw the foliage resulting in defoliation of tree. Larva is brown and hairy. Adult is large sized, uniformly light yellowish brown in colour with faint lines on wings.

5. Black hairy caterpillar: Caterpillars feed on leaf lamina initially by scrapping epidermal layers and later by cutting the blades.

6. Pod fly / fruit fly: Severe infestation results in drying of fruits from tip. Gummy exudate oozes from infested fruits. Adult is small yellowish fly with red eyes.

7. Bark caterpillar: Zigzag galleries and silken webbed masses comprising of chewed material and excreta of larvae are seen. Larva is stout and dirty brown. Adult is pale brown; forewings with brown spots and streaks.

8. Stemborer: Grub causes zigzag burrows beneath the bark, which results in death of the branch, or stem. Adult feeds on bark of the young petioleand twigs. Grub is stout and yellowish. Adult is large sized beetle with yellowish brown elytra.

Pests of Tuber Crops - Potato

1. Leaf Feeders:

a. Common cutworm: Young larvae feed on leaves and the grown-up larvae cut the stem at collar region. Larva is black colored with brown head. Adult forewing is grey with spot like markings. Hind wing is dull white.

b. Black cutworm: Damage as in common cutworm. Larva is black with pale mid dorsal stripes. Adult forewing is pale brown with dark purplish brown and hind wing is with brown tinge.

c. Spotted beetle: Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry up. Grub is yellowish in color and stout with spines all over the body. Adult is spherical pale brown and mottled with black spots (6 or 14) on each elytron.

d. Bihar hairy caterpillar: Young larvae feed gregariously and skeletonize the leaves. Later instars defoliate completely. Larva is stout with seven orange transverse lines with tuft of yellow hairs, which are dark at both ends.

Adult is crimson colored, body with black dots and black antenna. Wings are pinkish with black spots.

2. Borers:

a. Shoot and fruit borer: General symptoms of damage are withered terminal shoots, bore holes on fruits plugged with excreta, shedding of flower buds, drying of leaves due to boring on petioles by larvae. Larvae are pink in color. Adult is medium sized moth with forewing having black and brown patches and dots. Hind wings are opalescent with black dots.

b. Potato tuber moth: It is a pest of field and storage. Larva tunnels into foliage, stem and tubers, which leads to loss of leaf tissue, death of growing points and weakening or breaking of stems. In tubers, irregularly shaped galleries are formed near tuber eyes. Larva is white to yellow or greenish turns red at pupation. Moth is small with silvery body. Forewing is grey-brown with minute dark spots and has a narrow fringe of hairs. Hindwings are dirty white.

c. Root grubs: Grubs feed on roots and tubers. Adult feed on foliage during night. Damage is more during autumn. Grub is „C" shaped with orange head. Adult is brown beetle with pale prothorax.

Pests of Sweet Potato

1. Borers Sweet

a. Potato weevil: Grubs bore into stem and feed on soft tissues. Grubs and adults bore into tubers both in field and in godowns. Occasionally adults feed on stem and leaves as well. Grub is fattish, apodous and pale yellowish white in colour. Adult is ant like, slender bodied having elongated snout, bluish brown head with non-geniculate antennae, bright red thorax, brownish legs and red abdomen.

b. Tuber borer: Caterpillars bore inside the tubers and feed the starchy material. The adults are greyish brown; forewings are mottled with fine specks and greyish lines and black spots.

c. Stem or vine borer: Caterpillar bores into vines (stem) often killing the branch. Larva is stout and whitish in colour. The moth is yellow with dark wavy lines.

2. Leaf Feeders:

a. Leaf roller: Tiny larvae scrape the tender surface tissue of leaves and feed in beneath the thin webbings. Larva folds single leaf longitudinally and feed on green tissues

b. Tortoise beetles: Grubs and adults bite holes on leaves. Grub is flattened yellowish green with spiny processes covering the body. It has a raised anal portion with which it covers its back with excreta and carries the skin on its back. Adult beetle is medium sized with colour variation according to species.

i. *A. miliaris*: Broad oval shaped, brownish red in colour with black dots.
ii. *C. circumdata*: Beetle with green crescent –like mark in the middle
iii. *C. bipunctata*: Small metallic green with six black spots on elytra.

3. Root Feeder:

White grub: Grubs feed on roots and tubers and adults feed on leaves. Adult is chestnut coloured beetle with glistening pubescence.

Pests of Tapioca

1. Cassava scale: Nymphs and adult desap the plant and cause stunting and death. White elongate scales are present on stem.

2. Whitefly: Nymphs and adults cause chlorotic spots by sucking cell sap from leaves and then yellowing and drying of leaves. Nymph is greenish and oval in outline. Adult is with yellow body covered with white waxy bloom.

3. Thrips: Nymphs and adults cause silvery patches on leaves. Nymph is reddish in color. Adult is dark brown or black.

Pests of Chillies

1. Chilies - Stem borer: Stunted growth, withering and wilting of plants, stem and leaf axils covered with excreta covering bore holes are the infestation caused by the larvae. Larva is yellowish or light brown with red head. Moth is with greyish brown forewings having transverse lines and white hindwings.

2. Chili thrips: Leaves become crinkled, curled upward and shed. Buds become brittle and drop down. Plants get stunted and bronzed. Nymphs and adults are tiny slender, fragile and yellowish straw in color.

3. Green peach aphid: Leaves get curled and crinkled coated with honeydew and sooty mold. Plants remain stunted. Adult is mostly yellow in color.

4. Tobacco caterpillar: Young larvae scrap the leaves on ventral side. Grown-up caterpillar completely defoliates. Larvae also feed on young fruits. Larva is pale greenish brown with dark markings. Yellow and purplish spots are seen on the submarginal areas. Adult is stout moth with wavy white markings on the brown forewings and white hindwings are having a brown patch along its margin.

5. Cut worm: The greasy cut worms come out during night and curt the seedlings at ground level and eat tender leaves.

6. Fruit borer: Young larvae feed on tender foliage and from fourth in star onwards attacks fruits. They bore circular holes and thrust only a part of their body inside fruit and eat inner contents. Freshly hatched larva is yellowish white but gradually become green. Full-grown larva is apple green in color with white and dark grey-brown longitudinal lines and sparse short hairs. Adult is light brown and medium sized moth with dull black border.

7. Muranai mite: Sudden curling and crinkling of leaves followed by blister patches are initial symptoms. Plants are severely attacked, stop growing and die. Adult is tiny, oval, glossy or whitish mites.

8. Eriophyid mite: These mites infest tender shoot cause rusting, leaf size reduction and shedding of flowers.

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Identification of Lemon Pest

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Identification of Lemon Pest

1. Lemon butterfly *(Papilio demoleus):* It causes severe damage to citrus particularly in nurseries.

a. Distribution: It is distributed from North Australia to Arabia, including Iran, Pakistan, India, Sri Lanka, Bangladesh, Mynmar, China, Taiwan, South-East Asia.

b. Host range: All citrus species and other plants like bael, ber, curry leaves, bawachi etc.

c. Marks of identification: Butterfly has yellow and black markings on wings. Larva is green in colour and measures 38 mm, when disturbed they protrude two fleshy horns from the neck.

d. Bio-ecology: A female lays about 70-180 eggs singly on tender leaves. Eggs hatch in 3 -7 days. Larva develops in 2 weeks and Pupates on plant remaining attached by silken threads. Pupal period is 10-15 days, may extend upto 2-3 months in winter. The life cycle is completed in 3-6 weeks in summer and 13-15 weeks in winter. There are 4-6 generations in a year. Pest is active in monsoon season.

e. Nature of damage: Caterpillars feed on tender leaves right upto the midrib and defoliate the plants in case of severe infestation.

f. Management practices:

i. Hand picking of caterpillars in early stage of infestation.
ii. Spray Bacillus thuringiensis @ 20 g/10 lit. water.
iii. Spray Quinalphos 25 EC @ 30 ml or Thiodicarb 75 WP @ 10 g per 10 lit. water.

2. Leaf miner *(Phyllocnistis citrella):* Most destructive pest, active in monsoon , infestation noticed in seedling stage. The pest is suspected to be responsible for the spread of bacterial infection causing 'citrus canker'.

a. Distribution: It is found all over the orient from Africa to Australia.

b. Host plants: All citrus species.

c. Marks of identification: Moths are small, silver white colour, forewings with brown stripe and prominent black spot near the tip. Caterpillar is yellow in colour with brown mandibles.

d. Bio-ecology: A single female Lys about 36-76 eggs. Eggs are laid singly on underside of leaves and hatch in 3-6 days. Larval development takes place in 1-2 weeks and pupates inside the larval mines of leaves. Pupal period is 3-4 weeks. Total life cycle is completed in 12-55 days. About 9-13 generations are completed in a year. Pest is active in monsoon season. Population of the pest decreases during hot summer months.

e. Nature of damage: On hatching larva feeds on leaf tissues between upper and lower surfaces of leaves making glistening zigzag tunnels. The leaves turn pale, curl and finallydry. Besides, mined leaves may get bacterial infection which leads to 'citrus canker'.

f. Management practices:

i. Removal of infested leaves and their proper disposal.
ii. Soil application of Carbofuron 3 G @ 50 Kg or Phorate 10 G @ 15 Kg/ha.
iii. Spray Acephate 75 SP @ 15 g or Imidacloprid 17.8 SL @ 2.5 ml or Thiamethoxam 25 WG @ 1 g/ 10 lit. water as soon as attack is noticed.

3. Citrus psylla *(Diaphorina citri)*: Most destructive of all pests of citrus, also transmit "Greening malady", a micoplasma disease in citrus.

a. Distribution: It is found throughout tropical and subtropical Asia and the Far East.

b. Host plants: Citrus and other plants belonging to Rutaceae.

c. Marks of identification: Adults are small, dark brown in colour. Wings are folded like roof over body.

d. Bio-ecology: About 800 eggs are laid in leaf axis and hatch in 4-6 days in summer and 22 days in winter. Nymph develops in 2 weeks in summer and 3-4 weeks in winter. Adult longevity may extend over 6 months. The developmental period from egg to adult takes 15days in summer and 47 days in winter. There are 9 generations in a year. Pests overwinter in adult stage.

e. Nature of damage: Both nymph and adult suck the cell sap from tender leaves, shoot and buds, which as a result curl, dry up and ultimately drop down. Complete crop failure is reported in case of servere infestation.

f. Management practices: Spray Oxydemeton-methyl 25 EC @ 10 ml or Imidacloprid 17.8 SL @ 1 ml or Thiamethoxam 25 WG @ 1 g/10 lit. water as soon as new sprouts appear in June and January.

4. Whitefly *(Dialeurodes citri)*, Blackfly *(Aleurocanthus woglumi)*: Whitefly, D. citri is common in occurrence and destructive pest of citrus. It causes 'Kolshi' in citrus and reduces plant vigour.

a. Distribution: It is distributed in Asia, Africa, Central America.

b. Host range: Citrus, cotton, castor, banana, coffee and some ornamental plants.

c. Marks of identification:

i. Whitefly: Adults are minute insect with yellowish body and red eyes. Wings are white or greyish, covered with mealy secretions. Nymphs and pupae are oval shaped, scale like and blackish with marginal bristle like fringes.

ii. Blackfly: Smaller in size and black in colour.

d. Bio-ecology: A female lays about 200 eggs. Eggs are laid on underside of leaves and hatch in 10 days. Nymph develops in 3-10 weeks and forms pseudo pupa (quescent stage) on underside of leaves, pupal period is 16-22 weeks. The total life cycle is completed in 20-33 weeks. Two generations are completed in a year.

e. Nature of damage: Nymphs and adults suck the cell sap from leaves, as a result leaves wither and turn brownish. Nymphs excrete honey dew on which black sooty mould develops .The blackish coating commonly called "Kolshi". Fruit setting is adversely affected in case of severe infestation.

f. Management practices: Spray Oxydemeton-methyl 25 EC @ 10 ml or Chlorpyriphos 20 EC @ 10 ml/10 lit. water.

5. Fruit sucking moth *(Eudocima (Othreis)* fullonica, *E. (Othreis) materna, Achoea janata)*: Moths puncture the fruits and cause fruit rot.

a. Distribution: These are distributed in Asia, Africa, Australia.

b. Host range: Larva feeds on leaves of gulvel and vasanvel and moth feeds on fruits of citrus mango, pomegranate, grape, cashew nut etc.

c. Marks of identification: Moth is large sized with forewings grey or brown, hind wings orange or yellow with black spot in the centre and marginal dark bands. Kidney shape black spots in *E. fullonica* and round black spots in *E. materna*

d. Bio-ecology: A female lays about 300 eggs on leaves of weeds such as Gulvel, Vasanvel etc. The eggs hatch in 3-4 days. Larva is semilooper and 5 cm long. Larval development complete in 20 days and enters in soil for pupation. The adult emerges in 9 days from pupa. The life cycle is completed in 4-6 weeks. There are 2-3 generations in a year. Pest is active in Kharif season.

e. Nature of damage: Moths are nocturnal and seen flying in orchards after dusk. They puncture ripening fruits & suck the juice. Bacterial infection causes rotting of infested fruit.

f. Management practices:

i. Eradication of host plants viz. gulvel and vasanvel.
ii. Smoke the orchards in evening hours.
iii. Poison baiting (20 ml malathion 50 EC + 200 g jaggary + 2 lit. water).
iv. Bagging of fruits with paper or cloth bags.
v. Quick removal and disposal of fallen fruits.

vi. Collect and destroy moths by using light.

6. Citrus aphid *(Toxoptera aurantii)*

a. Distribution: *Toxoptera aurantii* is found in all the warmer parts of the world.

b. Host range: The black citrus aphids is the chief pest of citrus species but occur sporadically on custard apple, jack fruit, tamarind, drumstick, coffee, tea and some ornamental plants.

c. Marks of identification: Young ones are brown in colour. Two short tube like structures on dorso-lateral side of the latter half of abdomen know as cornicles.

d. Bio-ecology: Reproduction is parthenogenetic and viviparous. A female reproduces 1 to 16 nymphs per day and lays more than 100 in a life period of 12 to 33 days. The nymphs moult four times and become adult, the period varying from 4 to 16 days depending upon temperature and food conditions. A generation normally takes only 6 to 8 days but at 15o C it takes as long as 3 weeks and at 25o C only 6 days. There are about 12 generations in a year.

e. Nature of damage: Both nymphs and adults suck cell sap from leaves and tender shoots. This impairs the vitality of the tree and cause severe curling and deformation of young leaves resulting into stunted growth of leaves and twigs. Feeding also results premature falling of fruits and reduces their quality, which fetches poor price in the market. Besides, it secretes honeydew that attracts black sooty mould (Capnodium sp.) fungus, affecting photosynthesis. Also these aphids are the principal virus vector of Triesteza virus.

f. Management practices:

i. Conserve natural enemies.

ii. Spray Dimethoate 30 EC or Oxydemeton methyl 25 EC or Monocrotophos 36 SL @ 10 ml / 10 lit. water.

7. Citrus red scale (Aonidiella aurantii): The scale is also known as California red scale because it constitutes the chief pest of citrus in California (USA).

a. Distribution: The pest is one of the most destructive of all scales and native of India. Now it has spread all over citrus growing countries except West Africa.

b. Host range: The scale is reported to attack 86 host plant species. In India, it feeds on Acacia, Eucalyptus, Fig, grape, rose, shisham, willow, avocado, mulberry, castor, bean, jasmine, night shade, banana, coconut, Loquat, mango, olive, pear, pistachio, quince, walnut, carnation, Hibiscus, oleander, scotch broom, aloes, ash asparagus and cotton wood.

c. Marks of identification: The female scale insects is re-inform in shape, red in colour and measures 1.8 x 1.9 or 2 mm in size with distinct centrally located exuviae. The males are similar to female except after first moults it becomes elongated and possesses one pair of distinct purplish eyes.

d. Bio-ecology: The pest is active throughout the year, but its attack is maximum during autumn. A fertilized female produces more than 100 or 150 young ones, viviparous. The young ones known as "Crawlers" emerge from beneath the female. The female produces 2 to 3 nymphs a day for two months. The female nymphs during development moults two times. The first moult occurs in 7 to 20 days and the second moult occurs after 12 to 20 days. The wingless female becomes mature after a period of 10 to 15 days. The male crawler unlike female develops in a different manner. After first moult its shape elongate with a nipple on one side. In second moult the pre-pupa is observed and in third moult it changes to pupa. In fourth moult the winged adult male emerges beneath the scale covering. The period from nymphs to adult takes about 1 to 2 months.

e. Nature of damage: The leaves, branches and fruits may be covered with them. The nymphs and adults prefer to settle on the tender and succulent branches of 1 to 2 years in growth and suck cell sap. The feeding results into development of yellow marks on the leaves, twigs and fruits. The branches soon loose chlorophyll, turn scurfy grey and start dying. In case of severe infestation, leaves become pale and if a young tree is attacked death results. These insects also secrete a sugar material (honey dew), which affects photosynthesis.

f. Management practices:

i. Cut and destroy infested plant parts.
ii. Restrict movement of ants as they help in movement of pest.
iii. Apply sticky substance on tree trunk.
iv. Conserve natural enemies.
v. Spray Dimethoate 30 EC @ 15 ml + Kerosene 25 ml in 10 lit. water.

9. Mealy bug *(Planococcus citri)*

a. Distribution: It is distributed in subtropical regions and also found in greenhouses in temperate countries.

b. Host range: Main host is Citrus spp. It has been also recorded on fig, pine apple, sapota.

c. Marks of identification: The nymphs are amber coloured with a whitish waxy coating with filaments around the margins. The adult female is wingless and flattened with short filaments around the margins, whereas the male is winged with long antennae and atrophied mouthparts.

d. Bio-ecology: The females lay eggs in clusters on citrus plants, which are found in protective cotton-like masses. The eggs hatch in 10-20 days and the nymphs crawl out and start feeding on lower surface of leaves. Soon they envelope themselves with white fluffy material. A female nymph is full-grown in 6-8 weeks after passing through three moults. The male undergoes four moults after passing through per-pupal stage emerges as winged adults.

e. Nature of damage: The nymphs and adult females attack leaves, tender branches, fruits (at the base near the fruit stalk) and even the roots. They suck cell sap due to which the plants turn pale, wilt down and consequently dry up. Besides they also secrete large amount of honeydew on which sooty mould fungus grows interfering photosynthesis. Black ants are attracted to the honeydew and they become a nuisance. As a result, the growth of tree is arrested and the fruits fall prematurely. In severe infestation, the flowers do not from fruits.

f. Management practices: Same as scales.

10. Thrips *(Scirtothrips dorsalis)*

a. Distribution: *S. dorsalis* is widespread between India, Pakistan, Japan, the Solomon Islands and Australia, but it is now established in South Africa, Israel, the Caribbean and Florida (USA).

b. Host range: Polyphagous.

c. Marks of identification: Adults are minute, delicate insect less than 1 mm. long and yellow in colour. Wings are fringed with hairs. Nymphs are more minute and wingless.

d. Bio-ecology: Both sexual and parthenogenetic reproduction occur. Female lays 50-60 fertilized or unfertilized eggs inside the leaf tissues generally on lower side of the leaf. Eggs hatch in 8-9 days. Nymphs develop in 4-6 days. Pre pupal and pupal periods are generally found in soil at a depth of 2.5 -5 cm. There are several overlapping generations in a year. The pest is more active during later part of monsoon season especially during dry days.

e. Nature of damage: Both nymphs and adults suck the oozing cell sap from leaves, flowers and young fruits. Leaves become cup shaped and curled. Damage in nursery causes stunted growth of seedlings. On fruit, the scaping by thrips leads to scabby, greyish or silvery scars on the rind.

f. Management practices: Spray Dimethoate 30 EC @ 10 ml or Monocrotophos 36 SL @ 10 ml / 10 lit. water.

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Identification of Mango Pest

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Identification of Mango Pest

1. Mango hoppers *(Amritodus atkinsoni, Idioscopus clypealis, Idioscopus nitidulus)*: Mango hoppers are major, serious and wide-spread throughout the year inmango ecosystem. Hoppers species viz., *Amritodus atkinsoni, Idioscopus clypealis* and *Idioscopusnitidulus* remains active and damage each crop stage of mango from emergence of new flush to flowering cum fruit setting stages and causes up to 100 per cent losses.

a. Distribution: Mango hoppers have been reported from India, Sri Lanka, Pakistan, Bangladesh, Mynmar, Philippines, Malaysia, Indonesia, Vietnam and Taiwan. In India, *A. atkinsoni* is comparatively more common in North India. *I. clypealis* is found all over India, predominant in South Gujarat, Maharashtra and Karnataka. *I. niveosparus* has been observed in Peninsular India.

b. Host range: These hoppers have been reported on mango and sapota.

c. Marks of identification: The nymphs of *A. atkinsoni* are pale yellow, elongated and more active, whereas those of *I. clypealis* are dull yellow or dust yellow. Adults of *I. clypealis* are large, 6.3 mm length and greyish. There are three dark brown spots on the head, a median band and two black spots on the pronotum. *A. atkinsoni* adult is about 5.1 mm long. It differs from *I. clypealis* by the absence of a central longitudinal dark streak on the scutellum. *I. nitidulus* are medium sized and has prominent white bar crossing its dusk wings and three spots on the scutellum.

d. Bio-ecology: Egg laying starts around end of January or early February and continues till March. The females make tiny slits in the tissues of flowering shoots, flower buds or tender leaves with their ovipositor and lay the eggs singly therein. A singly female lays about 100 to 200 eggs. The eggs hatch in 4 to 7 days. The nymphs undergo 4 to 5 mouldings and the total nymphic period ranges from 10 to 20 days. In north India there are two distinct generations in year; spring generation in February to April and summer generation during June to August. The spring generation is definitely more destructive than summer generation, as during that period the hoppers feed on inflorescences. The hoppers are active throughout the summer and spring. The activity declines with the onset of monsoons and the adult hoppers remain inactive from August to January. A spell of cold weather with temperature dropping to 10-150C results in increase in egg laying.

e. Nature of damage: The injury is caused due to heavy egg laying on the inflorescence stalk and florets which withers and drops. The nymphs and adults suck the sap from the tender leaves, inflorescence causing withering and shedding of flowers. On attaining maturity, the hoppers leave the blossoms and move on leaves and trunks of the trees. The hoppers also secrete honeydew which encourages the development of fungi *Capnodium mangiferum* and *Meliola mangiferae* resulting in growth of sooty mould on dorsal surface of leaves, branches and even on fruits. This interferes with photosynthesis of the plant, ultimately resulting in non-setting of flowers and dropping of immature fruits.

f. Management practices:

i. Avoid dense planting, maintain open canopy; prune overcrowded overlapping branches after rainy season.
ii. Keep orchards clean by regular ploughing and removal of weeds.
iii. Avoid excess use of nitrogenous fertilizers.
iv. Smoking of orchards by burning of crop residues/cow dung cake at evening hours.
v. Conservation of bio control agents like predator, *Mallada boninensis, Chrysopa lacciperda*, egg parasite, Polynema spp. *Gonatocerus* sp. *Tetrastichus* sp. and fungus, *Verticillium lecanii*.

vi. Application of bio-agents, Metarhizium anisopliae @ 40 g or *Beauveria bassiana* @ 40 g /10lit. water on tree trunk once during off season and twice at 7 days interval during flowering season.
vii. First spray before flowering on bark of branches and two more sprays when buds begin to sprout with Thiamethoxam 25 WG @ 1 ml or Clothianidin 50 WP @ 1.2 g or Buprofezin 25 SC @ 10 ml or Deltamethrin 2.8 EC @ 3 ml or Lamda cyhalothrin 5 EC @ 10 ml or Dimethoate 30 EC @ 15 ml or Oxydemeton-methyl 25 EC @ 10 ml or Monocrotophos 36 SL @ 30 ml or Malathion 50 EC @ 15 ml per 10 lit. water.
viii. Spraying should be avoided at full bloom stage, because that will hinder the activity of pollinators and natural enemies.

2. Mango stem borer *(B. rufomaculata, Batocera rubus)*

a. Distribution: It is also an important pest of mango and reported from most of the tropical countries of the world. These are widely distributed in India and Bangladesh. In India *B. rufomaculata* is more common. *B. rubus* is more prominent in Maharashtra.

b. Host range: It is a peat of mango, fig, rubber, jack fruit, mulberry, papaya, etc.

c. Marks of identification: The adults of *B. rufomaculata* are stout, dark brown longicorn beetles, 50 to 55 mm long (females larger than males) with yellowish green pubescence; prothorax with two large kidney shaped orange spots and short thick spine-like projection on either side. Elytra is irrorated with small light orange spots. The beetles of *B. rubus* are 30 to 45 mm long, brownish-grey with elytra having shining granulations at base and 4 or more dirty yellowish spots of variable size, on each elytron. Full grown grubs are 85 to 95 mm long, fleshy, stout, yellowish-ivory in colour with well-defined segmentation and dark brown head having strong jaws. Eggs are white, shining oval in shape.

d. Bio-ecology: The female beetle's mate after 1 to 2 days of emergence and oviposit for 22 to 25 days laying on an average one egg per day. Eggs are laid singly either in the slits of tree trunks or in the cavities in main branches and stems which are then covered with a viscous fluid. Incubation period is 7 to 13 days; grubs remain active for 140 to 160 days while pupal period lasts for 20 to 25 days. Pupation takes place within the affected trunks or stems. Total life cycle is completed in 170 to 190 days and adult longevity is 60 to 200 days. Adults emerge with the onset of monsoon (May-June) and the emergence continues during the monsoon season.

e. Nature of damage: On hatching, the grubs make zig zag burrows beneath the bark and tunnel upwards feeding on the internal tissues. When the grubs reach sapwood, the attacked stems die and wither away. Normally the attack by this pest goes unnoticed till a branch or two starts shedding leaves and drying up. Sometimes however, sap and masses of frass may be seen exuding from the bored holes. In severe cases branches my collapse and tree may die. Adult beetles feed on the bark of young twigs and petioles.

f. Management practices:
i. Keep orchard clean and healthy.
ii. Cut and destroy the affected branches along with grubs and pupae.
iii. Clean hole and insert cotton wool soaked in emulsion of dichlorvos (7 ml in 10 lit.) or kerosene or petrol in each hole and plug them with mud.
iv. Use of fungi, Metarhizium anisopliae or Beauveria bassianna @ 40 g/10 lit. water.
v. Inject borer solution (2-part CS2 +1-part chloroform + 1-part creosote oil or CS2 or
vi. EDCT mixture or petrol in live holes with syringe and seal with mud.
vii. Application of Monocrotophos 36 SL @ 30 ml/10 lit. water.

3. Oriental fruit fly (Bactrocera dorslis)

a. Distribution: It is widely distributed in India and South East Asia. It has been also recorded in Malaysia, Indonesia, Formosa, Philippines, Australia and Hawaii island. In many countries, it has displaced the Mediterranean fruit fly, *Ceratitis capitata.*

b. Host range: It is recorded on 300 species of commercial/edible and wild hosts. The major hosts are mango, guava, peach, pear, apple, banana, fig, pomegranate , citrus and several vegetable crops.

c. Marks of identification: The adult is stout, a little larger than the ordinary house fly and measures 14 mm across the wings and 7 mm in body length. It is brown and has almost transparent wings with yellow legs and dark rust – red and black patterns on the thorax. The maggot is legless, 8-9 mm long and is yellow and opaque.

d. Bio-ecology: The female fruit fly deposits eggs in the rind of fruits with the help of conical ovipositor. Eggs are laid singly or in clusters (2 to 15). On an average 50 eggs are laid but under favourable conditions a single female can lay as many as 150 to 200 eggs in a period of one month. Incubation period 2-3 days during March and April but it is prolonged to 10 days in winter. The larval period lasts for 6-29 days. Pupation takes place 8 – 16 cm below the soil surface. The pupal period lasts for 8 to 10 days. Several generations are completed in a year in Maharashtra.

e. Nature of damage: The female flies lay eggs just below the epidermis (1 to 4 mm deep). On hatching, the maggots feed on pulp of fruits. As a result, a brown patch appears around the place of ovipositon and the infested fruits start rotting. These affected fruits drop down prematurely and the maggots come out from these fallen fruits to pupate in the soil.

f. Management practices:

i. Ploughing of orchard during November-December to expose pupae to sun's heat or for predatory birds which kills them.
ii. Prior to harvest (30-40 days) collect and dispose of infested and fallen fruits to
iii. Prevent further multiplication and carryover of population.
iv. Male annihilation technique: Set up fly trap using methyl eugenol. Prepare methyl eugenol 1 ml/l of water + 1 ml of malathion solution. Take 10 ml of this mixture per trap and keep them at 25 different places in one ha between 6 and 8 am. Collect and destroy the adult flies.
v. To control adult flies during severe infestation placing poison bait viz Protein hydrolysate +malathion 50 ml +200 ml molasses in 20 litres of water be sprayed adding an additional 18 liters of water to bait poison. Commencing at pre oviposition period and repeat at 15 days interval. Addition of 10 ml methyl eugenol in place of molasses is also recommended.
vi. Hot water treatment of fruit at 48 + 100 C for 60 min.
vii. Irradiation of fruits 400 G- rays using cobalt 60 to control fruit fly.
vii. Managing fruit flies also reduces anthracnose disease and prevents late fruit fall.

4. Mango stone weevil *(Sternochetus mangiferae)*: It is specific pest of mango preferring Alphanso, Bangalora , Neelum varieties. It is more common in South India where late varieties suffer the most. The export of mango fruits from India to the USA has been banned to prevent the entry of this weevil.

a. Distribution: It is widely distributed in tropics like India, Bangladesh, Pakistan, Sri Lanka, Myanmar, Malaysia, Vietnam, Philippines, Australia, Africa, Hawaii.

b. Host range: It is a pest of mango only.

c. Marks of identification: Adult weevils are 5 to 8 mm long, stout and dark brown in colour. Grubs are white in colour and legless.

d. Bio-ecology: Adults live from 1 to 2 years and diapauses most of the time except during fruiting season. Adults lay eggs on developing fruit by cutting a small boat-shaped incision. The exudate from the wound covers the egg and provides a protective opaque coating. One female lay about 15 eggs per day and a total of 300 eggs. Eggs hatch in 5 to 7 days, and larvae have 5 to 7 in stars. The larva develops inside the stone and pupates. The larval period ranges from 22 days to 10 weeks, and the pupal stage lasts about 1 week. The adult cuts its way through the stone and the pulp comes out. Time required from egg to adult is 35 to 54 days, and there is only one generation per year. Adults diapause in crevices in the bark or under stones.

e. Nature of damage: Eggs are laid singly on the epicarp of partially developed fruits or under the rind of ripening fruits. The tiny grubs on hatching bore through the pulp, feed on seed coat and later damage the cotyledons. The weevil cuts its way through the stone and the pulp comes out. Since the grub passes its entire life inside the seed, there are no external symptoms of injury on the fruits. On cutting open the fruits, the pulp adjacent to the affected stone is seen discoloured due to excretion of the grub.

f. Management practices:

i. Ploughing of orchard after harvest to expose hibernating adults, reduce infestation levels.
ii. Collection and destruction of infested and fallen fruits at weekly interval till harvest fruit.
iii. Destroy all left over seeds in the orchard and also in the processing industries.

4. Mealybug *(Drosicha mangiferae)*

a. Distribution: It has been reported from India, Bangladesh, China and Pakistan. It is widely distributed in the Indo-Gangetic plain in India.

b. Host range: Besides mango, it also attacks 62 other plants such as apple, apricot, ber, cherry, litchi, mulberry, papaya, peach, plum, pomegranate, etc.

c. Marks of identification: The nymphs and adult females are flat, oval, waxy-whitish insects, sometimes mistaken for fungal growth. Adult females are wingless while males are crimson coloured bugs with two dark brownish black wings and cause no damage, except fertilizing the females.

d. Bio-ecology: The gravid females crawl down the trees during April-May and enter the soil (80 to 150 mm deep) wherein they excrete whitish foam. This forms a pouch in which the female goes on depositing the eggs for 7 to 16 days and soon after completing oviposition, the female dies. Each female gives 400 to 500 eggs and these remain in the soil in a state of diapauses. Winter chilling terminates this diapause. There are three nymphal stages. The total life cycle occupies 67 to 119 days in case of males and 77 to 135 days in case of females. This pest is active from December to May and spends rest of the year in the egg stage.

e. Nature of damage: Soon after hatching, the majority of nymphs start crawling up the tree trunks and clusters of these may be seen on young shoots and panicles. Only these nymphs are destructive and suck plant juice, causing tender shoots and flowers to dry up. The young fruits also become juiceless and drop off. These are more active on bright sunny days.

f. Management practices:

i. Plough orchards during summer to expose eggs to natural enemies and sun.
ii. Flooding of orchard with water in the month of October kill the eggs.
iii. Remove weeds like *Clerodendron infortunatam* which are additional hosts of mealy bugs.
iv. Use of sticky bands to prevent the climbing on trees (Sticky substance or greasy band) half meter above ground in second week of December.
v. Spray NSKE 4 % or crude garlic oil 1 % on tree trunk at an interval of 15 days.
vi. Conserve natural enemies; parasitoids like Phygadeuon sp. *(Ichneumonidae)*, Getonides perspicax; predators like larvae of *Brinckochrysa scelestes* (Chrysopidae) and grubs of Rodolia fumida (Coccinellidae).
vii. Spray with Monocrotophos 36 SL @ 30 ml or Dimethoate 30 EC @ 15 ml/10 lit. water.

5. Shoot borer *(Chlumetia transversa):* Shoot Borer (Chlumetia transversa) is a serious pest of mango especially seedlings and young trees.

a. Distribution: It is distributed in Indo-Australian tropical countries of India, Pakistan, Sri Lanka, Bangladesh towards China, Korea and Indonesia, Malaysia, Thailand, Andaman Islands, Nicobar Islands and Solomon Islands.

b. Host range: It is a pest of mango and litchi.

c. Marks of identification: Adult moths are stout greyish brown in colour with wings having wavy lines and measure about 17.5 mm with expanded wings. Hind wings are light in colour. Caterpillar has dulled violaceous dorsum and greenish ventrum. Head is brownish, which becomes testaceous in late instars. Final instar is dark pink.

d. Bio-ecology: Female moths lay egg on tender leaves. After hatching, young larvae enter the midrib of leaves and then enter into young shoots through the growing points by tunneling downwards. The mature larva leaves the shoot and pupates on the bark of the tree or in the soil. The entire life cycle takes about 22 to 27 days. The pest overwinters from October to March in pupal stage and there are four overlapping generations in a year.

e. Nature of damage: Larvae bore into young tender leaves during August and freshly hatched caterpillar bore into mid rib. After a couple of days, they bore into tender shoots near the growing point tunnelling downward, throwing their excreta resulting in dropping of leaves and wilting of terminal shoots.

f. Management practices:

i. Attacked shoots should be clipped off and destroyed.

ii. Clean hole and pour kerosene/petrol/crude oil or formalin into the stem borer hole and subsequently close entrance of the tunnel by plugging with cotton wool and paste the mud.

iii. Use light trap@1/acre.

iv. Spray Monocrotophos 36 SL @ 10 ml/10 lit. at the commencement of new flush.

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Classification of Weeds

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Classification of Weeds

There are at least 450 families of flowering plants and well over 350,000 different species. Only about 3,000 of them have been used by humans for food. Fewer than 300 species have been domesticated, and of these, there are about 20 that stand between humans and starvation. There are at least 100 species of great regional or local importance, but only a few major species dominate the human food supply. Only about 15 plants provide most of the food that humans have consumed for many generations. Twelve plant families include 68% of the 200 species that are the most important world weeds (Holm, 1978).

These weeds share certain characteristics, including the following:
1. Long seed life in soil
2. Quick emergence
3. Ability to survive and prosper under the disturbed conditions of a cropped field
4. Rapid early growth
5. No special environmental requirements for seed germination

They are also competitive and react similarly to crop cultural practices. Weeds are usually defined primarily by where they are and how that makes someone feel about them. The fact that they may have shared characteristics means we may be able to define and classify them based on what their genotype enables them to do. Some characteristics that weeds share are discussed later on in this chapter.

The Poaceae and Cyperaceae account for 27% of the world's weed problems, and when the Asteraceae are added, 43% of the world's worst weeds are included. Nearly half of the world's worst weeds are in only 3 families, and any 2 of these include over a quarter of the world's worst weeds. The Poaceae is the family having most weedy species and also the family that includes many of the important crops that feed humans: wheat, rice, barley, millet, oats, rye, corn, sorghum, and sugar cane. About two-thirds of the world's worst weeds are single-season or annual weeds. The rest are perennials in the world's temperate areas, but in the tropics, they are accurately called several-season weeds. The categories annual and perennial do not have the same meaning in tropical climates, where growth is not limited by cold weather but may be limited by low rainfall. About two-thirds of the important weeds are broadleaved or dicotyledonous species. Most of the rest are grasses, sedges, or ferns. The United States has about 70% of the world's important weeds and they may be classified in different ways.

Phylogenetic Relationships

Weeds are classified by taxonomists and weed scientists the same way as all other plants and species based on phylogenetic (from the Greek *phylo* or *phulon*, meaning "race" or "tribe," plus the Greek *gen*, meaning "be born of" or "become") relationships, or a plant's ancestry. Phylogenetic keys to plant species, based on ancestry and ancestral similarity, include division, subdivision, class, family, genus, and species. A brief description of a plant key for weed species follows:

Division I—Pteridophyta: Description—Fernlike, mosslike, rushlike, or aquatic plants without true flowers. Reproduce by spores. Representative families: Salviniaceae, Equisetaceae, Polypodiaceae

Division II—Spermatophyta: Description—Plants with true flowers with stamens, pistils, or both. Reproduce by seed containing an embryo.

> **Subdivision I—Gymnospermae:** Description—Ovules not in a closed ovary. Trees and shrubs with needle-shaped, linear, or scalelike, usually evergreen leaves. Representative families: Pinaceae, Taxaceae Almost no weedy species.
>
> **Subdivision II—Angiospermae:** Description—Ovules borne in a closed ovary that matures into a fruit.

Class I—Monocotyledoneae: Description—Stems without a central pith or annular layers but with woody fibers. Embryo with a single cotyledon. Early leaves always alternate. Flower parts in threes, or sixes, never fives. Leaves mostly parallel veined. **Representative families:** Poaceae, Cyperaceae, Juncaceae, Liliaceae, Commelinaceae.

Class II—Dicotyledoneae: Description—Stems formed of bark, wood, and pith with the wood between the other two and increasing with annual growth. Leaves net-veined. Embryo with a pair of opposite cotyledons. Flower parts mostly in fours and fives. **Representative families:** Polygonaceae, Chenopodiaceae, Convolvulaceae, Asteraceae, Solanaceae All classified plants have a genus and specific name. By convention, the genus is always capitalized (e.g., *Amaranthus*) and is commonly written in italics or underlined. The species name is not capitalized.

Based on Life Span

Based on life span (Ontogeny), weeds are classified as Annual weeds, Biennial weeds and Perennial weeds.

1. Annual Weeds: Weeds that live only for a season or a year and complete their life cycle in that season or year are called as annual weeds. These are small herbs with shallow roots and weak stem. Produces seeds in profusion and the mode of propagation is commonly through seeds. After seeding the annuals die away and the seeds germinate and start the next generation in the next season or year following. Most common field weeds are annuals. The examples are:

a. Monsoon annual e.q. *Commelina benghalensis, Boerhavia erecta*
b. Winter annual e.q. *Chenopodium album*

There are also plants with much shorter life cycles than those mentioned before. These plants are known as ephemeral plants. The word ephemeral means transitory or quickly fading. You may gather from this that the plants live their lives - germinate, produce seeds, flower, and die - quickly. Ephemeral plants are usually classified under three types: spring, desert, and weedy. The first, spring ephemeral, refers to perennial plants that emerge quickly in the spring and die back to their underground parts after a short growth and reproduction phase. Examples include: spring beauties, trilliums, and harbinger of spring. Desert ephemerals such as the *Arabidopsis thaliana* are plants which are adapted to take advantage of the short-wet periods in arid climates. Mud-flat annuals take advantage of short periods of low water. In areas subjected to recurring human disturbance, such as plowing, weedy ephemerals are very short-lived plants whose entire life cycle takes less than a growing season. Examples include: *Cardamine hirsuta* and *Cannabis ruderalis*. In each case, the species has a life cycle timed to exploit a short period when resources are freely available.

2. Biennials: It completes the vegetative growth in the first season, flower and set seeds in the succeeding season and then dies. These are found mainly in non-cropped areas e.g. *Alternanthera echinata, Daucus carota.*

3. Perennials: Perennials live for more than two years and may live almost indefinitely. They are adapted to withstand adverse conditions. They propagate not only through seeds but also by underground stem, root, rhizomes, tubers etc. and hence are further classified into:

a. Simple perennials: Plants propagated only by seeds. e.g. *Sonchus arvensis*
b. Bulbous perennials: Plants which possess a modified stem with scales and reproduce mainly from bulbs and seeds. e.g. *Allium* sp.
c. Corm perennials Plants that possess a modified shoot and fleshy stem and reproduce through corm and seeds. Eg. *Timothy* (*Phleum pratense*)
d. Creeping perennials: Reproduced through seeds as well as with one of the following.
- **i. Rhizome:** Plants having underground stem – *Sorghum halapense.*
- **ii. Stolon:** Plants having horizontal creeping stem above the ground – *Cynodon dactylon.*
- **iii. Roots:** Plants having enlarged root system with numerous buds – *Convolvulus arvensis.*
- **iv. Tubers:** Plants having modified rhizomes adapted for storage of food – *Cyperus rotundus.*

Based on Ecological Affinities

1. Wetland weeds: They are tender annuals with semi-aquatic habit. They can thrive under waterlogged and partially dry condition as well. Propagation is chiefly by seed. Eg. *Ammania baccifera, Eclipta alba*

2. Garden land weeds (Irrigated lands): These weeds neither require large quantities of water like wetland weeds nor can they successfully withstand extreme drought as dryland weeds. e.g.*Trianthema portulacastrum, Digera arvensis.*

3. Dry lands weeds: These are usually hardy plants with deep root system. They are adapted to withstand drought on account of mucilaginous nature of the stem and hairiness. Eg. *Tribulus terrestris, Argemone mexicana.*

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Classification of Weeds

1. Based on soil type (Edaphic):

a. Weeds of black cotton soil: These are often closely allied to those that grow in dry condition. Eg., *Aristolochia bracteata*

b. Weeds of red soils: They are like the weeds of garden lands consisting of various classes of plants. Eg. *Commelina benghalensis*

c. Weeds of light, sandy or loamy soils: Weeds that occur in soils having good drainage. Eg. *Leucas aspera*

d. Weeds of laterite soils: Eg. *Lantana camara, Spergula arvensis.*

2. Based on place of occurrence:

a. Weeds of crop lands: The majority of weeds infests the cultivated lands and cause hindrance to the farmers for successful crop production. Eg. *Phalaris minor* in wheat

b. Weeds of pasture lands: Weeds found in pasture / grazing grounds. Eg. *Indigofera enneaphylla*

c. Weeds of waste places: Corners of fields, margins of channels etc., where weeds grow in profusion. Eg. *Gynandropsis pentaphylla*, *Calotropis gigantea*

d. Weeds of playgrounds, road-sides: They are usually hardy, prostrate perennials, capable of withstanding any amount of trampling. Eg. *Alternanthera echinata, Tribulus terestris*

3. Based on Origin:

a. Indigenous weeds: All the native weeds of the country are coming under this group and most of the weeds are indigenous. Eg. *Acalypha indica, Abutilon indicum.*

b. Introduced or Exotic weeds: These are the weeds introduced from other countries. These weeds are normally troublesome and control becomes difficult. Eg. *Parthenium hysterophorus, Phalaris minor, Acanthospermum hispidum.*

4. Based on cotyledon number: Based on number of cotyledons it possesses it can be classified as dicots and monocots.

a. Monocots Eg. *Panicum flavidum, Echinochloa colona.*

b. Dicots Eg. *Crotalaria verucosa, Indigofera viscose.*

5. Based on soil pH: Based on pH of the soil the weeds can be classified into three categories.

a. Acidophile – Acid soil weeds eg. *Rumex acetosella*

b. Basophile – Saline & alkaline soil weeds eg. *Taraxacum sp.*

c. Neutrophile – Weeds of neutral soils eg *Acalypha indica.*

6. Based on morphology: Based on the morphology of the plant, the weeds are also classified in to three categories. This is the most widely used classification by the weed scientists.

a. Grasses: All the weeds come under the family Poaceae are called as grasses which are characteristically having long narrow spiny leaves. The examples are *Echinocloa colonum, Cynodon dactylon.*

b. Sedges: The weeds belonging to the family Cyperaceae come under this group. The leaves are mostly from the base having modified stem with or without tubers. The examples are *Cyperus rotundus, Fimbrystylis miliaceae.*

c. Broad leaved weeds: This is the major group of weeds as all other family weeds come under this except that is discussed earlier. All dicotyledon weeds are broad leaved weeds. The examples are *Flavaria australacica, Digera arvensis, Tridax procumbens.*

7. Based on nature of stem: Based on development of bark tissues on their stems and branches, weeds are classified as woody, semi-woody and herbaceous species.

a. Woody weeds: Weeds include shrubs and undershrubs and are collectively called brush weeds. Eg. *Lantana camera, Prosopis juliflora.*

b. Semi-woody weeds: eg.*Croton sparsiflorus.*

c. Herbaceous weeds: Weeds have green, succulent stems are of most common occurrence around us. Eg. *Amaranthus viridis.*

8. Based on specificity: Besides the various classes of weeds, a few others deserve special attention due to their specificity. They are, a. Poisonous weeds, b. Parasitic weeds and c. Aquatic weeds.

a. Poisonous weeds: The poisonous weeds cause ailment on livestock resulting in death and cause great loss. These weeds are harvested along with fodder or grass and fed to cattle or while grazing the cattle consume these poisonous plants. Eg. *Datura fastuosa, D. stramonium* and *D. metal* are poisonous to animals and human beings. The berries of *Withania somnifera* and seeds of *Abrus precatorius* are poisonous.

b. Parasitic weeds: The parasite weeds are either total or partial which means, the weeds that depend completely on the host plant are termed as total parasites while the weeds that partially depend on host plant for minerals and capable of preparing its food from the green leaves are called as partial parasites. Those parasites which attack roots are termed as root parasites and those which attack shoots of other plants are called as stem parasites. The typical examples are;

i. Total root parasite – *Orabanche cernua* on Tobacco
ii. Partial root parasite - *Striga lutea* on sugarcane and sorghum
iii. Total stem parasite - *Cuscuta chinensis* on leucerne and onion
iv. Partial stem parasite - *Loranthus longiflorus* on mango and other trees.

c. Aquatic weeds: Unwanted plants, which grow in water and complete at least a part of their life cycle in water are called as aquatic weeds. They are further grouped into four categories as submersed, emersed, marginal and floating weeds.

i. Submersed weeds: These weeds are mostly vascular plants that produce all or most of their vegetative growth beneath the water surface, having true roots, stems and leaves. Eg. *Utricularia stellaris, Ceratophyllum demersum.*

ii. Emersed weeds: These plants are rooted in the bottom mud, with aerial stems and leaves at or above the water surface. The leaves are broad in many plants and sometimes like grasses. These leaves do not rise and fall with water level as in the case of floating weeds. Eg. *Nelumbium speciosum, Jussieua repens.*

iii. Marginal weeds: Most of these plants are emersed weeds that can grow in moist shoreline areas with a depth of 60 to 90 cm water. These weeds vary in size, shape and habitat. The important genera that comes under this group are; *Typha, Polygonum, Cephalanthus, Scirpus, etc.*

iv. Floating weeds: These weeds have left that float on the water surface either singly or in cluster. Some weeds are free floating and some rooted at the mud bottom and the leaves rise and fall as the water level increases or decreases. Eg. *Eichhornia crassipes, Pistia stratiotes, Salvinia, Nymphaea pubescens.*

9. Based on economic importance:

a. Absolute weeds: Weeds which have no economic value and growing out of their proper place are called absolute weeds i.e. *Euphorbia hirta*, *Amaranthus spinosus*, *Anagallis arvensis* etc.

b. Relative weeds: Weeds which have some economic importance but are called weeds because these are growing out of their proper place i.e. *Saccharum munja* and *Typha latifolia* are used in cottage industry and *Phalaris*, *Avena ludoviciana*, *Cynodon dactylon* etc. can be used as fodders.

10. According to association: Weeds present in crop fields differ in their soil and climatic requirements, cultural requirement, morphology, seed size and food habits. They have intense association with particular climate and crop, thereby they come in particular season and crop. Accordingly, on the basis of association weeds are classified in three groups.

a. Season bound weeds: There are three seasons in a calendar year, monsoon, winter and summer. Accordingly, weeds grow in that particular season with disregard to crop species cultivated. There are weeds which are of perennial types but they are considered of particular season weed in which their major vegetative growth period is passed like *Sorghum halepense* is a summer perennial and *Circium arvense* is a winter perennial weed. Annual weeds which come in more than one season are called multi seasonal annual or multi annual weeds. Those weeds which complete their life within a season and propogate by seeds are of four types:

i. Monsoon annuals (Kharif annuals): *Ammania baccifera, Sagittaria Sagittifolia, ludwigia, parviflora, Cyperus difforamis, Echinochloa crusgalli* etc.

ii. Winter annuals (Rabi annuals): *Chenopodiumalbum, phalaris minor, Avena fatua Spergula arvensis, Vicia hirsuta, Molilotus alba* etc.

iii. Summer annuals: *Solanum nigrum, Portulaca oleracea, Argemone mexicana, Tephrosia purpurea* etc.

iv. Multi seasons annuals: *Echinochoa colonum, Eclipta alba, Phyllanthus niruri* etc.

b. Crop bound weeds or parasitic weeds: Crop bound weeds are also called parasitic weeds. Such weeds are dependent on specific host crop as they get nutrition for their survival and growth from host crop. Accordingly, weeds are classified as:

i. Total parasitic weeds: These weeds are totally dependent on host plants as they take moisture, nutrients and food from host plants e.g. *Orabache* sp. It is usually parasitized tobacco, tomato, carrot, sarson etc.

ii. Semi parasitic weeds: Those weeds are partly dependent on host plant and partly on their own are called semiparasitic weeds e.g. *Cascuta* sp like *Cuscuta reflexa* and *Cuscuta chinensis* and *Striga sp*. These weeds after germination of host crop seeds germinate and their radicles attach to the roots of host crops. After their germination they produce and synthesize food materials, but they take water and nutrients from the host crops.

iii. Non parasite weeds: Those weeds which are not dependent on any other plants. These weeds germinate, take nutrients from soil and synthesis their food for themselves e.g. *Cyperus rotundus, Echinochloa sp, Phalaris minor, Chenopodium* album etc.

c. Crop associated weeds: The crop associated weeds, like crop bound weeds, are also crop specific, but for different reasons they may be associated with certain crops for one of the following causes.

i. Need for specific microclimate: Weeds like *Cichorium intybus* "chicory" and *Coronopus didymus*- "swine cress" require for their best growth shady, cool, and moist habitat which is amply available in crop like lucerne and berseem. Such weeds, therefore, are associated with these crops.

ii. Mimicry: *Oryza sativa* var fatua "wildrice" in paddy field and *Avena fatua* "wild oat" and *Phalaris minor* "canary grass" in small grain crops survive because of their similarity in morphology with the host crops. So is true of *Loranthus* in the tea gardens. The resemblance of one organism to another or to an object in its surroundings for concealment or protection from predators is called mimicry. A weed like wild oat tends to grow to the height of winter grains and adjusts its ripening time to the crop over a wide varietal range. This kind of mimicry is called phenotypic mimicry. Crop mimicry is defined as the phenomenon whereby weeds develop morphological and or biochemical close resemblance to the life history of crop as to be mistaken for the crop and thus evade eradication. A situation where close similarity in appearance occurs between weeds and crops at seedling and vegetative stages is called vegetative mimicry e.g. wild rice *(Oryza longistaminata)* in cultivated rice; wild sorghum *(Sorghum halepense)* in cultivated sorghum; wild sugarcane *(Saccharum spontaneous)* in sugarcane. Seed mimicry is a situation whereby the similarities between weeds and crops is observed in seed weight, size and appearance e.g. similarity in seeds of upland rice and those of itch grass (*Rottboellia cochinchinensis*). Biochemical mimicry is a situation in which a weed develops resistance to a herbicide that has been used.

iii. Contamination of crop seeds: Weeds like *Oryza sativa* var. *fatua* (wild rice) in rice, *Phalaris minor* (canary grass), *Avena ludiciana* (wild oat) and *Convolvulus arvensis* (hiran khuri) in wheat, *Cichorium intybus* in berseem mature their seeds almost at the same height and time as that of respective crops. Seeds of these weeds are morphologically similar to associated crop seeds. Thus, they easily contaminate crop seeds at harvest time and cannot separated out by any method.

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Characteristics of Weeds

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Characteristics of Weeds

Weeds are also like other plants but have special characteristics that tend to put them in the category of unwanted plants. Knowledge about these features will help in developing suitable methods for their control by studying their most sensitive stage in their life cycle. Knowing the characteristics of weeds will help in studying the means of their adaptation as well as extent of loss which these weeds can render to human beings.

1. Weeds have rapid seedling growth and the ability to reproduce when young. Redroot pigweed can flower and produce seed when less than 8 inches tall. Crops cannot do either. *Phyllanthus niruri* has faster growth in groundnut.

2. Quick maturation or only a short time in the vegetative stage. Ephemerals have lifecycle of 1 month. Canada thistle can produce mature seed two weeks after flowering. Russian thistle seeds can germinate very quickly between 28° and 110°F in late spring (Young, 1991). It would spread more, but the seed must germinate in loose soil because the coiled root unwinds as it pushes into soil and is unable to do so in hard soil.

3. Dual modes of reproduction. Most weeds are angiosperms and reproduce by seed. Many also reproduce vegetative (e.g., Canada thistle, field bindweed, leafy spurge, quackgrass). *Cyperus rotundus* can propagate through tubers.

4. Environmental plasticity. Many weeds are capable of tolerating and growing under a wide range of climatic and edaphic conditions. Weeds have the capacity to withstand adverse conditions in the field, because they can modify their seed production and growth according to the availability of moisture and temperature. They can germinate under adverse soil-moisture conditions, have short period of plant growth, generally grow faster rate and produce seed earlier than most of the crops growing in association. *Rumex spinosus* can germinate in acidic soil

5. Weeds are often self-compatible, but self-pollination is not obligatory.

6. If a weed is cross-pollinated, pollination is accomplished by nonspecialized flower visitors or by wind.

7. Weeds resist detrimental environmental factors. Most crop seeds rot if they do not germinate shortly after

planting. Weed seeds resist decay for long periods in soil and remain dormant.

8. Weed seeds exhibit several kinds of dormancy or dispersal in time to escape the rigors of the environment and germinate when conditions are most favorable for survival. Many weeds have no special environmental requirements for germination. Weed seeds remain viable for longer period without losing their viability, e.g. annual meadow grass (*Poa annua*) and scarlet pimpernel (*Anagallis arvensis*) remain viable for about 8 years; creeping thistle (*Cirsium arvense*) for 20 years and field bind weed (*Convolvulus arvensis*) for about 20-50 years. *Cyperus rotundus* have 78% viability.

9. Weeds often produce seed that is the same size and shape as crop seed, making physical separation difficult and facilitating spread by man. *Cichorium intybus* in berseem. Some weeds resemble morphologically with the crop and are difficult to identify at weeding or hoeing.

10. Some annual weeds produce more than one seed crop per year, and seed is produced as long as growing conditions permit.

11. Each generation is capable of producing large numbers of seed per plant, and some seed is produced over a wide range of environmental conditions. Most of the weeds especially annuals produce enormous quantity of seeds, e.g. wild oats (*Avena fatua*), produces 250 seeds per plant, whereas wild amaranth (*Amaranthus viridis*) produces nearly 11 million seeds. *Striga juncea* produces 50 lakh seeds/plant;

Amaranthus viridis produces 1.78 lakh seeds/plant. It has been observed that among 61 perennial weeds, the average seedproduction capacity was 26,500 per plant.

12. Many weeds have specially adapted long- and short-range seed dispersal mechanisms. Weed seeds have a tremendous capacity to disperse from one place to another through wind, water and animals including man. Many of times, weed seeds mimic with the crop seeds due to their size and get transported from one place to another along with them. There is formation of special structure for effective dissemination. *Physallis minima* forms balloon structure.

13. Roots of some weeds are able to penetrate and emerge from deep in the soil. While most roots are in the top foot of soil, Canada thistle roots routinely penetrate 3 to 6 feet and field bindweed (*Convolvulus arvensis*) roots have been recorded over 10-20 feet deep. Roots and rhizomes are capable of growing many feet per year.

14. Roots and other vegetative organs of perennials are vigorous with large food reserves, enabling them to withstand environmental stress and intensive cultivation.

15. Perennials have brittleness in lower stem nodes or in rhizomes and roots, and, if severed, vegetative organs will quickly regenerate a whole plant.

16. Many weeds have adaptations that repel grazing, such as spines (*Solanum xanthocarpus*), taste, or odor.

17. Weeds have great competitive ability for nutrients, light, and water and can compete by special means (e.g., rosette formation, climbing, allelopathy). For example, *Echinochloa colona* is most competitive and aggressive in rice.

18. Weeds are ubiquitous. They exist everywhere we practice agriculture.

19. Weeds resist control/eradication, including resistance to herbicides. In spite of the anthropomorphic aspects of the definitions of weed and the multiple traits that weeds share, weed scientists have a clear idea of which plants are weeds. It seems that weeds are everywhere in almost every place.

Harmful Effects

Weeds have serious impacts on agricultural production. It is estimated that in general weeds cause 5% loss in agricultural production in most of developed countries, 10% loss in less developed countries and 25% loss in least developed countries. In India, yield losses due to weeds are more than those from pest and diseases. Yield losses due to weeds vary with the crops. Every crop is exposed to severe competition from weeds. Most of these weeds are self-sown and they provide competition caused by their faster rate of growth in the initial stages of crop growth. In some crops, the yields are reduced by more than 50% due to weed infestation. Weeds compete with crops for water soil, nutrients, light, and space, and thus reduce the crop yields. An estimate shows that weeds can deprive the crops 47% N, 42% P, 50% K, 39% Ca and 24% Mg of their nutrient uptake. Weeds are also act as alternate hosts that harbor insects, pests and diseases and other micro-organisms. Alternate hosts of some of the pest and diseases.

Beneficial Effects

In spite of all the difficulties caused by weeds, they can offer some beneficial properties, particularly when occurring at low densities. These aspects should be utilized in the farming system, although this may make organic management more complicated than chemical based systems. Some of the potential benefits of weeds are listed below:

1. Helping to conserve soil moisture and prevent erosion. A ground cover of weeds will reduce the amount of bare soil exposed helping to conserve nutrients, particularly nitrogen which could otherwise be leached away, especially on light soils.

2. Food and shelter can be provided for natural enemies of pests and even alternative food sources for crop pests. The actual presence of weed cover may be a factor in increasing effectiveness of biological control of pests and reducing pest damage.

3. Weeds can also be valuable indicators of growing conditions in a field, for example of water levels, compaction and pH.

4. Weeds can be an important source of food for wildlife, especially birds. Bird populations have been declining on farmland over the last few decades and leaving weeds as a resource has been shown to help revive bird populations.

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Special Weed Problems Including Aquatic and Parasitic Weeds

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Special Weed Problems Including Aquatic and Parasitic Weeds

Weed flora of India is very rich. These plants pose a lot of management problem and adversely affect the productivity besides incurring heavy costs in preventive and damage control measures. It is generally very difficult to distinguish between native and exotic species, as they grow intermixed. Exotic invasive species, however, are usually confined to the areas managed or otherwise influenced by man and his dispersing agencies.

Weeds have been classified into the following three categories (Babu, 1977):
1. Category I: This group comprises of the species, which are thoroughly naturalized and appear to behave as wild plants. These plants are of tropical American origin and are usually obnoxious. They have Napoleonic ambitions to colonize new areas. Members of *Asteraceae, Amaranthaceae, Solanaceae, Malvaceae, Brassicaceae*, etc. belong to this category.

2. Category II: This group includes the plants of cultivated origin that have become naturalized or run wild. These weeds represent the members of the families such as *Solanaceae, Cucurbitaceae, Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Convolvulaceae,* etc.

3. Category III: Species falling under this category are exclusively cultivated, and also met with as escapes which include members of *Acanthaceae, Caryophyllaceae, Malvaceae, Asteraceae, Poaceae, Amaryllidaceae,* etc. Similarly based on his studies of the flora of the Garhwal Himalayas, Gaur (*Flora of the District Garhwal, Northwest Himalaya1*: 1999) has categorized weeds of the northwest Himalayas according to their seasonal appearance e.g.

a. Weeds appearing in the rainy season.
b. Weeds appearing in the winter and spring season.

The weed flora of North-eastern India is very diverse. Weeds of north-east are required to be taxonomically evaluated in terms of their rich genetic and species diversity. Exotic weeds, owing to their aggressive nature can expand their zone of occupancy in quick succession, spread over large tracts, and endanger the natural elements of flora and bring about abrupt changes in floristic composition. With seasonal variations invasive species pass through vigorous reproductive phases without any obstruction and hinder the efforts to eradicate them. Invasive plants have appeared at different times and have always sustained and multiplied at the cost of indigenous species. They have occupied vast areas and have even driven many indigenous species into red data categories.

In North-eastern India, there are some recent districts, regional and state level floras in addition to Kanjilal's classic work: *Flora of Assam* but for an accurate and up to date inventorization and taxonomic characterization of weeds, a detailed floristic study is the most desirable proposition. Dutta (*Some Common Weeds of the Tea Estates in North-East India,* 1982) worked on the weed flora of the region but confined himself to the tea estates. Impact of a few major invasive is explained below:

a. *Lantana camara* is one of the most obnoxios weeds that has encroached most of the areas under community and reserve forestlands. The outer fragile Himalayas are almost completely encaptured by this rapidly spreading weed. This weed, not only ruins common agricultural and forestlands but also makes shade as well as allelopathy impacts on the regeneration of important forestry species. Due to spread of *Lantana*, the yields of crops and pastures get reduced. The harvesting costs have increased manifolds. Heavy expenditure is incurred for afforestation of lands infested with this weed which requires frequent weeding so as to avoid suppression of young seedlings of planted species. Afforestation cost is also increased due to loss of stand and slower growth rate due to weed competition. *L. camara* is toxic to cattle and cost towards its control was US$70 per hectare (Singh et al., 1996). The economic loss from *Lantana* is estimated to be US$924 million per year.

b. *Parthenium* is difficult to control as it seeds prolifically. Seed germinates readily and the plant tolerates a wide variety of conditions. The weed is a menace to agriculture because it has allopathic effect and competes with pastures and reduces their carrying capacity. The weed affects human and animal health by causing respiratory problems, severe dermatitis and tainted milk.

c. *Eupatorium glandulosum* is found in the temperate region of the south and the north; ecological disruptions have given way to this weed. This weed spreads fast and checks the regeneration of other species particularly in Western Ghats and has replaced the valued flora at places. It comes in disturbed soils. In most of the goat travelled paths, it comes up well; that is why it is locally known as '*goat weed'*. Since the plant has no local or commercial use, it has widely spread in denuded and forestlands.

d. *Ulex europaeus* represents a fire hazard to private property in the Western Ghats. It invades watersheds, which supply a substantial amount of drinking water. It is threatening agricultural and grazing lands. Thickets of this weed are impenetrable to humans and have persistent spiny litter.

e. *Acacia mearnsii* was introduced in Western Ghats particularly in the Nilgiris to provide fuelwood to the rural people to save the shola forests, which were degraded in the past by human activities. It was also planted in the tea gardens to provide shade to the tea plants but now it has covered most of the shola forests and become menace in the Nilgiri Hills. Regeneration of shola forests is affected due to profuse regeneration and invasive nature of this species.

f. *Mikania micrantha* is a perennial fast growing weed of Neotropical origin and has become a major menace to the natural forests, plantations and agricultural systems in North-east and South-west India. This weed spreads very fast in areas where canopy is open.

g. *Cytisus scoparius* was introduced from European countries in the Western Ghats for ornamental purposes but now it has become menace in the Nilgiri Hills particularly in the shola forests and grazing lands. It reduces the regeneration of shola species and invades on the grasslands, thus decreases the production of grass for the cattle of Nilgiris. This species spreads fast in the areas distributed by forest fires or other biotic interferences.

h. *Euphorbia royleana* in the Himalayan zones comes up profusely and has covered thousands of hectares of land. This plant represents a desert environment. Being cactus in habit, it has no use in conserving or making of soil. Similarly, in this zone there are a few other plants viz. *Artemisia vulgaris, Carrisa carander and Dodonea viscosa,* which have spread like weeds and have large areas under their control. *Cannabis sativa* has canvassed most of the deforested and community lands, complicating land management. Besides the above, unabated free grazing and intense human activities have led the way too many other plant species having no use in supporting ecology and economy of the region. These are *Agave catula, Ageratum conizoides, Ageratum houstonianum, Cassia tora, Clerodendron viscosum* etc. *Mikania micrantha, Prosopis juliflora, Cabomba caroliniana,* and *Salvinia molesta* are worth mentioning aliens. Invasive alien weeds are *Lantana camera*, *Chromolaena odorata*, *Eichhornia crassipes, Opuntia dillenii, Mimosa pudica, Lippia geminate*, and *Jaropha gossipifolia* (Viraktamath, 2002). *Parthenium hysterophorus, Phalaris minor* (Diwakar, 2003), *Eupatorium glandulosum, Ulex europaeus, Acacia mearnsii, Cytisus scoparius*, *Opuntia vulgaris, Prosopis chilensis, Euphorbia royleana* (Srivastava and Singh, 2009) are also invasive. Weeds cause an estimated 30% loss in crop production (Singh, 1996) which worth more than US$90 billion per year.

Two prominent invasive alien plants in India are *Eupatorium odoratum* and *L. camara* amongst the World's worst invasives. These weeds originated in the Neotropical region and were introduced into India through the Calcutta Botanical Garden during the last century (Muniappan and Viraktamath, 1993). Other highly invasive Neotropical plants established in India are *M. micrantha*, and *P. hysterophorus*. *Mimosa invisa* has rapidly expanded its range in the Western Ghats (Ramkrishnan *et al*., 1996). A comprehensive inventory of the invasive alien flora in the state of Uttar Pradesh, India revealed 152 species from 109 genera and 44 families (Singh *et al*., 2010). The invasive species cause heavy losses to agricultural and forest production, blocking of water bodies, water transport ways, affecting wildlife habitat in the forests and wetlands and commercial activities such as cultivation of medicinal plants etc.

Aquatic Weed Problems in India

In India, many rivers, irrigation canals, lakes both natural and manmade, are choked by the explosive growth of aquatic weeds, resulting in enormous direct losses. Besides different type of algae, the most important representatives of aquatic weeds in India are *Eichhornia* (free floating), *Nymphaea stellata* (rooted floating), *Nelumbo nucifera* (rooted floating), *Hydrilla verticillata* (rooted submerged), *Typha angusta* (emergent), *Saggittaria* sp, *Potamogeton* sp (rooted submerged), *Pistia stratiotes* (free floating) and *Salvinia molesta* (free floating), *Azolla caroliniana*, *Alternanthera philoxeroides*, *Polygonum* sp, *Cyperus* sp etc. Although no precise estimates of the losses caused by aquatic weeds are available but it is estimated that submerged aquatic weeds like *Hydrilla*, *Ottelia*, *Valisnaria*, *Najus*, *Utricularia*, *Chara* etc, caused 50-60% loss of the cultivable water in Assam, Bihar, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal making them unsuitable for fish culture. Even the cultivation of the water chestnut (*Trapa bispinosa*) for edible purposes in these states is hampered by the presence of aquatic weeds.

Eutrophication has led to increasing weed problems in reservoirs. Holm *et al*. (1991) reported that in the Chambal Project in India, submerged aquatic had cut the flow of water by 80% in the canals. Vast areas of lowland paddy in the north eastern parts of India and Kerala state are badly infested with aquatic weeds. While in the north-east, *E. crassipes*, *Chara* sp, *Nitella* sp and algal scams are nuisance, in the coastal Kerala *Salvinia* plays havoc. Irrigation supply to paddy is hindered in about 1.6 lakh ha area in North eastern India alone. Added to this, several hectares of cultivable food plains are surrendered to noxious aquatic vegetation. Cultivation of *Trapa bispinosa* 'water chestnut' is also abandoned in east India because of water hyacinth and other aquatic weeds in water bodies. Mostly of fishery tanks and ponds in and around Bangalore and other cities have been badly invaded by water hyacinth. Among the floating weeds, particularly in Punjab, water hyacinth is the main problem. Of the 8-lakh ha of freshwater available in India for pisciculture, about 40% is rendered unsuitable for fish production because of invasion by aquatic weeds. Some of the weeds like *Eichhornia*, *Azolla*, *Nymphaea*, *Nelumbo*, *Nymphoides*, *Hydrilla*, *Vallisneria*, *Potamogeon*, *Najas*, *Muriophyllum*, *Ceratophyllum*, *Typha Utricularia* sp, are problemaric weeds in fishery lakes and tanks of AP, Assam, Haryana, Himachal Pradesh, Jammu and Kashmir, Maharastra, Tamil Nadu and Uttar Pradesh in India. Some of the well-known fishery lakes like Barwar, Ramgarh and Guiar lake in Uttar Pradesh, Ansupa lake in Orrissa, Ooty lake in Tamil Nadu, Kollern lake in Andhra Pradesh, Lotak lake in Manipur and the world-famous Dal, Nagin and Wular lakes in Kashmir have been largely invaded by the aquatic weeds.

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Why Farmers Today Need to Take Up Precision Farming

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Precision agriculture refers to application of technology and principles to manage temporal and spatial variability associated with all aspects of agricultural production for the purpose of improving crop performance and environmental quality. Precision farming differs from traditional agriculture by its level of management wherein instead of managing the whole fields as a single unit, management is customized for small areas within the same field. Precision farming is suitable when the holdings are large and variable exists in the field. In India the holdings are small even with the large farmers. Only in the states of Punjab, Rajasthan, Haryana and Gujarat do more than 20 per cent of agricultural lands have an operational holding size of more than four ha. Commercial as well as horticultural crops also show a wider scope for PA in the cooperative farms.

Precision farming in the Indian context is precise application of inputs based on soil wealth and crop requirement for maximizing productivity, profitability and quality on a sustainable basis. The basic steps in precision farming are,
1. Assessing variability.
2. Managing variability.
3. Evaluation.

The available technologies enable us in understanding the variability. By giving site specific agronomic recommendations we can manage the variability that make precision agriculture viable. Finally, evaluation must be an integral part of any precision farming system.

An information and technology-based farm management system identifies, analyses and manages variability in fields by conducting crop production practices at the right place and time and in the right way, for optimum profitability, sustainability and protection of the land resource.

Although a considerable research effort has been expended, it is still only a portion of farmers who have practiced any type of precision agriculture (PA) technologies system approach to re-organize the total system of agriculture towards low-input, high-efficiency and sustainable agriculture.

Sustainable PA is this century's most valuable innovation in farm management that is based on using Information and Communication Technologies (ICTs). This is the most recent innovation technology based on sustainable agriculture and healthy food production and it consists of profitability and increasing production, economic efficiency and the reduction of side effects on the environment.

Challenges

Research suggest educational and economic challenges as the two most important in the application of precision agriculture. Among the variables that contribute to educational challenges, lack of local experts, funds, knowledgeable research and extension personnel have more of an impact compared to others. PA and initial costs have more of an impact among the economic challenges compared to the other issues.

Why Precision Farming

1. Increases agriculture productivity.
2. Reduces soil degradation.
3. Prevents high chemical application in crop production.
4. Optimum use of water resources.
5. Dissemination of modern farm practices to improve quality, quantity and reduced cost of production.
6. Create favorable attitudes.
7. Precision farming changes socio-economic status of farmers.

Advantages

1. Agronomical perspective.
2. Technical perspective.
3. Environmental perspective.
4. Economic perspective.

Precision Farming Enables Climate-Smart Agri-Business

Climate-smart agriculture is necessary for achieving the goal. PA at the appropriate level in food insecure countries is also a powerful tool once it is applied appropriately, based on local crop and site-specific conditions. Consequently, the adoption of new techniques in less-developed areas should start with a basic, affordable, and effective mix of technologies and practices.

1. Drip irrigation: In addition to its advantages over other types of irrigation for improving yields, drip irrigation is the best delivery system for soluble fertilizers. It also drastically reduces the propagation of weeds and the need for herbicides.

2. Solar pumps: Solar pumps that lift well water to feed drip systems are a benefit multiplier. Yet the introduction of solar pumps is slow despite their zero-carbon footprint and low-maintenance photovoltaic technology. According to official estimates, over twenty million well pumps operate today in India, roughly split between electric and diesel at a solar unit cost ranging from $1,500 to $10,000 for multiple farmers. Changes to subsidy policies now underway may help pave the way for mass adoption and hence further increase the role of private firms contributing to the proliferation of solar pumps.

3. Soil and crop monitoring: Imagery-equipped drones are often technically and financially affordable for small farmer communities, also particularly suited for small plots and contract farming. Early detection and correction of soil and crop deficiencies is a win-win proposition for both farmers and off-takers. If purchased and operated by large agri-businesses, the investment in drones and imagery analysis can be factored into the produce price paid to farmers.

Extending the usage of equipment for soil and crop monitoring to farming cooperatives and contract farms also benefits from new forms of capex utilization led by the private sector, now spreading from developed countries into emerging markets.

4. Technology: This include a vast array of tools of hardware, software and equipment:

- a. Global Positioning System (GPS) receivers.
- b. Differential Global Positioning System (DGPS).
- c. Geographic information systems (GIS).
- d. Remote sensing.
- e. Variable Rate Applicator.
- f. Combine harvesters with yield monitors.

The Policy Approach to Promote Precision Farming at Farm Level

1. Identify the niche areas for the promotion of crop specific precision farming.
2. Creation of multidisciplinary teams involving agricultural scientists in various fields, engineers, manufacturers and economists to study the overall scope of precision agriculture.
3. Provide complete technical backup support to the farmers to develop pilots or models, which can be replicated on a large scale.
4. Pilot study should be conducted on farmers' fields to show the results of precision agriculture implementation.
5. Creating awareness among farmers about consequences of applying imbalanced doses of farm inputs like irrigation, fertilizers, insecticides and pesticides.

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Moringa - An Alternative Fodder

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Keywords: Alternative fodder, Moringa.

Introduction

India has vast livestock resources and ranks first in milk production (176.34 million tonnes) with meat production of 7.70 million tonnes (DAHD & F 2018-19). However, the productivity of individual animal is very low as compared to other countries. It might be due to several reasons but inadequate availability of feed and fodder is the main reason. Feed and fodder expenses constitutes to about 65 per cent of the total expenses on livestock rearing. Fodder trees leaves are preferred by several livestock animals such as sheep and goats. Fodder trees can be grown alongside the farm bunds and also in and around the farm in many parts of the world including arid and semi-arid regions. In such areas, fodder trees play vital role in supplying nutritious fodder for animals especially during the time of fodder scarcity. Among the several known fodder tree species, Moringa *(Moringa oliefera)* is gaining popularity in various parts of the world including India. It is a multipurpose tree species having potential to reduce the dependence on expensive conventional protein supplement or high cost concentrate feed, and thus proved to be a boon for livestock and dairy sectors.

Fig. 1 Moringa Tree

Characteristics of Moringa

Moringa also known as drumstick is a perennial tree species. It can be grown on marginal lands. Due to its deep root system it is able to withstand drought and requires less water compare to other trees, and can also tolerate high temperature. It is fast growing tree species having non-woody stem and succulent leaves which are preferred as a fodder by the animals, and can be fed without chaffing and thus, save the energy. It produces more flushes of leaves and requires frequent cuttings due to fast growing nature.

It is rich in protein, minerals and vitamins, and thus considered as miracle fodder tree species. Besides, it is relished by the ruminant animals due to palatability, and is also safe for feeding.

Nutritional Value

Morinaga is rich in several nutrients, minerals and rich in proteins. Besides, it is good source of pro-vitamin A, vitamin B, vitamin C and E, some carotenoids and amino acids like cysteine and methionine.

Table-1 Nutritional Profile of Moringa oleifera

Sr No.	Particulars	Content
1	Metabolizable energy (MJ/kg DM)	9.30
2	Organic matter digestibility (%)	72.0
3	Ash(%)	13.2
4	Crude fiber (%)	10.0
5	Crude protein (%)	28.9
6	Fat (%)	6.73
7	Nitrogen Free Extracts (NFE) (%)	45.0
8	Neutral detergent fiber (NDF) (%)	16.7
9	Non fiber carbohydrate (NFC) (%)	38.4
10	Acid detergent lignin (%)	6.49
11	Cellulose (%)	5.59
12	Hemicelluloses (%)	4.66
13	Calcium (%)	2.62
14	Phosphorus (%)	0.43
15	Magnesium (%)	0.56
16	Potassium (%)	2.0
17	Sodium (%)	0.03

(Source: www.vikaspedia.in)

Agronomic Management (Source: www.dairyknowledge.in)

1. Varietal wealth: Moringa tree variety PKM-1 or PKM-2 should be selected for higher green biomass production.

2. Soil and climate: Deep sandy loam soil is best suited. It is drought resistant crop hence requires dry climate. In heavy rainfall area care should be taken that field should not get waterlogged.

3. Propagation: It can be propagated through seeds or stem cuttings. Use of seed is most reliable and quick method of propagation. About 40 to 50 kg per hectare seeds are required for spacing of 30 x 30 cm. It can be sown throughout year except rainy season where rainfall is very high.

4. Manures and fertilizers: At time of land preparation 10 t/ha farm yard manure should be well mixed with soil. Recommended fertilizer doses of nitrogen (N), phosphorous (P) and potash (K) is 150: 60: 40 kg per ha, respectively. Full dose of P and K, and 30 kg/ha nitrogen should be applied at time of sowing and remaining dose of N in equal splits after each cutting.

5. Irrigation: During winter and summer season irrigations should be given at 15-20 days interval or when it is needed. During rainy season proper drainage of excess water should be done.

6. Weed management: Spraying of pre-emergence herbicide (pendimethalin @1.25 litre/ha) just after sowing followed by hand weeding is required for effective weed control.

7. Harvesting and yield: It becomes ready to harvest 3 months after sowing for fodder purpose while, subsequent cuttings can be done at 60 days interval. Average green fodder yield from 5 to 6 cuttings ranges from 100 to 120 t/ha per year.

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Abasement of Biodiversity and Risk of Pandemic Diseases

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Introduction

Now, the world is in the grips of a global pandemic, the like of which has never been seen before. The COVID-19 that has swept through countries and continents has caused untold human suffering, social upheaval and economic damage. But, while the spread of the current crisis is unprecedented, the new coronavirus follows a number of diseases that have emerged in recent decades, such as Ebola, AIDS, SARS, avian influenza and swine flu. All originated in animals and there is increasing evidence that humanity's over exploitation of nature is one of the factors behind the spread of new diseases (Galaverni et. al., 2020).

Human activities have significantly altered three-quarters of the land and two-thirds of the ocean, changing the planet to such an extent as to determine the birth of a new era: the "Anthropocene". Changes in land uses that bring wildlife, livestock and humans into closer contact with each other and facilitate the spread of diseases, including new strains of bacteria and viruses (Kilpatrick and Randolph, 2012 and Morse et. al., 2012). Meanwhile, illegal and uncontrolled trade of live wild animals creates dangerous opportunities for contact between humans and the diseases these creatures carry. It is no coincidence that many recent outbreaks have originated in markets that sell a mix of wild and domestic mammals, birds and reptiles, creating the conditions for the development of old and new zoonoses: infectious diseases that can be transmitted from animals to humans (Galaverni et. al., 2020). This article illustrates the link between humanity's impact on ecosystem and biodiversity and the spread of diseases.

What is Biodiversity?

The term biodiversity or biological diversity refers to the variety of life on earth at all its levels, from genes to ecosystem and can encompass the evolutionary, ecological and cultural processes that sustain life. Biodiversity includes not only species we consider rare, threatened or endangered but also every living thing (from humans to organisms) we know little about, such as microbes, fungi and invertebrates (American museum of natural history, 2020).

Importance of Biodiversity

Biodiversity is important to most aspects of our lives. We value biodiversity for many reasons, some utilitarian and some intrinsic. This means we value biodiversity both for what it provides to humans and for the value it has in its own right. Utilitarian values include the many basic needs humans obtain from biodiversity such as food, fuel, shelter and medicine. Further, ecosystem provides crucial services such as pollination, seed dispersal, climate regulation, water purification, nutrient cycling and control of agricultural pests. Biodiversity also holds value for potential benefits not yet recognized, such as new medicines and other possible unknown services (American museum of natural history, 2020).

Threats to Biodiversity

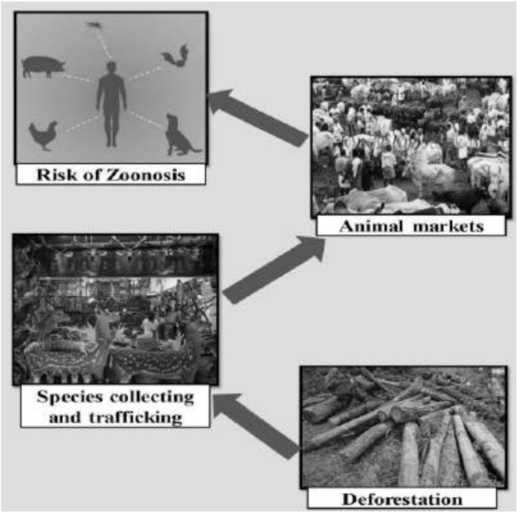
Biodiversity is under serious threat as a result of human activities. The main dangers worldwide are population growth and resource consumption, climate change and global warming, habitat conversion and urbanization, invasive alien species, over-exploitation of natural resources and environmental degradation.

What is Pandemic Disease?

A pandemic is the global outbreak of a disease. There are many examples in history, the most recent being the COVID-19 pandemic, declared as such by the World Health Organization on March 12, 2020. Pandemic are generally classified as epidemic first, which is the rapid spread of a disease across a particular region or regions.

COVID-19 began as an epidemic in china, before making its way around the world in a matter of months and becoming a pandemic. But epidemics don't always become pandemics and it's not always a fast or clear transition. For example, HIV was considered an epidemic in West Africa for decades before becoming a pandemic in the late 20th century. Now, thanks to advances in modern medicine, HIV is considered endemic, which means the rate of the disease is stable and predictable among certain populations, according to the American Medical Association. Most of the epidemic/endemic/pandemic diseases were transmitted to humans from other animals (Zoonosis).

The Pathway of Pandemic



Zoonosis and their Impact

A "zoonosis" is any disease or infection transmitted to humans from other animals. Zoonotic diseases include a diverse group of infections, which can be caused by viruses, bacteria, fungi and other organisms or abnormal protein agents (prions). Rabies, leptospirosis, anthrax, SARS, MERS, yellow fever, dengue, HIV, Ebola, Chikungunya and coronaviruses are all zoonotic, as is the most widespread flu. So is malaria carried by mosquitoes, which is responsible for more than 4,00,000 deaths every year. So too was the bubonic plague caused by the Yersina pestis bacterium transmitted to our species by fleas on rats, which in the Middle Ages killed up to a 1/3rd of the European population (Galaverni et. al., 2020).

Of all the emerging diseases, zoonoses of wildlife origin represent one of the most significant threats to the health of the world population (Jones et. al., 2008.). Three quarters of human diseases known to date come from other animals and 60 % of emerging diseases have been transmitted by wild animals. Zoonoses each year cause around one billion cases of disease and millions of deaths (Morse et. al., 2012) with incalculable human consequences.

Public Enemy Number One: COVID-19

Corona viruses are a large family of viruses widespread in many animal species, including humans. While many have no negative effects, they can cause illnesses ranging from the common cold to more serious diseases such as the Middle East respiratory syndrome (MERS, which first appeared in Saudi Arabia in 2012) and the severe acute respiratory syndrome (SARS, which emerged in Guangdong province in southern China in 2002). The virus responsible for the current pandemic is a new strain that has never before affected humans.

The World Health Organization (WHO) has given the disease the official name COVID-19, short for COrona VIrus Disease-2019, while the International Committee on Taxonomy of Viruses (ICTV) has assigned the official name SARSCoV-2 (severe acute respiratory syndrome coronavirus 2) to the virus that causes the disease. This name was chosen because the virus is genetically related to the coronavirus responsible for the SARS outbreak. While related, the two viruses differ in two fundamental characteristics: SARS-CoV-2 has a lower mortality rate but is more contagious than SARS (Galaverni et. al., 2020).

The new coronavirus can cause mild symptoms such as a cold, sore throat, cough and fever, or more severe symptoms such as pneumonia, severe acute respiratory syndrome and kidney failure (Wang et. al., 2020). While most of those infected will recover, many require hospital treatment, threatening to overwhelm health services. And for a minority, the complications can be fatal. Many thousands of lives have already been lost.

Wildlife Trafficking, Bushmeat and Pandemics

The unregulated trade in wild animals and direct contact with animal parts exposes human to contact with viruses and other pathogens hosted by those species. Contact with wild species such as bats, Asian palm civets, monkeys, pangolins and others can lead to the onset and contribute to the spread of serious zoonoses (Johnson et. al., 2015). It is no coincidence that recurrent outbreaks of Ebola have been linked to the hunting, butchering and processing of meat from infected wild animals.

Throughout history, human beings have hunted wild animals for meat. Today, bushmeat consumption is growing dramatically in many parts of the world. It can be an important source of nutrition for low-income and food-insecure households in forests and rural areas, particularly in Africa (Friant et. al., 2020). As well as being hunted for subsistence consumption, bushmeat may be sold in nearby villages, transported to cities and even trafficked to distant countries via illegal trade routes. In rural areas, it is the lower income households that consume more bushmeat. But in urban areas, the opposite applies: wild meat is preferred for its flavor and the price is higher than domestic meat. Some African and Asian diaspora communities also consume bushmeat, supporting a lucrative illegal international market.

As bushmeat consumption and trade grow, hunting, transportation, handling and cooking practices that do not follow food safety standards pose risks to human health, including through the transmission of pathogens (Vliet et. al., 2017). Wild animals or those that are captured and bred in captivity for consumption of meat or other parts have enormous potential to transmit viruses, particularly when packed close together. As they scratch. Defecate, urinate, cough and sneeze, they can contaminate each other and more worryingly contaminate humans. Moreover, the close proximity of different species in animal markets increases the chances for the genetic recombination between different viruses and spillover into new species.

The risk of pandemics, as highlighted by the current coronavirus crisis, underlines the urgent need for decisive global action to safeguard people's lives and health.

Ecosystem Damage and Human Health Risk

Natural ecosystems have a crucial role in supporting and nourishing life, including ourselves. Altering these ecosystems can aid the development and spread of infectious diseases. The loss of habitats, the modification of natural environments and more generally the decline in biodiversity are all factors in the spread of emerging infectious diseases. This can happen through various mechanisms, such as Increased breeding sites for disease vectors, such as irrigation channels and dams where mosquitoes proliferate, Increased spread of host species, Keeping wild species captive in close contact with each other and with domestic animals, Transfer of pathogens between different species, Loss of predatory species, Human induced genetic changes in disease vectors or pathogens, Environmental contamination by infectious disease agents (Galaverni et. al., 2020).

Land-use change, including deforestation and the modification of natural habitats, are held responsible for nearly half of emerging zoonoses (Loh et. al., 2015).

Conclusion

Biodiversity loss describes the decline in the number, genetic variability and variety of species and the biological communities in a given area. This loss in the variety of the life can lead to a breakdown in the functioning of the ecosystem where decline has happened. Altering these ecosystems can aid the development and spread of infectious diseases. The fallout from the COVID-19 pandemic will dominate the global agenda for the foreseeable future. As a global community, it is crucial that we take steps to reduce the risk of future pandemics. Some of the most important actions we can take are to crack down on illegal wildlife trade and close unregulated wildlife markets; and to preserve intact ecosystems and restore the health of those that have been degraded. As we survey the devastation wreaked by the coronavirus, we must take this time to reflect and to harness the power of nature to prevent future health crises.

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Government Initiatives for Doubling the Farmers Income by 2022

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Introduction

Agriculture and allied sector provide livelihood to 54.6% of the population of India (census 2011) and it contributes 14.4% to the country's Gross Value Added (2018-19) as per Economic Survey 2019. India ranks among the top countries in the world in production of a number of crops including rice, wheat, sugarcane, fruits and vegetables. Farmers are, and will remain the drivers of Agricultural sector. Since the development of Farm mechanization in India is still below the mark due to several factors like small land holdings, equipment cost and poor credit availability, the role of farmer in agriculture holds crucial importance and it is our imperative to ensure that farmers find Agriculture as a profitable economic activity.

In this backdrop, National Commission for Farmers was constituted in 2004, chaired by Prof. M. S. Swaminathan, to suggest methods for faster and more inclusive growth for farmers. Then, the Government of India in 2016 constituted an expert committee headed by Ashok Dalwai to look into the entire agriculture ecosystem in the country to suggest ways and means to reform it so that farmers' income can be doubled by 2022. The Committee submitted its final report to the Government in September 2018. Now, the government is in the process of setting up a panel to monitor the implementation of the recommendation of the Doubling Farmers' Income (DFI) committee.

Current Status of Farmers' Income

1. The estimates for farmers' income are not published by CSO. The absence of adequate information makes it difficult to analyses the growth trends in farmer's income.
2. According to NSSO survey, for the year 2012-13, the average annual income for a farm household from farm as well as non-farm source was Rs.77,112.
3. A study by Chand et al in 2015 reveals that it took 22 years (1993-94 and 2015-16) to double the farmers' real income.
4. More than 20% of the farmers in India are Below Poverty Line.

Honourable Prime Minister Advocated 7-point Strategy

1. Per drop more crop.
2. Provision of quality seeds and nutrients based on soil health.
3. Large investments in warehouse and cold chains to prevent post-harvest crop losses.
4. Promotion of value addition through food processing.
5. Creation of national farm market- e-platform.
6. Introduction of new crop insurance scheme.
7. Promotion of ancillary activities like poultry, bee keeping, fisheries etc.

Various Government Initiatives Operated to Achieve the Goal

1. Higher production through productivity gains:

a. NFSM for cereals, pulses, oilseeds and commercial crops.
b. Mission for Integrated Development of Horticulture (MIDH).
c. NMOOP (National Mission on Oilseeds and Oil Palm).
d. Rashtriya Gokul Machine- launched Dec 2014 (For gene pool of indigenous cattle and buffaloes).
e. National livestock machine-launched 2014-15 (Intensive development of small livestock-Sheep/goat, poultry etc).
f. Blue revolution-launched Dec 2015 (Enhancing production and productivity of Integrated Inland and Marine Fisheries Resources).

2. Reduction in cost of cultivation:

a. Soil Health Cards (2 years cycle).

b. Neem Coated Urea
c. PMKSY (Pradana Mantri Krishi Sinchai Yojana)- Har keth kho pani
d. PKVY (Parampargat Krishi Vikas Yojana)

3. To ensure remunerative returns:

a. E-NAM (National Agriculture Market scheme) One Nation One Market
b. The Agricultural Produce and Livestock Marketing Promotion and Facilitation act 2017
  i. Setting up of private markets
  ii. Direct marketing
  iii. Special commodity markets
  iv. Declaring warehouses/ silos/ cold storages as market sub yards
c. Ware housing and post-harvest loans
d. MSP (Minimum Support Price)
e. PSS (Price Support Scheme)- Procurement of oilseeds, pulses by central agencies
f. MIS (Market Intervention Scheme) – Procurement of agriculture and horticulture products which are perishable and not covered under PSS.

4. Risk management and sustainable practices:

a. Pradana Mantri Fasal Bhima Yojana (PMFBY) and Restructured Weather based Crop Insurance Scheme (RWCIS)- covers post-harvest risks.
b. Mission for organic farming in North-east.

5. Allied activities:

a. Har Madh Par Ped- launched at 2016- encourage tree plantation on farm land with crops.
b. National Bamboo Mission- launched 2018-19.
c. Bee keeping.
d. Dairying- National Dairy Plan1.
e. National Dairy Development programme.
f. Dairy entrepreneurship development scheme.
g. Fisheries- Blue revolution.

6. Investment in agriculture: Rashtriya Krishi Vikas Yojana (RKVY).

7. Operation greens: TOP (Tomato Onion Potato) - government proposes to launch Operation Greens just like operation flood. Operation greens promotes FPOs.

8. Pradan Mantri Kisan Sampadha Yojana (Scheme for agro marine processing and development of agro processing clusters):

a. Mega Food Parks.
b. Integrated Cold Chain and value addition infrastructure.
c. Creation/ Expansion of food processing and preservation capacities.
d. Infrastructure for agro processing clusters.
e. Creation of backward and forward linkages.
f. Food safety and quality assurance infrastructure.
g. Human resources and institutions strengthening.

9. Capital investment in agriculture:

a. AMIF (Agri Market Infra Structure Fund)- development of 22,000 rural huts.
b. Micro irrigation fund.
c. FIDF (Fisheries and Aquaculture Infrastructure Development Fund).
d. DIDF (Dairy processing and Infrastructure Development Fund).
e. Fund for integrated development of sheep, goat, piggery and poultry- encourage entrepreneurship modernization of poultry farms establishment or strengthening of district level Semen station for goat, sheep and pig.

Conclusion

The recent initiatives taken by the Government are definitely steps taken in the right direction. The agreements signed between India and Israel further underscore the fact how water management, and judicious usage of limited resources is vital for a thriving agricultural sector.

1. Recent developments further underscore the fact that India urgently needs to diversify its cropping pattern- this will help conserve moisture and thus help in judicious usage of resources. Efforts described above can further the objective of the Government of doubling farmer's income by the year 2022.
2. Such an effort would involve the collective participation of various stakeholders, including the wider farming community, pressure groups, private sector, banking sector, and both the central and state governments.

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Why Productivity of Pulses Remain Stagnant in India?

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Introduction

Pulses which are also known as poor men's meat are regarded as the cheapest source of protein for a largely vegetarian Indian population. According to NSSO 68TH round, cost of obtaining 1 kg protein from pulses is found to be almost half of the cost incurred from other animal sources. Despite of India being world's largest producer and consumer of pulses, Indians are among most protein deficient people in world.

Declining availability of pulses due to stagnant growth in production and productivity has naturally raised the cost of pulses leading to persistent problem of food price inflation. Total supply of pulses in India declined while net imports rose from 0.06 MT in 2000-01 to 6.6MT in 2016-17. But in recent years, scarcity has turned into surplus causing near-famine to near-feast like condition. In 2013-14 bumper harvest of 19 MT was followed by 2 subsequent draught years leading to markets prices touching sky high and rising imports due to lower prices in International market.

This was followed by two years of good monsoon and increased MSP in 2016-17 and 2017-18 again translated into a boom making India self-sufficient in pulses production for the first time ever. Bringing misery to farmers due to slump in prices. Higher growth in yield as well as production achieved in post 2000 period reflects the increased emphasis on enhancing pulses production through several government schemes introduced during this period. In past two years, India has successfully achieved near self-sufficiency in pulses production but prices remained highly volatile. To minimize price volatility, Sustaining the productivity and production in the long term is essential solution to safeguard the interest of both farmers as well as consumers.

Factors Contributing to Stagnant Production and Productivity in Pulses in India

1. Demand side issues: Low cross elasticity among the pulses has been one of the factor. As a result of which when prices increase demand immediately goes down. Heterogeneity in preferences across Indian states has been observed. Preference for pigeon pea is higher in southern region while chick pea are more in demand in northern states. Only specific types of pulses are consumed in each region, with little substitution among them. (Kumar & Joshi 2016).

2. Supply side issues: Subramanian (2016) reveals that the major pulse consuming districts are located in irrigated regions and are heavily populated whereas the top pulse producing districts are restricted to the dry tracts of Rajasthan, Madhya Pradesh and Deccan Plateau. These regions are highly prone to weather shocks like drought and irrigation availability is minimal.

3. Cobweb phenomenon: Dependence of production on lagged year prices is more persistent in case of pulses as compared to cereals in which this phenomenon is negligible. This renders the pulse production highly unstable in India. High growth in selling prices and increased MSPs in past 2014-15 and 2015-16 incentivized farmers to expand area under pulses resulting into bumper production in 2016-17 leading to slump in market prices.

4. Rising Imports: As per demand projections made by several studies, supply-demand mismatch of over 1 million tones in pigeon pea and urad is estimated in medium term. To avoid the shortfall, imports have been increasing by an average of 1 MMT year-over-year between 2013 to 2016.However exports have declined from 0.34MMT in 2013-14 to 0.14 MMT in 2016-17. Since high correlation of production between India and Top –pulse producer countries have been observed. When domestic production goes down so does production of major producer countries (Subramanian 2016). As a result, any extra demand for imports might end up dwindling world supplies.

5. Technical constraints: Pulses being rich in protein are highly susceptible to attack by insects and pests. Being self-pollinated, development of high yielding varieties is difficult.

Conclusion

For a largely vegetarian population in India, pulses are a cheaper and essential source of protein. In order to maintain the supply and avoid the food price volatility due to fluctuations observed in prices of pulses, increased emphasis needs to be on regulating pulses production. Major factors contributing to stagnant pulses productivity in India can be categorized into demand side issues, supply side, cobweb phenomenon, increased dependence on imports and technical constraints such as productions of pulses is more susceptible to pest attack as a result production goes down. Better incentives for farmers in the form of higher MSP which reflect the true social value of growing pulses accounting for the positive externality to environment combined with robust procurement mechanism could be one way of increasing domestic production and preventing price spikes. But MSP alone cannot sustain the production. Varietal improvement programs in pulses should be encouraged through increased thrust on R&D. Promoting pulse-based cropping in non-traditional areas as well as increasing irrigated area are found to have overall positive general equilibrium effect negating the effect of several environmental externalities caused by cereal based cropping.

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Role and Prospects of Nanotechnology in Agriculture

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Summary
Nanotechnology has shown promising potential to promote sustainable agriculture. The prediction that in 2050 our planet will be populated by over 9 billion people is quite reliable. This will pose serious problems with food, water and energy supply, particularly in less-developed countries. Considering that the human pressure over natural resources has already reached critical levels, international agencies such as the World Bank and UN Food and Agriculture Organization (FAO) are soliciting scientific research in order to identify innovative solutions to support the primary sector. Nanotechnology is a rapidly evolving field with the potential to take forward the agriculture and food industry with new tools which promise to increase food production in a sustainable manner and to protect crops from pests. Once entered in the soil system, nanomaterials may affect the soil quality and plant growth, effects on nutrient release in target soils, soil biota, soil organic matter and plant morphological and physiological responses. The mechanisms involved in uptake and translocation of nanomaterials within plants and associated defense mechanisms have also been discussed. Future research directions have been identified to promote the research into sustainable development of nano-enabled agriculture.

Introduction
Sustainable agriculture is crucial to achieve "Zero hunger" which is amongst the 17 sustainable development goals of the United Nations. World food production and distribution are facing huge stress due to increasing population, climate change, environmental contamination, and higher demands of water and energy. Recent research has shown the promising potential of nanotechnology to improve the agriculture sector by increasing the efficiency of agricultural inputs and offering solutions to agricultural and environment problems for improving food productivity and security. Therefore, research concerning applications of nanotechnology for agriculture has gained significant attention during the recent years (Parisi et al., 2015; Kah et al., 2019). The unique physicochemical properties of nanomaterials, that is, catalytic reactivity, high surface area, size and shape, have the potential to open new paradigms and to introduce new strategies in agriculture. The fate of nano materials is highlighted in soil-plant system with a critical evaluation of potential threats to the soil ecosystem.

Specific agronomic applications of nanotechnology include:
1. Enabled delivery systems of release of agrochemicals allowing a controlled release of fertilizers, pesticides and herbicides.
2. Field-sensing systems to monitor the environmental stresses and crop conditions.
3. Improvement of plant traits against environmental stress and diseases.

Nano Fertilizers in Agriculture
Increase in use of chemical fertilizers is amongst the major contributors to boost the crop yield. Fertilizer-responsive crop varieties have multiplied the use of chemical fertilizers. Use of chemical fertilizers is, however, limited by their poor use efficiency due to the loss of fertilizer (by volatilization and leaching) that contaminates the environment and increases the cost of production (FAO, 2017). Therefore, development of alternate strategies to ensure sustainable use of nutrients is gaining significant attention among the scientific community. In this context, nanotechnology is used to reduce the losses of mobile nutrients, to develop slow-release fertilizers, and to improve the accessibility of poorly available nutrients (Kah et al., 2019). Nano fertilizers improve crop yield and quality with higher nutrient use efficiency while reducing the cost of production and thus, contribute towards agricultural sustainability. It also improves the plant metabolism and the uptake of nutrients through nanometric pores facilitated by molecular transporters or nanostructure cuticle pores. Nanomaterials can significantly reduce the amount of fertilizer applied, both

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applied through soil and foliage, enhancing their efficiency and decreasing release into the environment as compared to the conventional formulations (Adisa et al., 2019). The design of smart fertilizers strongly influences the nutrient release and the minimization of losses. In field conditions such products are provided to crops via irrigation or sprayed to plant canopies. Through the application of nanotechnologies in agriculture the fertilization will be carried out in different ways. Encapsulated inside nanostructures designed to allow the controlled release of nutrients (Fig. 1).

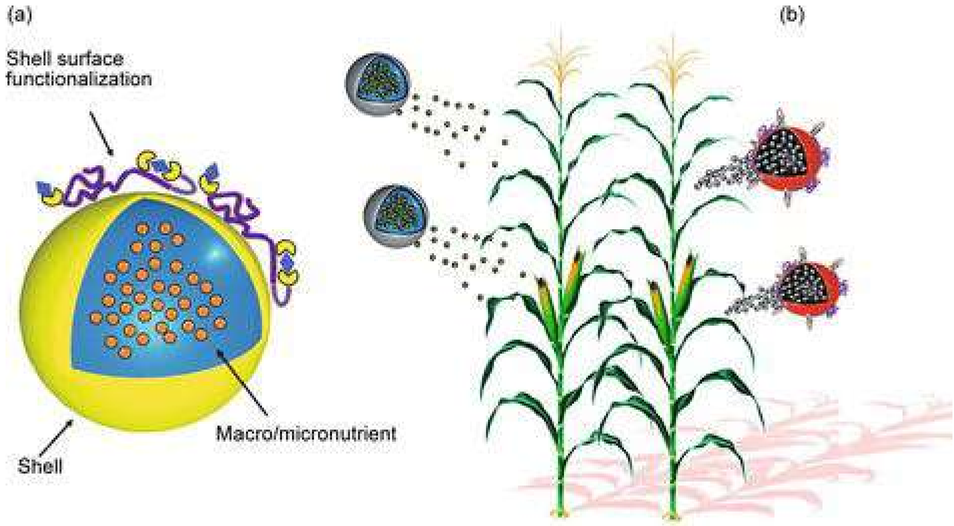

Fig.1. (a) Model of nano capsule containing macro/microelements. Examples of opening strategies of nano capsule: (b) release of nutrients as function of time to avoid or limit nutrient losses or designed to occur when a molecular receptor binds to a specific chemical.

Nano Pesticides in Agriculture

Pesticide use is a regular practice in commercial agriculture and development of new, efficient and target-specific pesticides is a continuous process. Biopesticides appeared to reduce hazardous effects of synthetic pesticides but their use is limited by their slow and environment-dependent efficiency against pests. Nano pesticides are showing viable potential to overcome these limitations. Slow degradation and controlled release of active ingredients in the presence of suitable NMs can offer an effective pest control over long time (Chhipa, 2017).

Therefore, nano pesticides are important for effective and sustainable management of different pests and have potential to minimize the use of synthetic chemicals and associated environmental risks. The nano pesticides behave differently from conventional pesticides to increase their efficacy (Kah et al., 2019). Overall, nano pesticides conserve energy and water as they are applied in smaller amount and less frequently than the conventional pesticides. They also enhance pesticide efficiency and crop productivity by higher yields and lower input costs by reducing waste and labor costs.

Nano-Biosensors for Soil-Plant Systems

Biosensors denote hybrid system of receptor-transducer which are used to sense the physical and chemical properties of a medium in the presence of biological or organic recognition element to detect the specific biological analyte present. Nano-biosensor technology can help in early detection and rapid decision to enhance crop yields by suitable management of water, land, fertilizers and pesticides. The most commonly used nano biosensors, their sensing strategy and applications in detection of analytes in soil and water bodies are given in the supplementary material.

Early detection of soil pollutants may help avoid their detrimental effects. Accumulation of potentially toxic metal ions in arable soils and plants above threshold levels is a global problem with serious health hazards. Although, use of nano-technology has opened new revolution in smart farming and reduced associated risks, wide use of nanomaterials -based agriculture and food products and less-likely immobilized nano sensors have raised concerns on human and environmental health. Complexity of nano-bioeco-interactions limit monitoring their behavior in soils. Therefore, a holistic approach is recommended to understand these interactions in soil-plant-air and ultimately in food chain.

Fate of Nanomaterials in Soil

Natural colloids and organic and mineral fractions could interact with nanomaterials (NMs) which would lead to their partitioning in solid and aqueous phase of soil system. Upon entering soil, NMs can undergo physical, chemical and/or biological transformations and inorganic). Aggregation is the major physical process which occurs spontaneously when NMs are introduced into the soil environment. Aggregation reduces the available surface area of NMs which affects their reactivity. Moreover, increase in size of aggregate will decrease their mobility in porous media which will affect reactivity and behavior of NMs (Lowry et al., 2012). Soil colloids and minerals, particularly clay and iron minerals, are considered as important sink for NMs. Soil organic matter (SOM) is another crucial factor with substantial effects on fate and behavior of NMs mainly through adsorption and stabilization (Lei et al., 2018). Adsorption of SOM would result in surface coverage of NMs and thereby decreasing their active surface area which can significantly mitigate the potential effects of NMs. Soil organic matter may exhibit contradictory effects on the mobility and stability of NMs depending upon their nature. On one hand, SOM was observed to accelerate aggregation of NMs by bridging flocculation. On the other hand, it can improve stability of NMs by increasing their electrostatic stability Chemical transformations of NMs proceed via biotic or abiotic pathways and involve oxidation, reduction, degradation, dissolution, sulfidation, surface modification, degradation of surface coating etc., (Lowry et al., 2012; Lei et al., 2018).

Conclusion

Nanotechnology has found many applications in agricultural applications such as nano fertilizers, nano pesticides, nano biosensors or as environmental remediation agents. However, a firm understanding of nanomaterials' fate and environmental impacts remains a major challenge in agricultural and environmental sciences. Collaborative research among institutes exploring different uses of nanomaterials would be crucial to develop efficient, multifunctional, stable, cost-effective and environment-friendly nanomaterials. This would also facilitate to complete the picture about the role, fate, behavior and ecotoxicity assessment of NMs. Application of NMs may help improve the growth and yield of crop plants, but response may vary as per plant species. Role of NMs should also be explored in bioremediation to develop integrated remediation strategies.

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Sensory Garden – An Innovative Opportunity to Stimulate Senses

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Sensory Garden – An Introduction

A Sensory garden is a collection of plants and materials with different textures, shapes, colors, scents and heights. The collection of plants and materials is laid out in such a way as to stimulate our Senses, Seeing, Hearing, Smelling, Touching and Tasting. Sensory gardens can also be therapeutic, Helping reduce stress and lowering blood pressure by offering a lovely place to escape too, to take time-out and simply relax, time to think after a stress day at work or looking after the kids, to escape from the television, read a book, listen to flowing water or just feel the leaves.

Most gardens offer visual appeal, but a sensory garden gives a bit more. It is primarily designed to stimulate the senses and for people living with disabilities, poor eyesight or dementia a sensory garden can also be a safe and tactile environment to enjoy, touching, hearing, smelling, seeing, tasting even the plants and natural materials.

Two Popular Forms of Sensory Gardens

1. Sensory pathways: Sensory pathways can be constructed of smooth, flat, stepping stones or tree cookies with gaps wide enough for in-between planting. Stepping stones can be natural stone or concrete or made by children to include hand prints, leaf prints, shells, marbles, colored tile mosaics, or smooth glass. Glass blocks or clay bricks can be laid in the sensory pathway to add additional sensory richness and variety. Sensory pathways should be considered part of the larger pathway system and should not dead end. They can be installed as a narrow (18″-24″), short loop off the primary pathway or a broad (36″-72″) connection between settings.

2. Keyhole gardens: Keyhole gardens provide an intimate space to rest while immersed in sensory plants. Keyhole gardens are shaped like a skeleton keyhole with a narrow entry and bulbous, interior space wide enough for a young child or two to sit and reach the plantings on either side (approximately 24” – 36” wide). Keyhole gardens can be installed as a subspace along a sensory path or be designed as a stand-alone setting.

Sensory Plantings

Sensory plantings should be hardy, vary in height, color, texture and scent, provide year-round sensory interest, and be planted within easy reach. Perennials, ground covers, ornamental grasses, small shrubs and edible plants can be incorporated

Factors to be Considered While Planning a Sensory Garden

When planning a sensory garden, it is important to feature elements that appeal to all five senses.

1. Seeing: Plants which change color through the seasons are interesting to watch as the leaves and berries grow and change color. Most flowers are very colorful during the summer, whilst many trees will blossom in spring before the leaves turn to shades of gold, brown and red in the autumn. For winter color check out my article, plants for winter color. Changes in colour and appearance of materials like paved and pebble pathways when they get wet also add color. Shapes are also important in a sensory garden, materials like crazy paving and rough-cut flags. The distinctive shape of oak and sycamore trees, flowers such as the daisy and poppy, the varied fruits of fruit trees. Movement catches the eye too, so maybe add trees such as willow that wave in the wind. A fountain or waterfall will add movement and attract birds rustling feathers as they bathe.

2. Hearing: There will be plenty of sound to listen to, the natural sounds of wind in the trees, wildlife sounds. A shallow stream flowing over pebbles or a waterfall, even wind chimes.

3. Scent and smell: Plant a mix of plants and flowers which give off different scents. Ones you can smell without touching, honeysuckle and roses, some you will need to "get up close to" like daffodils and violets and some you will have to "get up very close to and gently crush them" mint and most herbs come to mind. Also include plants in your sensory garden that might mean something to you personally, from way back. Composting leaves and grass clippings give off a distinctive smell and the compost can come in handy

4. Touch: Texture is very important in your sensory garden both rough and smooth (mosses, lichens, holly leaves, rivened stone and smooth pebbles, leaves, slate) and the stuff nature will provide like frog spawn and caterpillars.

5. Taste: Be careful with this one. Only include berries and fruits which you are sure are safe to eat.

Sensory Garden for Children

Children might not always want to just chill out and feel the wind and touch the leaves! So, it's a good idea to include plants, materials and structures that will encourage play.

Think about including a maze painted or raised on the side or top of walls for the kids to follow with fingertips. Vary the textures of walls, paths and paving by using wood, brick, stone, flints, tiles, cobbles, setts, gravel, pebbles, bark, rubber, or metals to add interest. Also, you could include a raised bed or area for young gardeners to practice gardening skills and add:

1. Moss and lichen: Grow it on walls to add interest over time, growth can be sped up by painting surfaces with yogurt.

2. Color: Color will come from the plants and materials, but don't be afraid to add color by painting and hanging stuff on the walls.

3. Games and Activities: Building a chess board from slabs, old bricks, etc. will stimulate most of the senses. See my design page for more.

4. Natural materials: Woven willow for fencing or cover over a seat, looks, sounds and feels good.

5. The Wind: Air can generate soothing sounds as it blows through trees, bamboo, grass and fences. Don't forget wind chimes and the different sounds different materials make.

Conclusion

A sensory garden is a wonderful way for children to explore their senses and learn about the environment around them. It is also a healthy place of discovery and gets children outdoors. Children with disabilities also greatly benefit from exposure to sensory gardens, as they provide a therapeutic and safe way for them to explore their senses. When creating a sensory garden, use care in choosing the elements that go into the garden, and also consider the layout in terms of the height and reach of the plants and walkways so that it is accessible to the children and or adults for whom it is intended.

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Vegetable Science – Small Space Vegetable Gardening

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Introduction

Vegetable gardening is a practice of growing and cultivating vegetable plants as a part of Horticulture which involves in active participation of growing vegetables. It is labor intensive and differ from farming. It is advisable because it nurtures us mentally and physically and favors benefits in improving health, healing and act as de-stress.

Procedure to Guide a Small Space Vegetable Gardening

You don’t need a large enough area to have a vegetable garden, if your garden is limited by space there is a chance of growing vegetables at your own houses at window sill, a patio, a balcony, or in a container, at the roof side or at terrace. Choose a good location which is preferably close by home. It is growing popularity because it’s easy to get started and enables any amateur to become a successful.

Advantages

1. It keeps us stay healthy.
2. Cheap and affordable.
3. Harvest fresh and eat fresh.
4. No hazard.
5. Year-round production.
6. More food per square foot.

General Considerations

Sunlight, growing media, water, nutrients (fertilizer), tools.

Crop Selection

Almost any type of vegetable that will grow in typical backyard gardens will also do well in a small space you selected or in containers you select. Vegetables which are ideally suited for growing in containers include tomatoes, peppers, brinjal, green onions, beans, peas, lettuce, squashes, radish, carrots, cabbages, cauliflower, kale, broccoli, Brussels sprouts, celery, parsley, Amaranthus, cucumbers, melons, gourds like bitter gourd, bottle gourd, sponge gourd and pumpkins but usually they require larger space because of their vining growth habit.

Soil Preparation

The soil which is used for raising vegetables must have some common characteristics as a filling material. The soil must have the capacity to hold water and nutrients very well. The soil must be free from weeds and diseases. Use clay soil, or sandy loam soils which are in microscopic in nature and has a good retention of water and nutrients. If you use raised beds in your kitchen garden of 120-150 square meter area and height should be 15 cm. Plant accordingly in raised beds with rich soil and by regular turning out the beds planting should be done.

Growing Media

A good growing media must have sufficient moisture retaining capacity, porous in nature, support good drainage and must be free from other debris. The soil mixture must be in a ratio of 1:2:1 ratio of FYM, red soil and sand. Soil less media: a) Saw dust b) Peat moss c) Perlite d) Vermiculite e) Sphagnum moss. These are having light in weight, ideal pH, absorb high water holding capacity. They are used in a ratio of 25 % soil +75 % compost / 25 % soil les media + 25 % soil + 50 % compost.

Containers Used

Different types of containers are used for growing vegetable crops. For example, we can use pots, barrels, plastic milk jugs, plastic crates, plastic bottles and wooden boxes etc. the size of the container will vary accordingly to the type of crop we select and the space available with us.

Pots of size 5-10-inch size are much satisfactory for green onions and parsley, lettuce. Irrespective of the size or type of container used, adequate drainage is necessary for a selected good container and the bottom of every container we use make sure the bottom of that container or pot is filled with sand or small stones for easy drainage. In cases such make a hole at the bottom of a selected container leaving a sum of space 5 cm for regular discharge. The drainage holes are best located at side of the container.

There are many different types of containers based on usage:
1. **Clay / Ceramic:** It is very attractive, usually don't rot even, dry out easily and hold the soil tightly.
2. **Wood:** Easily available and looks natural.
3. **Plastic:** These are very light in weight and very cheaply available in cost everywhere but not high durable may have easy wear and tear.
4. **Metal type:** Very high durable and but easily rust out and looks attractive.

Seedling and Transplanting

The vegetables like tomato, brinjal, chilly, onion, lettuce, celery, cabbage, cauliflower etc. are suitable for raising in a portrays and after a period of duration depend up on the crop they are transplanted. Other vegetables like pea, beans, cucurbits like cucumber, melons and some other squashes are directly sown in a suitable container or in an area in which you preferred to be for sowing.

Transplanting purpose seedlings are either directly purchased from local nurseries or else grown at our own home by using plastic portrays, pan or a pot. Fill the containers with good media and seed to be sown at a depth of 2-3 cm to insure good germination. The portrays are kept under moisture about a period of 4-8 weeks prior to the transplanting date in to the final container or in a selected small space area.

Most of the vegetables are transplanted in to suitable containers when the seedling develops their first two to three leaves stage. Transplanting should be done carefully to avoid the damage to root system. After planting, gently soak the soil with water being careful that may disturb or washout or displace seeds.

Fertilization

The best method of adding fertilizers to plants in growing containers is by mixing nutrient solution and basic requirement is completed by the basal dose of nitrogen, phosphorous, potassium. There are many other commercial fertilizers available in the market and utilize them as per the label mentioned on it. Also use water soluble fertilizers containing iron, zinc, boron, manganese. Do not add more than the recommended dose of fertilizers, since they may cause the plants to burn or kill the plants.

Irrigation

The plants need to watered carefully and the nutrient solution made is made available in early growth of the plants and irrigation may vary from one crop to the other usually once a day.

Plant Care

Protect the plants from very high heat caused by sun scorching by adjusting it under a shade net construction so that it may protect the plants from sun, a sort of rain and wind.

Diseases & Pests

Vegetables grown in containers can be attacked by various types of diseases and pests that are common to any vegetable gardening. Plants should be regularly inspected at the foliage and at the base of the stem. Fundamental things for plant care are first the seeds are treated before sowing with some fungicides.

Seed treatment with thiram and captan @ 2-3 gm / kg is advised. For bacterial infection use Pseudomonas and Streptocyclin. For biocontrol or organically use trichoderma @ 3-4 gm / kg. Chemically Mancozeb is sprayed for control.

Insects

Plants should be periodically noticed on foliage and fruit/ shoot feeding insects. It is better suggested to use Neem oil spray as a bio control agent. They can be applied in every regular intervals of 15 days at a dose of 5 ml / liter.

Harvesting

harvest the vegetables at their peak stage of maturity when vegetables are matured and full flavor or color develops. This will yield maximum and makes excellent taste from immediate harvested fruits and tender green beans and peas and crispy lettuce and other leafy vegetables.

Conclusion

Gardening is a great hobby for everyone from working professionals to retirees. It allows you to connect with your environment and with nature. Instead, learn as much as you can, take in basic tips and tricks and take baby steps. You will find that when given proper attention, a garden can soothe your soul and gardening can calm and center you. Gardening doesn't just help you physically, it also helps you mentally. In addition, it allows you to contribute to environmental health and even your own table. Although gardening yields relatively slow results, those results leave a deeper impact and are much more long-lasting.

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Effect of Corona Virus on Indian Economy and Agriculture: Agriculture Only Bright Spot

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Introduction

We often hear that India is an agricultural country. This basically means that agriculture is an important part of our livelihood. In India, agriculture is our primary economic activity and about two-thirds of our population is engaged in the same. Let us get acquainted with types of farming done in India. India is an agricultural country: Kids of 1980s, 1990s and early 2000s grew up reading this one sentence in school textbooks until LPG (liberalization, privatization and globalization) changed the complexion of Indian economy. Services became the king of economy and industries started pulling out workers from the fields. The outbreak of the novel coronavirus in India as part of global pandemic shut down offices of the gloating services sector and closed factories. But crops standing in fields kept growing, and farmers continued to tend them. Covid-19 has essentially and largely remained an urban outbreak in India till now.

Now, economy indicators show what is already known: production has contracted in factories and services have suffered losses. The seasonally adjusted IHS Markit India Manufacturing Purchasing Managers' Index (PMI) fell to 27.4 in April. This is the lowest reading of PMI in 15 years, that is, since it started recording data. A PMI of below 50 indicates contraction in manufacturing. It was 51.8 in March. Cases of the novel coronavirus started surging in India in the first week of March. States were going for lockdowns by the third week. The national lockdown was announced from March 25. India remained locked down through April.

Now, lockdown is in place and this coronavirus lockdown is actually an exit door. India will restart the economic engine that was practically switched off on March 25. The manufacturing units have started opening in green and orange zones (areas either free from coronavirus or less impacted by Covid-19, the disease).

It is expected that PMI will rise. But how long the economy will remain in revival mode is a difficult question to answer. The Indian economy was already in an extended slowdown before the coronavirus outbreak applied brakes.

As the novel coronavirus shows ebbing signs in Asia, Europe and America, there is a fresh round of trade war between the US and China. This has dampened the mood of revival. Stock exchanges including those in India have reflected the soggy sentiments.

In a Confederation of Indian Industry (CII) survey, about 45 per cent of CEOs in India said they don't see economic normalcy returning before a year. Another 36 per cent were more optimistic but said it would take 6-12 months for economy to function with normalcy.

Simply put, over 80 per cent of CEOs in India think normally is not going to return before six months. This is the beginning of May. So, before the end of October, the Indian economy of industry and services sectors (agriculture fields don't have CEOs) is to reel under the impact of coronavirus.

The Indian economy is left with agriculture, only agriculture to depend upon. And, the good news is India is expecting record food-grain production at almost 300 million tonnes -- 298.32 million tonnes to be precise (149.92 MT kharif + 148.4 MT rabi).

The government now has to ensure that all food-grains that farmers want to sell in the market is picked up. This is particularly necessary because with seemingly less significant contribution to the GDP at around 16 per cent, agriculture provides employment to about 55 per cent of workforce in India.

Add to this tally those migrants who are returning home in Shramik Special trains and are likely to return to their villages when lockdown is lifted and regular public transport resumes. A healthier and growing agriculture could not have happened at a better time.

Niti Aayog member Ramesh Chand has pointed to this silver lining in the dark clouds hovering over Indian economy. In media reports, Chand has been quoted as saying, "The farm sector will grow by 3 per cent this year despite adverse conditions and it would add at least 0.5 per cent to India's GDP growth in 2020-21."

This 0.5 per cent additional contribution by agriculture may actually prevent Indian economy from contracting this fiscal. This includes production of non-food crops such as oilseeds.

To top it up, the Indian Meteorological Department (IMD) has predicted a normal monsoon in 2020. There is no concrete study yet but coronavirus outbreak has put pressure on ground water resources everywhere.

Sanitizing body, hospitals, vehicles and public places requires a lot of water. Water consumption has increased in every household. With factories opening, water consumption will only increase as India eyes upscaling the fight against coronavirus. The IMD prediction, if it turns out accurate, will ensure that taps, wells and fields don't dry up when summer hits its peak.

With more production and more workforces, agriculture requires proper management by the government. If 100 per cent procurement happens, it will revive private consumption demand, which was originally responsible for the economic slowdown in India in pre-corona time.

Impacts of Covid-19 on Agriculture

1. Markets and farm prices: As we see growing levels of concern, recommendations for social distancing, reduced travel, avoiding crowds, closures, and other protective practices to slow the spread of COVID-19, consumers will be making tough choices about food, eating away from home, and overall spending. Dairy is prominently featured in out-of-home eating, and there may be some disruptions in food service sales. This will likely have an impact on markets and prices. There have also been bottlenecks at ports in other countries as ships wait to be offloaded with U.S. dairy and other farm products. The Chicago Mercantile Exchange has shut down floor trading of all products until "further notice," though electronic trading will continue.

Concerns about the impact of the virus on the broader economy are likely to have an even larger impact on dairy prices. Many countries of the European Union were already hovering just above a recession prior to the viral outbreak and this event is likely to push them over the edge. Prior to this event, China was also experiencing slower economic growth. The U.S. has enjoyed strength in the economy, but there have been leading indicators prior to pandemic concerns that suggested that we were past the peak of the business cycle and that an economic slowdown, or perhaps that a recession was coming. A worldwide recession, like the one experienced in 2008-09, would push the previously expected milk price recovery off for at least another year.

2. Supply chains slowdowns and shortages: As logistics are disrupted and efforts proceed to slow the spread of the virus, multiple connected industry sectors are already being impacted. With some products, "panic buying" is creating additional concern. As an example of supply chain interruptions on farms, the American Veterinary Medical Association (AVMA) suggests the potential for animal pharmaceutical products to be in short supply for at least some of the larger drug manufacturers. If the virus were to spread more broadly in an agricultural state like Wisconsin, we could see issues with farm product delivery and pickup as workers - milk truck drivers for example - stay home due to illness or because they are caring for family members or school-age children. These same concerns would affect processors. Slowdowns could also impact fertilizer, fuel and other input movement and availability as we head toward spring. In an extreme case, we could have concerns with utilities – electricity, natural gas, propane – based on input availability or labor shortages. However, utility companies generally do a good job of contingency planning which helps buffer the impact of unforeseen events.

3. Farmers' health: Throughout the Midwest, farmers are a relatively older population, as compared to the general worker population. The 2017 ag census shows the average age of farm operators to be almost 58 – at least a full 10 years older than workers in most other sectors. And, unlike other industry workers, farm operators, 26% are age 65 years and up. A full 11.7% of our principal farm operators are age 75 and older. Data from other countries that have done more extensive testing suggest that COVID-19 has a much higher level of severity for those in their 60s and older, meaning that preventive and protective recommendations from the CDC and state (and local) public health experts are critical for our farming population.

4. The farm workforce: Even if the general population infection rate remains relatively low, it is likely that we will see some workers who end up sick. But, perhaps more importantly, even if the infection rate stays low (single digits), it is highly likely that workers will need to be out of work particularly with school closures and/or workers who need to stay home to care for sick or elderly family members. The fear of this event and lack of information may also lead to higher levels of absenteeism.

5. Worker safety and Personal Protective Equipment (PPE): There are shortages of PPE and other protective equipment vital for operating a farm safely and keeping workers and animals healthy. As a result of the current demands by the healthcare industry, N-95 respirator supplies are highly limited (likely to be needed this spring for handling dusty grain as a result of last fall's sub-optimal harvest conditions). There are also reported concerns about availability of protective gloves which have now become commonplace in dairy operations as a protective means to improve milk quality and protect the health of animals and people.

6. Other disruptions: Sparse populations and less frequent travel may provide a natural social distancing for rural communities but there are challenges that may be faced by rural residents. Many gathering places, such as schools and churches, are being closed and told to halt normal routines and events. As a substitute, in some areas and for high school and college students, classes and services are being taught online. This may be difficult for some rural residents as high-speed internet service is not available in some areas of the state including some of our communities with a strong agricultural base.

Only time will reveal the severity of the impacts on agriculture from the novel coronavirus, say Stephenson and Shutske. They urge you to take reasonable precautions to limit the spread of the disease and its influence on your businesses and lives. Both say hoarding of farm supplies is not recommended and could cause even greater problems for the sector and that prudent purchases of necessary inputs might minimize disruptions to your business. Please keep informed, listen to the experts, and follow the recommendations of federal, state, and local agencies and authorities.

Conclusion

So, without agriculture it is very difficult during this period and it is very much essential to support the farmers and release good variety of seeds so that more production occurs. Good news is that Government of India has now increased its focus on nutrition (besides food)- security and raising farmers' income (rather than enhancing farm productivity). Changing the consumer behavior with suitable programs and incentives is already in the agenda. For all these to happen, the existing landscape of policy incentives that favor the two big staples of wheat and rice has to change. Designing agricultural policies, post-COVID19 scenario, must include these imperatives for a food systems transformation in India.

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Surge of Time: Gene Editing Techniques for Crop Improvement

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Introduction

In order to meet the demand of continuously growing population and at the same time protecting crops from different type of stresses, insects, pests and disease the surge for crop improvement is increasing. However, the conventional breeding methodologies are time consuming and labor intensive. Crop improvement using genome editing tools appeared to be a good alternative for such situation because of it's of its advantages over routinely used methods. Genome editing is defined as a process in which a specific chromosomal sequence is changed. This change can be due to an insertion, deletion and/or a substitution of at least one nucleotide. It is considered to be precise, time saving, non-labor intensive and efficient technique; and now even considered as a safe technique because no foreign sequences are left behind in the final genome-edited organism (GEO).

Different type of techniques is evolved and used in editing genome for crop improvement as per the requirements:

1. Meganucleases: Meganucleases (MNs) are basically generated from intron containing genes. They are capable to recognize longer and unique sequences of approx 12–40 bp so that they can cleave the DNA at a unique position. MNs are engineered to enable them to bind and cleave a specific sequence of DNA. They are often called homing endonucleases (HEs) (Miglani, 2017).

2. Zinc-finger nucleases (ZFNs): Zinc-finger nucleases (ZFNs) have been widely used for target specific mutagenesis to disrupt the normal functioning of gene and producing several gene knockouts (Bonawitz et al., 2018). ZFNs consist of zinc finger protein domains able to bind at sequence-specific, fused with nuclease domain for double strand DNA cleavage. It has been used for site-specific mutations in plants such as Arabidopsis thaliana, soybean, maize, tobacco, and petunia (Curtin et al., 2013).

3. Transcription activator-like effector nucleases (TALENs): Another widely used tool for genetic engineering is transcription activator-like effector nucleases (TALENs). They work as a eukaryotic transcription factors by binding to the promoter region and activating gene expression (Khan et al., 2016). TALENs, are constructed by modifying transcription activator-like effector (TALE) domain repeats for desirable target recognition and are then fused with the FokI nuclease producing in a TALEN (Stephens and Barakate, 2017).

5. microRNA (miRNA): They are small 18–22 nucleotide endogenous non-coding regulatory RNAs which regulate the expression of gene both at post transcriptional and translational level by causing mRNA degradation or by translational repression in sequence specific manner (Ku et al., 2015).

6. Small interfering RNA (siRNA): Small interfering RNA (siRNA) are a class of double-stranded non-coding RNA molecules of about 20-25 base pairs in length. It works by interfering in with the expression of specific genes with complementary nucleotide sequences by degrading mRNA after transcription and prevents translation (Khan, 2019).

7. CRISPR-Cas9: CRISPR-Cas9 emerges out as one of the powerful tools needed for precise genome editing tool which needs a guide RNA (gRNA) of ~20 nucleotides complementary to the gene of interest and a nuclease enzyme Cas9, which cuts 3–4 bases next to the protospacer adjacent motif. This motif is later repaired either by error prone non-homologous end joining or by homology directed repair pathway (Jaganathan et al., 2018). CRISPR-Cas technique can be classified into three types-based gRNA processing and further action (Khan, 2019).

- **a. Type 1 CRISPR/Cas system**: In this system Cas5 or Cas6 is used for pre-processing of gRNA and Cas3 for further cleavage functions.
- **b. Type 2 CRISPR/Cas system**: In it Cas9 is used under the guidance of gRNA to target DNA. RNase III, Trans activating RNA (tracrRNA) and an unidentified protein factor are involved in trimming at the 5′ end.

c. Type 3 CRISPR/Cas system: In this category Cas6 is used for trimming of gRNA 3′ end. The unique part of this technique is its targeting of RNA by a specific complex called type III Csm/Cmr complex.

Conclusion

With the availability and advancement in this genome editing techniques a wider platform for crop improvement is being created which when exploited properly can overcome many of the problems faced by researchers and farmers.

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Agricultural Productivity and Challenges in Sustaining Resource Base

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How India can build a stronger agriculture sector is still a matter of concern without further harm to the environment or depletion of its natural resources base. It is the high time to focus on agriculture productivity and challenges to meet demands of agriculture products by 2050 almost 50 percent more food, feed and biofuel produce than it was in 2012. This FAO estimate takes into account recent United Nations (UN) projections indicating that the world's population would reach 9.73 billion in 2050. It is certainly no doubt that, over the past six decades, India has come a long way from being a famine-prone country to comfortably producing food for more than 1.30 billion people from finite arable land. Food security is firmly in hand; the government is now targeting to double farmers' incomes by 2022. In 2017, India became the sixth largest economy in the world, beating France and closely tied with the UK. Agricultural growth in the country has come to be associated with green paddy fields and overflowing storehouses of surplus grains.

Today, Indian agriculture stands at a crossroad that inaction is not an option. The challenges are multifaceted viz., decrease in factor productivity, decline in soil health & water table, macro & micronutrient deficiency, costly inputs and reduce in farm profitability, higher labour cost & shift towards farm mechanization etc., but at the same time, smart solutions are available that have the potential to generate triple-wins, i.e. increase productivity, enhance climate resilience, and make agriculture climate-smart by reducing damaging emissions, increase in crop yield, soil health, nutrient use efficiency and income, water harvesting & water use efficiency, farm mechanization & good agricultural practices, agriculture diversification, post-harvest processing & value addition etc. This way we can move further to make Indian agriculture as a global agricultural powerhouse. In order to implement a holistic approach towards welfare development and nutrition security, we may link the goals for agricultural development, health and nutrition and economic development with each other (Fig. 1).

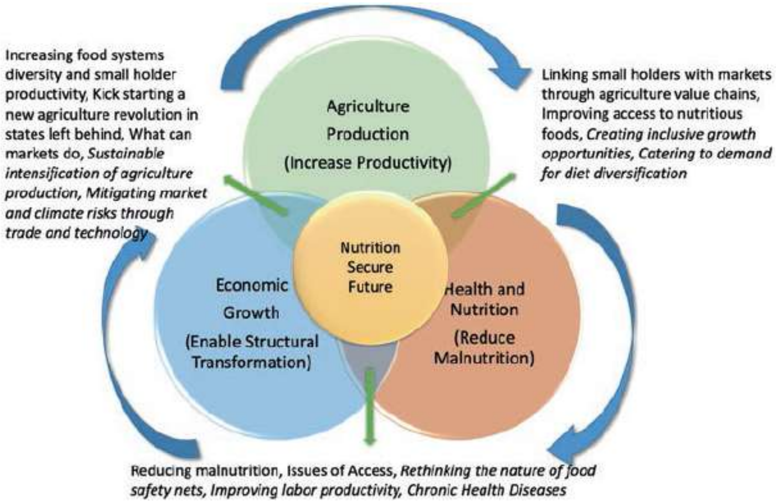

Fig. 1. The multi-sectoral approach for food system transformation

Concerns Over Agriculture Productivity

1. Slowing yield increases vis-à-vis agricultural efficiency: Increased use of land, irrigation and agro-chemicals played successive role in Green Revolution. Now it is felt that the gains were often accompanied by negative effects on agriculture's natural resource base, including land degradation, salinization of irrigated areas, over-extraction of groundwater, the build-up of pest resistance and the erosion of biodiversity. Agriculture has also damaged the wider environment through deforestation, emission of greenhouse gases and nitrate pollution of water bodies (FAO, 2011a). The gap between farm yields and potential yields reflects constraints, such as insufficient adoption of more productive technologies (FAO, 2011b).

2. Resource-conserving practices & productivity: The key to sustainable agricultural growth is more efficient use of land, labour and other inputs through technological progress, social innovation and new business models. For agriculture and aquaculture, innovation will not only need to improve the efficiency of inputs that are turned to be in outputs, but also conserve scarce natural resources and reduce waste (OECD, 2011; Troell et al., 2014). In 2015/ 16, Conservation Agriculture was practised globally on about 180 M ha of cropland, corresponding to about 12.5% of the total global cropland. The highest adoption levels– above 50 percent of cropland – are found in Australia, Canada and the southern cone of South America. Adoption has been low in Africa, Central Asia and China, but it is increasing (FAO, 2011a). CA in rice-wheat saves resources and labour cost and this can be more efficient through precision farming through decision support system. However, high levels of dis-adoption have also been observed, underscoring the need for a nuanced approach that takes into account different factors, such as the effects of climate change, as well as barriers to adoption (Arslan et al., 2013; Grabowski et al., 2016; IAPRI, 2016).

3. Climate-smart agriculture (CSA): It aims at sustainably increasing food security and incomes, and adapting and building resilience to climate change, while capturing potential mitigation co-benefits. It connects other innovations, such as conservation agriculture, agro ecology, agroforestry and the development of crop varieties that are more tolerant to pests, diseases, drought, waterlogging and salinity (FAO, 2013). CSA has promoted mixed crop-livestock systems, the rotation of pasture and forage crops to enhance soil quality and reduce erosion, and the use of livestock manure to maintain soil fertility. In CSA, agroforestry systems are also helpful in conserving ecosystems, especially in marginal areas prone to environmental degradation.

4. Total factor productivity (TFP) in agriculture: Increase in agricultural output owing to an overall efficiency increase of production processes, rather than through the intensification of input use led to TFP.

It has been the main contributor to increase in agricultural output in high-income countries, while output in low-income countries has increased mainly through the expansion of agricultural areas, over the last decade where TFP growth has increased significantly (USDA, 2016). As illustrated in Table 1, the factors for low productivity, high average cost, and low efficiency in Indian agriculture are seed replacement rate (Singh and Chand 2011).

Fertilizer use in most of states is sub optimal (Chand and Pavithra, 2015). Organic farming promotion is better option, whereas on the other hand use of compost as alternative source of plant nutrients is showing a big decline. Improved technology has not yet reached large number of farmers which is evident from the fact that more than 30 per cent area under cereals is still under traditional varieties.

Table 1: Factors related to low productivity and high average cost:

Sl. No.	Factor in Indian agriculture	Status
1.	Seed replacement rate %	
	Wheat	31.6
	Gram	21.7
	Rapeseed/mustard	63.4
2.	Crop intensity	1.42
3.	Irrigation coverage %	48.6
4.	Irrigated area under micro irrigation %	15.0
5.	Gap in NPK use as compared to optimum %	
	Nitrogen	3.31
	Phosphorous	19.14
	Potash	51.09
6.	Use of Compost	One third since early 1970s
7.	Average size of land holding hectare	1.08

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI.
For 5: Chand and Pavithra (2015)
For 6: Estimated from Unit level data of Cost of Cultivation Scheme.

Sustainability Challenges in Conserving Resource Base

1. Sustainable demand and supply of agricultural products: Demand for food and other agricultural products is projected to increase by 50 percent up to 2050. Demand will undergo structural changes while producing more with less, preserving and enhancing the livelihoods of small-scale and family farmers, is a key challenge for the future. This is required to promote the adoption of sustainable production systems and practices, including integrated crop-livestock and aquaculture-crop systems, conservation agriculture, agroforestry, nutrition-sensitive agriculture, sustainable forest and fisheries management. The present and projected level of aggregate demand for food commodities is presented in Table 2. Simultaneously, to maintain the country's food security, public procurement policy will need to be geographically reoriented to areas that are ecologically suited for the cultivation of these staples.

Table 2: Current Production and Demand for aggregate food commodities towards 2031-32.

Current food production 2015-16	726 million tonnes
Annual growth in demand in next 15 years	2.30 per cent
Total increase in food requirement by 2031-32	40.7 per cent
Quantity of food required by 2031-32	1016 million Tonnes

2. Ensuring sustainable natural resource base: Between now and 2050, the additional land needed for agricultural production is estimated at just under 100 million ha globally. Increase in the agricultural area is constrained by the fact that available land is not readily accessible due to the lack of infrastructure, physical remoteness and disconnection from markets, or is vulnerable to disease outbreaks. So that rising food demand will have to come mainly from improvements in productivity and resource-use efficiency. The northern states of Punjab and Haryana, which spearheaded India's food security, now face multiple environmental problems. Their resource intensive system of rice-wheat production has led to the over-extraction of groundwater, and their imbalanced use of fertilizers has added to soil and water contamination. Recently, the widespread burning of crop residues and its contribution to severe air pollution has attracted both national and global attention. So, to make this paradigm shift look like first, we need to conserve natural resources, make agriculture climate-resilient, and reduce agricultural pollution to safeguard farmer welfare and contribute to doubling farmers' incomes.

3. Climate change and natural hazards: Climate change and natural and human-induced disasters pose multiple concerns: damage and losses to production; the degradation of land, forests, water, fish stocks and other natural resources; declining rates in productivity growth; and added pressures on already fragile agricultural livelihoods and ecosystems. Agriculture is responsible for about 17 per cent of GHG emission in India which is almost same as its share in GDP. Three-fourth of this is due to methane produced from rice cultivation and livestock and the remaining 26% comes from nitrous oxide emitted from fertilizer. The share of agriculture in total GHG emissions will increase significantly if burning of crop residue, which is now spreading to all states, is taken into account. Food security and human livelihoods will be increasingly jeopardized beyond 2030 owing to climate change impacts. Climate change affects food availability and has adverse impacts on crop yields, fish stocks and animal health. Beyond 2030, adverse impacts will intensify with significant losses of yields in most parts of the world. Extreme events, such as droughts and floods, will intensify and become more frequent with climate change.

4. Eradicating extreme poverty and reducing inequality: Despite global economic growth and a reduction in poverty over the last 30 years, about 2.1 billion people are still living in poverty, with 700 million in extreme poverty worldwide. High and rising inequality is hindering progress towards the eradication of poverty. Most of the world's poor and hungry are rural people who earn meagre livings from agriculture, fisheries and forestry. Poor people's reliance on agriculture for their livelihoods, and the high share of their expenditure on food in their household budgets, make agriculture the key to poverty and hunger alleviation. Reducing rural poverty requires measures to increase productivity and profitability, link farmers to markets, and provide efficient extension and agricultural advisory services. However, pro-poor growth also requires access to good quality education, economic diversification to rural non-farm income generating activities, support for job creation and adequate social protection mechanisms.

5. Making food systems more efficient, inclusive and resilient: Food systems are characterized by the coexistence of modern and traditional supply channels. However, there is a growing reliance on supply chains and large-scale distribution systems, such as supermarkets. More efficient food systems also create new challenges and concerns: the high-calorie, but low-nutrient content of many food items; the reduced access of small-scale producers and family farmers to viable markets; the high levels of food loss and waste; food safety problems; plant disease and animal health issues; and the higher energy intensity. India's nutrition indicators and child health indicators are low. According to FAO largest number of people who are hungry or undernourished live in India. IFPRI in its annual publication "Global Hunger Index" shows India in a very poor light year after year. All this despite the fact that India has become largest rice exporting country with about 10 percent of its rice production sold in overseas market. Food losses occur throughout food value chains, owing to managerial and technical limitations in harvesting, storage, transportation, processing, packaging and marketing. At the consumer level, inadequate planning of purchases and failure to use food before its expiry date also lead to waste. Food systems that link farmers to cities can have an enormous impact on rural poverty alleviation and agricultural development.

6. Job opportunities in rural areas to address the cause of migration: Pervasive and persistent inequalities are leaving too many rural people mired in hunger and rural poverty. Young people in the absence of decent work opportunities and access to social services and protection, they join the flow of internal and international migrants. Arguably, the single biggest global development challenge in the decades to come will be the need to integrate hundreds of millions of young people into the labor market. High levels of youth unemployment and underemployment in rural areas prevent households from their diversifying livelihoods and escaping poverty for good. However, agriculture and agriculture-related services will need to continue to absorb a large share of new workers (Table 3). In the decades ahead, distress migration, both within and across countries, will be accelerated by population growth, globalization, climate change and political conflict.

Table 3: Structural transformation of economy of selected developing countries

Country	Share in National Income %		Share in employment %	
	1991	2017	1991	2017
Brazil	6.8	4.4	22.4	9.5
China	24.0	7.2	59.7	27.0
India	27.3	15.6	63.0	44.5
Malaysia	14.4	8.8	22.0	11.2
Vietnam	40.5	15.3	68.6	39.8

Even in recent years' agriculture growth remain stuck around long run average of 2.9 per cent whereas non agriculture growth hovers around 8 per cent. The higher growth rate in non-agriculture sector has been accompanied only by a small shift of farmers to non-farm occupations. Consequently, the income of cultivators (farmers) has remained relatively lower and the gap with non-farm workers has enlarged. A cultivator (farmer) earns less than one third of the income of a non-farm worker (Chand 2019). This is major cause of rural distress. Special focus is needed to raise income of farmers at faster rate like "Doubling Farmers Income by 2022". This would require transformation of agriculture production as well as marketing through a multi-pronged strategy that involves increase in productivity, reduction in average cost, better price realization for farm produce, expansion of allied activities and shift of farmers to non-farm occupations (Chand 2017).

7. Need for coherent and effective governance: Since, the challenges facing food and agriculture are interconnected, addressing them will require integrated policy approaches at all levels. The 2030 Agenda for Sustainable Development and related global agreements stress the interdependence of the challenges facing the global community on the path to sustainable development. However, this can only be achieved through discerning public policies, increased investments and public-private partnerships, which exploit the opportunities for maintaining current levels of productivity, sustainably raising yields, and reducing poverty and food insecurity. Decision-makers need to revisit policies, so that appropriate incentives are provided to farmers to make the right choices on what to produce and how to produce it. Current policies have not taken into account the fact that India would be more urban than rural by 2050. Most of the existing food-based policies have a greater rural presence. Public works program Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has only been designed for the rural areas, assuming rural employment is the only concern. With rising urbanization, urban informality and unemployment in urban areas, especially among the educated, raise important challenges for the food systems going ahead.

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New Insight in Management Strategies of Nitrogenous Fertilizers

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Introduction

Over the past years, nitrogen fertilizers have played an important role in increasing crop yield which resulted in an increase in per capita food production. In India the total N fertilizer consumption has increased from 55000 tons in 1950-51 to 16.73 million tons in 2016-17 (Fertilizer scenario 2017 by Department of chemical and Fertilizers). Rice is the major crop grown in India in which approximately 50 per cent of applied nitrogen is lost to the environment and the average nitrogen use efficiency is 30-35 per cent. During the last 50 years nitrogen fertilizers application has improved crop yield, but with considerable negative impacts on the environment. So new solutions are urgently needed to maintain environment quality while increasing yield with maximizing nitrogen use efficiency of crops.

Studies have shown that only 50 to 60% of the applied nitrogen is taken up by the crop plants. Around 20 to 30% remains in the soil after harvest and 10 to 20% becomes unavailable to plants during the growing season. The losses of nitrogen occur due to three processes, volatilization, leaching and denitrification. Volatilization occurs when fertilizers containing urea undergo rapid hydrolysis in the soil under high pH condition, which result in losses of nitrogen in the form of ammonia gas. Nitrate-nitrogen is vulnerable to losses by leaching and denitrification. Leaching is most likely to take place in coarse-textured soils. Denitrification of nitrate-nitrogen occurs under saturated conditions.

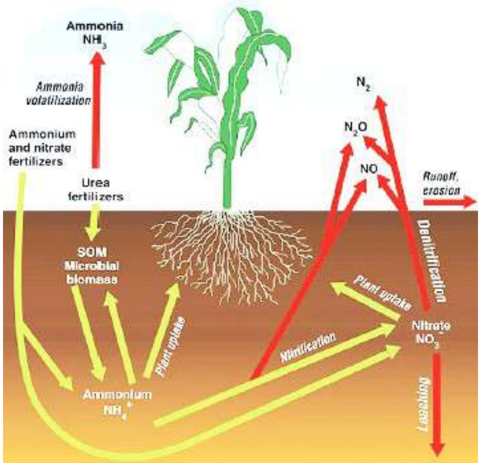

Fig. 1 Nitrogen Cycle

Management Strategies: Proper Selection of Fertilizer

The three main nitrogen fertilizer sources are anhydrous ammonia, urea and urea ammonium nitrate solutions (UAN). Anhydrous ammonia is still the least expensive form of nitrogen. Being the slowest fertilizer to get converted into nitrate, proper application of anhydrous ammonia can make it the most stable nitrogen source. Urea is subjected more to volatilization losses.

Volatilization occurs rapidly under warm air temperatures in fields having low CEC's, heavy residues, high pH and adequate moisture. These losses can be reduced by incorporating the fertilizer with at least 2 to 5 cm deep tillage. Urease inhibitors are available to mix with the fertilizers and they can prevent volatilization for 2 to 3 weeks following a surface application.

The urea will not be available to plants during this time. UAN solutions are comprised of half urea and half ammonium nitrate. Therefore, half of the nitrogen is subjected to volatilization losses and other half losses by leaching or denitrification.

Economical Nitrogen Application Rate

The first step is to determine the soil fertility of the field. According to the recommendation from soil test data select suitable fertilizer recommendation for each crop. If the nitrogen status of soil is low then apply 50% extra fertilizer over the usual recommendation and if it is high, then reduce the N application to half of its original recommendations. By knowing the yield potential of variety used and determining its realistic yield we can accurately calculate the nitrogen dose for obtaining economical yield.

Application of Fertilizers at the Optimum Time

Always apply nitrogen fertilizers in split doses. Initial dose should be provided at the time of planting followed by two doses during crop growing period. Avoid application of nitrogenous fertilizers on heavy rainfall period which significantly increases the nitrogen losses due to leaching and denitrification. For application of nitrogen prior to planting, consider using a nitrification inhibitor. These products can delay the conversion of ammonium to nitrate by 4 to 10 weeks. When application rate of nitrogen fertilizer is slightly deficient, use of nitrification inhibitors are found to be more effective.

Nitrogen Application Methods

Placing fertilizer directly into the soil is most efficient method for nitrogen fertilizers, but other methods such as banding, conservation tillage, and use of enhanced efficiency fertilizers can also help to increase nitrogen use efficiency. Incorporate urea-containing nitrogen fertilizers into soil immediately. Around one third of the N in urea may be lost to the atmosphere within a few days to a week if the fertilizer is left on the soil surface. Immediate incorporation by tillage, proper irrigation, or a gentle soaking rain will minimize volatilization of ammonia nitrogen. Banding or dribbling liquid UAN nitrogen fertilizers on the surface rather than broadcasting or spraying over the surface can significantly reduce ammonia volatilization. Use of a urease inhibitor minimizes the volatilization loss of N from urea or UAN fertilizer applied on the surface with no or delayed incorporation. Manure should be incorporated as soon as possible into soil if it hasn't been injected directly. Incorporation of manure within two days of application is necessary to significantly reduce N volatilization. In cases where incorporation is not possible, manure should be applied immediately before a non-runoff-producing rain event or by conservation tillage methods or proper irrigation. Other practices such as residue management and growing cover crops are also be beneficial.

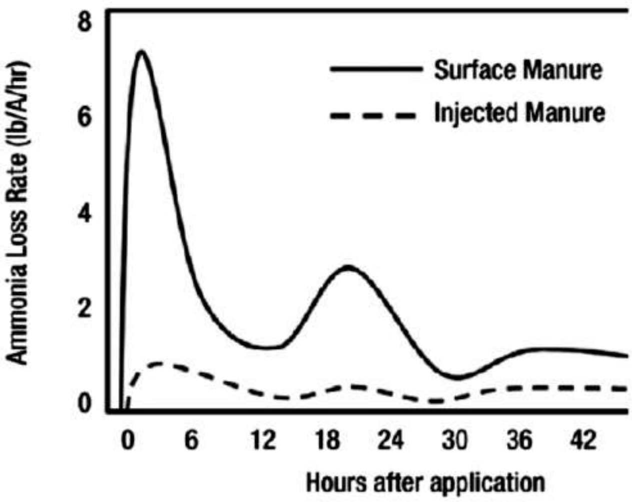

Fig. 2 Ammonia volatilization from surface-applied and injected manure. Source: C. Dell, USDA-ARS.

Evaluate Nitrogen Management

Use of late season nitrate test to evaluate overall N management on different crop can be done (Used widely in corn). This test has to be run on a sample of crops at near to crop maturity, which will be very helpful in determining their N requirement. Results from this test can be used as the basis for making adjustments in management in the future to improve overall N management for optimum crop production with minimal environmental impact.

Use of Remote Sensing and Geographical Information System (GIS)

Fig. 3 The concept of remote sensing. Source: STARS (2015).

An improvement in the NUE can be reached by using modern tools like remote sensing and GIS. The reflectance of near infrared radiation can be measured using remote sensing tools. This reflectance is correlated with crop N status, as shown by the greenness of the leaves (Gill et al. 2008). Other methods based on measurements of reflectance in the red (defined by chlorophyll content) and near infrared (defined by living vegetation) region of the electromagnetic spectrum for estimating the N requirement of different crops using early season estimates of N uptake and potential yield have been established. Normalized difference vegetative index (NDVI) based on the in-season sensor reading can predict biomass, plant N concentration and plant N uptake (Gupta 2006). The NDVI increases with increasing leaf greenness and green leaf area, and can be used as a guide for N applications.

Simulation Model Application

Computer-based software systems are useful for arranging the relevant information and presenting data in a fashion that is helpful for a better understanding in nutrient management. Such decision-support systems have taken various forms and differ in their level of sophistication (Kitchen and Goulding 2001). The soil N balance processes in the decision support systems include root N uptake, mineralization, immobilization, nitrification, denitrification and N leaching. The CROPGRO-legume model is a process-oriented, mechanistic model with subroutines that simulate crop development, carbon balance, crop and soil nitrogen balance, and soil water balance.

Use of Nanoparticles

The development of new nano devices and nano materials have opened up potential applications in the plant nutrient management. These inexpensive nanotech materials applied to increase input use efficiency and crop productivity, will bring about major growth in agriculture. It is important to know whether nanoparticles have any phytotoxic effects and its impact on food chain must be considered and studied. If they are environmentally safe and economically feasible, then they can improve nitrogen management to a longer extent.

Other Management Practices

Inorder to manage nitrogen effectively, other nutrients also need to be managed as part of a total crop production system. All aspects of crop production such as soil quality, seeds and varieties, planting, pest control, various soil factors, all essential nutrients, and water, must be managed together to achieve optimum crop production. Not only are these factors critical to the crop yield, but many will have important impact on N use efficiency. For example, low pH can seriously limit root growth. With a limited root system, even with all the N management practices discussed here, will still have a very poor N use efficiency and increased N losses.

Conclusions

More precise and diverse N management strategies are needed to maintain and increase the efficiency of N use. For precise N management, we should adopt modern techniques such as remote sensing and GIS or canopy N status sensors to quantify real-time crop N status, spatial variability in N application, etc. Besides these, knowledge on soil fertility and its N supply capacity is also necessary. Maintenance of a harmony between N supply and crop demand through the adoption of balanced fertilization, integrated N management, the use of SRNF and nitrification urease inhibitors, optimizing the time and method of fertilizer application, and changing the fertilizer form to suit need, are all are equally important to maximize the NUE.

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Gilory: The Ayurvedic Root of Immortality

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Tinospora cordifolia, which is known by common names heart-leaved mooneseed, guduchi, and gilory, is herbaceous vine of family Menispermaceae indigenous to tropical regions of the Indian subcontinent. It is found throughout the tropical regions in India. Giloy or Guduchi (Tinospora cordifolia Miers.) is a rejuvenating herb for the body. The plant is also known as Gilo, Gulancha, Guduchi (Hindi), Amrita (Sanskrit), Guduchi, Gulancha (Bengali), Gado, Galo (Gujarati), Gulvel (Marathi), Duyutige, Teppatige (Telugu), Amrutha balli (Kannada), Shindila kodi (Tamil) and Heartleaf moonseed (English).

The active adaptogenic constituents are diterpene compounds including tinosporone, tinosporic acid, cordifolisides A to E, syringen, the yellow alkaloid, berberine, Giloin, crude Giloininand, a glucosidal bitter principle as well as polysaccharides, including arabinogalactan polysaccharide.

Giloy is drug of choice amongst all the remedies in treating gout (vatarakta). The decoction of Giloy and sunthi is a very effective combination for the treatment of gout and rheumatic disorders. The juice of Giloy is helpful for gout if taken for a period of two to three months. Also purified shilajit with juice of Giloy is helpful for gout if taken twice daily.

Its benefits and uses have even been approved by the FDA (Food and Drug Administration, “Giloy can be consumed in the form of juice, powder or capsules”. Know the benefits of giloy. Giloy is a universal herb that helps boost immunity”. It is a powerhouse of antioxidants which fight free-radicals, keep your cells healthy and get rid of diseases.

Gilory: Plant Description

1. **Type:** Right Twinning Plant.
2. **Bark:** Fine, Grey or Yellowish White.
3. **Leaves:** Heart shaped, smooth.
4. **Flowers:** In bunches, small, yellow.
5. **Fruits:** Pea shaped, smooth, red (ripped).
6. **Seeds:** White, like pepper seeds.
7. **Plant part used:** Mainly - stem, Rarely - leaves and roots.
8. **Collected period:** Before rainy seasons in summers.

Health Benefits of Gilory

1. Boosts Immunity: Giloy helps remove toxins, purifies blood, fights bacteria that causes diseases and combats liver diseases and urinary tract infections. Giloy is used by experts is treating heart related conditions, and is also found useful in treating infertility.

2. Treats Chronic Fever: Giloy helps get rid of recurrent fevers. Since Giloy is anti-pyretic in nature, it can reduce signs and symptoms of several life-threatening conditions like Dengue, Swine Flu and Malaria as well.

3. Improves Digestion: Giloy is very beneficial in improving digestion and treating bowel related issues. Tip: You can take half a gram of giloy powder with some amla regularly to maximize results, or with jaggery for treating constipation.

4. Treats Diabetes: Giloy acts as a hypoglycaemic agent and helps treat diabetes (particularly Type 2 diabetes). Giloy juice helps reduce high levels of blood sugar and works wonders. Benefits of giloy: Giloy acts as a hypoglycemic agent and helps treat diabetes.

5. Reduces Stress and Anxiety: It helps reduce mental stress as well as anxiety. It helps get rid of toxins, boosts the memory, calms you down and makes for an excellent health tonic if combined with other herbs.

6. Fights Respiratory Problems: Giloy is popularly known for its anti-inflammatory benefits and helps reduce respiratory problems like frequent cough, cold, tonsils.

7. Treats Arthritis: Giloy contains anti-inflammatory and anti-arthritic properties that help treat arthritis and its several symptoms. For joint pain, the powder from giloy stem can be boiled with milk and consumed. It can be used along with ginger to treat rheumatoid arthritis. Benefits of giloy: Giloy juice contains anti-inflammatory and anti-arthritic properties.

Some photographs of gilory plants

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8. Reduces Asthmatic Symptoms: Asthma causes chest tightness, shortness of breath, coughing, wheezing, etc. which makes it very difficult to treat such a condition. "Chewing on giloy root or drinking giloy juice helps asthma patients and is often recommended by experts", adds Dr. Manoj K. Ahuja, Fortis Hospital.

9. Improves Vision: In several parts of India, Giloy plant is applied to the eyes as it helps boost vision clarity. All you need to do, is boil Giloy powder in water, let it cool down and apply over the eyelids.

10. Reduces signs of ageing: Giloy plant contains anti-aging properties that help reduce dark spots, pimples, fine lines and wrinkles. It gives you that flawless, glowing skin you've always wanted.

History and Importance in Ayurveda

The plant is a powerful rasayana mentioned in Indian Ayurvedic literature. It is considered as a bitter tonic and powerful immuno modulator. Giloy acts as a memory booster, develops intelligence and promotes mental clarity. It is described as one of the Medhya Rasayana (mental rejuvenative) in the Charak Samhita. It has long been used in India as a medicine and in the preparation of a starch known as giloe-ka-sat or as palo which is said to be a tonic, antiperiodic, and a diuretic.

Giloy is used in Ayurvedic as a hepatoprotectant, protecting the liver from damage that may occur following exposure to toxins. Recent studies have shown that a combination with turmeric extract is effective in preventing the hepatotoxicity which is otherwise produced as a side effect of conventional pharmaceutical treatments for tuberculosis using drugs such as isoniazid and rifampicin. Giloy is considered helpful in eye disorders as a tissue builder and promotes mental clarity. The stem of Giloy is used in general debility, dyspepsia and urinary diseases.

It is used in the Indian Ayurvedic system of medicine for the treatment of jaundice, diabetes rheumatoid arthritis and is also used as an immunostimulant. It is an alternative, anthelmintic, anti-pyretic, aphrodisiac, bitter tonic, and blood purifier, cardiac, carminative digestive, diuretic and expectorant. The starch from the roots and stem is used in chronic diarrhoea and dysentery. The juice of fresh plant is diuretic and used in gonorrhea.

Varietal Aerial Plant Parts of Gilory

1. The root, stem, leaves and sattva of Giloy are used for medicinal purpose. Externally the medicated oil of the plant is effectively used to relieve pain and oedema, in gout and skin disorders.

2. In filariasis, the paste of Giloy, shunthi, devadara and vidanga works when applied externally. Internally, Giloy is an effective rasayana - rejuvenative. It works on all the seven 'dhatus' and keeps the body system in balance.

3. The rasayana property bestows longevity, enhances memory, and improves general health, better complexion, energy and luster of the skin. In vata doshas diseases, it is given with ghrita, pitta doshas diseases, it is given with sugar, kapha doshas diseases, it is given with honey. It is especially helpful in the digestive ailments like hyperacidity, colitis, worm infestations and loss of appetite, abdominal pain, excessive thirst, emesis and liver disorders like hepatitis.

Different Products

Popular giloy products in the market are Giloy sattva, Giloyyadi churna, Giloyadi Kwath, Amritarishta, Amrita guggulu, Guduchyadi taila, Sudarshan churna, Sanjivani vati, Kaishore guggulu, Rasnapanchak kwath. The major ayurvedic preparations using Giloy as one of the constituents are Amrtarista; Amrtottara kvatha churna, Guduci taila; Guduchyadi churna; Guduchyadi-kwatha, Giloy sattva; Chinnodbhavadi kvatha churna.

A plant with as diverse a role as *Tinospora cordifolia* is a versatile resource for all forms of life. Despite centuries of use in traditional medicine to treat various disorders, there is no high-quality clinical evidences that it has any effect of diseases. With so much to offer to the scientific world of medicine, the plant Tinosporia truly act as an incredible source.

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Allspice

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Introduction

Allspice is a dioecious minor tree spice known scientifically as Pimenta dioica, belongs to the family Myrtaceae. The spice is also called 'Pimenta', 'Jamaican pepper' and 'Nalkenpfeffer'. Economic or edible part of allspice is the dried immature fruit. The name 'Allspice' came from the fact that the spice is said to possess the characteristic flavor and aroma of cloves, nutmeg and cinnamon all combined in this one spice. This spice is available in whole or ground form, used as a condiment and flavoring agent in ketchups, soups, sauces, pickles, canned meats, sausages, gravies, relishes, fish dishes, puddings, preservatives etc. Apart from culinary uses allspice is also an important flavoring ingredient for wines and as a perfume in soap making. Medicinal uses like it is used as a stimulant in digestive troubles, the powdered fruit is used in flatulence, dyspepsia and diarrhea. Earlier, it was used in medicine as an adjuvant to tonics and preservatives. Allspice is a tropical evergreen tree native to West Indies and Central America and grows semi-wild in Jamaica, which is the major producer. In India, it is cultivated in west Bengal, Bihar and Orissa. The cultivation is slowly increasing in Kerala, Karnataka and Tamil Nadu.

Cultivation Aspects

The plant grows in a wide range of soils including poor soils with good drainage. It is not suited to red soil with inadequate moisture. It grows from sea level to an altitude of 1065 m above MSL; however, it also grows well below 300 m. An annual rainfall of 100 to 200 cm or more with a mean monthly temperature up to 270 C are ideal. The performance of allspice in the plains is poor and fruiting is not observed. At higher, cooler and wetter areas, the incidence of rust disease is severe.

Propagation and Planting

Allspice is commercially propagated through seeds, are collected from ripe fruits from high yielding and regular bearing trees. The seeds should be sown immediately or else germination is reduced. The seeds are sown in nursery beds containing suitable potting mixtures. Germination takes place between 9 and 10 days or sometimes 15 days after sowing. Six to ten months old seedlings are transplanted into a main field at a spacing of 6m x 6m. Crae should be taken at the young stages by providing shade and regular irrigation to reduce causalities in the main field. It can be grown as an intercrop in arecanut, coconut gardens and coffee estates.

Manures and Fertilizers

10kg compost along with 20:18:50 g of N, P2O5 and K2O during the first year and 20kg compost with 40:36:100 g of N, P2O5 and K2O during the second year. The dose is gradually increased to 50 kg compost and 300:250:750 g of N, P2O5 and K20 per tree upto 15 year after planting. After 15 years of planting it is recommended to apply 80 kg of FYM and 300:250:750 g of N, P2O5 and K20 per plant from 15th year onwards.

Irrigation

The plants are watered during the dry months in the early stages of growth, upto 2-3 years after planting.

Weeding

As the crop is widely spaced, weed problems are common, especially in the early stages. The base of the plants should always be kept clean by regular weeding and mulching. Weeds are controlled chemically by using a herbicide like Gramaxone.

Plant Protection

Pests: Infestation by the tea mosquito bug has been observed on tender shoots and leaves. The pest infestation results in drying of the tender shoots and formation of necrotic spots on the leaves. Spraying with Quinalphos @ 0.05 per cent will control the pest. Other minor pests: Scales, white ants, white fly, red-banded thrips, bag worm caterpillars, feeder beetle etc.

Diseases

1. Leaf-spot *(Cylindrocladium quinqueseptatum)*: Grey to brownish-grey discolorations appear on the margins of the leaves which extend inward causing leaf rot. The affected leaves drop off causing varying degree of defoliation. The lower surface of infected leaves shows a downy growth due to the production of abundant conidia. The disease is generally noticed during July-September.

2. Leaf rust *(Puccinia psidii)*: It is the most serious disease in Jamaica which results in the defoliation of the young leaves, successive rust attack results in the death of the tree. This disease can be successfully controlled by spraying the young leaves and inflorescence with Dithane M-45.

3. Other diseases: Leaf rot and dieback.

Harvesting, Processing and Yield

Usual flowering time of allspice in India is during March to June. It takes 5-6 years for flowering under good management. The tree takes 20-25 years to come to the full bearing stage and continues up to a good age. The fruits are ready for harvest after 3-4 months of flowering. The berries grow in clusters and are best used as the spice when they are green, fully matured but not ripe. The unripe berry is spicier and somewhat peppery in taste. They are manually gathered by climbing up the tree on a ladder. After harvesting, the ripe berries are separated from the green ones.

The berries are spread out in the sun and turned over with a wooden rake, so that they dry uniformly. Drying takes 3-12 days. A good dry wind accelerates the drying process. The end product should be bright brown in color. The completion of drying is confirmed by sharp, dry and crisp rattling sounds when a handful is shaken close to the ear. Then the berries are cleaned by winnowing and stored after removing any dust. Allspice should be stored in gunny bags lined with polyethylene in covered premises, well protected from the sun, rain and excessive heat.

Grades / Types

Pimento is marketed as whole or ground pimento. There are four major grades/types of pimento that are traded. They are, Mexican, Guatemala, Honduras and Jamaican pimenta. Jamaican pimenta has the best aroma, flavor and volatile oil content of 4-4.5 per cent. The dried berries range in size from 6.5 to 9.5 mm in diameter and there are 13 to 14 berries per gram.

Yield

A well grown tree yields 20-25 kg of dry berries per year. The berries are light and about 14,000 berries weigh 1kg.

Value Added Products

1. Pimenta berry oil: The essential oil obtained by steam distillation of the crushed dried berries is known as pimento berry oil. The oil has resin, protein, pentosans, starch, traces of alkaloids, pigment and minerals. It is yellow to yellowish-red in color. It darkens with age and possesses the characteristic color and warm spicy and sweet flavor of allspice. It contains eugenol of 65-80 per ecnt, methyl eugenol 8 per cent, beta-caryophyllene 4.2 per cent and cineole of 2.3 per ecnt.

2. Pimenta leaf oil: Steam distillation of dried pimento leaves yields 1.8-3.8 per cent of an oil, which is the pimento leaf oil. The leaf oil contains eugenol (58-62%) as its main component, it also contains myrcene (14-17%) and 1, 8-cineole (6.6-8.4%) but has an inferior odour and flavor to that of the berry oil. The leaves also contain tannin which may be used for tanning purposes.

3. Pimenta oleoresin: The berries are processed on a small scale in some of the importing countries for the manufacture of oleoresin.

Pimenta Bark and Wood

Pimento bark also contains tannin and a small quantity of essential oil. The wood from the tree trunk is dark to light salmon pink in color with a very firm, hard, close texture and a smooth surface. The wood is used for making sticks, umbrella handles and cart shafts.

		
a. Allspice tree	**b. Unripe berries**	**c. Dried allspice berries**

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India's Worst Locust Attack in 26 Years: What Does This Threat Mean?

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Introduction

Locusts are insects that belong to the family of grasshoppers. The Food and Agriculture Organisation (FAO) describes them as the oldest migratory pests in the world, with the desert locust being the "most devastating" of them all. In addition, swarms of these 'deadly' desert locusts have now made their way to India, threatening our agricultural economy. As their population becomes abundant and dense, they change their behavior, form swarms, and start damaging crops.

This is known as gregarisation. The change in behavior is triggered by close physical contact, following which they then become inclined to disperse together to find food. They feed on nearly all green vegetation - leaves, flowers, bark, stems, fruit, and seeds. The crops that it eats include millet, rice, maize, sorghum, sugarcane, barley, cotton, fruit trees, date palm, vegetables, acacia, banana, pines, and rangeland grasses.

Why are they Dangerous?

According to FAO, an adult locust can eat a quantity equal to its weight about 2 grams for every single day. Now, this might hardly seem like cause for concern. However, a single square kilometer of the swarm can contain somewhere between 40-80 million adult locusts. Every single day, if they cover 130-150 kms, they can eat the food consumed by as many as 35,000 people.

A desert locust lives for about three to five months. Again, this is extremely variable and depends mostly on weather and ecological conditions. For example, a swarm the size of Paris eats the same amount of food in one day as half the population of France; the size of New York City eats in one day the same as everyone in New York and California. However, it is also important to note that these locusts do not directly attack human beings or animals.

"In the past few years, there has been a significant increase in the frequency of such cyclones at the beginning and end of the summer period. For example, there were 8 cyclones in 2019 when in most years there are only one or two. Three cyclones in 2018 and two in 2019 have contributed to the current Desert Locust upsurge in the Horn of Africa where large and numerous swarms are present in Ethiopia, Somalia and Kenya."

What is Happening in India Right Now?

India is witnessing its worst locust attack in 26 years. On Monday, 25 May, as predicted, many states including Madhya Pradesh, Rajasthan, and Uttar Pradesh started their battle against the locust attack. The current swarm originated in East Africa and has reached India via Pakistan. The locusts have already destroyed crops in 18 districts of Rajasthan and almost a dozen districts of Madhya Pradesh. It is feared that 17 more districts in the state including Aligarh, Mathura, and Jhansi will be hit in the next couple of weeks. Gujarat and Punjab farmers have also been warned and have been asked to prepare for an impending invasion by the grasshoppers. The United Nations had warned that armies of locusts swarming across continents pose a "severe risk" to India's agriculture, and would have an impact on the economy this year.

"This year the locusts are breeding 400 times more than usual due to the favorable climatic conditions brought on by the untimely rains and increased cyclonic activity. The government preparedness has been too slow to keep up with this rapid increase. They must step up support. This is an emergency and requires emergency measures. These desert locusts will not only leave a severe impact on India's food production but also deal a double whammy to the famers who were already reeling from the economic downfall of the lockdown due to COVID-19."

What Led to Their Early Arrival?

This can be traced back to the cyclonic storms Mekunu and Luban that had struck Oman and Yemen respectively in 2018. These turned large deserts tracts into lakes, facilitating locust breeding that continued through 2019. Swarms attacking crops in East Africa reached peak populations from November, and built up in southern Iran and Pakistan since the beginning of 2020, with heavy rains in East Africa in March-April enabling further breeding.

How has Locust Swarmed in India?

Consecutive waves of spring-bred swarms from Pakistan and Iran arrived in Rajasthan throughout the past couple of months with additional swarms coming from East Africa to Rajasthan and Gujarat. The locusts first settled in cropping areas of Jaipur, Rajasthan, and continued eastwards towards Madhya Pradesh, Maharashtra, Uttar Pradesh, Bihar, and as far as east Odisha and Chhattisgarh. The early migration of spring-bred locust crowds from Pakistan to Rajasthan appeared in May before the monsoon and some bunches travelled to northern states for the first time since 1962.

What Measures have been Taken by Government for Locusts Control in India?

1. Vehicles deployed to spray for Locusts Control: Government has already deployed 89 fire brigades; 47 control vehicles; 120 survey vehicles and 810 tractors to spray pesticides for effective locust control.

2. Procurement of 60 more sprayers: Union Ministry of Agriculture & Farmers welfare has approved procurement of 60 more sprayers from the United Kingdom for spraying the chemicals to stop invasion of locust swarms in the fields.

3. Use of Drones: The Union Ministry of Civil Aviation gave approval to DPPQS to deploy Remotely Piloted Aircraft System (drones) for containing the locusts plague. Two companies have been roped in to spray pesticides through the drones.

4. Locusts Control Operations in affected States: Government has undertaken locusts control operations in affected states including Punjab (1 district), Rajasthan (21 districts), Gujarat (2 districts) and Madhya Pradesh (18 districts).

5. Alert issued in states likely to attract locusts' swarms: The Government has issued alert in the states where locusts are likely to affect crops including Uttar Pradesh and Indo-Pakistan Border.

Effect of Locust Plague on Food

Desert locust are a direct threat to the food security of a country. In favorable conditions, a locust swarm can cover an area from less than one square kilometer to several hundred square kilometers. A swarm of desert locust containing around 40 million locusts can consume (or destroy) food that would suffice the hunger need of 35,000 people, assuming that one person consumes around 2.3 kg of food every day. The Ministry of Agriculture and Farmers Welfare, Ministry of External Affairs, Ministry of Home Affairs, Ministry of Earth Sciences, Ministry of Civil Aviation and other stakeholders such as State Governments and farmers get involved in the locust control.

Conclusion

The world has seen numerous terrifying events in the past couple of months, 2020 that are easily the worst in the past few decades. People are becoming evil and are performing evil deeds. Corruption, Adulteration, Female Foeticides, Dowry, Thieving, Intoxicating, Consumption of Non-veg, and many other social evils have emerged and have reached their heights. It is a great sin to break the constitution of God and create a hindrance in the path of attaining God. The current events are responsible of all actions, is giving more and more sorrows to creatures.

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Behavioural Pest Management and It's Practical Considerations

Article ID: 31149

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Abstract
Host finding by insects comprises of following important steps including, host habitat finding, host finding, host recognition, host acceptance and host suitability. Any obstruction or deviance from the normal sequences can hinder the entire process. Thus, the role of olfactory and visual cues is important in attraction of pests towards the host plants, which is the basis of behavioral pest management practices. Thus, an eco-friendly and sustainable practice can be adopted through behavioral pest management practices to control the menace of pests.

Keywords: Host finding, olfactory, visual, behavioral, eco-friendly.

Introduction
Semiochemicals (Gk. semeon, a signal) are chemicals that mediate interactions between organisms. Insects use many different semiochemicals, chemicals that convey messages between organisms or mediate interactions between organisms. Semiochemicals maybe classified into Allelochemical (interspecific semiochemicals) and Pheromones (intraspecific semiochemicals). Allelochemicals (Inter-Specific) are chemicals that are significant to individuals of a species different from the source species. Allomones: Favorable to Producer, the response of the receiver is adaptively favorable to emitter, but not the receiver. Allomones are mostly defensive chemicals, producing negative responses and reducing chances of contact and utilization. They include repellents, oviposition and feeding deterrents, and toxicants. Kairomones are advantageous to an insect, such as promoting host finding, oviposition, and feeding. (Feeding deterrents, oviposition deterrents, repellents, toxicants). Kairomones: Favorable to Receiver but not the emitter. Kairomones are advantageous to an insect, such as promoting host finding, oviposition, and feeding. Feeding attractants, feeding arrestants, oviposition attractants, feeding stimulant, flight arrestant. Synomones: Favorable to both Producer & Receiver The response of receiver is adaptively favorable to both receiver & emitter. Pheromones are chemicals secreted into the external environment by an animal which elicit a specific reaction in a receiving individual of the same species. Pheromones are volatile in nature and they aid in communication among insects. Pheromones are exocrine in origin (i.e. secreted outside the body). Hence, they were earlier called as ectohormones. In 1959, German chemists Karlson and Butenandt isolated and identified the first pheromone, a sex attractant from silkworm moths.

Semiochemicals (Gk. semeon, a signal) are chemicals that mediate interactions between organisms.	
Allelochemical (interspecific semiochemicals)	Pheromones (intraspecific semiochemicals)
Allelochemicals (Inter-Specific) are chemicals that are significant to individuals of a species different from the source species.	Primer pheromones: They trigger off a chain of physiological changes in the recipient without any immediate change in the behaviour. They act through gustatory (taste) sensilla. (eg.) Caste determination and reproduction in social insects like ants, bees, wasps
Allomones: Favorable to Producer, the response of the receiver is adaptively favorable to emitter, but not the receiver. Allomones are mostly defensive chemicals, producing negative responses and reducing chances of contact and utilization. They include repellents, oviposition and feeding deterrents, and toxicants.	Releaser pheromones: These pheromones produce an immediate change in the behaviour of the recipient. Releaser pheromones may be further subdivided based on their biological activity into 1. Sex pheromones 2. Aggregation pheromones 3. Alarm pheromones

Kairomones are advantageous to an insect, such as promoting host finding, oviposition, and feeding. (Feeding deterrents, oviposition deterrents, repellents, toxicants). Kairomones: Favorable to Receiver but not the emitter. Kairomones are advantageous to an insect, such as promoting host finding, oviposition, and feeding. Feeding attractants, feeding arrestants, oviposition attractants, feeding stimulant, flight arrestant.	4. Trail pheromones
Synomones: Favorable to both Producer & Receiver The response of receiver is adaptively favorable to both receiver & emitter.	

According to Foster and Harris (1997), manipulation of a pest's behavior for purposes of pest management may be conceived primarily as use of stimuli that either stimulate or inhibit a behavior and thereby change its expression. In some cases, the stimuli used may be natural. Manipulation includes such practices as arranging particularly attractive cultivars or species of plants as barriers to intercept or concentrate immigrating pests (trap cropping); arranging unattractive plants in association with principal crop plants to disrupt host finding or host acceptance (intercropping, under sowing, companion planting) (Finch and Collier, 2000); and breeding for biotypes of desired plants or animals that are unattractive or unacceptable to pests (antixenosis) (Kogan, 1994). In the great majority of cases, however, stimuli used in behavioral manipulation are artificial equivalents or variants of natural stimuli presented in sub natural, natural, or supranatural amounts. So, deployment of defined artificial stimuli permits greater flexibility and control in behavioral manipulation than does use of undefined or natural stimuli. This chapter focuses exclusively on use of artificial stimuli in behavioral manipulation.

Artificial stimuli for behavioral management of pests are either chemical or physical.
1. Chemical stimuli include odor stimuli operative at some distance from the source and contact-chemical stimuli operative upon arrival.
2. Physical stimuli include visual and acoustical stimuli (rarely mechanical stimuli) that usually operate at some distance from the source.

Deployment of an artificial stimulus may attract or repel a pest engaged in resource-finding behavior at some distance, positively stimulate or deter a pest engaged in resource-examining or resource-acceptance behavior upon arrival, or mask arthropod perception of stimuli emanating from a resource. Management of pests responding to a deployed stimulus can be achieved by various means. Individuals attracted by an odor, visual, or acoustical stimulus can be trapped on arrival or otherwise killed on arrival by touching a contact type insecticide incorporated with the stimulus or applied to the locale of the stimulus. Toxic or debilitating sublethal effects of insecticide can be enhanced by deploying a contact feeding stimulant in association with the attractive stimulus to encourage ingestion of insecticide, or at least increase the frequency of contact or prolong the period of contact with insecticide.

Concepts advanced by Bernays (2000) in regard to fundamental aspects of host selection by insects would suggest that, for management of pest arthropods which are resource specialists and exhibit great sensitivity to one or a few positive host-specific stimuli, synthetic attractant or positive contact stimuli might need to be applied in a particularly high amount in order to achieve contrast with levels characteristic of the resource, though not in such high amount as to compromise effectiveness of traps or insecticide. For management of resource generalists, which often exhibit lesser sensitivity than do specialists to positive stimuli of prospective hosts but greater sensitivity to negative stimuli of non-hosts, a lower amount of synthetic attractive or positive contact stimuli may suffice to achieve an effective level of contrast with natural host stimuli. Individuals repelled from arrival at a resource or deterred from accepting a resource through deployment of a chemical, visual, or acoustical stimulus should refrain from using the resource in the treated locale. Affected individuals may, however, move to and accept less protected resource items or, after undergoing sensory adaptation or central habituation to the artificial stimulus, no longer be repelled or deterred. Thus, repellents and deterrents are often most successful when deployed in association with attractants or positive contact stimulants in what have come to be known as deterrent stimulo or push-pull behavioral management systems (Prokopy, 1972; Miller and Cowles, 1990; Borden, 1997). Masking of resource stimuli can be achieved by application of natural or synthetic equivalents, or analogs of resource stimuli, which are applied in sufficiently high concentration over a sufficiently broad area to effectively prevent a pest individual from finding targeted resources.

Some Practical Considerations

The foremost practical consideration in behavioral pest management is that the targeted pest should be a key pest or one with populations that repeatedly exceed tolerable levels if unmanaged. Because behavioral management is usually more informationally and operationally challenging and more expensive than alternative management approaches. Behavioral pest management almost invariably results in use of less pesticide against a key pest and should have a less negative effect on beneficial arthropods and non-target organisms than does a purely pesticide-based approach to management. This inherent appeal must be weighed against possible build-up of secondary and occasional pests if key pests are managed behaviorally and no effective biological, cultural, or other control measures are taken against secondary or occasional pests that may rise to higher pest status after the decline of key pests.

In addition to these, Foster and Harris (1997) put forward the following as desirable attributes of candidate stimuli for use in behavioral manipulation of arthropod pests:

Accessibility	the stimulus ought to be presented in a form suitable for detection by the pest.
Definability and reproducibility	the more precisely the stimulus can be defined, the more precisely it can be reproduced artificially
Controllability	the better the ability to control various parameters of a stimulus, particularly its intensity and duration, the greater the probability of achieving successful behavioural manipulation
Specificity	the more specific a stimulus is in affecting a behaviour of a pest, the more likely it is to be perceived above background level and succeed in manipulating that behaviour.
Practicability	use of the stimulus ought to be as simple as possible, affordable, and not affect non-target organisms.

Conclusion

According to these attributes, it is not surprising that odor stimuli have predominated over contact chemical, visual, and acoustic stimuli in behavioral management of pest arthropods. So identification of proper pheromone or pheromone blends for managing key pests can be an effective way to mitigate the chemical based management practices.

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Serological Methods Used in Detection of Bacteria

Article ID: 31150

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Introduction

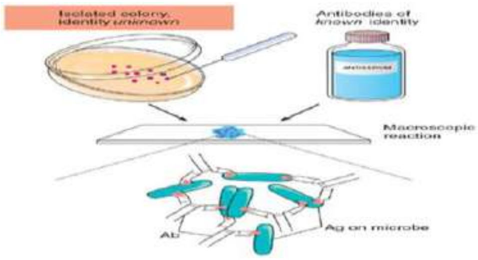
Serology deals with the study of antigen and antibody reactions in vitro. It includes identification and quantification of antigen or antibody using its known counterpart. Serological techniques depend on the ability of the chemical constituents of the bacterial cells to behave as antigens, that is to elicit the production of antibodies in vertebrate animals. The antibodies are the humoral antibodies found in the blood serum usually called as antiserum.

There are two types of serological studies which are useful:
1. Those based on cell surface antigens usually present on flagellum, pilli, walls, membrane and capsules etc.
2. Those based on the use of antisera raised against purified enzymes to assess the structural similarities between homologous proteins from different bacteria.

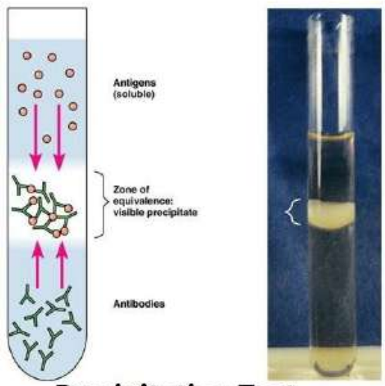
Antigen and Antibody Reactions

Important serological techniques that are commonly used may include Agglutinations, Precipitation, complement fixation, Opsonization, Neutralization, Immune-cytolysis, Immuno-adherence, Immuno-fluorescence, Immuno-electrophoresis, Counter immuno-electrophoresis, Radio immune assay, Enzyme linked immuno-sorbent assay and Immuno blotting.

1. Agglutination: Agglutination means clumping of the particles. As a result of antigen-antibody interaction, particulate form of antigen or antibody coated particles form clumps. Such kind of reaction is termed as agglutination reaction. In most of the agglutination reactions, the antigen remains particulate and the antibody may be in soluble form.



2. Precipitation: In this reaction, soluble forms of antigen and antibody interact with each other, resulting in the formation of precipitation. Such kind of reaction is called as precipitation reaction. A precipitation reaction requires antibodies more than that for agglutination because with the decrease in size of particles, the total available surface of the antigen increases. Most precipitation reactions occur better at 37 0C to 45 0C.

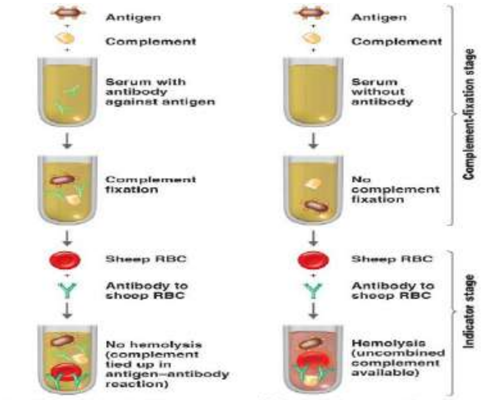


Precipitation Test

Precipitation reaction teat consists of three tests:

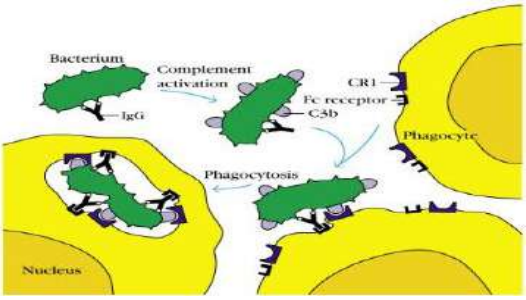
a. Simple mixture.
b. Inter -facial ring test.
c. Gel diffusion test.

3. Complement fixation test: Complement fixation test is based on the principle of fixation of complement factors to antigen antibody complexes. As a result of antigen and antibody interaction, compliment is activated and fixed to the antigen-antibody complex. It is detected by an indicator system consisting of sheep RBC and antibodies to sheep RBC. It has been used frequently for detection of specific antibodies to viruses, protozoa, rickettsia and a number of bacteria for diagnosis of the disease caused by them.

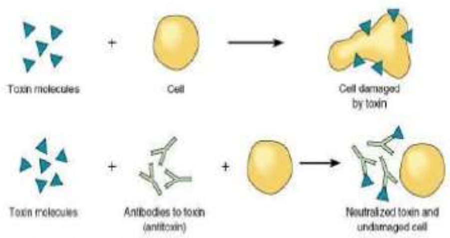


(a) Positive test. All available complement is fixed by the antigen–antibody reaction; no hemolysis occurs, so the test is positive for the presence of antibodies.
(b) Negative test. No antigen–antibody reaction occurs. The complement remains, and the red blood cells are lysed in the indicator stage, so the test is negative.

4. Opsonization: Enhanced phagocytosis by antigen-antibody interaction is known as opsonization. In this test attachment of antibodies to a particular antigen usually makes the antigen easily phagocytosed by phagocytic cells. Pathogen is marked for ingestion and destruction by phagocytic cells.



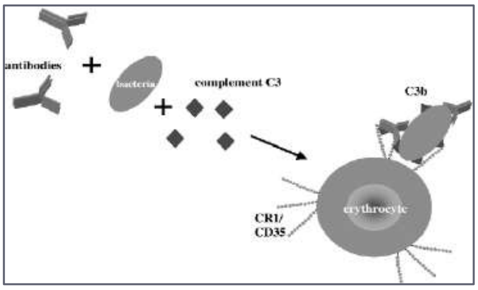
5. Neutralization test: This test is also called as toxin-antitoxin interactions. In this test attachment of antibodies to antigen neutralizes the toxic effect of the antigen, resulting in the reaction known as neutralization.



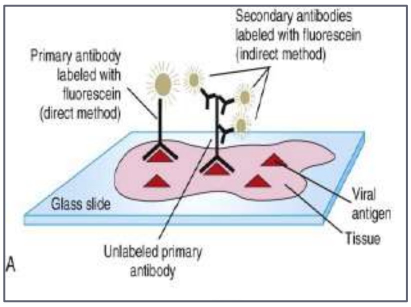
(a) Effects and neutralization of a toxin

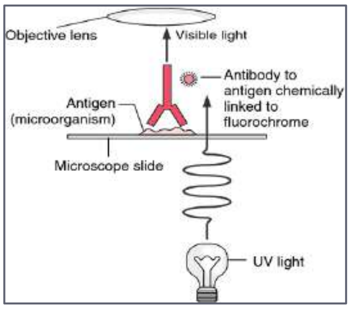
6. Immune cytolysis: As a result of complement activation, antibodies and surface antigen of certain cells interact, resulting in cytolysis.

7. Immune adherence: This test used to detect antigen or antibodies. Certain erythrocytes are known to bear surface receptors for C3. Therefore, erythrocytes may adhere with C3 attached to the antigen-antibody complexes. This is known as immune adherence.



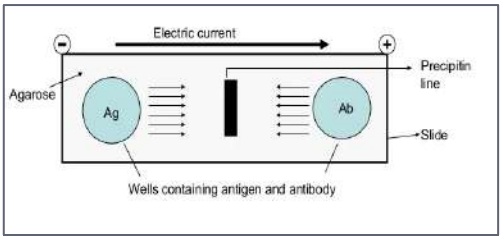
8. Immune fluorescence: It involves labelling of antibody with fluorescent dye followed by its use in detection of antigen. It can detect protein of less than 1µg/ml of the body fluid. Fluorescent dyes usually absorb UV light between wave length 290 – 295 nm and emit light of longer wave length (525 nm) of visible spectrum.



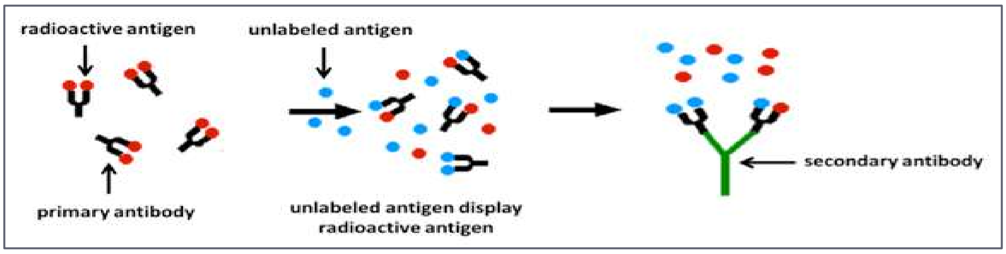


9. Immune-electrophoresis: In this method antigens are separated from the mixture by the use of electrophoresis and such antigens are detected by immune-diffusion technique.

10. Counter immune-electrophoresis: In this reaction, oppositely charged antigen and antibody molecules are subjected to migrate in an agar gel under the influence of electric current. It results in quick precipitation when both antigen and antibody molecules meet in optimum concentration. Quick precipitation under the influence of electric current is known as counter immune electrophoresis.



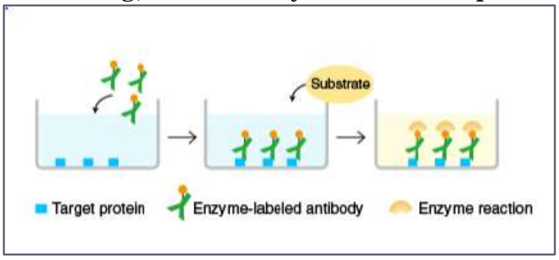
11. Radio immune assay (RIA): In this reaction, assay of antigen and antibody is made in a given sample through the utilization of radio-active labelled antigen or antibody. For the measurement of the amount of labelled antigen attached to the antibody, separation of antigen-antibody complexes from the mixture is essential. The separation is done by centrifugation and filtration. There after the radioactivity is measured and percentage of labelled antigen bound to antibody is calculated. Amount of unknown antigen is determined using reference curve.



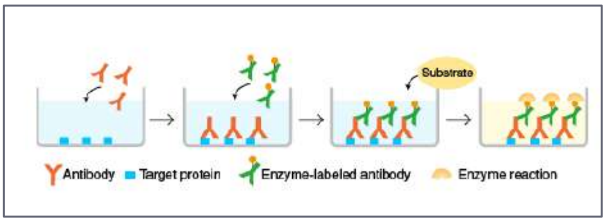
12. Enzyme linked immuno-sorbent assay (ELISA): When the antigen and antibody reaction is observed or one of the components is quantitated through enzyme labelled counterpart. And subsequent part demonstration of fixed enzyme by its substrate is done, such reaction or the technique is known as enzyme linked immuno-sorbent assay.

Types of ELISA:

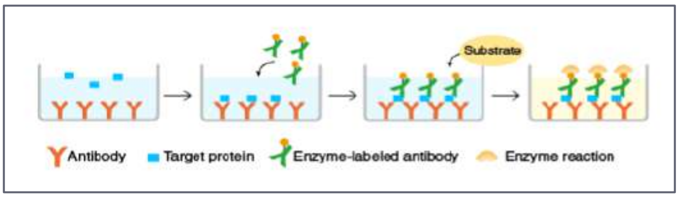
a. Direct ELISA: A target protein (or a target antibody) is immobilized on the surface of microplate wells and incubated with an enzyme-labelled antibody to the target protein (or a specific antigen to the target antibody). After washing, the activity of the microplate well-bound enzyme is measured.



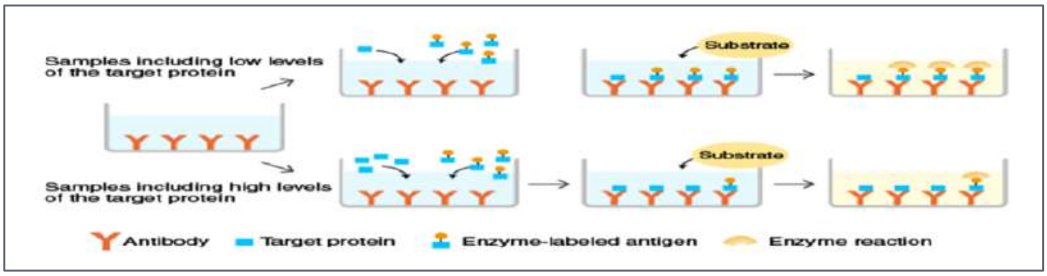
b. Indirect ELISA: In this both primary ad secondary antibody is used. But in this case, the primary antibody is not labelled with an enzyme. Instead, the secondary antibody is labelled with an enzyme.



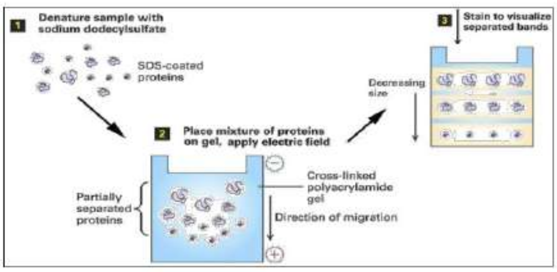
c. Sandwich ELISA: In this the antibody is immobilized to the plate, and this antibody is called capture antibody. Firstly, the antigen of interest binds to the capture antibody immobilized to the plate. Secondly, primary detection antibody binds to the antigen. Thirdly, the secondary detection antibody binds to the primary detection body, and then the enzyme reacts with its substrate to produce a visible signal that can be measured.



d. Competitive ELISA: It involves the use of inhibitor antigen. This competes with the antigen of interest for binding to the primary antibody.



13. Immuno-blotting: Antigens are first separated by poly-acrylamide gel electrophoresis and then transferred on to nitro-cellulose paper strips. These are the used for the detection of antibodies in the unknown samples.



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Silicon: A Tool in Host Plant Resistance Against Insects

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Introduction

Elements play a pivotal role in the life cycle of living organisms. Among the 92 known elements on earth, 17 are considered to be essential for the plants and they are divided into macronutrients and micronutrients. The macronutrients include C, H, O, Ca, K, Mg, N, S and P of which C, H and O make up approximately 95% of plant dry matter and others are present at >1000 mg/kg dry weight. The micronutrients include Cl, B, Cu, Fe, Mn, Mo, Ni and Zn which are present at <100 mg /kg dry weight. The elements which promote growth and act as essential element to particular taxa but are not required by all plants are known as beneficial elements. The five beneficial elements are Al, Co, Na, Se and Si, these elements promote growth of various plant species under certain environmental conditions, however, their function and concentration varies for plant species.

Silicon in the Soil

Silicon constitutes 27.7% of total weight in the soil after oxygen which is 47% and it occurs as silica (SiO2) and silicates (SiO3) but not in its elemental form. Depletion of available silicon in the soil is an important factor is closely related with progressive yield decline as experienced in various crops. Silicon occurs in the soil is in an unavailable polymerized form and for its absorption by plants it has to be depolymerized and rendered soluble by means of chemical and biological reactions in the soil. Silicon content in the soil ranges from < 1 to 45% by dry weight while the silica (Si to SiO2 - 2.1; Si to SiO3 - 2.6) constitute 50-70% of the soil mass varying from less than 20-100%. It mainly occurs as an inert mineral of sands, quartz (SiO2 pure), kaolinite, mica, feldspar and other clay minerals (aluminum, magnesium, calcium, sodium, potassium or iron forming silicates). Silicon as silicic acid (0.1-0.6 mM) occurs as one of the main constituents of soil solution and it can be regarded as a plant nutrient. Silicon ranges from 200-300g silicon/kg in clay soil and 450 g silicon/kg in sandy soils. Soil treatment with bio-geochemically active silicon optimizes soil fertility through improved water, physical and chemical properties of soil and maintenance of nutrients in plant available forms in the soil.

Utilization of Silicon Against Biotic Stresses

Silicon is dispersed throughout the plant via transpiration stream and inhibits diseases through the modification of epidermal layer of leaves and fruits as well as by increasing the presence of low molecular weight metabolites. The toughness of the cell wall and plant protection against abiotic and biotic stresses is imparted by silicon. Silicon delays the onset of diseases or reduced them and therefore it can be used as preventive measure.

The application of silicon as pest management resource can save the cost of expensive fungicides and insecticides and other fertilizers as reported in rice that silicon eliminates the need of fungicides or pesticides. Silicon is potent enough to act as a biological inducer of plant defense responses other than being a mechanical barrier. The possible mechanism reported to confer resistance to pest attack by silicon in the plants are:

1. Silicon accumulates in the cell wall of plants and form silicon-cellulose network which acts as a mechanical barrier against pathogen.

2. Silicon reduces the rate of progress of the disease by restricting the lesion size and production of spores for secondary infection.

3. The presence of silicon crystals in the plant tissues hinders the feeding of the insect as these crystals can damage the mandibles of the insects. In this way silicon acts as a physical barrier. The cuticle-silica double layer mechanically impedes the penetration of fungi and thus disrupt the infection process in rice.

4. The role of silicon in the water conservation in the plants has been observed. Silicon may enhance activity of chitinase, peroxidase and polyphenyl oxidases after fungal or pathogen infection.

5. Silicon enhances host resistance by enhancing the levels of inhibitors like phenolic compounds or by mediating the synthesis of antifungal phytoalexins after the infection or by activating antioxidative enzymes.

6. Silicon can increase resistance of the plants by formation of papillae, deposition of callose and H2O2, upregulation of phenylpropanoid pathway and by stimulating systemic stress signals (salicylic acid, jasmonic acid and ethylene).

7. The soluble silicon can produce phenolics and phytoalexins in response to infection and the antifungal phytoalexin-momi-lactones that accumulate in silicon amended rice plants acts against blast pathogen.

8. Silicon deposition beneath the cuticle to form cuticle silicon double layer impede the penetration of fungi and inhibits the infection process. Due to silicon supplementation, monosilicic acid polymerizes into polysilicic acid and then transforms to amorphous silica which forms a thick silicon-cellulose membrane and it gets associated with pectin and calcium ions. The double cuticular layer protects and provides strength, rigidity and resistance to the plants against pests and diseases may also form complexes with organic compounds in the cell wall of epidermal cells and increases their resistance to degradation of enzymes.

9. Silicon also gets associated with lignin-carbohydrate complexes in the cell wall of epidermal cells. Silicon bioactivity has been compared to that of the known activator/secondary messengers of systemic acquired resistance (SAR), which can be considered the plant's equivalent of an immune system.

10. Silicon has a similar effect and can significantly modulate the activity of post elicitation intracellular signaling systems, including the mitogen activated protein (MAP) kinases. However, it is different from SAR activators as the effect of silicon on plant induced resistance to pathogens vanishes when silicon supply to plants is stopped or silicon had irreversibly accumulated.

Silicon Reduces Insect Attack and Pest Incidence on Plants

It has been observed that sucking pests and leaf eating caterpillars have a low preference for the silicified tissues than low silica containing succulent parts. Silicon decreases the food intake, growth longevity, fecundity and population growth of xylem feeding white backed plant hopper *Sogatella frucifera*. Soluble silicon reduces reproduction capacity of phloem feeding aphids *Myzus persicae* in potato, wheat and white fly (*Bemisia tabaci*) in cucumber plants. The hardness of cane of sugarcane plants is due to a higher silica content which reduces the shoot borer attack .The attack of stem maggot, plant hopper, green leaf hopper and leaf folder on rice plants were reduced with silicon nutrition. Low silicon concentration in rice tissues is associated with increased susceptibility to insect pest and fungal diseases . Whitefly (*Bemisia tabaci*) is important pest of cotton, wheat, cucumber and sugarcane which reduces their yield but soil or foliar application of silicon as calcium silicate increases the mortality of the nymphs of whitefly.

Suppression of Pests by Silicon in Stored Grain Products

Sand or soil has been used to cover the top of stored grains from centuries in North America and Africa to control the infestation of insect pests in stored grains. The use of ash and diatomaceous earth, a pure form of silica from fossilized diatoms in India has been also used from ancient times to control the household pests.

The ash has been incorporated in the walls, floors and ceilings of home due to its insecticidal, repellent, ovicidal properties and low mammalian toxicity. This practice prevents infestation of ants, white ants, earwigs, bed bugs, flies, silver fish, fleas, chicken lice, mites and ticks etc. From the past few years activated clay, rice husk ash, wood ash, lime, rock phosphate, silica-pyrethroid mixtures, silica aerogel and silica nano particles are also popular. Several commercial formulations based on silica or diatomaceous earth such as Aerosil R 972, Grasil 23 D, Dryacide and Insecto are also available in the market. The inert dust containing silicon are safe and adversely effect on pests by their dehydration and desiccation, it impaires the digestive tract of the pests, blocks spiracles and tracheae, absorbs lipids from cuticle by damaging the wax layer and reduces the weight of the insects.

Possible Mechanisms for Silicon Mediated Resistance

Two hypotheses for the Si-enhanced resistance to diseases and pests have been proposed. One is that Si deposited on the tissue surface acts as a physical barrier. It prevents physical penetration and / or makes the plant cells less susceptible to enzymatic degradation by fungal pathogens. This mechanism is supported by the positive correlation between the Si content and the degree of suppression of diseases and pests. The other one is that Si functions as a signal to induce the production of phytoalexin. Si application to cucumber resulted in the stimulation of the chitinase activity and rapid activation of peroxidases and polyphenol oxidases after infection with *Pythium* spp. Glycosidically bound phenolics extracted from Si-treated plants when subject ed to acid or, B-glucosidase hydrolysis displayed a strong fungistatic activity. However, in oat attacked by *Blumeria graminis*, Si deficiency promoted the synthesis of phenolic compound. The phenylalanine ammonia-lyase activity was enhanced by Si deficiency. The reason why Si deficiency exerts opposite effects on the synthesis of phenolic compounds, as a disease response in different plant species, has not been elucidated

Physical Mechanisms

An increased physical barrier produced by silicon deposition beneath leaf cuticles has long been considered to represent a major component underlying silicon-mediated plant resistance to insect pests. Silicon deposition contributes to increased rigidity and abrasiveness of plant tissues ,there by forming a mechanical barrier and reducing their palatability and digestibility to both vertebrat and invertebrate herbivores . Increased abrasiveness of leaves due to silicon deposition reduces food quality for herbivores and may cause wear of herbivore mouthparts, which further reduces feeding efficiency and growth rates. Conversely ,using a simple method to determine mandibular wear, it was shown that although there was a trend for increased wear in *Eldana saccharina* larvae that developed on silicon-treated sugarcane, the ability of larvae to renew their mandibles at each moult probably allows them to compensate for increased wear. Finely ground wollastonite(CaSiO3) in artificial diets substrates of up to 3.3%silicon had no significant effect on larval growth of *Helicoverpa armigera* (Hübner; Lepidoptera: Noctuidae)and *Helicoverpa punctigera* suggesting that silicon may not be directly deleterious to insects via ingestion and other mechanisms may be involved in silicon-mediated plant resistance. It should be noted, however, that by grinding the silicon ,this as likely removed potential abrasive attributes, in addition to the potential effects of soluble-silicon-induced plant defences.

Biochemical / Molecular Mechanisms

Increasing evidence shows that silicon treatment increases transcript levels of defence-related genes, thereby enhancing the activities of plant defensive enzymes leading to increased accumulation of defensive compounds, such as phenolics, phytoalexins, and momilactones . Further, silicon pre-treatment increased the activities of the defensive enzyme's peroxidase, polyphenol oxidase, and phenyl alanine ammonia lyase. In particular, silicon facilitated the strongest resistance if wheat plants had previously been infested with aphids. Chérif *et al.* (1994) found that silicon-treated cucumber plants show increased activity of the enzyme's peroxidase, polyphenol oxidase, b-1,3 glucanase, and chitinase in response to infection by pathogens. Perennial ryegrass (*Lolium perenne* L.) grown in silicon-amended soil exhibited greater activity of peroxidase and polypheno loxidase, higher levels of several phenolic acids, including chlorogenic acid and flavonoids, and enhanced expression levels of genes encoding phenylalanine ammonia lyase(PAL a and PAL b) and lipoxygenase (LOXa)in response to infection by *Magnaporthe oryzae* (T.T. Hebert) M.E. Barr (Rahman *et al.*, 2015). Histological and ultrastructural analyses revealed that silicon mediates active localized cell defences, and epidermal cells of silicon-treated plants displayed specific defense reactions including papilla formation, production of callose, and accumulation of glycosilated phenolics in response to pathogen infection by the fungus *Blumeria graminis* f. sp. *tritici.*

Conclusion and Future Research

Research has shown clearly that Si applications can contribute significantly to reducing damage due to pests and diseases. Furthermore, they may alleviate aluminum (Al) and manganese (Mn), reduce excess nitrogen (N) uptake leading to enhanced insect damage, and enhance biological control. They reduce pest populations, leave no insecticide residues in food or the environment, are relatively cheap, and could easily be integrated with other pest management practices including biological, chemical, and cultural practices.

Future research into pest management with Si applications could include:
1. Validation of Si application for pest control.
2. Identification of good Si sources, and their optimal dosages for effective pest control in different crops.
3. Clarification of the mode of action of Si in plant resistance to pests.
4. Integration of Si applications with biological control for ecologically sustainable pest (and disease) management.

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'Terpenes' A Secondary Metabolite and Plant Defence Compound

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Introduction

In natural habitats, plants are surrounded by an enormous number of potential enemies. By their nature, plants cannot avoid these herbivores and pathogens simply by moving away; they must protect themselves in other ways. The cuticle (a waxy outer layer) and the periderm (secondary protective tissue), besides retarding water loss, provide barriers to bacterial and fungal entry. Plants also produce a large, diverse array of organic compounds that appear to have no direct function in growth and development, called secondary metabolites.

Secondary metabolites have no generally recognized, direct roles in the processes of photosynthesis, respiration, solute transport, translocation, protein synthesis, nutrient assimilation, differentiation, or the formation of carbohydrates, proteins, and lipids. These also differ from primary metabolites in having a restricted distribution in the plant kingdom. Secondary metabolites are often found in only one plant species or related group of species, whereas primary metabolites are found throughout the plant kingdom. Secondary metabolites defend plants against a variety of herbivores and pathogenic microbes.

It may serve other important functions as well, such as structural support, as in the case of lignin, or pigments, as in the case of the anthocyanins. Plants have evolved multiple defense mechanisms against microbial pathogens. Besides antimicrobial secondary metabolites, some of which are preformed and some of which are induced by infection, other modes of defense include the construction of polymeric barriers to pathogen penetration and the synthesis of enzymes that degrade pathogen cell walls.

In addition, plants employ specific recognition and signaling systems enabling the rapid detection of pathogen invasion and initiation of a vigorous defensive response. Once infected, some plants also develop immunity to subsequent microbial attacks. Secondary metabolites are divided into four groups given below-

There are four groups of secondary metabolites: terpenes, phenolics, and nitrogen-containing compounds.
1. Terpenes (Monoterpenes, Diterpenes, etc): Terpenes, composed of five-carbon isoprene units, are toxins and feeding deterrents to many herbivores.

2. Phenolics (Phenolic glycosides, Bound phenolics and Lignin): Phenolics (aromatic substances), synthesized primarily from products of the shikimic acid pathway or the Malonic Acid Pathway, have several important roles in plants such as lignin mechanically strengthens cell walls, Flavonoid pigments function as shields against harmful ultraviolet radiation and as attractants for pollinators and fruit dispersers and finally serve as defenses against herbivores and pathogens.

3. N-Containing (Alkaloids and Mustard oils): Nitrogen-containing secondary metabolites/alkaloids, are synthesized principally from common amino acids. Compounds such as alkaloids, cyanogenic glycosides, glucosinolates, non-protein amino acids, and proteinase inhibitors protect plants from a variety of herbivorous animals.

4. Defense-related proteins: Peroxidases, Polyphenol oxidase, PAL, Condensed tannins, Hydrolysable tannins.

Function of Secondary Products

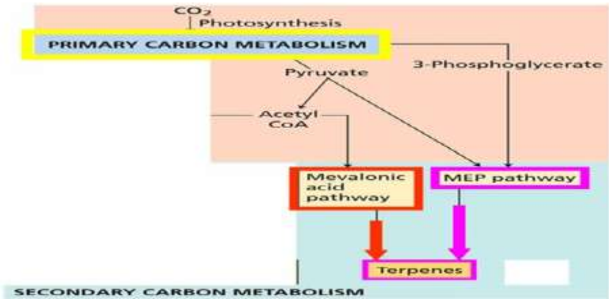
Protect the plant against herbivory (Deter grazing animals and insects), Inhibit bacterial or fungal pathogens, Inhibit growth of competing plants, Attract pollinators, Attract seed dispersing animals.

Outline of Terpenes

The terpenes, or terpenoids or isoprenoids, constitute the largest class of secondary products. The diverse substances of this class are generally insoluble in water. They are biosynthesized from acetyl-CoA or glycolytic intermediates. These are constituents of essential oils and building block of 5-C isoprene unit.Terpenes are classified by the number of isoprene units they have. They are produced from the Mevalonic Acid Pathway (MAP). Some terpenes are functions in primary metabolism. It functions as herbivores deterrents and can be produced in response to herbivore feeding, and to attract predatory insects and parasites of the feeding herbivore. Examples of Terpenes (2*C-5 Unit): Monoterpenes have two C5 units (10C), Sesquiterpenes have three C5 units (15C), Diterpenes have four C5 units (20C), Triterpenes (30C), Tetraterpenes (40C), Polyterpenes ([C5] n), n>8.

Two Pathway for Terpenes Biosynthesis

1. Mevalonic Acid Pathway.
2. MEP (Methylerythritol phosphate Pathway).



Functions of Terpenes

1. Growth and development: Gibberellins: A Diterpene, plant hormone. Brassinosteroids: A Triterpene, plant hormone. Abscisic acid: A Sesquiterpene, plant hormone. Sterols: A Triterpene derivative, phospholipids. Carotenoids (red, orange, yellow): A Tetraterpenes. Dilichols: A Polyterpene alcohols, carriers of sugars in cell wall and glycoprotein synthesis. Phytol: Terpene-derived side chain, chlorophyll.

2. As defensive compounds: Toxins and feeding deterrents to insects and mammals (Gershenzon and Croteau, 1992). Examples-Pyrethroids, Essential oils, Resin of conifers, Phytoecdysones.

Pyrethroids (Monoterpene esters found in the leaves and flower of different plants are popular ingredient in commercial insecticides. Ex. *Pyrethrum* (from chrysanthemums) can be used as “natural” insecticides in agriculture). Essential oils (Mixture of volatile monoterpenes and sesquiterpenes caused characteristic odour to plants foliage and has insect repellent property. Example- Peppermint (Menthol), Lemon (Limonene), Citrus fruits (Limonoids), Basil, Pyrethrum, Azardirachtin, Sage). Resins of conifers (These are monoterpenes, found in needle, twigs and trunk of plants, toxic to bark beetles (Trapp and Croteau, 2001)).

Phytoecdysones (These are plant steroids (terpene) first isolated from fern (*Polypodium vulgare*) that have the same basic structure as insect molting hormones and thus interfere with molting. These compounds sometimes cause death of the insect herbivore). Note: Recently Phytoecdysones found to have a defensive function against plant-parasitic nematode (*Soriano et al.,* 2004).

Terpenes that Act Against Vertebrate Herbivores

1. Cardenolides (glycosides): A triterpene, extracted from Foxglove (Digitalis) that taste bitter and are extremely toxic to higher animals. In human, have toxic influence on Na+/K+ ATPase of heart muscle. In carefully regulated doses it used to treat heart disease. Can slow and strengthen heartbeat.

2. Saponins (Soap Like): Steroid and triterpenes glycosides so named because of their soap like properties. They have lipid and water-soluble element in one molecule, give saponins detergent property. Toxicity is related to its ability to form complexes with sterols, cause membrane disruption after being absorbed into the bloodstream.

Terpenes as Human Medicinal Drugs

1. Limonene: Monoterpenoid (C-10) Dietary Anticarcinogen.

2. Artemisnin: Sesquiterpenoid (C-15) Antimalarial.
3. Taxol: Diterpenoid Anticancer drug from Pacific yew *(Taxus brevifolia)*.

Conclusion

The study of plant secondary metabolites has many practical applications. By virtue of their biological activities against herbivorous animals and microbes, many of these substances are employed commercially as insecticides, fungicides, and pharmaceuticals, while others find uses as fragrances, flavorings, medicinal drugs, and industrial materials. The breeding of increased levels of secondary metabolites into crop plants has made it possible to reduce the need for certain costly and potentially harmful pesticides. In some cases, however, it has been necessary to reduce the levels of naturally occurring secondary metabolites to minimize toxicity to humans and domestic animals.

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Xeriscaping - Convenient Conservation Solution

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Introduction

Xeriscaping is the process of landscaping or gardening that reduces or eliminates the need for supplemental water from irrigation. It is promoted in regions that do not have accessible, plentiful, or reliable supplies of fresh water and is gaining acceptance in other regions as access to irrigation water is becoming limited. Xeriscaping may be an alternative to various types of traditional gardening. In some areas, terms as water-conserving landscapes, drought-tolerant landscaping, and smart scaping are used instead. Plants whose natural requirements are appropriate to the local climate are emphasized and care is taken to avoid losing water to evaporation and run-off. The specific plants used in xeriscaping depend upon the climate. Xeriscaping is different from natural landscaping, because the emphasis in xeriscaping is on selection of plants for water conservation, not necessarily selecting native plants.

Principles

1. Plan and design: Create a diagram, drawn to scale, that shows the major elements of the landscape, including house, driveway, sidewalk, deck or patio, existing trees and other elements. Once a base plan of an existing site has been determined, the creation of a conceptual plan that shows the areas for turf, perennial beds, views, screens, slopes, etc. is undertaken. Once finished, the development of a planting plan that reinforces the areas in the appropriate scale is done.

2. Soil amendment: Most plants will benefit from the use of compost, which will help the soil retain water. Some desert plants prefer gravel soils instead of well-amended soils. Plants should either fit the soil or soil should be amended to fit the plants.

3. Efficient irrigation: Xeriscape can be irrigated efficiently by hand or with an automatic sprinkler system. Zone turf areas separately from other plants and use the irrigation method that waters the plants in each area most efficiently. For grass, use gear-driven rotors or rotary spray nozzles that have larger droplets and low angles to avoid wind drift. Spray, drip line or bubbler emitters are most efficient for watering trees, shrubs, flowers and groundcovers.

If watering by hand, avoid oscillating sprinklers and other sprinklers that throw water high in the air or release a fine mist. The most efficient sprinklers release big drops close to the ground. Water deeply and infrequently to develop deep roots. To reduce water lost to evaporation, never water during the day. With the use of automatic sprinkling systems, adjust the controller monthly to accommodate weather conditions. Also, install a rain sensor to shut off the device when it rains.

4. Appropriate plant and zone selection: Different areas in a yard receive different amounts of light, wind and moisture. To minimize water waste, group together plants with similar light and water requirements and place them in an area that matches these requirements. Put moderate-water-use plants in low-lying drainage areas, near downspouts, or in the shade of other plants. Turf typically requires the most water and shrub/perennial beds will require approximately half the amount of water. Dry, sunny areas support low-water-use plants that grow well in the specific climate. Planting a variety of plants with different heights, color and textures creates interest and beauty.

5. Mulch: Mulch keeps plant roots cool, prevents soil from crusting, minimizes evaporation and reduces weed growth. Organic mulches, such as bark chips, pole peelings or wood grindings, should be applied 2 to 4 inches deep. Fiber mulches create a web that is more resistant to wind and rain washout. Inorganic mulches, such as rocks and gravel, should be applied 2 to 3 inches deep. Surrounding plants with rock makes the area hotter; limit this practice.

6. Limited turf areas: Native grasses (warm-season) that have been cultivated for turf lawns, such as buffalo grass and blue grama, can survive with a quarter of the water that bluegrass varieties need. Warm-season grasses are greenest in June through September and may go dormant during colder months.

Native grasses (cool season) such as bluegrass and tall fescue, are greenest in the spring and fall and go dormant in the high heat of the summer. New cultivars of bluegrass, such as Reveille, and tall fescue, can reduce typical bluegrass water requirements by at least 30 percent. Fine fescues can provide substantial water savings and are best used in areas that receive low traffic or are in shady locations. Use the appropriate grass and limit the amount of grass to reduce the watering and maintenance requirements.

7. Maintenance: All landscapes require some degree of care during the year. Turf requires spring and fall aeration along with regular fertilization every 6 to 8 weeks. It should be cut to a height of 3 inches, allowing the clippings to fall. Trees, shrubs and perennials will need occasional pruning to remove dead stems, promote blooming or control height and spread. Much of the removed plant material can be shredded and used in composting piles.

Advantages

1. Lowered consumption of water: Xeriscape landscapes can reduce water use 60% or more compared to regular lawn landscapes.
2. Makes more water available for other domestic and community uses and the environment.
3. Reduce Maintenance: Aside from occasional weeding and mulching Xeriscaping requires far less time and effort to maintain.
4. Xeriscape plants in appropriate planting design, and soil grading and mulching, takes full advantage of rainfall retention.
5. Less cost to maintain: Xeriscaping requires less fertilizers and equipment, particularly due to the reduced lawn areas.
6. Reduced waste and pollution: Lawn clippings can contribute to organic waste in landfills and the use of heavy fertilizers contributes to urban runoff pollution.
7. Reduce fertilizer use (phosphorus, nitrogen, potassium) that help grow harmful algae.

Disadvantages

Xeriscapes can be expensive to install. Though the cost will differ greatly depending on the types of rock you want to use, and their availability in your location, in general the cost of installing a xeriscape is significantly higher than a traditional lawn. Additionally, if you want to set up irrigation, you should do so beforehand as installing it after your xeriscape can be a hassle. These factors make the up-front cost of a xeriscape very high, and unaffordable for many people.

Conclusion

Xeriscaping is not a planting of cactus and yuccas in gravel beds. It is a technique of developing a landscape that conserves water by using plants that have drought tolerance as one of their characteristics. Many of these plants can also be grown under normal rainfall amounts and some can even tolerate wet conditions. A well-planned xeriscape not only uses less water, it is attractive, colourful, and utilizes a variety of landscape forms and textures. Many of our native plants fit well within a xeriscape setting.

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Site Specific Recombination for Marker Free Transgenic Plants

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Abstract

Site specific recombination technology used in molecular biology to get a desirable genome of our interest. One of the applications is that, to produce the marker free transgenic plants. There are many transgenic events had evolved nevertheless limited number of transgenic crops are under commercial cultivation since it has regulatory concerns and risk in public health and environment. Different strategies are available to produce a normal plant with transgene alone. Here, site specific recombination system would be discussed.

Introduction

Site specific recombination is one of the strategies to obtain marker free transgenic plants by eliminating marker from nuclear and chloroplast genome after selection. This system based on site specific recombinases and their recognition sites in target region of the genome. It was first reported about twenty years ago by Russell et al. (1992). So far, microbial site-specific recombinases system is widely adopted in transgenic plants. Recombinases have the ability to cleave the DNA at specific sites which was placed in between the direct repeat-oriented recognition sites of the recombinase enzyme. Selectable marker genes (SMGs) such as antibiotic or herbicide resistance genes are used in every plant transformation to efficiently distinguish transformed from non-transformed cells. It is of no use after transformation event is completed. Hence, to produce the marker free transgenic plants, Selectable Marker Gene (SMG) and gene which code for recombinase are placed between recombination or recognition site of the enzymes which leads to excision of SMG and recombinase gene. This type of hit - run cassette system has been introduced into transgenic plants during transformation of foreign gene.

Need of Marker Free Transgenic Plants

1. To reduce the potential risk of horizontal gene transfer of antibiotic resistance genes to pathogenic organisms or the transfer of herbicide resistance genes to weeds.
2. Improvement of efficiency in transferred gene of interest due to single copy of gene rather than multiple copies in target genome.
3. To minimize the pleotropic effect due to marker gene presence.
4. To alleviate the public and regulatory concerns regarding human health and environment.

Types of Recombination Systems

There are different types of recombination systems are used from bacteriophage and yeast genome.
1. Cre/lox from bacteriophage (Zuo et al., 2001)
2. FLP/FRT from Saccharomyces cerevisiae (Huang et al., 1991)
3. R/RS from Zygosaccharomyces rouxii (Matsuzaki et al., 1990)

Cre, FLP and R are the different genes encoding recombinases and lox, FRT and RS are the recombinase recognizing sites respectively. Among the above, Cre/lox has been most successfully adopted in crop species. These recombination systems are tyrosine recombinase family and undergo intra molecular recombination event to do precise elimination of unwanted region of the genome (Wang Y et al., 2011).

These systems are further classified into two categories according to position of the recombinase gene in constructed cassette which is going to be integrated to the transgenic plants. It would be described below:
1. Recombinase gene and the selectable marker gene are on a two different vector: In this system, recombination cassette would be introduced to the transgenic plant which had the selectable marker gene within the recombination site. This could be achieved by re-transformation or sexual crosses in which crosses were made between plant with marker gene and plant with recombinase gene. It has some limitations such as time consuming and applicable to sexual species or the species which suitable for re-transformation (Fig.1).

2. Recombinase gene and the selectable marker gene are on a single vector: In this system, marker gene along with recombinase gene placed within the recombination site in same cassette system and would be integrated into the transgenic plants. This often referred to as auto - excision / self - excision system. An improvement of this system was called 'GM-gene-deletor'. The expression of recombinase gene and their excision activity was controlled by external and internal signals. This system has some advantages over previous strategy. It could be applied in every species and shows flexibility with higher efficiency (Fig.2).

Expression of Recombinase Gene

It could be controlled by two sites in the vector namely inducible promotor and recognition sites of the enzymes. This could help to control the transient expression of recombination system in plants (Khattri A et al., 2011).

1. Inducible promotors: The promotors which control the expression of recombinase gene in targeted genome. Their expression depends on different factors including crop stages like microspore specific promotor, floral specific promotor, embryo specific promotor, seed specific promotor and heat inducible promotor as well as chemically inducible promotor which will induced by herbicides.

2. Flanking site of the target region: Excision target site flanked with same site or two different sites. Different fused target site is an alternative for use of one site at each side. For example, lox-FRT site in which activation of either recombinases for these recognition sites would excise the target region.

Virus Based Site Specific Recombination

This system mainly used to produce marker free transplastomic plants (transgene in chloroplast) by phage site specific recombinases. Excision of the marker by phage recombinase/Integrase (Int) via recombination takes place between bacterial (attB) and phage (attP) attachment sites within the host. Cre/lox was the first site-specific recombination system used to excise the SMG from the plastid genome followed by plant segregation removes the marker and recombinase gene in some plants (Kittiwongwattana C et al., 2007).

Conclusion

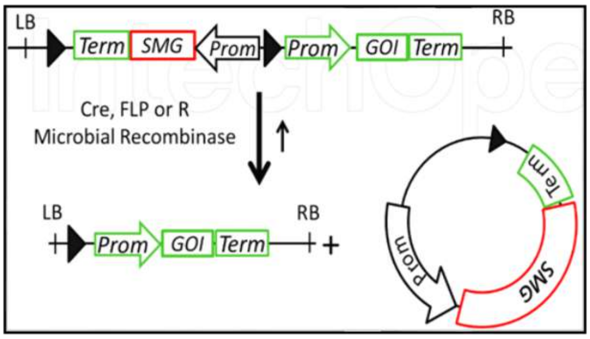

Fig.1. Double vector-based transformation

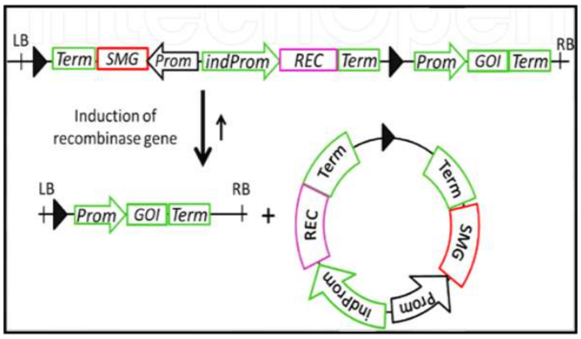

Fig.2. Single vector-based transformation

Site specific recombination is an efficient method to precise integration and elimination of particular gene in the genome. Single copy of gene could be placed instead of multiple copies to prevent gene inactivation. Use of visual marker like green fluorescent protein simplifies the operation than selectable marker like antibiotic and herbicide markers. Still, improvement of availing strategies is needed to succeed the research programs.

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Entomology - Impact of Pollution on Insects in Present Scenario

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Introduction

Currently, insect abundance and diversity are in decline worldwide. Various factors are contributing to this decline. Besides biological factors, habitat destruction, climate change and one of the main drivers is anthropogenic pollution. Pollution is essentially the wrong substance, in the wrong place, in the wrong concentration, at the wrong time or pollution is the process of making land, water, air or other parts of the environment dirty and not safe or suitable to use. This can be done through the introduction of a contaminant into a natural environment, but the contaminant doesn't need to be tangible. Things as simple as light, sound and temperature can be considered pollutants when introduced artificially into an environment.

Toxic pollution affects more than 200 million people worldwide, according to Pure Earth, (a non-profit environmental organization). In some of the world's worst polluted places, babies are born with birth defects, children have lost 30 to 40 IQ points, and life expectancy may be as low as 45 years because of cancers and other diseases. However, insects are also used to assess the effects of pollution as surrogates or representatives of the larger assemblages of organisms in communities and ecosystems. Thus, understanding how environmental factors such as pollution may affect insects is important.

Types of Pollution

As stated before, there are different types of pollution, which are either caused by natural events (like forest fires) or by man-made activities (like cars, factories, nuclear wastes, etc.).

These are further classified into the following types of pollution:
1. Air pollution.
2. Water pollution.
3. Soil pollution.
4. Noise pollution.

Besides these 4 types of pollution, other types exist such as light pollution, thermal pollution and radioactive pollution. The latter is much rarer than other types, but it is the deadliest.

Effects of Air Pollution

Air pollution has been associated with both primary (i.e. direct) and secondary (i.e. indirect) effects on insect populations. Fluorides are biologically active and may injure plants and animal's field distribution studies implicate fluorides in the decline of silk worms, honey bees, the European pine shoot moth (*Rhyacionia buoliana*) and some bark beetles (*Pityokteines*).

Accounts of the direct action of sulphur contaminants on insect populations offer the same kinds of observations as with fluorides. Aphids showed a reverse pattern, increasing in density with sulphur exposure, presumably in a secondary effect involving the suppression of natural enemies. Reduced flight activity and brood-rearing activity occurred in bees exposed to $S0_2$. Although the free radical of ozone may function as a mutagen, there is little research suggesting that ozone directly affects insect populations. When *Drosophila*, *Musca*, and *Stomoxys* were fumigated for a prolonged period with high concentrations of ozone, there was a 15% inhibition of egg hatching, under the same conditions, adults showed significantly stimulated oviposition, a dramatic increase in the number of eggs laid, and an increase in the adult population when compared to controls.

Lead is tightly bound by plant tissues and little translocation occurs. Thus, most of the lead that contaminates foliage originates from aerial pollution. Resulting in increases in aphid density near a highway area (Fliickiger and Oertli, 1978). Water vapor and CO_2 in industrial emissions slow the re-radiation of heat, and clouds of vapor reduce incoming radiation. This would result in a slight reduction of temperature extremes that could be favourable to insects.

Effects of Light Pollution

Artificial light at night (ALAN), is the light emitted by man. This category includes not only local light sources (e.g. street lamps). It's also light scattered in the atmosphere over cities (so-called sky glow), car headlights and even gas torches associated with oil extraction.

Artificial light at night is unique among anthropogenic habitat disturbances in that it is fairly easy to ameliorate and leaves behind no residual effects. With artificial light increasing by around 2 per cent per year globally light pollution has become a pertinent issue. Night-time light pollution can cause a decrease in 'visits' of pollinators by up to 62%, which in turn causes a yield lower by 13% (in the case of thistles) (Grubisic et al., 2018).

The new research draws attention to similarly harmful effects of light on insects. There are thought to be millions of insect species, most still unknown to science, and about half are nocturnal. Those active in the day may also be disturbed by light at night when they are at rest. The most familiar impact of light pollution is moths flapping around a bulb, mistaking it for the moon. One-third of insects trapped in the orbit of such lights die before morning. Light from both ambient and direct sources can be detrimental. The development of juvenile insects, such as field crickets, also has been shown to be affected by light pollution, which changes the perceived length of the day and night.

Different Effects of Light Pollution

1. Reproduction: Corn earworm *(Helicoverpa zea)* will not breed if its closest surroundings are illuminated by lighter than exactly that reflected by half the moon's disk.

2. Migrations: Dung beetles, for instance, use the arc of the Milky Way to orient themselves at night and may become lost in areas where light pollution obscures the galaxy.

3. Predation: Predatory arthropods, such as spiders, benefit most from insects orbiting the light source. Increased predation pressure is favourable for its beneficiaries only in the short term. Insects do not seem to cope with new threats. Their populations are not recovering, but gradually decreasing.

4. Trauma: Collisions with a heated light source can kill many moths. Over heating or dehydration normally can be caused by the sun and is the probable reason moths are so active at night. Now that very danger they seek to avoid can be achieved by artificial lights, especially ones that entrap them because of their design or because of a breakage. Other traumas include damage to wings or other body parts, collisions with automobiles under street lights or drowning under lamps over water.

Effects of Noise Pollution

Noise pollution, also known as environmental noise or sound pollution, is the propagation of noise with ranging impacts on the activity of human or animal life, most of them harmful to a degree. The source of outdoor noise worldwide is mainly caused by machines, transport, and propagation systems.

Human created noise is affecting a wide range of animals - from birds, fish, mammals and amphibians, to arthropods, molluscs and reptiles. Noise pollution (or sound pollution) is any noise which has a harmful impact on human or animal life.

Excessive noise causes the birds and the bees to alter their behaviour in many significant ways: it interrupts mating, reduces the number of birds and insects in the vicinity, causes them to stop moving (a "shock" reaction), and prevents birds from hearing fellow bird song that's important to their day-to-day life.

Noise pollution has also been found to affect insect behaviour. Some arthropods are affected by loud anthropogenic infrastructure for instance, bow-winged grasshoppers, *Chorthippus biguttulus* (Orthoptera: Acrididae), found near loud roadside sites produce higher frequency calls than individuals from quiet sites the cicada species, *Cryptotympanata kasagona* (Hemiptera: Cicadidae), exhibits a strong positive correlation between call frequency and noise exposure level in urban parks and in traffic noise, female field crickets, *Gryllus bimaculatus* (Orthoptera: Gryllidae), fail to orient to played-back male calls (Schmidt *et al.,* 2014).

Effects of Water Pollution

Water pollution is the contamination of water bodies (like oceans, seas, lakes, rivers, aquifers, and groundwater) usually caused due to human activities. Water pollution is any change in the physical, chemical or biological properties of water that will have a detrimental consequence of any living organism. Sources of water pollution are:

1. Domestic waste.
2. Industrial effluents.
3. Insecticides and pesticides.
4. Detergents and fertilizers.

Responses/effect of aquatic insects to water pollution many ways like contaminants in the water can range from deficiencies (e.g., oxygen) to excess (e.g., copper) of certain components, to contamination with substances that are increasingly deleterious as concentrations increase (e.g., pesticides).

However, while most species of aquatic insects react negatively to most contaminants (e.g., oil, sedimentation) there are some species that thrive like mayflies are known to be sensitive to acidification, and show reduced densities and/or richness at low-pH sites, which often result from acid deposition through precipitation (i.e., acid rain). Stone flies are intolerant of oxygen loss (and they tend to be only found in highly oxygenated, cool-water habitats). Caddis flies are sensitive to both organic and inorganic contaminants.

Species of odonata (dragonflies and damselflies) have had their distributional range reduced because of increased eutrophication caused by the discharge of nutrients from agriculture and sewage. Hemiptera (bugs) have surface-dwelling species that are adversely affected by inputs of soap and other surfactants, and many of the water-column dwelling taxa are known to be sensitive to pesticide applications (either direct or as runoff) (Resh et al., 2008).

Effects of Soil Pollution

Soil pollution refers to the contamination of soil with anomalous concentrations of toxic substances. It is a serious environmental concern since it harbours many health hazards. The root cause of soil pollution is often one of the following:

1. Agriculture (excessive/improper use of pesticides).
2. Excessive industrial activity.
3. Poor management or inefficient disposal of waste.

Soil pollution can negatively affect the metabolism of microorganisms and arthropods, which can destroy some layers of the primary food chain and have a harmful effect on predator animal species. Also, small life forms may consume harmful chemicals in the soil which may then be passed up the food chain to larger animals, which may lead to increased mortality rates and even animal extinction.

Urban farmers are often faced with the challenge of heavy metal contamination of their soils from decades of pollution. While the health risks of heavy metal soil contamination to humans are well established, heavy metals' impact on beneficial insects is largely unknown.

Sunflowers *(Helianthus annuus)*, a popular plant in urban agro ecosystems and an important nectar source for pollinators, are hyper accumulators of lead. This bioaccumulation may result in an exposure pathway for bees.

Conclusion

The diversity of insects in agro ecosystems indirectly provide natural protection against pests, effective pollination of plants or seed spread, preservation of soil structure and fertility. As we are losing species at a rate 1,000 times greater than at any other time in recorded human history and one million species face extinction.

There is a significant progress in providing legal protection to environment but there are several loopholes. Though under Indian legislative environmentalism there are many enactments such as Water Act, Air Act, the Forest conservation and the recent comprehensive Environment (Protection) Act, they are inadequate to deal with present contingency. India is in need of a new effective legislation for this 21stcentury. Much is being done to control, monitor and rectify damage done by pollutants.

The problems are diverse and some are only being recognized but it is important to keep a close control over pollutants so that we can maintain the environment in an acceptable condition for future generations. In addition to important moments for decision makers, to bring nature back from the brink. The future of humanity depends on action now.

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"Locust Swarm" Impact on Agriculture in India

Article ID: 31156

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Introduction

As the world is dealing with the pandemic COVID-19, India is facing one more destructive factor that is "the desert locust swarm, a migratory insect from Eastern Africa and Southeast Asia. These migratory pests are millimeters in size but millions in number.

The locust swarm entered India on May 13, 2020, through the western state of Rajasthan. In India, the locust attack was initially reported in Rajasthan, Gujarat, Madhya Pradesh which later spread throughout the larger parts of Chhattisgarh, Maharashtra and Uttar Pradesh and it is predicted that the spread will increase in the coming months.

According to the country's Locust Warning Organization (LWO), India is facing the worst locust infestation since 1993 and the swarms are being favored due to the present weather conditions. In India, the farmers noticed the crop damage when the second month coronavirus lockdown was going on. This led to the double crises threat to the India's food security.

The locust swarms are destroying the crops in a very fast rate due to their highly voracious nature, this is increasing fears over food security and also causing economic threat in the country already battling with the Coronavirus pandemic.

What is Locust? How it Multiplies and Spreads?

Dessert Locusts *(Schistocera gregaria)* looks similar to the grasshoppers and it confuses people many times. Locust can migrate over much large distances in comparison to grasshoppers. They are believed to be the biggest enemy of farmers because even a small swarm of about 40 million locusts can destroy enough food for 35,000 people.

According to Food and Agriculture Organization (FAO), these swarms prefer arid or semi-arid areas for egg laying and nymph development and also have the ability to change behavior. The desert locust covers the migratory area about 30 million square km in nearly 64 countries, including parts of the Indian subcontinent.

Desert locusts are voracious pest which can fly up to 150 km daily. In a research it is found that one square km of a locust swarm contains around 80,000 adults. Food and Agriculture Organization informed that a solitary female lays about 95-158 eggs for the three times within a lifespan of 90 days.

According to a biologist from Kenya, when there is enough of rainfall in the areas of sandy soil, the desert locusts start to lay more and more eggs. Soon the desert or arid areas turn into huge vegetation leading to more and more locust reproduction (Jaun Siliezer, 2020). The huge locust population requires a large area for survival, thus, resulting in swarm formation and migration from place to place and country to country.

Fig: A desert locust on a shea tree- a source of food and income for farmers

Damage and Impact on Agriculture

Locusts aren't much dangerous in their "solitary phase" or when they live individually, but they become more powerful and dangerous when found in swarms and we call it "gregarious phase". As the normal locust season in India is found to be June-November which coincides with kharif season hence, it has proved to be very harmful for the economy as well as the food security. It was reported that the locust swarm caused the huge crop infestation in 2,80,000 hectares across 13 countries before they attacked India. One of the renowned journals informed that around 26.79 lakh hectares of land was used for the sugarcane production in 2019-20 in state of Uttar Pradesh which contributes for economic income of Rs 40,000 crore, which is now under the threat of Locust swarm (The Print). A Union agriculture minister official announced that at least 4.8 lack hectares of farmland has been eaten up by the locust swarm this year.

As the nation was already dealing with economic crisis due to COVID-19, almost every economic sector was facing this period of loss. Agriculture was the only sector that was left as a hope for future prospectus but that too got hit due to this great locust swarm.

Can we Deal with the Locust Swarm?

Yes, we can fight against these local swarms by using modern as well as traditional methods for the pest management. A very eye caching activity was noticed in the state of Uttar Pradesh and Punjab, the farmers were making loud noises by beating 'thali' and other utensils so the swarms couldn't settle down the fields. The state governments of Haryana, Rajasthan and Uttar Pradesh are using drones, tractors and vehicles of the fire department for spraying the pesticides over the fields. Government is supposed to take more vulnerable steps in the future if the locust swarm.

Conclusion

India is already fighting with the pandemic COVID-19 and now this locust swarm attack is causing double economic loss to the country. It is estimated that if the locust swarm spread continue in the coming months then it will probably cause more and more loss to the whole country especially the farming sector. Hence, it is expected from the state government and agriculture officials that they might take some serious and effective measures to control the spread of swarms. Proper awareness should reach to the small scale as well as large scale farmers so that they can prepare themselves for the upcoming threat. It is the high to use all the modern facilities with proper management and utilize agricultural knowledge, then only we can save our crops as well as our economy.

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Elevated Atmospheric Carbon Dioxide: Friend and Foe to Plants and Plant Diseases

Article ID: 31157

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Introduction

Carbon dioxide occurs naturally in the atmosphere and it is an essential ingredient in photosynthesis. Levels of atmospheric carbon dioxide have increased since the industrial revolution. The global average atmospheric carbon dioxide in 2018 was 407.4 ppm, with a range of uncertainty of ± 0.1 ppm. Carbon dioxide accounts for less than 1 per cent of the atmospheric gases. The global growth rate of atmospheric carbon dioxide was roughly 0.6 ± 0.1 ppm per year during 1960's. However, over the past decade, the growth rate has been closer to 2.3 ppm per year. The annual rate of increase in atmospheric carbon dioxide over the past 60 years is about 100 times faster than previous natural increases.

Causes for Increase in Carbon dioxide

1. Deforestation.
2. Burning of fossil fuels.
3. Volcanic eruptions.

Effect of Increased Carbon Dioxide on Plant Growth

Elevated carbon dioxide levels can have both direct and indirect effects on the plant growth. The direct effects include changes in plant growth with the levels of temperature, precipitation, evaporation and growing season at their present values. The indirect effects are the results of any changes in the other variables which affect plant growth that come as a result of the effect of increased CO_2 on global climate.

The effects of an enriched CO_2 atmosphere on crop productivity, in large measure, are positive, leaving little doubt as the benefits for global food security. The quantification of the enhanced growth due to higher levels of CO_2 has been given by Poorter (1993), with increase in CO_2 levels by 100 per cent plant growth increases by 41 per cent and 22 per cent in C3 and C4 plants respectively.

Plants grow faster at a higher temperature providing they have adequate levels of CO_2, water, sunlight and plant nutrients. A higher temperature without adequate level of the necessary ingredients for growth might produce no response or even damage. Under most circumstances the availability of CO_2 is the factor which limits growth. Thus, with a higher level of CO_2 in the air plants can grow faster with a higher temperature (Sylvan, 1995).

Plants transpire water vapour to keep an even temperature. Stomata are the small openings through which the plant absorbs CO_2, with higher level of CO_2 concentration in the air the stomata do not have to be open as wide. The narrower opening means that less water is transpired and less water is required by the plants thus CO_2 increase the efficiency of water use by plant. Enhanced CO_2 increased growth by 31 per cent in plants with adequate moisture but it increases growth by 62 per cent for plants in moisture-stressed condition. In effect, enhanced CO_2 by reducing water loss created the same effect as providing more water. Thus, the effect in moisture-stressed plants was the effects of enhanced CO_2 plus the effect of increased water.

The effect of enhanced CO_2 is even greater for plants grown under low light conditions. The enhance growth is greater than 100 per cent for a 100 per cent increase in CO_2. This compares to less than 50 per cent for plants grown in normal light conditions.

Effect of Elevated Carbon Dioxide on Plant Diseases

Plant diseases are malfunctions caused by plant pathogenic organisms and those caused by other factors. Plant pathologists have long considered environmental influences in their study of plant diseases: the classic disease triangle emphasizes the interactions between plant hosts, pathogens and environment in causing disease.

Increased CO_2 levels can impact both the host and the pathogen in multiple ways. New races may evolve rapidly under elevated temperature and CO_2, as evolutionary forces act on massive pathogen populations boosted by a combination of increased fecundity and infection cycles under favourable microclimate within enlarged canopy (Garrett *et. al*., 2015). Elevated CO2 concentration and temperature have impact on plant-disease interaction (Ghini *et. al*., 2008) and posing a higher threat perception of late blight (*Phytophthora infestans*) of potato and blast (*Magnaporthe grisea*) and sheath blight (*Rhizoctonia solani*) of rice.

Lower plant decomposition rates observed in high CO_2 situations could increase the crop residue on which disease organisms can overwinter, resulting in higher inoculum levels at the beginning of the growing season, and earlier and faster disease epidemics. Pathogen growth can be affected by higher CO_2 concentrations resulting in greater fungal spore production.

However, increased CO_2 can result in physiological changes to the host plant that can increase host resistance to pathogens. An increase in CO_2 levels may encourage the production of plant biomass; however, productivity is regulated by water and nutrients availability, competition against weeds and damage by pests and diseases. Alternatively, a high concentration of carbohydrates in the host tissue promotes the development of bio trophic fungi such as rust. Thus, an increase in biomass can modify the microclimate and affect the risk of infection (Debela *and Tola*, 2018)

Increased size of plant organs, leaf area, leaf thickness, and more numbers of leaves, higher total leaf area, stems and branches with greater diameter are resulted from increased CO_2 levels. Dense canopy favours the incidence of rust, powdery mildew, *Alternaria* blight, *Stemphylium* blight and anthracnose diseases. Higher CO_2 concentrations induce greater fungal spore production.

In the pathogens which targets the stomata, potential of dual mechanism *i.e*., reduced stomata opening and altered leaf chemistry under elevated CO_2 conditions, results in reduced disease incidence and severity In soybean, elevated concentration of CO_2 and O_3 altered the expression of downy mildew (*Perenospora manshurica*), brown spots (*Septoria glycines*) and sudden death syndrome (*Fusarium virguliforme*) and response to the diseases varied considerably.

Elevated CO_2 leads to production of papillae and silicon accumulation by barley plants at the site of appressorial penetration of *Erysiphe graminis* and this change in leaf chemistry decreases susceptibility to the powdery mildew pathogen.

Conclusion

Climate change is an important phenomenon that affects agricultural production. By anticipating the future, we can prepare ourselves for problems caused by climate change, especially those related to agricultural activities. The effects of an enriched atmospheric CO_2 on crop productivity, in large measure, are positive, leaving little doubt as the benefits for global food security and in general, the effects of elevated CO_2 concentration on plant diseases can be positive or negative, but majority of the cases disease severity increases.

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Precision Agriculture in Indian Farming: Application of Remote Sensing and GIS.

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Introduction

In present scenario, Indian agriculture is facing big challenge i.e., feeding nutrition for booming population with limited land resources. Furthermore, food demand for 2050 is nearly 480 million tonnes where we are far back in production. To meet this demand, increase in productivity is the need of this hour. Another big challenge in Indian agriculture is land degradation, inappropriate application of fertilizers, low productivity and low input use efficiency. In this context, Precision agriculture is an integration of crop management system which enhances resource use efficiency and attempt to match the kind and amount of inputs applied with the actual requirement of crop for small areas or grids in a farm field. Conventional agriculture, level of management is taken whole field into single unit whereas in precision agriculture the management zones are isolated in different grid depending upon the availability of resources which distinguishes conventional agriculture from precision agriculture. Precision agriculture has two main components viz., Remote sensing (Liaghat and Balasundram, 2010) and GIS. Remote sensing is the art and science of gathering information about the objects or area of the real world at a distance without coming into direct physical contact with the object under study. Remote sensing is a tool to monitor the earth's resources using space technologies in addition to ground observations for higher precision and accuracy. The principle behind remote sensing is the use of electromagnetic spectrum (visible, infrared and microwaves) for assessing the earth's features. GIS is a tool that creates visual representations of data and performs spatial analyses in order to make informed decision. GIS is a powerful set of tools for collecting, storing and retrieving the data at will, transforming and displaying the spatial data for particular purpose.

Need of Precision Agriculture

1. To meet huge food grain requirement of 480 mt by the year 2050 and with increasing challenges like biotic and abiotic stresses experienced by crops.

2. To face the problem of downward spiraling of land resources in present decades of Indian farming.

3. As we all know that the average productivity of India is far lower average yield of developed country. So, there is necessity to increase the productivity.

4. Even the technology is developing day by day but our poor Indian farmers are adopting traditional technologies.

5. Within the field also, there is much variability in their fertility. This demands a more precise approach than a general approach.

6. In this context, there is urgent need to convert our farming system approach to produce more with less available of land, labor and resources. In this contrast, precision agriculture proposes to prescribe tailor made management practices that can help to serve the purpose.

Tools of Precision Agriculture

1. Global positioning system (GPS).
2. Geographic information system (GIS).
3. Grid sampling.
4. Variable rate technology (VRT).
5. Yield Maps.
6. Remote sensors.
7. Proximate sensors.

Status of Precision Agriculture in India

Precision farming is still at nascent stage in Indian agriculture. Development of specialized centres and scientific databank is a well-known pre-requisite for PA. The laser land levelling is one among the precision technologies, that has been used in India successfully from few years especially in rice-wheat cropping system in north-western part of country. Laser levelling is a laser guided precision levelling technique used for achieving fine levelling with the desired grade on the agricultural field. Laser levelling uses a laser transmitter unit that constantly emits 3600 rotating beams parallel to the required field plane. This beam is received by a laser receiver fitted on a mast on the scraper unit. The signal received is converted in to cut and fill level adjustments and the corresponding changes in scraper level carried out automatically by a two-way hydraulic control valve. Laser levelling maintains the grade by automatically performing the cutting and filling operations. This practice improves irrigation use efficiencies of the farm through the reduction in water losses and increases the uniformity of water application with less chance of over and under irrigation. In traditional practices of irrigation about 30-50% of total applied water is lost due to various conveyance losses of irrigation system. Apart from this, Country has also been trying to made significant advances through the use of precision technologies such as micro-irrigation and protected cultivation during the last two decades. This is attributed to the support of government policies, which is encouraging farmers to adopt precision technologies. It is also true that adoption of precision farming in the entire country is not possible as every farmer will not be ready to accept these sophisticated technologies, but there are some relatively developed areas, which can act as incubators for adoption of these technologies for emerging. In this context to increase the adoption of precision farming methods in developing countries, pilot demonstration projects must be conducted at various growers' locations by involving farmers in all stages of the project.

Application of GIS and Remote Sensing in Precision Agriculture

1. Crop production forecasting.
2. Assessment of crop damage and crop progress.
3. Crop yield modelling and estimation.
4. Identification of planting and harvesting dates.
5. Identification of pests and disease infestation.
6. Soil moisture estimation.
7. Irrigation monitoring and management.
8. Soil mapping.
9. Monitoring of droughts.
10. Land cover and land degradation mapping.
11. Crop nutrient deficiency detection.

Challenges Issues and Implication of Precision Agriculture

1. Introducing various precision agriculturally based technologies requires improved modern tools; such as computers, remote sensing, yield monitors etc. Currently, there is in large scale no such facilities are available in our country and therefore, introduction of these technologies is still awaited.

2. Small size of landholdings in most of the Indian agriculture limits economic gains from currently available precision farming technologies.

3. Unique pattern of land holdings, poor infrastructure, lack of farmers inclination which are characteristics of Indian farming are the reasons for low adoption of precision farming.

4. For India in particular, non-availability of data from remote areas and farmlands that don't meet minimum hectare criteria during surveys are often left out, given the majority of our farmlands still remain fragmented, a mass dissertation or holistic data collection may be quite ambitious.

Benefits of Adopting Precision Agriculture

1. Refinements and wider application of PA technologies can help in reducing costs, increasing productivity and better utilisation of natural resources.
2. Increase the efficiency of irrigation efficiency when water resources are low.

3. Increases the opportunity for skilled employment in the agriculture sector and also provides new tools for evaluating multifunctional aspects including non-market functions.
4. Plays a vital role in monitoring greenhouse conditions in agricultural fields.
5. Traditional crop health monitoring techniques are extremely time consuming and mostly categorical where PA can offer real time monitoring.

Future Prospects

Future strategy for the adoption of PA in India should consider the problems of land fragmentation, lack of highly sophisticated technical centres for PA, specific software for PA and poor economic condition of general Indian farmers. Strategically proportionating back up from the public and private sectors is essential to promote its rapid adoption. PA has created scope of transforming the traditional agriculture, through proper resource utilization and management, to an eco-friendly sustainable agriculture. Technological advancements and government initiatives to foster and promote precision agriculture through aids, reliefs, tax holidays and other incentives to farmers will greatly attract investment. This move will thus help deliberate efforts to protect the growth and sustainability of future generations yet to come.

Conclusion

Precision farming provides a new solution using a systems approach for today's agricultural issues such as the need to balance productivity with environmental concerns. It is based on advanced information technology. It includes describing and modelling variation in soils and plant species, and integrating agricultural practices to meet site-specific requirements. It aims at increased economic returns, as well as at reducing the energy input and the environmental impact of agriculture.

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Herbicides: Movement and Sites of Entry in Plants

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Introduction

Herbicides are applied either directly to the soil and/or to the foliage of plants. Therefore, herbicides enter in plants via their underground and/or aerial vegetative parts. However, effectiveness of herbicides is dependent upon certain factor like plant species involved, herbicides characteristics etc. Certain herbicides are effective only when they are absorbed by aerial plant parts while others when absorbed by underground plant parts.

Soil-Applied Herbicides

Soil applied herbicides are absorbed by seeds, rhizomes, bulbs and tubes. The primary entry site for soil applied herbicides are roots and developing shoots while foliage in case of aerial plant parts.

Roots: For better effectiveness, some herbicides, must apply directly to the soil which moved in the upper soil layer (1-4 inches) by cultivating tools or leaching. The roots of broad-leaved plants are major site for entry for soil applied herbicide but not for all plant species.

Herbicides may penetrate through the walls of epidermal and cortical cell of roots by mass flow and the absorption is complete when they have penetrated the plasmalemma of these cells and released in the cytoplasm. If herbicides are failed to penetrate the plasmalemma they will be obstructed for further movement into the plant via the apoplast pathway by a waxy barrier present in the cell walls of the endodermis.

Herbicides which are readily absorbed by the roots of broad-leaved plants are sulfonylureas, imidazolines, dinitroanilines and urea's. These herbicides are translocated from the roots to the leaves of plant.

In soil applied herbicide roots are the principal site of absorption; shoot and hypocotyl are of less importance but absorption can occur in shoot and hypocotyl when these plant parts push their way towards soil surface, resulting in death of the seedlings.

For example- Dimethyl tetrachloroterephthalate (DCPA) is not translocated when absorbed by hypocotyl in broad leaved seedlings following root absorption but when absorbed by hypocotyls, translocation is primarily upward.

Grass Shoots

The coleoptilar node and crown node of emerging grass seedlings are the important site if herbicide absorption, whereas the coleoptile, buds and leaves encased by the coleoptilar sheath epicotyl are of lesser importance. In case of shoot absorbed herbicide, the grass species are of much importance than the root absorbed herbicide. Example of shoot absorbed herbicides are: - DCPA, trifluralin, EPTC

In soil applied herbicides the interception takes place by the following process:
1. Mass flow: The mass flow of dissolved herbicides to plant roots results from a bulk flow of soil solution to plant roots.
2. Interception: It refers to the relation between soil applied herbicide and the plant parts (Growing root tip).
3. Diffusion: It is a process in which herbicide move from higher concentration region to lower concentration.
4. From non-volatile herbicides the mass flow is the most important than interception & diffusion.
5. For volatile herbicides diffusion is more important especially in dry soil.

Foliar-Applied Herbicides

These are used to control weeds which have emerged from the soil. Sites of entry into plants are:
1. Leaves.

2. Stems.
3. Buds.

Leaves

When the foliar application of herbicides is performed, the upper surface of leaf is the area where the herbicide spray gets deposited. Due to thinner cuticle and greater density of stomates, the lower leaf surface is usually penetrated more rapidly by herbicides.

For entry of herbicides in leaves it must penetrate:
1. The waxy cuticle covering the epidermal cells.
2. The cell wall of epidermal cells.
3. The plasmalemma of leaf cells.

The penetration of foliar herbicide in cuticle and cell walls of leaves by diffusion.

Stems

Many plants which are resistant to foliar applications of herbicides are susceptible to stem applications. A suitable oil, diesel is often used as the carrier for the herbicide when treating woody plants.

Buds

For contact type herbicides buds of the plants are of primary importance and minimal for systematic herbicide. When contact type herbicides are applied, the bud of the plant must be in direct contact by the herbicide otherwise the bud may continue to grow, flower and produce seeds if the stems of the plant survive the herbicide.

Translocation

The movement in plants of herbicide ions and molecules from their sites of entry to the other locations within plants is called translocation.

The translocation of herbicide ions and molecules in plant may be described as:
1. Intercellular Translocation: It is the movement of ions and molecules within an individual cell.

2. Extracellular Transport: It is the movement of ions and molecules in the cuticle and the apoplast.

3. Intercellular Translocation: It is the movement of ions and molecules from cells to cells via symplast. This involves short distance transport.

Short Distance Transport Pathways

1. Apoplast: The apoplast is composed of:
  a. A network of connected cell walls.
  b. Any voids between adjacent cell walls.

The apoplast extends throughout the plant, forming a continuum from near the root tips to the upper extremities of the shoots, except for the blockage provided by the casparian strip located in the walls of the endodermal cells separating the root cortex from the stele. The basic mechanism for the solute transport in the apoplast is diffusion, and at times, mass flow; such movement is passive, requiring no metabolic energy.

2. Symplast: The symplast is primarily a short-distance living solute transport pathway. The symplast extends throughout the plant, forming a continuum from the tips to the shoot extremities. The basic mechanism responsible for solute transport within the symplast is cytoplasmic streaming and to a lesser extent diffusion.

3. Intercellular: The basic mechanisms responsible for intercellular solute transport are cytoplasmic streaming, thermal diffusion.

4. Membranes: Penetration of membranes occurs either by diffusion or by active uptake. The herbicides 2,4-D and Glyphosate apparently penetrate the plasmalemma by active uptake but they may also penetrate by diffusion.

Long Distance Transport Pathways

1. Xylem: The Xylem conduits are the principal water-conducting tissue of vascular plants and they are the 'Pipeline' for the transpiration stream. They consist of the two kinds of conducting cells:

a. Vessel members.
b. Tracheids.

The basic mechanism responsible for the solute transport via Xylem conduits are mass flow and root pressure.

2. Phloem: The Phloem conduits are the principal food conducting tissue of vascular plants. Translocation of solutes in the phloem occurs in 3 major steps:

a. Loading of solutes into the phloem at the source.
b. Transport of solutes via the photosynthate stream in the phloem conduits from the source to the sink.
c. Uploading of salutes from the phloem into the sink tissue.

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New Seed Bill Draft, 2019 in Relation to Seeds Control Order, 1983

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In India, to regulate seed quality, Seeds Act, 1966 was the first milestone that provided a legal status to seed in view of providing good quality seed to farmers timely. After that, many provisions were made by Indian Government time to time to strengthen the Indian Seed Programme like Seeds control Order, 1983, New Seed Policy, 1988, Plants, Fruits and Seeds Order (Regulation of Import into India order), 1989, PPVFR Act, 2001 and National Seed Policy, 2002. All of them provided sufficient support to Indian agriculture in maximizing production with considering the farmer's, breeder's and researcher's ethic values. It was felt that with time there is need to revise the provisions of these policies as they are not fitted in present context to boost up the agriculture sector in India.

The quality of seed in India is regulated under the Seeds Act, 1966 by seed certification system, while licensing for the sale of this seed is regulated by the Seeds Control Order, 1983 under the Essential Commodities Act, 1955. The major drawback in existing system is that all the provisions for seed quality control are applicable only on notified kind or varieties. By definition, notified kind or varieties are those varieties which are notified under section 5 of Seeds Act, 1966. Notification of varieties is also non mandatory in India resulted in voluntary seed certification system. Although labelling is compulsory but not enough for legal quality control of all varieties seed which directly affects the agriculture production.

Seeds Act, 1966 was introduced at green revolution era to overcome the food scarcity problem in country by providing good quality seed of high yielding varieties to the farmers and proven as very successful step taken by the Government. At that time, majorly the high yielding varieties development programmes were run by the public sector. Involvement of private sector was very less or negligible. But presently, private sector is participating about 70% involving major contribution of vegetables, fruits, ornamentals and cotton. Public sector contribution is limited to only about 30 % involving the food crops in majority. So, in view of present scenario, on recommendations of Seed Policy Review Group (1998), New Seed Bill, 2004 was prepared to replace the existing Seeds Act, 1966 for removing some deficiencies with provisions of compulsory registration of varieties (previously voluntary), maintenance of National Register of Seeds, more easier regulation of imports and exports of seeds, registration of transgenic varieties and improving the market for private seed sector.

Although, New Seed Bill, 2004 was constructed to overcome the drawbacks of Seeds Act, 1966, but it could not pass in parliament till present day due to some opposes by certain groups. According to them, this Bill is friendlier to industrial structure than farmers in country. In considering the view, New Seed Bill, 2004 is being revised time to time i.e. 2006, 2010 and more recently New Seed Bill draft has been proposed in 2019. New Seed Bill draft, 2019 was formulated to remove drawbacks of New Seed Bill, 2004, is being different from existing Seeds Act, 1966 in many important aspects as it ends the concept of notified varieties, comply with compulsory registration of any kind or variety of seeds, taking the seeds of private hybrids (officially released or truthfully labelled) under legally regulated purview and also redundant the provisions of Seeds Control Order, 1983.

Seeds Control Order, 1983 was introduced to regulate the trading of seeds for improving genetic stamina of seed. Seed (seed for sowing or planting materials of food crops, fruits, vegetables, cattle fodder and jute) was declared as essential commodity by the ministry of civil supplies under the section 2(a) of Essential Commodity Act, 1955 followed by issuing of Seeds Control Order dated on 30th December, 1983 the Ministry of Agriculture, Dept. of Agriculture and Co-operation. The Essential Commodities Act, 1955 was enacted for ensuring the easy and timely availability of essential commodities to the consumers and protecting them from unwanted exploitation by dealers and traders. The farmers were directly benefitted by including seeds in essential commodities as section 3 of Essential Commodities Act gives power to the Central Government to control and regulate the production, supply and distribution of essential commodities.

Under this order, there is a provision of compulsory licensing with a validity period of three years from the date of its issuing. Any seed producing company, seed dealer or any person involved in seed business should have a license which is obtained from Licensing Authority, appointed by the State Government. Seed dealers have to display the price list and seed stocks to the buyers to ensure that seed quality standards claimed by him are in accordance with the prescribed seed standards and labelling under section 6 of Seeds Act, 1966. Also, the dealers should provide a receipt or cash memorandum to the purchaser of seed. There is a provision of controller appointed by Joint Secretary (Seeds), Ministry of Agriculture (Department of Agriculture & Cooperation), Government of India to regulate the seed market according to the provisions of Seeds Control Order, 1983. Seed controller is strengthened with powers to issue the order against any producer, distributor or dealer in a specified manner if it is necessary in public interest. To control the offences against this order, there is provision of appointment of inspectors by the State Government, inspections and punishment. Inspector can draw a seed sample from a dealer or place as he thinks fit in specified manner under the provisions of this order and send it to seed testing laboratory to confirm that the seed is having prescribed quality standards or not. Analysis Report has to be sent by the laboratory to the concerned Inspectors within 60 days from the date of the receipt of the sample in the laboratory. License can be cancelled by the Licensing Authority if there is any contradiction founded and if concerned dealer is not satisfied with decision of Licensing Authority, he can file an appeal against the orders of the Licensing Authority within 60 days from the date of the order.

New Bill will replace all existing Bills in the country. In that case, Seeds Control Order which is an important piece of regulation under the Essential Commodities Act, 1955 will no longer exist. Essential Commodities Act, 1955 mandates dealers to ensure minimum standards of germination, purity and other quality parameters even for other than notified kind or variety of seeds. New Seed Bill draft, 2019 enforces a mandatory registration under a new Seeds Act, encompassing all varieties and cross hybrids, is expected to bring a greater accountability of seed industries, even while rendering the Seeds Control Order redundant. Agriculture is not like other manufacturing firms and is based on seasons and weather completely. At harvesting time of crops, supply is maximum which results in lowering the prices of seed. The Essential Commodities Act, 1955 empowers the government to control the storage and sale price of seed and restrictions on price or quantity of seed of various crops are not placed in the primary legislation.

Essential Commodities Act, 1955 also saves the farmers from the monopoly of private seed firms and MNCs. For example, previously when BT-cotton producing private companies increased the seed prices in 2016, State Government lowered down the prices with the help of Essential Commodities Act, 1955 in the welfare of farmers. If New Seeds Bill is enforced to replace Seeds Act, 1966, all the provisions of Seeds Control Order of 1983 will become obsolete. So, incorporation of all the powers that State governments have under the provisions of the Order into the proposed Seeds Bill, including the 'Power to Distribute Seed' (compulsory licensing) is necessary to preserve the farmers from uncalculated risks.

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Assisted Reproductive Technology for Improving Bovine Production

Article ID: 31161

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Introduction

Milking Cows and buffaloes have been the secondary source of income for farmers living in rural India. Farmer's daily milk requirements are fulfilled through their animals. However, fertility remains the prime concern in cows and buffaloes for farmers. Despite several advancements in the field of reproductive physiology of farm animals, low conception rate and high embryo death rate remains a major problem. Reproductive biotechnology helps us to improve our livestock production through various ways like Artificial insemination, Estrous synchronization, multiple ovulation and embryo transfer, Ovum pickup, superovulation, In vitro fertilization, Somatic cell nuclear transfer, Intra Cytoplasmic Sperm Injection, Semen sexing and Embryo transfer technique.

Artificial Insemination (AI)

AI has been practiced worldwide for more than half a century. It is the main contributor to improving the reproductive ability of dairy animals. It involves the use of cryopreserved semen instead of live animal, which enables the transportation of superior germplasm to long distances and reducing the transport cost. Artificial insemination provides the opportunity to a farmer to get his animal fertilized with the outstanding bull of superior germplasm. Identified bull with high reproducibility can increase the fertility rate in females. It also reduces the risk of spreading sexually transmitted diseases.

Estrous Synchronization

Detection of heat is not possible every time in buffaloes due to conditions called 'silent heat'. Failure of heat detection is a major factor responsible for economic loss to farmers because of the extended calving interval. Synchronization of estrous helps in estrous signs detection in bovines. Estrous synchronization helps in the arrival of female calves to heat within a short time frame (36 to 96 hours). This is achieved through the use of hormones i.e. gonadotropin-releasing hormone and PGF2α.

Multiple Ovulation and Embryo Transfer (MOET)

Embryo transfer is an effective way of increasing the reproduction rate in livestock. For multiple ovulations, donor animal is treated with hormones (LH and FSH) to release more than one egg in a cycle from the ovary. Donor animals are artificially inseminated with the semen of proven bull. Fertilized eggs can be non-surgically collected, usually 7 days after mating or (artificial insemination). The embryo produced can be transferred to the surrogate mother who is at the same stage of their cycle but have not been mated. Many of these embryos get accepted by the recipient surrogate mother and lead to pregnancy.

In-Vitro Fertilization (IVF)

It involves the collection of oocytes (unfertilized eggs) from the ovaries of slaughtered animals or live animals through the ovum pickup technique. These unfertilized eggs are allowed to mature followed by fertilization with sperm of proven bull. After fertilization embryos are harvested in the CO_2 incubator with controlled temperature, humidity, pH, and CO_2 to mimic the uterus conditions for 7 days till the blastocyst stage is achieved. These embryos are transferred into the uterus of the recipient cow using a long syringe that is at the correct receptive stage of the estrous cycle. This technique provides an opportunity of producing offspring of the superior parents.

Cloning

Cloning is a more advanced form of assisted reproductive techniques. It involves the production of genetically identical animals from a single cell taken from the parent animal. A cloned animal is a similar copy of its parent as it has the same DNA content. Cloning involves the removal of DNA from an egg cell (mature oocyte) and fusing it with a somatic cell from the donor animal to be cloned. The donor cell is electrofused with the enucleated oocyte /egg followed by activation of the cell to develop further. Splitting of bovine embryonic blastomere in 2-4 cell stage, embryo bisection at (morula or blastocyst) stage, and nuclear transfer are the main strategies involved to get genetically identical offspring in bovines. Embryo splitting has been applied to MOET programs; major commercial advantage of demi-embryos is that more calves result per embryo. Somatic Cell Nuclear Transfer (SCNT) has been efficiently used for the production of genetically similar calves using fetal cells (mainly fibroblast cells) as a nuclear donor. Other applications of Nuclear Transfer involve parthenogenesis (production of bovine embryos without fertilization) and ICSI (direct injection of spermatozoa into the ooplasm).

Intracytoplasmic Sperm Injection (ICSI)

ICSI is a procedure in which a single sperm cell is injected directly into the cytoplasm of an egg. This technique produces the embryos that may be transferred to a maternal uterus. ICSI is different from IVF as it involves single sperm per oocyte while IVF involves thousands of sperm cells. Fertilization rates have been found to higher with ICSI as compared to IVF. Its main purpose is to overcome male infertility. It can be applied for the production of transgenic animals.

Semen Sexing

Semen having X or Y bearing sperm to produce progenies of a desired sex either female or male (with about 80-90% accuracy) is known as sexed semen. Sperm are sorted based on the size difference of the DNA content in the X- and Y- bearing sperm. The X-chromosome (female) has 3.8% more DNA than the Y-chromosome (male) in cattle. This difference in DNA content is the basis to sort the X- from the Y- bearing sperm. Among several methods for semen sexing, flow cytometry-based sorting has is the most efficient. Only sperm bearing the Y chromosomes are selected to fertilize the female and lead to the production of female calves only. Production of female calves helps in the conservation of the resources that would have been spent on undesired males and save money. This involves short distance transport.

Conclusion

Assisted reproductive techniques (ARTS), is much needed in the developing countries to meet their daily production demands. Reproductive technique helps in shortening the calving interval and thereby directly providing the benefit to farmers. These techniques help in the genetic improvement of the animals as it involves the insemination of female calves with semen of proven quality bulls only. The ART allows the good quality semen to be stored and transported to long-distance and which later can be used for Artificial insemination. Artificial insemination has improved the reproductive efficiency of the animals tremendously. Artificial Insemination (AI) has an effective contribution to the genetic improvement of dairy animals. Estrous synchronization helps in increasing the number of chances an animal to be artificially inseminated at the right time in a herd. Invitro fertilization helps in the production of genetically superior animals as well as producing the embryo to study purpose. The study of embryo helps in understanding the developmental associated events during the pregnancy. Animal cloning has opened ways for the development of identical animals to their parents. Helps in conservation of germplasm of indigenous livestock breeds. It made possible some embryo manipulation techniques for the development of transgenic animals of selected traits. Semen sexing is a new project in India. It ensures the production of selected sex animals, which reduces the burden of growing the unwanted male calves. The successful reproductive technology needs to be made available to the farmer, and awareness programs must be carried out in the country. These emerging techniques have the potential to rapidly improve our livestock breed quality.

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Interactions of Cytokinin Signalling with Abiotic Stress Responses

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Introduction

Plants, as sessile organisms, have evolved elaborate mechanisms for sensing and responding to suboptimal environmental conditions. Abiotic stresses caused by these conditions trigger a wide array of local and long-distance signals which must be coordinated and integrated into whole plant processes. Several phytohormones function as key regulators of stress tolerance, connecting local stimuli to systemic responses. Cytokinin is a multifaceted plant hormone well known for its role in numerous aspects of growth and development. Cytokinin was first identified as a potent inducer of cell division in tissue culture, although abundant evidence also indicates that cytokinin functions in stress responses as well. Current knowledge of the physiological relationships between cytokinin and abiotic stresses which is more or less based on measurements of cytokinin levels under stress conditions and the effects of cytokinin treatment on stress tolerance has been described. A pattern of transcriptional regulation of stress related genes by cytokinin in different plant species have also been identified.

Cytokinin is generally considered to play a negative role in plant adaptation to stress. Evidence exists for cytokinin having both positive and negative effects on stress tolerance. Numerous studies conducted in a wide range of plant taxa, have found that cytokinin concentration decreases in response to extended stress. By contrast, other investigations have reported both short term and sustained increase in cytokinin levels particularly in response to severe stress.

Role of Cytokinin in Drought and Salinity Tolerance

Drought and salinity stress are the most frequent abiotic stresses plants face and both reduce crop production on a global scale. From analysis of natural variants of *Arabidopsis*, it has been shown that even mild drought can adversely affect plants if they are not evolutionarily adapted to it. Plants react to limiting water conditions by reducing their cytokinin levels, mainly through the modulation of cytokinin metabolism and/or the regulation of expression of cytokinin receptors. However, other mechanisms like activation of the negative regulators of cytokinin signaling AHP6 and ARR5 also probably participate in this process. Appropriate modulation of cytokinin metabolism and signaling has been known to improve drought and salinity tolerance for many years. At least five mechanisms may contribute to cytokinin-mediated enhancement of tolerance of water deficiency. These are: i. protection of the photosynthetic machinery, ii. enhancement of antioxidant systems, iii. improvement in water balance regulation, iv. modulation of plant growth and differentiation, and v. modulation of activities of stress related plant hormones.

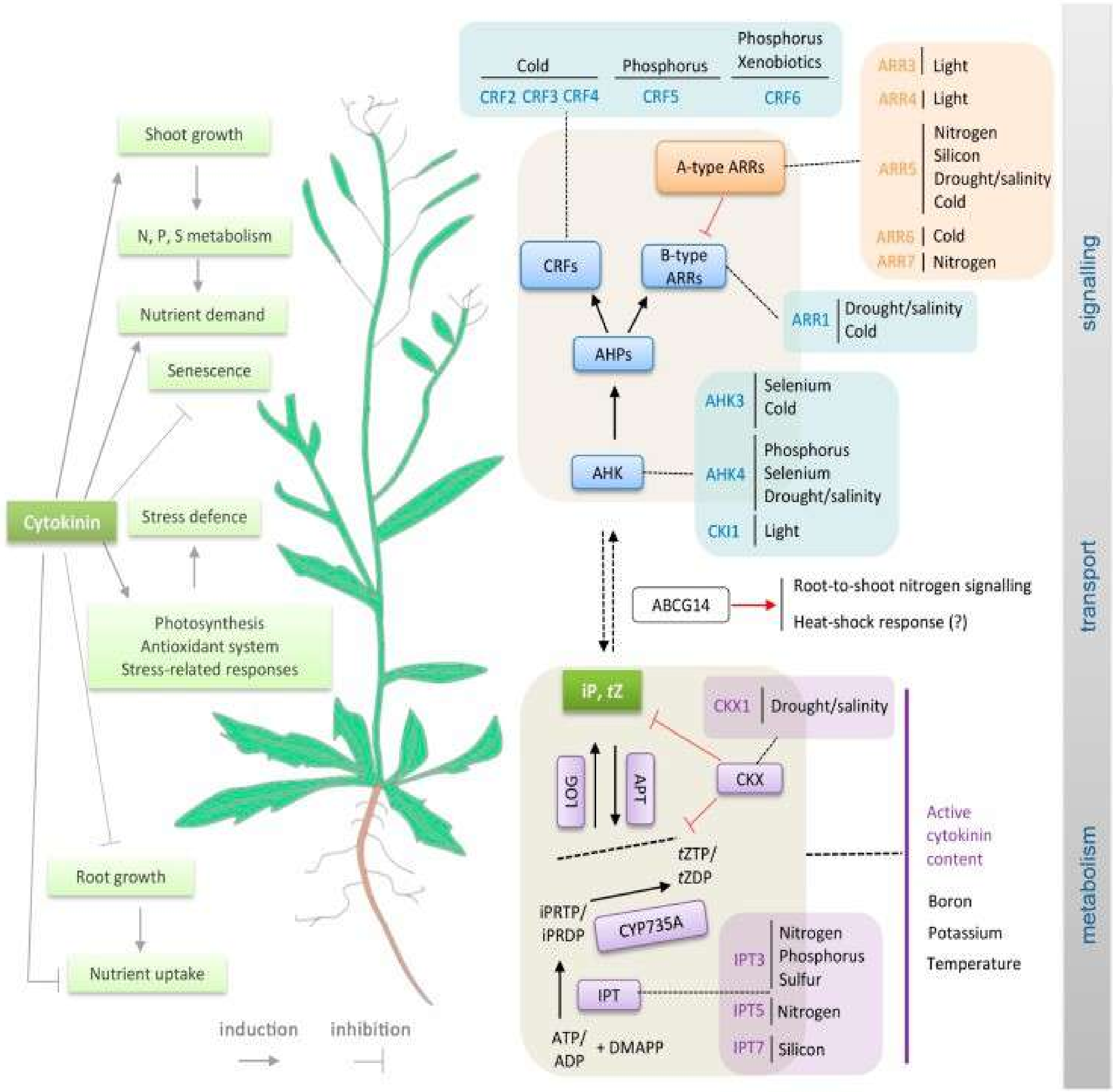
Role of Cytokinin in Temperature Stress

Temperature is one of the most important abiotic factors that affects plant growth, development, productivity and yields. Plants have ability only to grow within taxa-specific temperature ranges, thus suboptimal temperature causes stress, and temperature limits their geographical distributions. The mechanisms that are involved in temperature perception and signalling in plants are far from completely understood, but important aspects of associated morphological changes are totally mediated by several plant hormones.

1. Low temperature stress (Cold and Freezing): Most reported responses of cytokinin metabolism or signalling systems to low temperatures in plants are repressive, but there are some documented exceptions, notably cold-mediated up-regulation of AHK3. Cold-induced attenuation of cytokinin signalling seems to impair plant's tolerance to low temperature because the exogenous application of cytokinin significantly promotes cold tolerance in *Arabidopsis*. Cold has also been shown to activate expression of type-A ARRs in a cytokinin and ethylene dependent manner. Mutation of ARR5, ARR6, and ARR7 leads to higher freezing tolerance, but the over-expression of ARR7 reportedly has both positive and negative effects. The mechanisms whereby cytokinin could both promote cold tolerance and activate negative regulators of cold stress responses are unclear and hence, further research is required.

2. High temperature and Heat stress: In *Arabidopsis*, heat stress treatments show a rapid but transient increase in active cytokinin contents. A rapid proteomic heat-shock response that could be mimicked to some extent by cytokinin treatment at standard temperature has also been reported, indicating that cytokinin may play a role in temperature perception. Plants with increased levels of cytokinin's show a higher accumulation of heat shock proteins (HSPs) and enhanced activity of the antioxidant system. Further, several analyses of temperature induced hypocotyl growth in cytokinin deficient transgenic plants and cytokinin receptor ahk double mutants have shown that impairment of the cytokinin pathway strongly hamper growth of plant at high temperatures. This indicates that cytokinin can serve as a signal for thermomorphogenesis. It is also proved that a higher temperature sensitizes cytokinin signalling. It has been proposed that heat stress induced cytokinin depletion can promote stomatal closure, as this process is inhibited in plants with increased levels of cytokinin.

Role of Cytokinin in Nutrient Stress



International Journal of Molecular Sciences, 2018: Crosstalk between abiotic stress signals and cytokinin

Generally, plants require a number of elements for their growth and development. Besides carbon, hydrogen, and oxygen, which are primarily obtained from carbon dioxide and water, plants actively take up at least twenty essential elements. These include both macronutrients including nitrogen, phosphorus, sulphur, potassium and micronutrients including boron, iron, silicon and selenium. Cytokinin plays a pivotal role in plants' uptake of nutrients like nitrogen, phosphorous, potassium, sulphur, boron, iron, silicon, selenium and their responses to toxic metal(loid)s, including cadmium, aluminium, and arsenate.

Nitrogen is one of the most strongly plant growth limiting nutrients. Thus, their internal nitrogen status and both the availability and distribution of nitrogen in their growth media are sensed by a complex network of signalling pathways which generate and regulate integrated responses to local and long-distance signals, including several plant hormones. A well-known connection between nitrogen metabolism and cytokinin is nitrate supplementation-induced cytokinin biosynthesis in the plant roots. Like nitrogen sensing, a complex signalling system is required to maintain inorganic phosphate (Pi) homeostasis, and plant's response to Pi-limiting conditions involve multiple phytohormones, especially cytokinin. Potassium is the most abundant inorganic cation in plants, and it is one of the primary macronutrients that are generally added (together with nitrogen and phosphorus) to soil in fertilizers. From the analysis of Arabidopsis plants, it has been shown that potassium deprivation reduces cytokinin contents and cytokinin signalling regulates root growth inhibition and potassium uptake. Similarly, Boron is an essential micronutrient for the growth of higher plants, but there is a very narrow range between deficient and toxic concentrations. Boron deprivation induces the down-regulation of cytokinin signalling genes. From several instances, it has been proved that cytokinin suppresses expression of several genes that respond to iron deficiency. Silica minerals are major soil components, and high silicon uptake which is boosted by root silicon transporters, promotes plant's tolerance to many biotic and abiotic stresses. The beneficial effects of silicon are partially mediated by cytokinin.

Conclusion

It can be concluded that cytokinin metabolism and signalling play important roles in abiotic stress tolerance and the manipulation of these processes in crops could be beneficial for sustainable agriculture. However, recent studies have mainly focused on global transcriptomic, proteomic and metabolomic changes in various plant species with modulated cytokinin levels. Thus, further detailed analysis is required to confirm the importance of identified candidate genes or proteins and validate their roles in different stress tolerance. To fully understand the interactions of phytohormone signalling with abiotic stress responses, it will be crucial to integrate protein-protein interactions and the associated signalling hubs and networks.

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Constraints of Green Pesticides

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Pesticides are the chemicals that are used to control or prevent the pests like insects, weeds, fungus, pathogens, vectors etc. that may cause serious injury to our utmost livelihood material, crops. Pesticides were synthetically start producing since the era of green revolution to enhance the productivity of crops by effectively controlling the major pests. But the farmers became so attached to the use of this fast, effective pest killers that excessive use generated huge environmental and ecological risk. Therefore, people started believing in ecological revitalization and started using naturally originated pesticides called green pesticides.

What Actually Green Pesticide is?

Green pesticides, also called ecological pesticides are referred as nature-oriented and beneficial pest control matters that can significantly reduce the pest population below threshold level and also besides being safe and eco-friendly, they can also enhance the food production (Isman and Machial. 2006). Plants may contain several secondary metabolites like flavonoids. alkaloids, saponins, sterols, quinones, tannins, essential oils etc. Such products which are plant derived have been endowed with different biological properties and those properties can direct this product for effective control of pests.

Why Green Pesticides?

Green concept on pesticides came due to ever increasing ecological and environmental pollution, runoff, acid rain depositions, high mammalian toxicity, neurotoxicity and genotoxicity, high level of persistence of synthetic pesticides, pest resistance and resurgence due to overuse of synthetic pesticides. Plant products are not only safe to nontarget organisms and environment but also, they can possess very less amount residue due to their volatile nature.

Some Green Pesticides

Essential oils are the majorly used as insecticides like oils of canola, eucalyptus, anise, cedarwood, citronella (domestic insect), menthol, camphor, neem oil etc. Neem has excellent antifeedant, repellent, oviposition inhibition effect. Tobacco is also a sole source of antiviral, insecticidal effect. Rotenone from *Deris* sp., mineral oils having ovicidal effects. Some of the biopesticide formulations like Neem Aura, Skinsations (DEET, Spectrum Crop.,), Natrapel (citronella 10%, Tender Crop., Repels (Lemon eucalyptus insect repellent lotion)., Mosquito safe (Geraniol 25%, aloe vera 1%, mineral oil 74%), Neem based like Nimbicidines etc. Apart from this different plant are tested and their plant parts being extracted at par for formulating different green pesticides.

Constraints of Green Pesticides

Now the question is that, can the green pesticides replace the entire spectrum of synthetic and conventional pesticides? The answer lies in considering the cons of green pesticides usage in field level as well as in storage levels.

1. Synthesis and Identification: Most natural products are complex mixtures of different structures. Firstly, separation of the complex mixtures using normal chromatographic techniques and identifying using spectroscopic techniques are too much tedious work. These are very difficult to synthesize and also formulating the active ingredient and maintaining the proper particle size with optimum thermodynamic stability is a major concern.

2. Cost: The cost involved in the manufacturing of these intricate substances are too much higher than a mere chemical reaction involved in the synthesis of conventional pesticides.

3. Plant factors: Again, plants may be of different origins and their chemical profiling is entirely dependent on the geographical, seasonal, genetic, climate annual factors. So, to get consistent performance, the pesticide manufacturers have to take additional steps and many of the industries are not willing to produce such high cost product without any market potential.

4. Instability of a.i.: The active ingredients of botanical origin are generally aqueous solutions and therefore liable to be decomposed under sunlight and also microbes. Sufficient quantity of plant materials is difficult to obtain and standardization of these complex compositions are also much difficult to handle.

5. Slow and Steady: The slow acting nature and comparatively less efficacy of most of the botanical pesticides are one of the major problems, since the farmers think that the pesticides applied are not working. Farmers are more interested in knockdown effect rather than the slow actions.

6. Farmers aspect: Moreover, farmers cannot handle such large number of spraying schedules and their short residual period of action added an extra disadvantage to be accepted by farmers. The amount needed for control is also very high.

7. Regulatory issues: If all the issues regarding the product formulation and all have met, then comes the regulatory approval by the governing body. This regulatory approval works as a major commercialization barrier and plant-based products continues to suffer until this system are adjusted to accommodate for the betterment of the products.

8. Toxic effects: Again, some natural pesticides are considered to have more toxicity than the synthetic agrochemicals like arsenic, nicotine (the major alkaloid of tobacco) have high mammalian toxicity. Pyrethrin obtained from chrysanthemum can cause neurotoxicity and certain hepatotoxicity. Neem derived azadirachtin can cause some renal dysfunction. Neem extract was evaluated for cytogenetic in murine germ cells thereby inducing genotoxic effects.

Some of the essential oils like eugenol, menthol, carvacrol, linalool (Moderately hazardous to slightly hazardous) have also considered to cause oxidative stress, lipid peroxidation, genotoxic damage to rats. Conclusion In spite of all these constraints, there does not exist any such alternative to reduce the high levels of environmental pollution as can be done using green pesticides. But Green or Natural does not merely mean that the compounds are safe. So, to replace the conventional pesticide completely, efficacy should be enhanced, cost reduction with proper standardization of product spectrum and efficient regulatory approval of natural or green pesticides should be implemented.

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Role of Polyamines in Plant Stress Tolerance

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Introduction

In the changing climate, plants are being exposed to various biological or abiotic stresses, which can affect their growth, yield and geographic distribution. Plants have developed various adaptive strategies to survive in adverse climatic conditions, among which the accumulation of polyamines plays a protective role in plant stress Plants have developed various adaptive strategies to survive in adverse climatic conditions, of which the accumulation of polyamines plays a protective role in plant stress tolerance.

Polyamines are low molecular weight metabolites (aliphatic) that are synthesized in the cell, including putrescine, spermidine, and spermine. Polymines are widely implicated in plant growth and development of plants through cell division and differentiation, root elongation, floral development, fruit ripening, leaf rigidity, programmed cell death, DNA synthesis gene transcription and protein translation (Tavladoraki et al. 2012). Incorporating these functions, polyamine plays an important role in most environmental stresses, such as salt, drought, low and high temperatures, heavy metals (Cu, Cr, Fe, and Ni), acids, ROS scavenging, and oxidative stresses (Tavladoraki et al. 2012).

On the other hand, the exogenous use of polyamine on plants and transgenic plants engineered for the overprocessed polyamine metabolic pathway exhibits a protective role in abiotic stress conditions, whereas low levels of in vivo polyamine result in decreased tolerance (Alet et al. 2012; Minocha et al., 2014). Therefore, polyamines are ideal for targeting genetic engineering to improve abiotic stress tolerance in plants.

Synthesis and Catabolism of Polyamines

PAs belong to the class of aliphatic amines and are present in bacteria, animals, and plants (Zhang et al., 2011ab). Putrescine (*Put*), spermidine (*Spd*), and spermine (*Spm*) are three major PAs in plants (Sharma et al., 2017). Two precursors, l-ornithine and l-arginine are involved in biosynthesis of putrescine. In plants, *Put* is produced via the catalytic actions of ornithine decarboxylase (ODC) and arginine decarboxylase (ADC). Put is then converted into Spd by Spd synthase (SPDS), with the addition of an aminopropyl moiety donated by decarboxylated *S*-adenosylmethionine (dcSAM).

Spd is then converted into Spm or thermospermine, again using dcSAM as an aminopropyl donor, in a reaction catalysed by Spm synthase (SPMS) and thermospermine synthase (ACL5), respectively (Gupta *et al.*, 2013). PA synthesis may vary between tissues for example that the shoot apical meristem of tobacco (*Nicotiana tabacum*) serves as the predominant site of Spd and Spm synthesis, while Put is mostly synthesized in roots (Moschou *et al.*, 2008). PAs catalysed by two classes of enzymes, copper-containing diamine oxidases (CuAOs) and FAD-containing polyamine oxidases (PAOs; Cona *et al.*, 2006). CuAOs mainly catalyze the oxidation of *Put*, producing 4-aminobutanal, peroxide (H_2O_2) and ammonia and have high affinity for *Put* then Spd, Spm.

Generally, CuAOs are present at high levels in dicots. In contrast to CuAOs, PAOs are present at high levels in monocots and have a high affinity for Spd, Spm, and their derivatives. Plant PAOs are divided into two major groups, the first group catalyses the terminal catabolism of Spd and Spm to produce 1,3-diaminopropane (DAP), H_2O_2, and *N*-(3-aminopropyl)-4-aminobutanal (Spm catabolism), or 4-aminobutanal (Spd catabolism). The second group is responsible for PA conversions, in which Spm is converted back to *Spd*, and *Spd* to *Put* (Moschou *et al.,* 2012). *PAO* genes have been identified in several plant species, including *A. thaliana*, tobacco, rice, barley, maize, poplar, apple, cotton and sweet orange. PA catabolism gives rise to the production of H_2O_2, which may act either as a signalling molecule at low levels or as a toxic compound when the level is high, the ratio of PA catabolism to biosynthesis has been considered as a crucial factor for induction of tolerance responses or plant cell death under abiotic stress.

Manipulation in PA Levels and Transcript Levels of Genes Involved in Polyamine Biosynthesis and Metabolism Under Abiotic Stress Conditions

Plant polyamines (Pas) function in adaptive responses to various environmental stresses. The accumulation of PAs *Put*, *Spd* and *Spm*, show substantial increases under abiotic stress conditions due to the increased *de novo* synthesis of free PAs. PA accumulation is influenced plant species, stress tolerance capacity, stress types, and the physiological status of the tissues. Generally, tolerant genotypes accumulate greater amounts of PAs than sensitive genotypes (Hatmi *et al.*, 2015). For example, in apple callus, *Put* levels increased when it was treated with salt, sweet orange callus was reported to show predominant increases in Spd content when exposed to salt and cold stress conditions, and grape (*Vitis vinifera*) plants showed a dramatic accumulation of *Spd* and *Spm* following salt stress. Since PAs synthesis is primarily regulated at the transcriptional level (Romero et al., 2018). Most of the PA biosynthetic genes, including *ADC*, *SPDS*, *SPMS*, and *SAMDC*, are up-regulated by stresses (Table 1.). Of these genes, *ADC* is most widely characterized in different plants and has been demonstrated to be a crucial stress-responsive gene (Wang et al., 2011b). PAs, significantly enhance the activity of important antioxidant enzymes glutathione (GSH), superoxide dismutase (SOD), catalase, and glutathione peroxidase. Scientists developing transgenic varieties harboring genes encoding the PA biosynthesis enzymes (ADC, ODC, SPDS, and SAM) to enhance the endogenous PAs levels.

Table 1. List of Transgenic Plants Overexpressing Candidate Genes for Polyamines Accumulation

Transgene	Host	Target crop plants	Remarks
CsSPDS	*Cucurbita ficifolia*	*A. thaliana*	Twofold *Spd* accumulation, inducing abiotic stress tolerance
DsADC	*Datura stramonium*	*O. sativa L.*	threefold putrescine accumulation inducing drought tolerance
DsSPDS	*D. stramonium*	*N. tobacum*	Enhanced spermidine accumulation, chlorophyll content, and plant growth
AsADC	*Avena sativa L.*	*O. sativa L.*	Enhanced polyamine accumulation inducing abiotic stress tolerance
SAMDC	*Saccharomyces cerevisiae*	*Lycopersicon esculentum*	1.7- to 2.4-fold higher levels of spermidine and Spm, heat stress tolerance, CO2 assimilation
SAMDC	*Tri tordeum*	*O. sativa L.*	threefold increase of Spd and Spm, higher seed germination, salt tolerance
LcSAMDC1	*Leymuschinensis*	*A. thaliana*	Enhanced Spm, proline, and chlorophyll content under salt and cold stress
AvADC	*Avena sativa L*	*Medicago truncatula*	Enhanced polyamine content, seed yield, and desiccation stress tolerance

Effect of Exogenous Polyamines on Plant Tolerance to Abiotic Stresses

To gain more information about the role of PA in inducing stress tolerance, many researchers have applied PA exogenously to plants growing in stress environments. The exogenous application of Spm to plants under high temperature (40°C), salt (200 mM NaCl), and drought stress, exhibits low H2O2 content, lipoxylase activity, and reduced ROS status. Exogenously applied polyamines (*Put, Spd*, and *Spm*) enhances salt tolerance in rice, *Atropa belladonna* and barley, ozone and salt tolerance in tobacco, chilling and salt tolerance in cucumber, salt and heavy metal (Cu, Fe, and Ni) tolerance in *Brassica napus*, dehydration tolerance in *Citrus reticulate* , and heat stress tolerance in *Arabidopsis*.

Mechanism of Polyamines in Plant Abiotic Stress Tolerance

Abiotic stress (salt, drought, temperature, heavy metals, etc.) modulate gene expression of polyamine biosynthetic and metabolic pathways, thus manipulated the accumulation of polyamines (*Put, Spd* and

Spm). Additionally, abiotic stress induced the burst of abscisic acid (ABA) and nitric oxide (NO). The interactions among ABA, NO and polyamines activated downstream protective responses and regulating ion channel, stomatal response (via H_2O_2), antioxidant enzymes (via NDPK), osmolytes biosynthesis (via amino acid, carbon pathways) and other gene expression, resulting in ion homeostasis, improved water status, ROS homeostasis, balance of osmotic pressure and other unknown adaptive responses, respectively, and finally caused enhanced abiotic stress tolerance in plants.

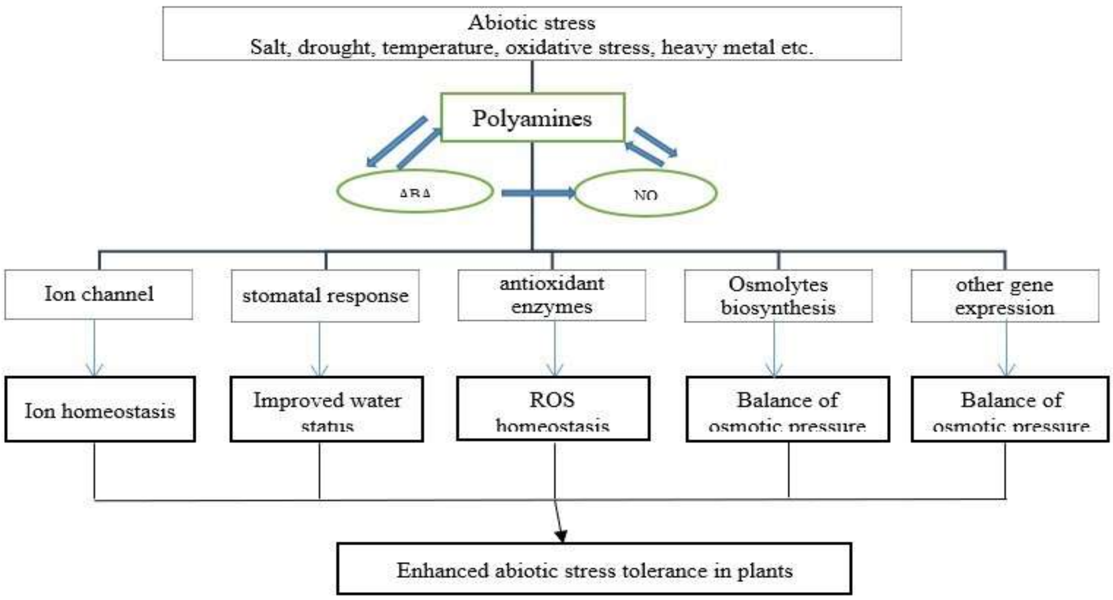

Figure 1. Mechanism of polyamines involved in plant abiotic stress responses

Conclusion

Polyamines are considered to play an important role in protecting plant cells against stress-damage. Polyamines involved in plant abiotic stress responses was studied by many researchers and concluded the physiological and genetic manipulation of polyamine biosynthetic and metabolic pathways related genes is an effective approach for the development of stress-tolerant plants. Further work should really need the omic profiling of polyamines, and interactions between polyamines and other stress responsive molecules such as ABA and NO. Omics studies will bring us new insights to manifest polyamines related signalling pathways and downstream targets.

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Biofertilisers - Enhancers of Soil Fertility

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Summary
Plants nutrients are essential for the production of crops and healthy food for the world's ever-increasing population. Bio-fertilizer can be an important component of integrated nutrients management. Microorganisms that are commonly used as bio-fertilizer components include; nitrogen fixers (N-fixer), potassium and phosphorus solubilizers, growth promoting rhizobacteria (PGPRs), endo and ecto mycorrhizal fungi, cyanobacteria and other useful microscopic organisms. The use of bio-fertilizers leads to improved nutrients and water uptake, plant growth and plant tolerance to abiotic and biotic factors. These potential biological fertilizers would play a key role in productivity and sustainability of soil and also in protecting the environment as eco-friendly and cost-effective inputs for the farmers.

Introduction
A bio-fertilizer is a substance which contains living microorganisms applied to the soil, seed or plant surface colonizes the rhizosphere and promotes growth by increasing the supply or availability of nutrients to the host plant.

History of Bio-Fertilizer
The commercial history of bio-fertilizer began with the launch of "Nitragin" by Nobbe and Hilther in 1895. This was followed by the discovery of Azotobacter and then Blue-green algae and a host of other microorganisms which are being used till date as bio-fertilizer.

Mechanism of Actions of Bio-Fertilizers
Among the PGPRs species, *Azospirillum* was suggested to secrete gibberellins, ethylene and auxins. Some plant associated bacteria can also induce phytohormone synthesis, *Rhizobium* and *Bacillus* were found to synthesize IAA at different cultural pH, temperature and in the presence of agro-waste as carrier material. Unlike other phytohormones, ethylene is responsible for inhibition of growth of dicot plants.

Biochemistry of Bio-Fertilizer Production
The production of bio-fertilizer involves three biochemical steps which include the breaking down of complex materials into simpler substances in a process known as anaerobic digestion. In the first stage, complex organic matter is broken down by cellulolytic microorganisms to produce simple molecules such as long chain fatty acids and other substances. In the second stage, the products from stage one is fermented leading to the production of simpler intermediates such as acetic acids, pyruvic acids, carbon dioxide and so on. In the third stage, methanogens act on the products, giving off a mixture of gases known as biogas. This can be represented by the following reactions:

$$\underset{Aceticacid}{CH_3COOH} \rightarrow \underset{Methane}{CH_4} + \underset{Carbondioxide}{CO_2}$$

$$\underset{Ethanol}{2CH_3CH_2OH} + \underset{Carbondioxide}{CO_2} \xrightarrow{CH_4} \underset{Methane\ +\ Acetic\ acid}{2CH_3COOH}$$

$$\underset{Carbondioxide}{CO_2} + \underset{Hydrogen}{4H_2} \rightarrow \underset{methane}{CH_4} + \underset{Water}{2H_2O}$$

Advantages of Bio-Fertilizer Over Chemical Fertilizers
1. Bio-fertilizers are environment friendly and do not cause pollution unlike inorganic fertilizers.

2. The issue of excessive application does not arise in the use of bio-fertilizer and special skills are not required for its application.
3. Bio-fertilizers have long lasting effects due to their slow nutrient release.
4. As a result, long term use of bio-fertilizer leads to the build-up of nutrients in the soil thereby increasing the overall soil fertility.
5. Bio-fertilizer acts as a soil conditioner adding organic matter to the soil
6. It enriches the soil with beneficial microorganisms while boosting the already existing ones unlike chemical inorganic fertilizers
7. Bio-fertilizers contain a wide range of nutrients which are often absent in inorganic fertilizers (these include trace elements).

Types of Bio-Fertilizers

Bio-fertilizers are classified into different types depending on the type or group of microorganisms they contain. Table 1 shows the classification of bio-fertilizers on the bases of the different types of microorganisms used. The different types of bio-fertilizers include:

Table 1: Different Microorganisms used in Bio-fertilizer Production:

Groups	Examples
	Nitrogen fixing bio-fertilizers
Free-living	*Azotobacter, Bejerinkia, Clostridium, Klebsiella, Anabaena, Nostoc*
Symbiotic	*Rhizobium, Frankia, Anabaena, Azollae*
Associative symbiotic	*Azospirillum*
	Phosphate solubilizing bio-fertilizer
Bacteria	*Bacillus megaterium var, Phosphaticum, Bacillus subtilis, Bacillus circulans*
Fungi	*Penicillum Spp. Aspergillus awamori*
	Phosphate mobilizing bio-fertilizers
Arbuscular Mycorrhiza	*Glomus Spp., Gigaspora Spp., Acaulospora Spp.*
Ectomycorrhiza	*Laccaria Spp., Boletus Spp. and Amanita Spp.*
Ericoid Mycorrhiza	*Pezizella ericae*
Orchid Mycorrhiza	*Rhizoctonia solani*
	Bio-fertilizers for micronutrients
Bacillus Spp	Silicate and zinc solubilizers
	Plant growth promoting Rhizobacteria
Pseudomonas	*Pseudomonas fluorescens*

Importance of Bio-Fertilizers

The importance of biofertilizers are highlighted below: Secretion of plant growth hormones which help in plant growth, Protection of the plant against attack by pathogens, Improvement soil fertility, No special care is necessary while using bio-fertilizer, Reduction in the use of chemical fertilizers, Bio-fertilizers are cost effective compared to synthetic fertilizer, Promotes growth of plants, Bio-fertilizers restore the soil's natural, nutrient cycle and build soil organic matter and Bio-fertilizer provides protection against drought.

Limitation of Bio-Fertilizer

1. Unavailability of suitable strain due to lack of availability of specific strain.
2. Unavailability of suitable carrier.
3. Lack of awareness among farmers.
4. Inadequate human resources and inexperienced staff.
5. Environmental constraints.

Caution in the Use of Bio-Fertilizers

1. Never mix bio-fertilizers with nitrogen fertilizers.
2. Never apply bio-fertilizers with fungicides.

3. Never expose bio-fertilizers to sunlight directly.
4. Bio-fertilizers are stored at room temperature, not below O °C and above 35°C
5. Do not keep used solution overnight.

Conclusion

The application of bio-fertilizers containing beneficial microbes promote to a large extent, crop productivity. These potential biological fertilizers would play a key role in productivity and sustainability of soil and protect the environment as eco-friendly and cost-effective inputs for the farmers. Using the biological and organic fertilizers, a low input system can help to achieve sustainability of farming. This technology will help provide relief from environmental stresses. However, the ignorance regarding improved protocols of bio-fertilizers application to the field is one of the few limiting factors to bio-fertilizers usage.

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Plant Mediated Synthesis and Characterization of Silver Nanoparticles

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Introduction

Agriculture is one of the major sectors that provides food for human, indirectly or directly in addition to feed, fibre, fire and fuels. The ever-increasing population results in increase of demand of all above tremendously in spite of constant availability of natural resources.

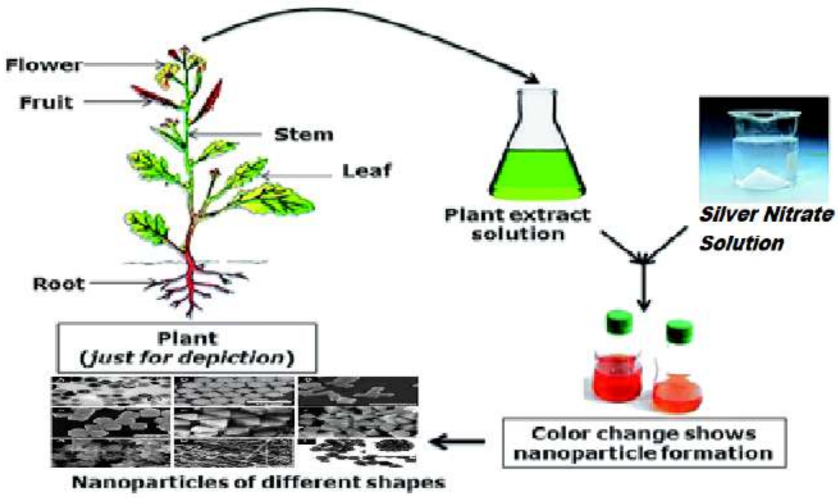
This is one of the concerning factors to accept the modern technique, the nanotechnology in particular. Nanotechnology has become boon and its wide application in the field of agriculture increasing day by day. Nanoparticles of size 1-100 nm, have unique properties due to their size, distribution and morphology, are critical components of any nanotechnology. Particularly, the silver nanoparticles (AgNPs) have received tremendous research attention.

Almost 5000 years ago, Romans, Greeks, Egyptians and Indians used silver in several forms to preserve the food products (Block, 2001). In ancient period usage of silver utensils for eating and drinking and preservation of eatable and drinkable items perhaps due to the awareness of antimicrobial action.

AgNPs and Ag-based compounds are extremely cytotoxic to several microorganisms, displaying robust biocidal effects on various species of bacteria, including *Escherichia coli* (E.coli), *Staphylococcus* and *Streptococcus mutans*. AgNPs have been widely used for bacterial diseases, incorporated into dental materials, treatment of severe skin burns and water purification (Jain et al., 2009).

Different Modes of Synthesis

Several approaches such as physical and chemical methods are proposed for the synthesis of AgNPs (Iravani et al., 2014). However, these methods are associated with the use of heavy equipment, huge amount of energy input, highly toxic and dangerous chemical compounds that generate biological hazards and most of the times these methods are not ecological and safe. On the other hand, Plant-mediated synthesis of AgNPs seems to be very rapid, simple, dependable, non-toxic and eco-friendly (Natsuki et al., 2015). The synthesis of metal nanoparticles using plant extracts deliver beneficial over other biological synthesis methods which are associated with very difficult procedures such as maintaining microbial cultures. Phytochemicals present in plant extracts act as reducing and capping agent, there is no need to add stabilizing agent.



Characterization of AgNPs

After synthesis, AgNPs characterisation is essential to investigate their characteristic features such as surface area, morphology, size, shape, aggregation and solubility, etc. Several analytical techniques have been used for the characterisation of nanoparticles.

UV-Visible Spectrophotometry

UV-Vis spectrophotometry is one of the most commonly used techniques for the characterization of synthesised nanoparticles which is also used to monitor stability and synthesis of AgNPs. It involves quantifying the amount of ultraviolet or visible radiation absorbed by a constituent in solution.

UV-Vis measures the ratio, or function of ratio, of the intensity of two beams of light in the UV-Visible region. In AgNPs, the valence band and conduction band lie very near to each other in which free movement of electrons. These electrons produce a surface plasmon resonance (SPR) band due to the combined oscillation of electrons of AgNPs in resonance with the incident light wave.

The absorption spectra of AgNPs depend on the dielectric medium, morphology, shape, size, and chemical surroundings of synthesised nanoparticles.

X-Ray Diffraction Analysis (XRD)

XRD is an analytical technique which has been utilised to investigate the crystal or polycrystalline structures, quantitative resolution of chemical compounds, qualitative identification of various chemical species, measuring the degree of crystallinity, particle sizes, etc. A beam of X-rays projected onto the crystal and the incident beam is scattered by the atoms it leads to the formation of diffraction patterns. The scattered x-rays interfere with each other. This interference could be observed by using Bragg's Law to find different characteristics of the crystal or polycrystalline material.

Scanning Electron Microscope (SEM)

Among several electron microscopy techniques, SEM is a surface imaging technique, capable of determining different particle shapes, surface morphology, sizes and size distributions of the synthesised nanoparticles at the micro (10-6) and nano (10-9) scales. Energy Dispersive X-Ray Spectroscopy (EDX) is a chemical analysis method used in combination with SEM to know the elemental composition AgNPs sample. The EDS technique detects x-rays emitted from the sample during the bombardment by an electron beam and EDS x-ray detector quantifies the relative abundance of discharged x-rays vs their energy.

Transmission Electron Microscope (TEM)

The Transmission electron microscope (TEM) is a powerful tool to characterise the nanoparticles. It is used to acquire quantitative measures such as size distribution, particle size and morphology of the synthesised nanoparticles. It utilises an electron beam to interact with a sample and forms an image on a photographic plate. TEM is distinctive in detecting and quantifying the chemical and electronic structure of individual nanoparticles.

Fourier Transforms Infrared Spectroscopy (FTIR)

FTIR spectroscopy is used to investigate the metal nanoparticle surface chemistry and to find out whether bio-molecules are involved in the nanoparticle's synthesis. FTIR is a non-invasive, suitable, valuable, cost effective, and simple technique to investigate the role of biomolecules in the reduction of $AgNO_3$ to silver.

Zeta Potential Measurement

Zeta potential measures the effective electric charge on the nanoparticle surface and it is a crucial parameter for characterization of stability in aqueous AgNPs suspensions. Nanoparticles have a surface charge that attracts a layer of opposite charge ions to the nanoparticles surface. Formed double layer of ions moves with the nanoparticles as it diffuses throughout the aqueous solution. The net electric charge potential between the layers is known as the Zeta potential of the nanoparticles and has values that usually range from +100 mV to -100 mV. The magnitude of the zeta potential is predictive of the nanoparticles stability.

Conclusion

Predominantly AgNPs are synthesised by wet chemical methods, where the chemicals used are associated with toxicity and biological hazards. So, there is a requirement of plant-mediated AgNPs synthesis method. Green nanotechnology could achieve this essential by synthesising the AgNPs without utilising any toxic chemical as a reducing agent.

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Climate Smart Agriculture (CSA): An Approach

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Climate Smart Agriculture (CSA)

Climate Smart Agriculture (CSA) is an integrated approach to managing landscapes-cropland, livestock, forests and fisheries-that address the interlinked challenges of food security and climate change.

"Climate-smart agriculture isn't distinct from sustainable agriculture; it's a way of combining various sustainable methods to tackle the specific climate challenges of a specific farming community."

Agricultural production systems are facing increasing competition from other sectors for limited natural resources. The availability of these resources and their quality are also being affected by unsustainable management practices and changing climatic and weather conditions. To respond to this situation, the agriculture sectors must improve their sustainability performance and adapt to the impacts of climate change in ways that do not compromise global efforts to ensure food security for all. These challenges are intimately and inextricably related, and need to be addressed simultaneously.

Introduction

Climate-smart agriculture (CSA) may be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper et al. 2014).The most commonly used definition is provided by the Food and Agricultural Organization of the United Nations (FAO), which defines CSA as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals". In this definition, the principal goal of CSA is identified as food security and development (FAO 2013a; Lipper et al. 2014); while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal.

The Three Pillars of CSA

1. Productivity: CSA aims to sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment. This, in turn, will raise food and nutritional security. A key concept related to raising productivity is sustainable intensification

2. Adaptation: CSA aims to reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses. Particular attention is given to protecting the ecosystem services which ecosystems provide to farmers and others. These services are essential for maintaining productivity and our ability to adapt to climate changes.

3. Mitigation: Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions. This implies that we reduce emissions for each calorie or kilo of food, fibre and fuel that we produce. That we avoid deforestation from agriculture. And that we manage soils and trees in ways that maximizes their potential to acts as carbon sinks and absorb CO2 from the atmosphere.

What is the History of Climate-Smart Agriculture?

FAO coined the term CSA in the background document prepared for the 2010 Hague Conference on Food Security, Agriculture and Climate Change. The CSA concept was developed with a strong focus on food security, for now and the future, including adaptation to climate change.

The CSA concept now has wide ownership among, governments, regional and international agencies, civil society and private sector. Emerging global and regional (Africa) Alliances on Climate-Smart Agriculture (ACSA) provide a platform for shared learning and collaboration among all interested parties.

Why is CSA Needed?

The UN Food and Agriculture Organization (FAO) estimates that feeding the world population will require a 60 percent increase in total agricultural production. With many of the resources needed for sustainable food security already stretched, the food security challenges are huge. At the same time climate change is already negatively impacting agricultural production globally and locally.

Climate-smart agriculture helps in the following ways:
1. Sustainably increase agricultural productivity and incomes;
2. Adapt and build resilience to climate change
3. Reduce and/or remove greenhouse gas emissions, where possible.

The climate-smart agriculture approach seeks to reduce trade-offs and promote synergies to make crop and livestock systems, forestry, and fisheries and aquaculture more productive and more sustainable.
Climate-smart agriculture is not a new agricultural system, nor a set of practices. It is an innovative approach for charting development pathways that can make the agriculture sectors more productive and sustainable and better able to contribute to climate change adaptation and mitigation.

How is Climate-Smart Agriculture Implemented?

Climate-smart agriculture relates to actions in fields, pastures, forests, and oceans and freshwater ecosystems. It involves the assessment and application of technologies and practices, the creation of a supportive policy and institutional framework and the formulation of investment strategies.

Climate-smart agricultural systems include different elements such as:
1. The management of land, crops, livestock, aquaculture and capture fisheries to balance near-term food security and livelihoods needs with priorities for adaptation and mitigation;

2. Ecosystem and landscape management to conserve ecosystem services that are important for food security, agricultural development, adaptation and mitigation;

3. Services for farmers and land managers that can enable them to better manage the risks and impacts of climate change and undertake mitigation actions; and

4. Changes in the wider food system including demand-side measures and value chain interventions that enhance the benefits of climate-smart agriculture.

What is Different About Climate-Smart Agriculture?

What is new about CSA is an explicit consideration of climatic risks that are happening more rapidly and with greater intensity than in the past. New climate risks, require changes in agricultural technologies and approaches to improve the lives of those still locked in food insecurity and poverty and to prevent the loss of gains already achieved.

CSA approaches entail greater investment in:
1. Managing climate risks,
2. Understanding and planning for adaptive transitions that may be needed, for example into new farming systems or livelihoods,
3. Exploiting opportunities for reducing or removing greenhouse gas emissions where feasible.

Conclusion

Climate change poses a growing threat to sustainable development. The climate-smart agriculture approach is particularly important for agricultural producers in developing countries who are at risk of food insecurity as a result of climate change and who have limited means, little policy support and few institutions that can help them cope with change. The high efficiency of integrated agriculture production systems delivers socio-economic and ecological benefits that benefit farmers as well the whole society. There are many ways in which integrated agriculture production systems can help producers to adapt to climate change and provide important mitigation co-benefits. However, several factors hamper the effective adaptation of integrated production systems, such as lack of data on the impacts of climate change, and high requirements in terms of knowledge and labour and initial investments that may pay off only over long time periods.

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Recycled Water Use in the Agriculture

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Introduction

India has been ranked 13th amongst 17 'extremely water stressed' countries with a quarter of the world's population in the Aqueduct Water Risk Atlas released by Water Resources Institute (WRI). Warning of unsustainable depletion, the report finds that global water withdrawals have doubled since the 1960s. NITI Aayog report 2018 warns that, 21 major Indian cities will face extreme water crisis in the future. Wasteful use of water in agriculture and also the waste of sanitation water in urban areas remains unaddressed.

WRI notes that, from 1990 to 2014, groundwater tables in some north Indian aquifers have been declining at a rate of 8 cm per year. To tackle this crisis, WRI recommends increased agricultural efficiency, investing in grey and green infrastructure, and treating, reusing and recycling water.

India conserves only a mere 8% of rainfall-the lowest in the world. The key intervention has to be on reusing and recycling wastewater. It is estimated that if 80% of urban wastewater could be collected and treated by 2030, there would be a total volume of around 17 billion m3 (BCM) per year; an increase of around 400% in the volume of available treated wastewater. This 17 BCM of treated wastewater resource, if captured, treated safely and recycled, is equivalent to almost 75% of the projected industrial demand in 2025 (MoWR 2006) and almost a quarter of the total projected drinking water requirements in the country.

Recycled Wastewater in Indian Agriculture Scenario

Recycled wastewater also plays an important role in providing a reliable source of water for agriculture. Several countries use treated wastewater to varying degrees to meet agricultural water demand. The practice of using treated or untreated wastewater for agriculture has also been historically prevalent in India; however, there is a need to understand the environmental, economic and health implications of using untreated wastewater. In coastal areas, reclaimed wastewater (discharged to the sea) is an additional resource to meet irrigation demand, and in upstream locations, use of reclaimed water in agriculture frees up freshwater for domestic and industrial consumption.

In addition to recycled wastewater becoming an additional and valuable water source, there are opportunities to recover nutrients and energy from wastewater. Recycled waste water contains valuable nutrients (nitrogen, phosphorus and potassium [NPK], among others), which aid in crop growth and could reduce the need for synthetic fertilizers in India by up to 40% (Minhas 2002; Silva and Scott 2002; Kaur *et al*. 2012).When reclaimed water is used for irrigation in agriculture, the nutrient (nitrogen and phosphorus) content of the treated wastewater has the benefit of acting as a fertilizer. This can make the reuse of excreta contained in sewage attractive. Analysis presented in various studies (WII 2006; Londhe *et al*. 2004; Amerasinghe *et al*. 2013) also suggests a 30% increase in annual farm income to farmers utilizing treated and untreated wastewater for irrigation compared to freshwater. The increase in farm income is a result of an increase in yield, multiple cropping seasons and lower fertilizer requirement. Wastewater, a valuable source of plant nutrients, needs to be viewed as an economic resource by the planning authorities.

Let us also, understand the use of treated grey water in irrigation and its benefits. In India, the urban wastewater generated (estimated currently at about 38,000 million liters a day [MLD])would provide 14 BCM of irrigation water, which could safely irrigate (if treated) an area ranging between 1 and 3 million hectares (ha), depending on the type of crop cultivated and its irrigation requirement. This wastewater irrigation (WWI) potential (taken at 2 million ha) is 44% of the major and medium potential created. This is also significant when considering our national circumstances as 70% of India's population relies on agriculture for sustenance, and agriculture is heavily reliant on rain-fed irrigation in large parts of the country. The use of treated wastewater for irrigation has the immense potential of reducing the ground water uptake for irrigation, and thereby reducing the pumping and the associated energy requirement and associated costs. Conservation of energy occurs as a result of using wastewater for irrigation also has an accompanying benefit of reducing harmful greenhouse gas (GHG) emissions that would have been generated during the production of an equivalent amount of electricity. Estimates in this advisory suggest that avoiding ground water pumping due to wastewater irrigation has the potential to reduce about 1.75 million MWh of electricity, which is equivalent to reducing about 1.5 million tonnes of CO_2 GHG emissions. Currently it is estimated that India has a cultivated area of more than 40,000 ha irrigated with untreated wastewater (World Bank 2010) which needs to be mitigated and corrected where absolutely necessary.

Challenges in Wastewater Recycling in India

1. Restructuring of sewerage systems.
2. Cost of setting up.
3. Unavailability of land.
4. Continuous power supply.
5. Skilled labour force.
6. Adhering to environmental guidelines.
7. Public and farmer acceptance.
8. Water quality.

The Centre for Science and Environment estimates that Rs. 1 crore per million litres is the cost incurred to build a wastewater plant. Without adequate support from the government and private sector, to set up plant and buy the expensive land, preferably in the outskirts of a town. Urban and rural India will not be able to afford the building of such plants and would rather opt to discharge wastewater directly into water bodies.

Approaches for Municipal Sewage Treatment

There are two main technological approaches for wastewater treatment, i.e., the intensive treatment approach and the extensive treatment approach.

1. Intensive sewage treatment systems (such as activated sludge) are optimized for biological oxygen demand (BOD) removal. Sewage is introduced to a large biomass of heterotrophic microorganisms together with intensive supply of oxygen. This results in efficient BOD removal, performed in relatively short time (residence time of 8–14 h) and confined space, which has an obvious financial benefit especially in densely populated urban areas.

The disadvantage of the short residence time is the lack of buffer capacity, making the system sensitive to transient quality and quantity interruptions and thus reducing its reliability. Moreover, intensive treatment systems fail to efficiently remove detergents, heavy metals, xenobiotics, and pathogens as well, nor do they have any significant storage capacity.

As a result of the above shortcomings, intensive systems alone cannot achieve the requirements for agricultural irrigation and have to be followed by polishing treatment systems. This polishing treatment can be done as said below:

To add advanced intensive treatment units for further treatment of effluent. These may include disinfection unit (chlorination, ozonation, UV, etc.), coagulation–flocculation unit, filtration or even membrane filtration, activated carbon treatment, etc. This approach is high investments and operational costs, high energy consumption, and the release of series of sludges, the treatment and disposal of which are also difficult and expensive.

2. Extensive sewage treatment systems (such as wastewater stabilization reservoirs, constructed wetlands, etc.) for further treatment of effluent. By doing so, the extensive unit will not suffer from overloading, since most of the BOD has been removed in the intensive unit. These low rate processes are responsible for the removal of the remaining 'hard' pollutants from the effluent of the intensive units. Moreover, the long residence time in the extensive units enables them to act as a buffer zone for short-term breakdown of the intensive reactors.

To conclude, combining the two types of treatment units, especially in arid and semi-arid countries, would lead to better treatment and thus better quality of effluent to be utilized for agricultural irrigation.

Precautions in Using Treated Waste Water

The World Health Organization, in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environmental Program (UNEP), has developed guidelines for safe use of wastewater in 2006. These guidelines advocate a 'multiple-barrier' approach wastewater use, for example by encouraging farmers to adopt various risk-reducing behaviours. These include ceasing irrigation a few days before harvesting to allow pathogens to die off in the sunlight, applying water carefully so it does not contaminate leaves likely to be eaten raw, cleaning vegetables with disinfectant or allowing faecal sludge used in farming to dry before being used as a human manure.

Summary

Reuse of treated wastewater is a common and rapidly increasing practice, mainly in arid and semi-arid regions around the world. There, treated wastewater serves as a 'new' resource which is added to the water balance and substitutes conventional water in agricultural irrigation. Wastewater reuse may enhance the quality of conventional water resources by reducing demand pressure and by eliminating the main pollution source (municipal sewage) from the conventional water resources. Using untreated or partially treated wastewater exposes farmers and crop consumers to potential health risks. Ideally wastewater should be treated before using it for irrigation; health and risk aspects, along with international guidelines for treatment.

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Locusts: An Outlook on its Migratory Behaviour

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Introduction

Locusts are species of short-horned grasshoppers in the family Acrididae that can form dense migrating swarms through a phenomenon known as phase polyphenism. These species forms swarms under intermittently suitable condition called locusts. These grasshoppers are normally innocuous, their numbers are low and they do not pose a major economic threat to agriculture. However, under suitable conditions of drought followed by rapid vegetation growth, serotonin in their brains triggers a dramatic set of changes; they start to breed abundantly, becoming gregarious and nomadic when their populations become dense enough. They form bands of wingless nymphs which later become swarms of winged adults. Both the bands and the swarms move around and rapidly strip fields and cause damage to crops. The adults are powerful fliers; they can travel great distances, consuming most of the green vegetation wherever the swarm settles. They live in two different phases *viz.,* solitary and gregarious phases. Locusts show marked variations in behaviour, metabolism, development, reproductive physiology, morphology, and colour in response to population density. Uvarov (1966) stressed the fact that when population density changes, it is the behaviour of individuals that alters first, with other changes being secondary. Hence, the behaviour of insects, that are solitarious by morphological and colour criteria, can be shifted by experience of crowding toward that characteristic of phase gregaria, and vice versa. There are four species of locusts reported in India *viz.,* Desert locust: *Schistocerca gregaria,* Migratory locust: *Locusta migratoria,* Bombay Locust: *Nomadacris succincta* and Tree Locust: *Anacridium* spp.

Fig. 1 Locusts' species; (1) Schistocerca gregaria, (2) Locusta migratoria, (3) Nomadacris succincta and (4) Anacridium spp.

Life Cycle of Locusts

Locusts go through egg, nymph and adult stages without having any pupal stage. Fledgling is an intermediate stage that occurs between the nymph and adult periods. The life cycle period of locust varies from species to species. Female locusts lay eggs in suitable locations shortly after mating. Female locusts make holes in the soil using their abdomen tip and lay eggs in a pod-like structure shielded by foam. The holes range between 2 and 10 centimetres in depth. The foam covering secures the eggs from predation, dehydration and contamination. The eggs hatch within 10 to 20 days depending on temperature and moisture conditions. Afterwards the nymphs move to the ground and hop around as they have no wings. They undergo the five hopper stages, also known as instars. In addition, they grow wing buds, which develop to full wings as they approach adult stage. The locusts spend four to eight weeks in the hopper stages and tend to congregate in bands. Due to the softness of their wings, the final molts of the nymphs are not able to fly. These flightless young adults are known as fledglings and their wings take at least a week or more to harden. During this stage the locusts consume lots of green food to boost wing development and egg production. Characterized by massive movement and feeding, adult is the final stage of the locust life cycle. The locusts at this level have fully pledged wings and can fly. They tend to swarm together in areas with plenty of green feed and are destructive in gardens. They move in large swarms and migrate to new fields on exhaustion of current feeds. They have a lifespan of at most eight weeks during which they reproduce and die.

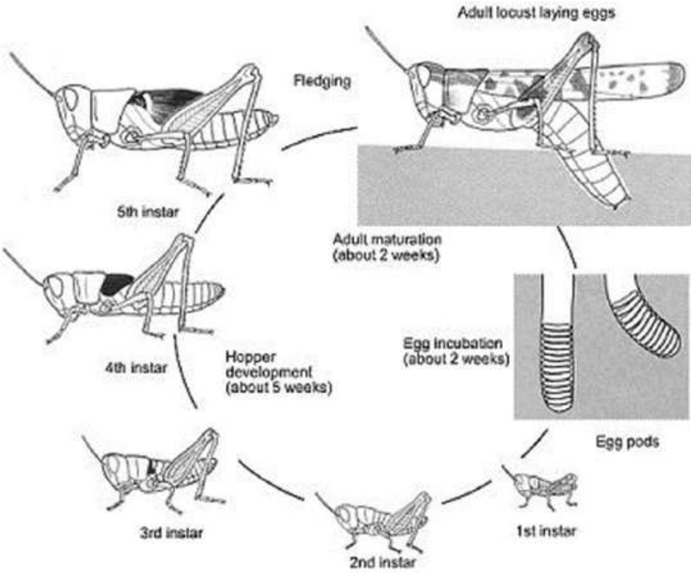

Fig. 2. Life Cycle of Locust

Swarming Grasshoppers

Locusts are the swarming phase of certain species of short-horned grasshoppers. These insects are usually solitary, but under certain circumstances become more abundant and change their behaviour and habits, becoming gregarious (Simpson et al., 2008). Swarming behaviour is a response to overcrowding. Increased tactile stimulation of the hind legs causes an increase in levels of serotonin. This causes the locust to change colour, eat much more and breed more easily. The transformation of the locust to the swarming form is induced by several contacts per minute over a four-hour period. A large swarm can consist of billions of locusts spread out over an area of thousands of square kilometres with a population of up to 80 million per square kilometre. Desert locusts meet, their nervous systems release serotonin, which causes them to become mutually attracted, a prerequisite for swarming. The initial bands of gregarious hoppers are known as "outbreaks", and when these joins together into larger groups, the event is known as an "upsurge". Continuing agglomerations of upsurges on a regional level originating from a number of entirely separate breeding locations are known as "plagues". During outbreaks and the early stages of upsurges, only part of the locust population becomes gregarious, with scattered bands of hoppers spread out over a large area. As time goes by, the insects become more cohesive and the bands become concentrated in a smaller area (Showler, 2013).

Solitary and Gregarious Phases

One of the greatest differences between the solitary and gregarious phases is behavioural. The gregaria nymphs are attracted to each other, this being seen as early as the second instar. They soon form bands of many thousands of individuals. These groups behave like cohesive units and move across the landscape, mostly downhill, but making their way around barriers and merging with other bands. The attraction between the insects seems to be largely visual, but also involves olfactory cues, and the band seem to navigate using the sun. They pause to feed at intervals before resuming their march, and may cover tens of kilometres over a few weeks. Also, differences in morphology and development are seen. In the desert locust and the migratory locust, the gregaria nymphs become darker with strongly contrasting yellow and black markings, they grow larger and have longer developmental periods. The adults are larger with different body proportions, less sexual dimorphism, and higher metabolic rates. They mature more rapidly and start reproducing earlier, but have lower levels of fecundity. The mutual attraction between individual insects continues into adulthood, and they continue to act as a cohesive group. Individuals that get detached from a swarm fly back into the mass. Others that get left behind after feeding, take off to re-join the swarm when it passes overhead. When individuals at the front of the swarm settle to feed, others fly past overhead and settle in their turn, the whole swarm acting like a rolling unit with an ever-changing leading edge. The locusts spend much time on the ground feeding and resting, moving on when the vegetation is exhausted. They may then fly a considerable distance before settling in a location where transitory rainfall has caused a green flush of new growth (Dingle, 1996).

Impact on Agriculture

About 49,000 hectares of cotton, summer pulses and vegetable crops have been affected by locusts across six states of Rajasthan, Gujarat, Madhya Pradesh, Haryana, Delhi, Uttar Pradesh and parts of Maharashtra during the year 2019-20. Swarms of desert locusts occur irregularly in North Africa, the Middle East and South Asia, usually when drought is followed by heavy rain. Normally, with the arrival of the monsoon, locust swarms enter the desert areas of India via Pakistan for breeding in June-July, but this year pink adult swarms were reported as early as April 30 in Rajasthan and Punjab. This is in part because of the uncontrolled swarms in Pakistan that breed continuously. Swarms of pink adults fly high and travel long distances with strong winds coming from Pakistan. Most of them settle on trees during the night and mostly fly during the day. This is the second round of locust attack in India, the first one having occurred during December-February. In January, the biggest locust swarm to hit Gujarat in over a quarter of a century resulted in more than 25,000 hectares of wheat, rapeseed, cumin and potatoes being attacked, with at least a third of the crops damaged in 75% of the affected areas.

Management Strategy

Early warning and preventive control are the strategy adopted by locust-affected countries in Africa and Asia to try to stop locust plagues from developing and spreading. Locust surveillance by Locust Warning Organizations (LWO) with the help of various surveys (foot transect, vehicle transect and aerial transects) and survey equipment's (survey nets and cages, digital equipment's like eLocust-3 and GIS based data analysis tools like RAMSES v4). The primary method of controlling desert locust infestations is with insecticides applied in small concentrated doses by vehicle-mounted and aerial sprayers at ultra-low volume (ULV) rates of application. The desert locust has natural enemies such as predatory wasps and flies, parasitic wasps, predatory beetle larvae, birds and reptiles. These may be effective at keeping solitary populations in check but are of limited effects against gregarious desert locusts because of the enormous numbers of insects in the swarms and hopper bands. Farmers often try mechanical means of killing locusts, such as digging trenches and burying hopper bands, but this is very labour-intensive and is difficult. Locust swarms can be scared away from the fields by making noise, burning tires or other methods. This tends to shift the problem to neighbouring farms and locust swarms can easily return to re-infest previously visited fields. Biological control products have been under development since the late nineties; Green Muscle and NOVACRID are based on a naturally occurring entomopathogenic fungus, *Metarhizium acridum*.

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Method of Application Organic Manure

Article ID: 31170

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Introduction

Animal manure is a great source of nutrients for crops, but it is also complicated. Luckily, one of the complications is something that can be controlled: manure application method. As a reminder, N occurs in two forms in manure. Organic N is not available to plants. Inorganic N, on the other hand, can be broken down into ammonium and nitrate (both are available to plants). This will be important as you consider the various types of application methods and how they impact nutrient losses.

What is Manure?

1. Manure is a mixture of feces and urine and can include other things such as bedding, spilled feedstuffs, feathers, hair and soil
2. It may also include wash-water from milking parlours or egg-wash facilities, and run-on water.
3. Manure can be used as fertilizer source, soil amendment, feedstuff, bedding and energy source
4. Manure from any source can cause water quality pollution if not managed properly.

Application Criteria of Manure

1. Determine application rate based on nutrient.
2. Needs of crops.
3. Adequate capacity of application equipment.
4. Calibrate manure application equipment.
5. Achieve uniform distribution.
6. Avoid repeated application in same area.
7. Do not apply manure in the winter.
8. Follow all setbacks or land application.

Application of Different Type of Manure

1. Application method of Vermi-wash: Vermi wash is a very nutritious substance. In this, all the micronutrients suitable for the plant are available in appropriate quantities. Along with this, there are also hormones and enzymes in the Vermi Wash which increase the growth of flowers and fruits.

Vermi wash is very useful especially for fruits, flowers and vegetable plants. The nature of Vermi Wash is intense like cow urine, so it should be sprayed after mixing at least 20 parts in water (add 20 liters of water in one liter of Vermi Wash). In this way, at least half a litre of mixed vermi wash is put in the circle around the plant.

Spraying of Vermi wash not only improves plant growth but also pest control. Vermi wash can be used on any crop, but do not use it on very small plants, because they are afraid of burning. Plants are also burnt due to the increase in the volume of vermi wash. Therefore, use Vermi Wash only after adding appropriate amount of water. Chemical fertilizers are not needed by using the Vermi Wash well. Dilute with water (10%) before spraying effectively on the plant. Vermi Wash must be diluted 5 to 10 times with water and then applied. Verm wash can also be mixed with cow's urine and diluted for use as foliar spray and pesticide as follows;

a. 1 liter of Verm wash.
b. 1 liter of cow's urine.
c. 8 liters of water.

2. Application method of de-composer:

a. Method of spraying: Spray this prepared solution on standing crop. Spray 50% solution on all crops every seven days. Spray 40% solution in vegetables every day. Sprinkle 60 percent solution on the fruit every seven days. With irrigation water: Mixed with irrigation water is also given. 200 liter solution per acre is used in the drop-by-irrigation method.

b. In situ compositing of crop residues: After harvesting, you can spray this solution on the stalks and other residues left in the field, due to which they rot quickly.

c. In drip irrigation: Put 200 liters of solution in the field through drip irrigation, combined with enough water for one acre.

d. As a foliar spray: The ready mixer of the West decomposer can also be used as a foliar spray in crops. This solution can be sprayed 4 times in a crop at the interval of 10 days, which protects plants from many types of diseases.

e. In seed treatment: By this treatment, crops can be saved from many types of seed-borne diseases.

f. Method of seed treatment: First of all, wear gloves in your hands because it is a slurry of micro-organisms can cause odor in the hands and can also be harmful. Now mix the contents of 1 bottle well with 30 grams of jaggery and some water. About 20 kg of seeds can be treated with this prepared solution. The treated seeds dry in the shade for half an hour. In this way, the prepared seeds are used for sowing.

3. Biogas slurry applications: Biogas slurry is a good source organic manure. The following are the different methods of applying bio digested slurry as manure:

a. Air dried biogas slurry can be applied by spreading on the agricultural land at least one week before sowing the seeds or transplanting the seedlings.

b. The liquid slurry can be mixed directly with the running water in irrigation canal which will enable spreading of the slurry uniformly in the cropped area or in cultivation land.

c. Biogas slurry can also be coated on the seeds prior to sowing. This acts as insecticide and prevents seeds or plants from insect attack. This helps in early germination and healthy growth of seedlings.

d. The digested slurry is fed through the channel, flowing over a layer of green or dry leaves and filtered in the bed. The water from the slurry filters down which can be reused for preparing another fresh dung slurry. The semi-solid slurry can be transported easily as it was in the consistency of fresh dung and used for top dressing of crops like sugarcane and potato.

Biofertilizers with Composting and Application Method

After dilution in water, it is sprayed directly on land during autumn (March. April-May and early spring September-early October) concentration 30-35 gms in 12 litres of boiled cool water and stirred for one hour in the evening before sowing or transplanting. Mixing of PSM, KMB, Azotobacter, Azospirillum and Bacillus subtilis 100 ml each in solution ensures better yields in all crops.

Benefits of Organic Farming

1. It helps in maintaining environment health by reducing the level of pollution.

2. It also reduces human and animal hazards by reducing the level of residue in the product. It helps in keeping agricultural production at a higher level and makes it sustainable.

3. It reduces the cost of agricultural production and also improves the soil health; sustainable. iv. It reduces the cost of agricultural production and also improves the soil health. It ensures optimum utilization of natural resources for short-term benefit and helps in conserving them for future generation.

4. It not only saves energy for both animal and machine, but also reduces risk of crop failure. Besides these, it has been demonstrated extensively that plant products produced from organic farming are substantially better in quality like, bigger in size, look, flavor and aroma. Even animal products like milk, meat etc. have been observed to be of better quality when they are fed with feed and fodder produced organically. The underground water of the area where such farming systems in practice has been found to be free of toxic chemicals.

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Why Do Farmers Not Want to Come Forward in Doing Organic Farming?

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Introduction

The need of crops, vegetables and fruits produced from organic farming is increasing as people want in today's time. But due to lack of proper facilities, farmers are still not coming forward to produce livelihood. If we talk about the need, then almost all the people writing and knowing want to buy organic products, but the question is, who will do organic farming? The question is that if the farmer does not know the right way of production, then if he has the information and does the production in an organic way, then there is a problem that he said to be sold? If they get a proper platform to sell with great difficulty, but they do not get the proper price for their production, due to this, the farmers have become disillusioned.

Neither can they help in improving their family development and social status. Because farming with organic farming method is very troublesome in today's time. Due to modernization and increasing production of innovative technology in the growing agriculture with time, the farmers get more profit, due to which the farmers are hesitant to go into organic farming. In today's time, the biggest problem of farming and farming is that the farmer does not want to adopt innovation in farming.

"Swami Vivekananda ji had said that the farmers of our country cannot develop themselves until their fear of going to modernization or going out of their traditional farming practices goes out of modernization."

Why Farmers Don't Come Forward?

It is not easy for farmers to eliminate their fear. Because small-scale farmers who have small holdings and do not do it economically and resourcefully, they cultivate traditional methods. New and ongoing by his ancestors does not change agriculture. In fact, they are afraid that if the new crop system gets spoiled, then their entire capital will be wasted, which they planted. Whose whole family's livelihood structure will be destroyed. This is the main reason that the farmer does not want to adopt the schemes or schemes. Which are some of the main reasons which are as follows.

Lack of Technical Information

At the rural level, small and middle-class farmers who have very little land holdings are afraid to do something new. But the main thing is that they do not even have access to the right and appropriate information. The most important reason for this is that the officials related to agriculture and rural development who work at the rural level, they have no access to the farmers, who are more important to the farmer for information and technology, and these farmers social and educational conditions Due to the plight of the people, they are afraid to talk to the officials and talk. Due to such minor reasons, these new technologies and information keep revolving near one of the two rich villages of the entire Gram Panchayat. One reason for this is that due to the low number of officers at the rural level, they are not able to give time to the farmers properly.

Non-Adoption of Organic Farming Due to Non-Availability of Material

It is a very worrying topic that the materials needed to start organic farming are not available in the market, it is here that farmers in this terrible chemical and modern farming environment of today's era They want to be taken, but due to not getting the necessary items used on time, the farmer has to face many difficulties to do this work. Due to which, the mentality of the farmers is over and it deviates from its purpose and gets revived in modern chemical farming.

Risk in Adopting New Technology

The main problem of India is the same that most of the farmers here are small and medium class, due to which they are afraid to adopt every new practice which is related to farming. The reason is that they have only 1-2 acres of cultivation, now if another new crop is planted in that field, which the farmer does not know about, how to grow and sell it. And in such a situation, the farmers are afraid that if we do not grow the crop properly or the market is not available to sell, then the economic and family ecosystem of that farmer's entire family will be ruined. This kind of fear does not allow the farmers to move forward and they remain the same.

Non-Sale of Organic Products

It is seen in most of the market that all the production of normal production such as vegetables, cereals, pulses, oilseeds and others, are sold in the market and mandis. Leave the sale and increase the demand for organic matter. From the above study it has been found that our marketization system is not such that the organic products of the farmer should be helpful or encouraged in the growth. So, this is a wrong message, for the farmers who want to do organic farming or are making up their mind to do it.

Conclusion

Realizing the need of the farmers, farming is to increase organic farming, meeting the needs of farmers. For this work, it is necessary that a plan should be made keeping in mind all the materials required for organic farming. The development of agriculture is the basis of social development. And thus, if the method of agriculture is healthy and pure, it will not take much time to improve human diseases, socio-economic conditions as well as the condition of the farm and the environment.

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Agri-Clinics and Agri-Business Centres - An Initiatives Towards Empowerment of Farmers and Agriculture Graduates

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Introduction

Agriculture is the primary source of livelihood for about 58 per cent of population in India and about 75 per cent of country's population involved directly and indirectly in agriculture and allied activities. In order to strengthen the dissemination of agriculture extension services to the farmers and at the same time to tap the potential of unemployed graduates the Ministry of Agriculture and farmer's welfare, Government of India in associated with National Bank for Agriculture and Rural Development (NABARD) has launched a unique programme called Agriclinics and agribusiness centre. Under this scheme agricultural graduates provided training so, that they can open their own agriclinics and agribusiness centres and provides professional extension services to the needy farmers.

Concept of Agriclinic and Agribusiness Center

1. Agriclinics: Agriclinics are developed to provide to diagnose and treatment of farm problems on various aspects like soil health, cropping practice, plant protection, crop insurance, post-harvest technology, clinical service for animal, feed and fodder management and price of various crop in the market etc.

2. Agribusiness center: Agribusiness centres are the agri ventures for income generation like entrepreneurship, developed by trained agriculture professionals. Such ventures cover maintenance and custom hiring of farm equipment, sale of input and other services in agriculture and allied areas. It also includes post-harvest management and market linkage activities.

Objective of the Scheme

1. To supplement efforts of public extension by necessarily providing extension and other services to the farmers on payment basis or free of cost as per the business model of agripreneur, local needs and affordability of target group of farmers.

2. To support agricultural development.

3. To create gainful self-employment opportunities for unemployed agricultural graduates, agricultural diploma holders, intermediate in agriculture and biological science graduates with Post Graduation in agri-related courses.

Training Activities

Under agriclinic and agribusiness center scheme a two-month training programme is organized by National Institute of Agricultural Extension Management (MANAGE) through various Nodal Training Institutions (NTIs) to the eligible candidates and certificates provided at the end of the training programme.

The eligibility criteria for the candidates are:
1. Age of the agricultural graduates should be between 18 to 60 years.
2. Graduate/ post graduate in agriculture or allied subjects like Horticulture, Sericulture, Dairy, Animal Husbandry, Fisheries, Home/ Community Sciences, Biotechnology, Agricultural Engineering, Forestry, Food Technology, Food Nutrition and Dietetics etc,
3. Biological science students with PG in agriculture and allied subjects.
4. Diploma holders (with 50% mark)/ PG diploma holders in agriculture and allied subjects
5. Degree courses recognized by UGC having more than 60 percent of the course content in Agriculture and allied subjects.

6. Agriculture related courses at intermediate (i.e. plus two) level, with at least 55% marks.

It also organizes refresh training for agri-preneurs and sensitization training for the bankers. About 500 selected agri-preneurs undergo refresh training of about 3to 4 days every year and is conducted by specialized Institutions like SAUs/ ICAR Institutes /IIMs/IITs/CSIR Institutes /DST Institutes/ reputed Private/ Non- governmental Institutions. Whereas sensitization training organized by NABARD to motivate bankers across the county for proving lone to agri-preneurs.

Credit Support

1. This scheme is linked with various banks these are Regional Rural Bank (RRB), commercial banks, state cooperative banks, state cooperative agriculture and rural development banks and such other institution eligible for refinance from NABARD to provide loan on a commercial and economically viable project.

2. Project ceiling cost- Rs. 20 lakhs for individual project (25 lakhs for extremely successful individual project), and 100 lakhs for group project (group consist of at least 5 trained person).

3. Term loan- term loan is composite in nature covers fixed cost and working capital for one operating cycle. At least 10 % value of the total financial outlay of the project should be in capital form. Repayment period is 5 to 10 years depending of the project activity and gestation period of maximum 2 years. Interest rate is as per RBI guideline.

4. Margin Money-In accordance with RBI guideline and no margin money in case of loan up to Rs.5 lakh. A maximum of 50% of the margin money prescribed by banks could be given by NABARD to meet the shortfall in borrower's contribution.

5. Security-As per RBI guideline. But up to loan amount of Rs. 5 lakhs, the loans can be secured against hypothecation of assets created and no further security would be necessary.

6. Time limit for completion of project is 6 months which may extend for further 6 months if the reasons for the further extension is justifiable. If the project is not completed within the time period benefits of subsidies will not be available.

7. Subsidy- It is 44% of project cost for women, SC/ST & all categories of candidates from NE and Hill states and 36% of project cost for all others. Subsidy released upfront in one instalment by NABARB to banks after sanction of loan and it is available to all candidates who are trained under this scheme. The subsidy provided will kept in "Subsidy Reserve Fund Account" (Borrower-wise) and banks will not charge interest rate on this portion.

Conclusion

In order to eliminate employment problem in India this scheme will act as a catalytic agent for agricultural graduates by providing comprehensive support in the form of training, credit facility, subsidy and landholding support for the establishment of agriclinic and agribusiness centres. And these centres will provide extension service to the farmers at their doorstep. So, this scheme act in two ways to solve the problem of the farmers as well as agricultural graduates.

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Basics of Precision Agriculture

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Introduction

Precision agriculture is a management strategy that assembles, processes and analyses temporal, spatial and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production. Precision farming is made up of two words i.e. "Precision" and "Farming". The term precision means to the quality or state of being precise. Where precise means minutely exact or correct. Therefore, precision farming refers to exactness and implies correctness or accuracy in any aspect of production. Precision farming or satellite farming is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. Today, precision farming is about, whole farm management with the goal of optimizing returns on input while preserving resources. The objectives of precision farming are to increase production efficiency, improve product quality, use of chemicals more efficiently, energy conservation and soil and ground water protection.

Components of Precision Farming

1. Computers: Many technologies support precision farming, but none is important than computers in making precision agriculture possible. Precision farming requires the acquisition, management analysis and output of large amount of spatial and temporal data. Mobile computing systems were needed to function on the go in farming operations because desk top systems in the farm office were not efficient. Also, it is not computers along that are important but their ability to communicate that is powerful for agriculture.

2. Remote Sensing: Remote sensing is collection of data from a distance and have been used for several years to distinguish crop species and locate stress conditions in the field. Remote sensing involves the detection and measurement of photons of differing energies emanating from distant materials. Soil nutrient sensors are used to detecting the soil fertility status. With the help of these soil nutrients sensors the fertilizer rate is determined for accurate place where particular nutrient is deficient and other applications include yield monitors or moisture sensors. Remote sensing holds great promise for precision farming because of its potential for monitoring spatial variability over time at high resolution.

3. Geographical Information System: It is a software application that is designed to provide the tools to manipulate and display spatial data. It is an effective way of computerizing maps. An important function of an agricultural GIS is to store layers of information such as yields, soil survey maps, remotely sensed data, crop scouting reports and soil nutrients levels. GIS technology allows the manager to store field inputs and output data as separate map layers in digital maps and to retrieve and utilize these data for future input allocation decision. Clark and McGucken refers to GIS as the brain of a precision farming system because precision farming is concerned with spatial and temporal variability and it is information based and decision focused. GIS has the capabilities to analyse spatial variability.

4. Differential Global Positioning System (DGPS): The DGPS was developed by American Military for accurate positioning of military personnel. It is a navigation system-based network of earth-orbiting satellites that lets user's record near- instantaneous positional information (latitude, longitude and elevation) with accuracy ranging from 100 m to 0.01 m. The GPS technology enables precision farming because all phases of precision farming require positioning information. GPS is able to provide the positioning in a practical and efficient manner for a field location so that input can be applied to individual field segments based on performance criteria and previous input application.

5. Variable Rate Applicator: The variable rate applicator has three components viz. control computer, locator and actuator. In variable rate technology, crop production input rate changed with a field in response to variable factors that affect the optimum rate of application. Uniform application of crop production inputs does not allow optimum efficiency or profitability because factors that affect crop production are not always uniform within fields. It has the potential to improve or ideally maximize efficiency of inputs and profitability of individual fields by targeting application where needed and at optimum rate.

Emerging Technologies

Precision agriculture is an application of breakthrough digital farming technologies like, Drones and satellite imagery, Robots and Smartphone applications.

Problems in Adoption of Precision Farming in India

Precision Agriculture has been mostly confined to developed countries. Reasons of limitations of its implementation in developing countries like India are small land holdings, heterogeneity of cropping systems and market imperfections, high cost, lack of technical, expertise knowledge and technology etc. In India, major problem is the small field size. More than 58 per cent of operational holdings in the country have size less than 1 ha. Only in the states of Punjab, Rajasthan, Haryana and Gujarat more than 20 per cent of agricultural lands have operational holding size of more than four hectare. There is a scope of implementing precision agriculture for crops like, rice and wheat especially in states of Punjab and Haryana. Commercial as well as horticultural crops show a wider scope for precision agriculture.

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Molecular Evolution of Root – Knot Nematodes

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Introduction

Root-knot nematodes Meloidogyne spp. are highly adapted obligate parasites that settle in roots and complete their life cycle by feeding from specially adapted host cells and they able to escape from plant recognition, establish feeding sites and suppress host defence reactions which makes them the most predominant pest species associated with various crops. The recent completion of the genomes of two RKNs, *Meloidogynehapla* and *Meloidogyne incognita*, that exhibit striking differences in their mode of reproduction (with and without sex, respectively), their geographic distribution and host range has opened the way for deciphering the evolutionary significance of (a)sexual reproduction in these parasites. In this aspect we provide a reappraisal of the current hypotheses about the molecular evolutionary mechanisms that have shaped the *Meloidogyne* genus in light of recent findings that have mainly emerged from the molecular and genomic eras.

Molecular Evolution

To date, whole RKN genomes have been sequenced for only two species, the obligate mitotic parthenogenetic *M. incognita* and the facultative meiotic parthenogenetic *M. Hapla* . Comparison of these two genomes from two species with different reproductive modes may point to genomic specificities linked to the presence/absence of sexual reproduction in an animal. Initial comparison of these genomes revealed a series of features common to the two species that might represent *Meloidogyne* signatures but also revealed differences that may be associated with the different modes of reproduction.

Among common features, both RKN genomes were found to contain a number of genes that encode plant cell wall–degrading enzymes unprecedented in animals. Interestingly, phylogenetic analyses have shown that these genes were most probably acquired via horizontal gene transfer (HGT) from bacteria and fungi. Recently, a systematic search for genes of nonmetazoan origin in RKNs has shown that up to 3.34% of protein-coding genes in *M. incognita* might originate from HGTs (2). Because many of these genes have been found in other plant-parasitic nematodes of the Tylenchida order, it is thought that most transfers have taken place earlier in an ancestor of Tylenchida and may have promoted emergence of plant-parasitism in this clade (3). In comparison with the free-living nematode *Caenorhabditis elegans*, both *Meloidogyne* genomes appear to be depleted in genes that encode G protein–coupled receptors and collagens. However, this apparent paucity appears to be due to specific gene family expansions in *C. elegans* and may not reflect a general case for nematodes (4). Several genomic features, in contrast, appear to be notably different between *M. incognita* and *M. hapla*. The most striking differences concern the genome structure itself as well as the proportion of repetitive elements. Both features are probably linked to the differences in the modes of reproduction between these two RKNs. Indeed, *M. incognita*, as a mitotic parthenogenetic animal, reproduces without meiosis and without fusion of gametes, and this is likely to have a series of consequences at the genome level. For instance, without constraint linked to the pairing of homologous chromosomes to produce functional haploid gametes, it is very likely that many genomic rearrangements otherwise counter-selected in a species that does meiosis can occur and be fixed.

Possibly as a consequence, whereas *M. hapla* has a standard genome structure for a diploid sexual species, *M. incognita* has a peculiar structure in which most genomic regions are present in two or more copies with substantial rearrangements and an average nucleotide divergence of 7 % (5). This within-genome divergence level is substantially higher than heterozygosity levels observed between genomes of individuals of wild populations in natural species. As a consequence of this structure, a number of genes present in one copy in *M. hapla* are present in two or more copies in *M. incognita*. This feature is in part responsible for the substantially bigger genome and higher gene number in *M. incognita* (86 Mb; 19,212 genes) than in *M. hapla* (54 Mb; 14,420 genes). This genome structure is also probably linked to what had been originally considered as high allelic sequence divergence in ameiotic parthenogenetic RKNs (*M. javanica*, *M. arenaria*, and *M. incognita*). Indeed, for a given gene, occasionally higher divergence was observed within a species than between species. It has been postulated that in asexually reproducing species, former alleles independently accumulate mutations and become increasingly divergent over time, eventually resulting in two genomes in one. This phenomenon is commonly referred to as the Meselson Effect. More recently, it has been proposed that divergent copies of genes or genomic regions observed within asexually reproducing RKNs did not necessarily represent former alleles but rather former orthologs combined into one genome as a result of interspecies hybridization. Whether these divergent multicopy regions represent former alleles reminiscent of a past sexual ancestor or homeologs resulting from hybridization is still debated and being investigated. Whatever their origin, these regions present a level of nucleotide divergence that could potentially allow functional divergence between the corresponding encoded gene products. Such functional divergence would represent a mechanism of plasticity through neofunctionalization in the absence of meiotic recombination. In addition to the genome structure itself, the abundance of repetitive and transposable elements distinguishes *M. incognita* from other nematodes. Indeed, although these elements represent only 12% and 16% of the *M. Hapla* and *C. elegans* genomes, respectively, they constitute up to 36% of the *M. incognita* genome. It has been suggested that in the absence of specific meiotic mechanisms to control their proliferation, these elements may invade the genome. Whether these elements are proliferating or have since become under control of an as yet unknown mechanism would be interesting to determine. From an evolutionary point of view, transposable elements might be a major source of genetic diversity, allowing response to environmental changes. Interestingly, genomic alterations mediated by the *Tm1* mobile element were recently found associated with phenotypic changes in the mitotic species *M. Javanica* and may contribute to the genetic diversity of this clonal species, despite the lack of obvious recent transposition activity. Independently from the duplicated structure of the entire genome as exhibited by *M. incognita*, several genes in RKNs appear to have undergone a series of duplications that led to the formation of multigene families. For example, after their acquisition via HGT, massive duplications have been observed for genes that encode plant cell wall–degrading enzymes. Finally, it is anticipated that the use of next generation DNA sequencing technologies will in the near future allow comparison of the entire genomes of individual nematodes that have been submitted to various experimental biotic or abiotic stresses, which in turn will provide a deeper understanding of the forces that shape their gene and genome evolution.

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Smart Irrigation System: An alternative Way for Efficient Utilization of Irrigation Water

Article ID: 31175

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Introduction

Indian Agriculture is mostly dependent on monsoon. Again, an over-irrigation and under-irrigation leads to poor crop production. So, it needs some alternative irrigation method which utilize the irrigation water judiciously and also increase the crop productivity. In order to solve this issue, the best choice is an automatic irrigation system. By using this system, it will possibly reduce such wastages. So that better utilization of resources can be made possible. It shows the basic switching mechanism of motor using sensors by sensing moisture present in the soil. Soil moisture, air humidity, temperature and water level in the soil are wirelessly transmitted using wireless technology for better production Ogidan et al. (2019).

System Hardware Design

The Hardware consists of two sections: 1. Transmitter section 2. Receiver section. The system also consists of microcontroller 328P, GSM module, LCD, and zigbee module. It also consists of three sensors which used in the system. These are following:

1. Temperature.
2. Soil moisture.
3. Humidity.

Temperature Sensor

Generally, LM35 temperature sensor is used. The output voltage is linearly proportional to the Celsius temperature. Temperature range is varying in between -55 to 150 0C.

Soil Moisture Sensors

Common type is a Frequency domain sensor. It is a neutron moisture gauge. In this sensor we are using 2 probes to be dipped into the soil as per moisture we will get analogue output variations from 0.60- 12volts. Input voltage is 12 VDC.

Humidity Sensors

It measures both air temperature and moisture. Relative humidity expressed as a percentage. HS1100 is used for sensing humidity. The output is in terms of frequency range 5khz to 10khz.

Microcontroller

Generally, ATmega328P microcontroller is used. ATmega328P gets a result of throughputs approaching 1 MIPS per MHz which allows the system designer to find optimize power consumption versus processing speed

Gsm Module

The SIM900 can be used embedded in many of the applications. The SIM900 has the capability of delivering GSM/GPRS 850/900/1800/1900MHz performance for voice, Data, SMS and requires low power consumption. GSM900 has a small configuration of 24mm x 24mm x 3 mm. It can be fit in nearly all the space requirement in M2M application, as there is slim and compact demand of design.

Zigbee Module

Zigbee 802.15.4 RF modules are of XBee family, looking for excellent wireless performance. XBee Series 1 is depended on Zigbee 802.15.4 silicon from free scale. It is ideal for the topologies such as point-tomultipoint, point-to-point. Automatic route discoveries are performed by the XBee Series 2 which can create a self- healing. Network for the routers which are fully function and also for low-power end devices.

Function

System uses sensors to measure the relative parameter in order to give the water to crops. Outputs of the sensors measured are analogue in nature the system makes use of ADC which is inbuilt in microcontroller. These digital signals at microcontroller 328P then uses Zigbee module for communication to send data at the receiver and GSM module at the receiver side interfaced with microcontroller 328P for communication at a particular level. Microcontroller sends the measured values to wireless communication zigbee module and further uses GSM module to send message to the farmer. Microcontroller sends the measured values of different parameter and according that water is given to the crops.

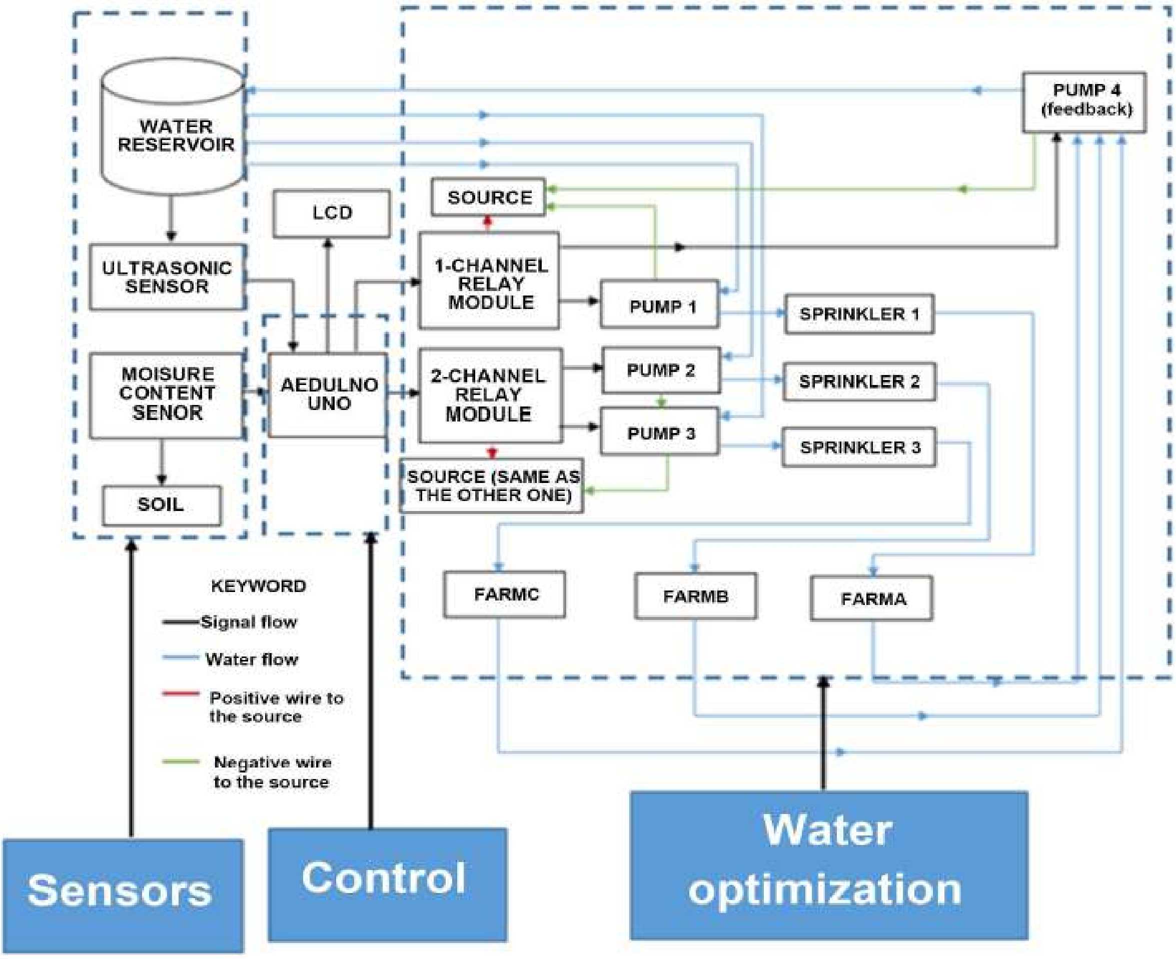

Figure1. Block diagram of SMI

Advantages and Strength

It increases the productivity. It reduced water consumption. It also reduces soil erosion and nutrient leaching. It is safe and require smaller water sources. It works according to the soil moisture condition. It completely eliminates the manpower. It is fully automated irrigation system which will turn ON and OFF a water pump as per the level of moisture in soil. It is highly sensitive, low cost and reliable circuit. It can handle heavy loads.

Conclusion and Opportunities

The smart irrigation system is feasible and cost effective for optimizing water resources for agricultural production. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. It proves that the use of water can be diminished. The use of solar power in this system is significantly important for organic crops. There are huge opportunities in the local market since these types

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of automations are not yet penetrated to the villages and rural markets. Indian agriculture still uses conventional methods for many cases so that a huge opportunity is still awaiting in rural India.

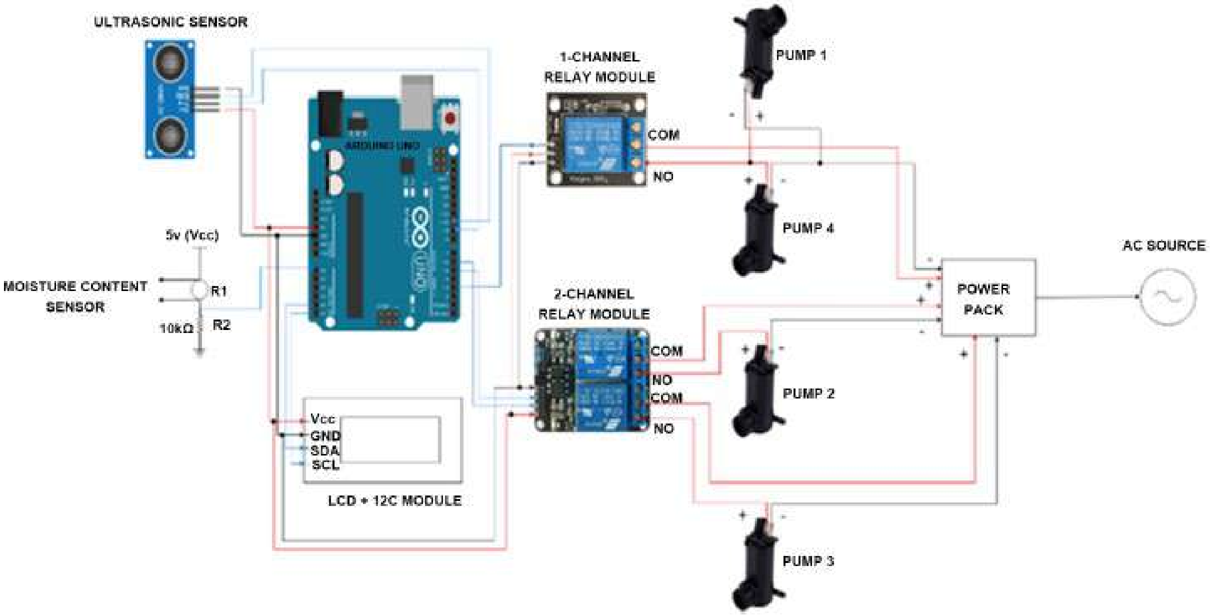

Figure 2. Laboratory scale model of SMI

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Hydroponics: A Versatile System in Smart Agriculture

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Needs of Hydroponics

The Indian farmers face the several challenges due to drought conditions, unpredictable weather, rising temperatures, polluted water systems, lack of irrigation, poor water management and under-nourished or over nourished crops etc., Lack of water for agriculture leads to production of lesser food, which means more hunger and malnutrition. Hence, needs for some alternative technology in agriculture that can contribute towards water savings and have a positive impact on food production and availability. Cultivation of plants in water is called as Hydroponics. It is technique for growing plants without use of soil. By utilizing this technology, the roots absorb balanced nutrients dissolved in water that meets all the plant developmental requirements. It may be also called as "The Cultivation of Plants without Using Soil". Plants grow through a process called photosynthesis, in which they use sunlight and a chemical inside their leaves called chlorophyll to convert carbon dioxide (a gas in the air) and water into glucose (a type of sugar) and oxygen.

$$6CO2 + 6H2O \rightarrow C6H12O6 + 6O2$$

There's no mention of "soil" anywhere in the definition of Photosynthesis and that is the proof that plants can grow without it. What they do need is water and nutrients, both easily obtained from soil. But if they can get these things somewhere else say, by standing with their roots in a nutrient-rich solution they can do without soil altogether. That is the basic principle behind hydroponics. For making this article we collected the information from following research articles Sardare et al. (2013); Nguyen et al. (2016) and Maucieri and Shradhdha (2019).

Types of Hydroponic System

For all techniques, most hydroponic reservoirs are now built of plastic, but other materials have been used including concrete, glass, metal, vegetable solids, and wood. The containers should exclude light to prevent algae and fungal growth in the nutrient solution. The different techniques and types of hydroponics system are as follows; Static solution culture, Wick System, Ebb & flow (Drain and flow sub irrigation), Drip system Recovery/Non-recovery, N.F.T. (Nutrient film Technique) and continuous flow solution culture, Aeroponic system, Passive sub-irrigation, Run to waste, Deep water culture and Rotary culture.

Nutrient Solutions / Fertilizer Uses and System Requirement

Plant nutrients used in hydroponics are dissolved in the water and are mostly in inorganic and ionic form. Primary among the dissolved cations (positively charged ions) are Ca^{2+} (calcium), Mg^{2+} (magnesium) and K^{+} (potassium). The major nutrient anions in nutrient solutions are NO_3^{-} (nitrate), SO_4^{2-} (sulphate) and $H_2PO_4^{-}$ (dihydrogen phosphate). Numerous 'recipes' for hydroponic solutions are available. Many use different combinations of chemicals to reach similar total final compositions. Commonly used chemicals for the macronutrients include potassium nitrate, calcium nitrate, potassium phosphate, and magnesium sulphate. Various micronutrients are typically added to hydroponic solutions to supply essential elements; among them are Fe (iron), Mn (manganese), Cu (copper), Zn (zinc), B (boron), Cl (chlorine) and Ni (nickel). pH Control in between 5.8 and 6.4 or slightly acidic. Horticultural Lighting Metal Halide (MH), High Pressure Sodium (HPS) lamps. Electrical Conductivity (EC) 1.2-3.5 Mho. Temperature and Environmental Control 68-78 °F.

Training Centres / Institutes of Hydroponics in India

States / UTs	Centres / Institutes
Karnataka	City Gardens, Bangalore, KN
	BeLesiri, Bangalore, KN

	Hydrilla, Bangalore, KN
	Hydrobloom, Bangalore, KN
Telangana	Sneha Hydro systems, Hyderabad, Telangana
	FuturePoint Technologies, Hyderabad, Telangana
Delhi	Ponic Greens, New Delhi
	Hydro controls, New Delhi
	Container Farms, New Delhi

Advantages

Higher yields achieved in a smaller space, nutrients can precisely controlled, grow, bloom and boost formulas used at the appropriate growth stage, indoor gardens grown using full-spectrum horticultural lighting, soil-borne pests and diseases are eliminated, weeds are eliminated, plants are healthier and reach maturity faster and automation is possible etc.

Disadvantages

Cost of initial investment is high, production is management, capital and labour intensive, a high level of expertise is required, daily attention is necessary, specially formulated, soluble nutrients must always be used and some water borne diseases can spread rapidly in recirculation system etc.

Conclusion and Future Aspects

Progress has been rapid and results obtained in various countries have proved that this technology is thoroughly practical and has very definite advantages over conventional methods of crop production. The main advantage of soil-less cultivation is the much higher crop yields. People living in crowded city streets, without gardens, can grow fresh vegetables and barren and sterile areas can be made productive at relatively low cost. The future lies in locally grown and sold produce limiting the road miles. This method of growing our food is a more sustainable model than those currently practiced. The consumer is becoming increasingly concerned over health issues, environmental issues, even water consumption cost and availability. These all are drivers for the further development of hydroponic growing techniques.

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Climate Change and Food Security

Article ID: 31177

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Abstract

Climate change is posing a threat to humanity, as the world's population grows the demand for food and water will also increase. The rise in global surface temperatures is a challenge for food security. The rise in temperature will also cause water shortage and increase discomfort due to high temperature. Haryana is primarily an Agriculture state and stands second at food production in India. Climate change in Haryana will lead to reduced crop yield henceforth a threat to Nations food basket. The rise in temperature will impact the Rabi crop for every degree rise in temperature there is a significant decline in the yield of Wheat and reduced rainfall will impact the Khariff crop. Further, the change in Agriculture practices, as well as the change in consumption patterns, is also responsible for the long-term change in the climate. Change in consumption patterns alone cannot combat the challenge of food security; new technology has to be adopted to meet the ever-growing needs of Food and Water.

Introduction

Climate change is a change in the usual weather found in a place; this could be a change in annual rainfall or a change in usual temperature for a month or season (NASA). Climate change is a threat to Food security as changes in temperature and precipitation threaten agricultural productivity and the capacity to feed the world's ever-growing population. The changing climate will influence the crop pattern of a region.

Groundwater needed for global water and food security will probably intensify under climate change as more frequent and intense climate extremes (droughts and floods) increase variability in precipitation, soil moisture and surface water.- (Nature Climate change 2013).

This review article is about Climate change in Haryana state of North India and specifically of its Sirsa district.

The climate of Sirsa district is tropical desert type. The climate of the area is characterized by its dryness, extremes of temperature and scanty rainfall. This region in Haryana was Arid before the 1980s from the 1980s it started turning semi-arid, the humidity increased and an increase in annual rainfall was observed. The crop pattern changed from crops like Maize Barley to Rice cultivation. Most of the waterlogged soils occur in arid and semi-arid regions of the state including Sirsa district where 2325 hectares land turned barren due to shallow water at 1.5 meters.

On the other hand, recent data gathered by the Groundwater wing of Agriculture Department of Haryana State revealed that most districts in the state have witnessed a critical fall of 7.29m on an average in the past 12 years.

The Annual rainfall dropped down to 384 mm in 2017. The situation is alarming; farmers now draw more groundwater to irrigate their crops, particularly Rice-paddies, accelerating the fall of the water table. Fewer rains mean lesser groundwater availability as the groundwater mainly depends on the rainfall for recharge. Sirsa shows a decreasing trend in the monsoon rainfall.

The long-term analysis for trends in observed temperature over Haryana using IMD gridded temperature at daily time scales shows that there is no significant trend in the mean maximum temperature while the mean minimum temperature shows an Increase of about 1.00C to 1.20C.

Maximum temperature of Sirsa in all the months in winter has decreased from normal. Annual mean maximum temperature also decreased by 0.2oC during the period 1995-2014 from normal of 31.5oC, whereas, mean minimum temperature in all months had increased from normal with an annual increase of 0.14oC during the period 1995-2014.

Changes in rainfall pattern are of greater importance for agriculture than the annual changes in temperature, especially in regions where lack of rainfall may be a limiting factor for crop production.

Haryana emits nearly 2% of national greenhouse gases (GHG). Sirsa and Hisar are the highest N2O emitting districts contributing about 11%, 9% and 8% of the state N2O emissions respectively. Synthetic nitrogen application is the main N2O emissions source in these districts.

Impact of the Climate Change on Crop Productivity of this Region

The water limitation is key to food security and is normally the rate-limiting factor for plant growth at lower latitudes (Churkina & Running, 1998 S.K. Sinha and M. S. Swaminathan (1991) analysed that a 2ºC increase in mean air temperature could decrease rice yield by about 0.75 ton/hectare and 0.5ºC increase in winter temperature would reduce wheat crop duration by 7 days and reduce yield by 0.45 ton/hectare. An increase in winter temperature of 0.5ºC would thereby translate into a 10 % reduction in wheat production in the high yield states of Punjab, Haryana and Uttar Pradesh. The minimum temperature increased by 1ºC to 1.3ºC in the Districts of Fatehabad, Jhajjar and Karnal which is higher than the other parts of the Haryana.

As per IMD trends and patterns of Rainfall and Temperature for about past 10 years (2005-2014) is reflecting how the climate changed the increase in temperature also causes a reduction in rainfall in the arid plains and the reduction in rainfall and rise in temperatures will reduce the agricultural productivity. Increased temperature will increase Evapo-transpiration that will have an adverse impact on surface runoff which will affect the canal water availability.

Impact of Climate Change on Rice Crop

Aggarwal et al. (2000) mention potential rice productions of 10.8 X 103 kg/ha for Sirsa. However, 2002 was a year with relatively high temperatures and a shorter growing season, resulting in relatively low productions. In years with a lower average day temperature, the growing season was a little longer (crop development is determined by temperature, TSUMs). As a result of climate change temperatures are expected to increase. The rise in atmospheric temperature causes detrimental effects on growth, yield, and quality of the rice crop by affecting its phenology, physiology, and yield components (Singh 2001, Sheehy et al. 2005, Peng et al. 2004).

The rise in global surface temperature and water scarcity due to climate change is posing a threat to our food security as it is estimated that the Crop yields might decrease as a consequence of Climate change. Precision Agriculture, Climate-smart agriculture as well as Advances in Agriculture technology could be a sustainable way to achieve the target of Food Security. If current trends in Climate change persist until 2050, major crop yields and the food production capacity of Asia will decrease significantly.

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Food Security and Farm Mechanisation

Article ID: 31178

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Abstract

Growth in agriculture sector and poverty elimination is directly correlated. As per the Global Food Security Index 2019, India is amongst the bottom 50 countries in terms of food security in a list of 113 countries. The key reason being that the focus has been more on staple crops, rather than on crops with high nutritious value. In this paper, we look at two key components of agricultural growth, i.e., farm mechanization and government role. Mechanisation level in India is at 40% but varies significantly across crops and stages of crop production. Mechanisation level is seen to be higher for staple crops, like, paddy and wheat, while lower for cash crops. To have a high food security index, it is essential that we have a diversified agriculture sector. This is possible with committed research in producing crops of high protein quality, dietary diversity and high micro-nutrient availability. Government investment in agriculture has remained stagnant for several years. For a more diversified agriculture sector, it is essential that government scale up its investment in agriculture research.

Keywords: Food security, farm mechanisation, government role.

Introduction

Agricultural growth has long been recognised as an important instrument for poverty elimination (World Bank, 2009). Growth in agriculture not only helps in earning income within the sector but also induces growth in other sectors. Cross-country estimates have shown that GDP growth resulting from agriculture is at least twice as effective in reducing poverty as GDP growth outside agriculture (Anjum & Tarique, 2018). According to the Bill and Melinda Gates Foundation's "three –quarters of the world's poorest people get their food and income by farming small plots of land (Martin Drake, 2013). Hence, GDP growth from agriculture benefits mostly the poor section of the population and supports the rural economy.

In India, the relationship between poverty reduction and growth in agriculture GDP has been studied by several researchers. Ravillion, Dutt (2002) in their study on inter-state differences on level of poverty, found non-farm economic growth was less effective in reducing poverty in states with low rural development. Department for International Development, DFID (2004) emphasises the relationship between poverty reduction and the growth of agricultural productivity.

They have linked the relationship through four transmission mechanisms:
1. Direct impact of improved agricultural performance on rural incomes.
2. Impact of cheaper food for both urban and rural poor.
3. Agriculture's contribution to growth and the generation of economic opportunity in the non-farm sector.
4. Agriculture's fundamental role in stimulating and sustaining economic transition.

These transmission mechanisms can lead to poverty reduction depending on the extent to which agricultural productivity can be increased where it is most needed (Anjum and Tarique, 2017).

In this paper we look at two key elements of agriculture growth which can lead to higher food security and therefore eliminate poverty. These include, farm mechanisation and government role. The paper is organised as follows: The following section gives an overview of India's position in terms of food security in the world map. Section 3 gives a relationship between food security and farm mechanisation. Section 4 elucidates government role in promoting farm mechanisation and trends in investment on agriculture research. Section 5 concludes the paper.

India's Position in Terms of Food Security

Agriculture sector in India have shown rapid strides. Green revolution during 1960s has taken India to the path of National Food Security and more precisely self-reliance in food production. In the period, 2001 to 2018, food grain production increased almost 1.5 times and horticulture production almost doubled. During this period, poverty reduction in India has also been significant. The Multi-Dimensional Poverty Index for 105 nations which is released by the Oxford University-based Oxford Poverty and Human Development Initiative (OPHI), showed that 55% of Indians were classified as 'Poor' in 2005-06 which came down to 28% in the next 10 years. In absolute terms, the number of poor fell from 630 million in 2005-06 to 360 million in 2015-16, i.e., 270 million people were out of poverty in 10 years.

However, despite the remarkable performance in agriculture sector and poverty reduction, India is still amongst the bottom 50 countries in terms of Global Food Security Index (GFSI) in a list of 113 countries. The GFSI considers the core issues of affordability, availability and quality across a set of 113 countries. As per the GFSI 2019, India is in 72nd rank in terms of food security index. Even amongst the countries in Asia & Pacific, India is in bottom 16, much lower than Singapore which tops the list, Japan in the 4th rank, China in the 7th rank and also Sri Lanka that stands at 14th rank. India is just a notch higher than Pakistan, Nepal & Bangladesh.

Evidently from the table below (table 1), in terms of affordability measure of food security, India is in a good position as there has been a significant reduction of poverty. Also, in terms of presence and quality of food safety net programmes, India tops the chart. Similarly, there has been reduction in food cost which makes food more affordable. However, the score on GDP per capita is way below global score. Clearly, affordability is mainly in terms of staple food and much less on nutritious food.

In terms of availability, sufficiency of supply, though improved over the years, but still much lower as compared to that of the global average. However, what essentially holds back in terms of food availability is poor agriculture infrastructure, high level of corruption and extremely low public expenditure on agriculture R&D.

In terms of quality and safety, India fares poorly as compared to that of the global average. Poor protein quality, low dietary diversity and low micro-nutrient availability are the key factors resulting in the low food security index.

Table 1: Food Security Index: India Profile

(Score: 0-100
Score =100 – Best; Score =1 Worst)

Category	Score	Rank	Average score (all countries)
OVERALL	58.9	72	62.9
1) AFFORDABILITY	64.2	70	67.5
Change in average food costs	99.5	8	96.4
Proportion of population under global poverty line	71.9	85	83.5
Gross domestic product per capita (US$ PPP)	5.6	73	17.8
Agricultural import tariffs/	38.5	109	75.6
Presence and quality of food safety net programmes	100.0	1	74.3
Access to financing for farmers	75.0	43	63.9
2) AVAILABILITY	58.4	61	59.4
Sufficiency of supply	47.3	91	60.8
Public expenditure on agricultural R&D	2.8	52	5.0
Agricultural infrastructure	39.8	76	49.1
Volatility of agricultural production	95.3	14	81.2
Political stability risk	66.7	27	49.6
Corruption	25.0	50	38.5
Urban absorption capacity	93.3	13	82.0
Food loss	86.4	70	84.9

3) QUALITY AND SAFETY	47.0	85	61.0
Dietary diversity	37.9	81	55.8
Nutritional standards	65.4	43	67.4
Micronutrient availability	40.5	97	60.3
Protein quality	18.3	98	47.0
Food safety	92.8	68	82.5

Very good (Score 80+)	Good (Score 60-80)	Moderate (40-60)	Weak (Score 20-40)	Very Weak (Score: 0-20)

Source: https://foodsecurityindex.eiu.com/

Clearly, both from the demand side and the supply side, there is a need to expand from basic staple food to more nutritious food which is supported with strong agriculture infrastructure and high R&D expenditure in agriculture.

Food Security and Farm Mechanisation

Many proven technologies and planting improvement practices have promises to boost agricultural production and reduce poverty in developing countries (Pretty, et.al, 2002). Globally, mechanization has been one of the key components of high agricultural growth and therefore high food security. As evident from the table below (Table 2), countries rated high in mechanisation are also high in Food Security Index. Agricultural technology played a part in lifting the living standards of the developed world and it is assumed that the mechanisation of the developing world could deliver a similar outcome (Piesse,2019). Mechanization encompasses the use of farm equipment including the power sources that are used to operate the various machines (Kaul and Egbo, 1992). It is the act of making judicious use of agricultural inputs such as seeds, irrigation water, fertilizer, herbicides or insecticides, and farm equipment in order to maximize production with minimum cost (Ndubuisi, 2019).

Table 2: Food Security Index & Level of Mechanisation

Countries	Food Security Index (Score: 0-100; 0- Worst; 100- Best)	Level of Mechanisation (%)
USA	76.5	95
Russia	69.7	80
Brazil	70.1	75
China	71.0	55
India	58.9	40

Source: https://foodsecurityindex.eiu.com/; Indian Council for Food and Agriculture

Mechanisation can play a double role in food security index. Use of improved implements has potential to increase productivity up to 30 percent and reduce the cost of cultivation up to 20 percent (NABARD, 2018). Mechanization has a major impact on demand and supply of farm labour, agricultural profitability, and a change in rural landscape and can be defined as an economic application of engineering technology to increase the labour efficiency and productivity. History shows that agricultural mechanization has led to rapid industrialization in the western hemisphere. More recently in the twenty-first century, many Asian countries have embraced this western thinking and implemented mechanization policies in accordance with their own particular circumstances (Emami et.al, 2018).

As shown in table 2, India's mechanisation level is at 40% as compared to 96% in USA and close to 80% in many other developed countries. However, if we compare the mechanisation level of 2 staple crops, like, paddy and wheat, with cash crop, i.e., sugarcane and cotton – mechanisation level is clearly high for staple crops at all stages. Seedbed preparation is a more mechanised stage for all the 4 crops. However, there is immense scope to increase mechanisation at all other stages of production. Higher, mechanisation level in paddy and wheat as compared to that of sugarcane and cotton, again explains the focus in India has been more on increasing the productivity of staple crops. Increasing mechanisation level for diversified crops is yet to be attained.

Table 3: Crop wise Mechanisation Level by Stages

	Seedbed Preparation	Sowing/ Planting / transplanting	Weed and pest control	Harvesting
Paddy	70	20	30	60
Wheat	70	60	50	70
Sugarcane	55	10	20	10
Cotton	50	30	25	0

Source: Indian Council for Food and Agriculture

Government Role in Promoting Farm Mechanisation

Considering the immense potential of farm mechanisation to bring in growth in agriculture sector, several measures have been taken by the government. Some of the key measures taken in this direction are:

1. Sub Mission on Agricultural Mechanization (SMAM) has been introduced by Government, under which subsidy is provided for purchase of various types of Agricultural implements and machinery used for tillage, sowing, planting, harvesting, reaping, threshing, plant protection, inter cultivation and residue management.

2. Farm Machineries at concessional rate - Some of the State Governments like Kerala, Tamil Nadu and Madhya Pradesh are providing farm machineries to the farmers at a concessional rate through their Agricultural Departments.

3. Custom Hiring Centres (CHC) through a SMAM scheme- under which subsidy is provided at 40% of the project cost to individual farmer up to a project cost of Rs.60 lakh and 80% to the group of farmers up to a project cost of Rs. 10 lakhs. A special consideration for the farmers of North Eastern Region (NER) is available, 95% subsidy up to a project cost of Rs. 10 lakhs are provided to group of NER farmers for establishment of Custom Hiring Centres.

4. Multi-lingual Mobile App "CHC- Farm Machinery" which helps the farmers for getting rented farm machinery and implements through Custom Hiring Service Centres (CHC) in their area.

5. Kisan Credit Card (KCC) Scheme, which enables farmers to purchase agricultural inputs and draw cash to satisfy their agricultural and consumption needs.

6. Interest subvention scheme for short term crop loans up to Rs.3.00 lakh is implemented. The scheme provides interest subvention of 2% per annum to Banks on use of their own resources. Besides, additional 3% incentive is given to the farmers for prompt repayment of the loan, thereby reducing the effective rate of interest to 4%.

While mechanisation is crucial for improving food security, it cannot be attained unless there is an effort in diversifying production to a more nutritious crops with a dietary diversity, high protein quality and micronutrient availability at minimum cost and high productivity levels. This requires committed effort in agricultural research. However, research is a capital-intensive business with a very long gestation period and highest level of uncertainty in terms of results. As a result, developing countries, like India struggle to balance spending between research and basic necessities (Bhaskar, Hindu Business Line).

Evident from the figure below, spending on research in agriculture remained almost stagnant since F12 at 0.2 -0.3% of Agri GDP. Also, India's spending in agricultural research as compared to that of other countries is miniscule. For instance, South Africa, spends at least 10 times more than that of India, Brazil spends 6 times more than that of India, US spends 4 times more and China spends almost double than that of India.

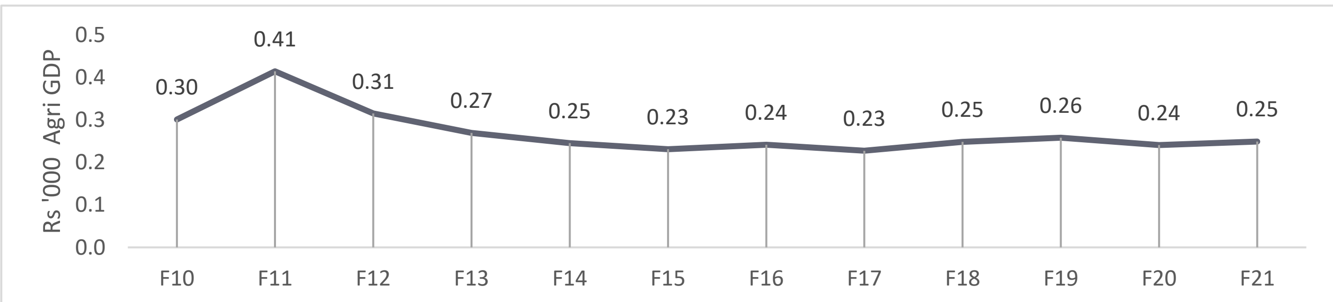

Fig 1: Government spending on Research in Agriculture '000 Agri GDP (Source: Union Budget)

Table 4: Agriculture Research Spending as Proportion of Agriculture GDP

Countries	Spending as percentage of Agri GDP
India	0.30
China	0.62
US	1.20
Brazil	1.82
South Africa	3.06

Source: World Bank

Conclusion

Growth in agricultural sector is essential to improve food security and eliminate poverty. India's position in term of food security though improved, yet much below the global average in various indicators measuring food security. As per the Global Food Security Index of 2019, India stands at 72nd rank in a list of 113 countries. On the demand side, with the reduction in poverty rate and well expanded food safety programs, affordability of attaining food is high. However, significantly low per capita GDP as compared to global average indicates the affordability of attaining nutritious food is still very low. Similarly, on the supply side, while production of food grains crops has increased, but availability in terms of crops with high protein quality, dietary diversity and micro-nutrient availability is still low. Poor agriculture infrastructure and exceedingly low investment in agriculture has been the major hindrances in the growth of a diversified agriculture sector.

Farm mechanisation has been one of the key components of agricultural growth in many developed countries. Mechanisation can play a double role in improving food security index by minimising cost and maximising productivity levels. India's mechanisation level is at 40% as compared to 96% in USA and close to 80% in many other developed countries. However, mechanisation level in India varies significantly by crops and stages of crop production. Comparing the mechanisation level of staple crops, like, paddy and wheat, with other cash crops, sugarcane and cotton, suggests that the focus on increasing productivity has been more on staple crops.

Government has a large role to play in improving food security. Several measures have been taken so far, to improve growth in agriculture sector. Promotion of farm mechanisation has also been one of the key measures of the government. However, investment in agricultural research remained almost stagnant for several years. A more diversified agriculture sector with high productivity levels at minimum cost requires committed research. Thus, for India to improve its food security index, it is important government scale up the investment on agricultural research.

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Global Dimming: Its Probable Causes, Impact on Agriculture and the Way Forward

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Summary

There is growing observational evidence that the level of sunlight received at the Earth's surface is not stable over the years but undergoes substantial decadal changes. Global dimming, a decadal decrease in incident global radiation is often accompanied with an increase in the diffuse radiation fraction. Hence, the impact of global dimming on crop production is hard to predict. The effects of the observed solar radiation reductions on plant processes and agricultural productivity are discussed here. Finally, the steps needed to strengthen the evidence for global dimming, elucidate its causes, impact on agriculture and minimize its effect are outlined.

Introduction

Global radiation, the total short-wave irradiation from sun and sky provides energy for both the carbon assimilation of plant canopies and their water loss to the atmosphere. The amount of solar radiation received in the photosynthetic active range (PAR) of the solar spectrum (between 400 and 700 nm), as well as the relative proportion of direct and diffuse radiation directly affects the rate of photosynthesis. It also determines the heat balance of agricultural surfaces to a great extent and thus the temperatures of crop canopies, livestock surfaces, soil and air, the major environmental factor controlling the development of crops, pastures, forest and livestock. Any significant and widespread change in this incoming short-wave radiation is therefore likely to be of major importance for agricultural production as well as for climate change and the direct exploitation of solar energy. There is growing observational evidence that the level of sunlight received at the Earth's surface is not stable over the years but undergoes substantial decadal changes (Stanhill and Cohen, 2001; Wild et al., 2012).

What is Global Dimming?

Global dimming is the reduction in the amount of global direct irradiance at the Earth's surface. Over the past few decades, it has been a worldwide phenomenon and this decadal decrease in incident global radiation was dominated by the increase in atmospheric aerosols (Wang et al., 2012). Aerosols and other particulate matters resulted from pollution, dust or, volcanic eruptions, generally absorb the solar energy and reflect sunlight back into space. The pollutants can also become the nuclei of the cloud when the water droplets coalesce around them. Thus, the greater number of particulates in the air creates clouds consisting of greater number of smaller droplets which are more reflective in nature. As a result, more incoming sunlight is reflected back into space and less reaches the Earth's surface. This same effect also reflects radiation from below, trapping it in the lower atmosphere. Thus, clouds intercept both heat from the sun and heat radiated from the Earth giving a cooling effect during daytime and slowing the Earth's heat loss during night.

Evidence of Global Dimming

1. Decadal changes in surface solar radiation: Early studies carried out in the 1990s reported a general decrease of solar radiation at widespread locations over the earth between the late 1950s and the late 1980s (Wild, 2012). Increasing air pollution and associated increase in aerosol concentrations are considered as major cause of the decline of surface solar radiation. Changes in amount and optical properties of cloud, which may or may not have been linked to the aerosol changes, have also been proposed to contribute. A direct assessment of the origins of the decline of surface solar radiation is complicated by the lack of adequate long-term observational datasets of major influencing factors such as clouds and aerosols. Clouds intercept both shortwave radiation from the sun and long wave radiation from the Earth. Their effects are complex and vary in time with location and altitude.

2. Decadal Changes in Diffuse and Direct Solar Radiation: Of particular interest for plant photosynthesis and agricultural production are not only the variations in the total solar radiation flux but also the partitioning into the diffuse and direct components, since diffuse radiation can penetrate deeper into the vegetation canopy than direct radiation and therefore can be used more efficiently for photosynthesis. It has been reported by several authors that compared to direct radiation, diffuse radiation is more uniformly distributed over all the leaves in a canopy, thereby, resulting in an improved whole-canopy light distribution and interception (Wang et al., 2018; Shao et al., 2020). Such a spatial distribution in a canopy allows the incoming radiation being more efficiently utilized by plants. Furthermore, an increased fraction of diffuse radiation avoids the photosynthetic saturation of top leaves in a canopy, thereby, leading to another common belief that global dimming enhances radiation use efficiency.

3. Change in pan evaporation: In 1990s Europe, Israel, and North American scientists noticed that the rate of evaporation was decreasing, although they had expected it to increase due to global warming. The similar trend was also observed in China over a similar period. According to Roderick and Farquhar (2002), a decrease in solar irradiance is responsible for decrease in evaporation.

Causes of Global Dimming

Darnell et al. (1992) had identified possible causes of global dimming in accordance with the following simplified model:

$$E_{g\downarrow} = E_0 \exp(-r_r + r_g + r_w + r_a + r_c)$$

where, global irradiance at the earth's surface, Eg↓ is estimated as the product of extra-terrestrial irradiance at the top of the atmosphere, E0, modified by a chain of five transmissivities r which quantify the solar scattering and absorbing properties of the different components of the atmosphere. These include rr, representing Rayleigh scattering and rg, permanent gas absorption, rw, absorption by water vapour and the absorption and ra and rc, scattering by aerosols and cloud components, respectively. The increase in Rayleigh scattering and permanent gas absorption substantially reduce the Eg↓. The aerosol and clouds are mainly responsible for decreasing global irradiance accompanied by an increase in diffused solar radiation (Stanhill and Cohen, 2001).

Impact of Global Dimming on Agriculture

A detailed analysis of the effect of changing solar radiation is of special interest for agricultural crop production as the amount and composition of radiation unlike other controlling factors for plant growth like water and nutrient availability, can hardly be influenced by agricultural practice on larger field scales.

1. Effect on plant photosynthesis and carbon uptake: Changes in the short-wave radiative properties of the sky and increase in cloud cover resulted in reduced atmospheric transmissivity. It has also been reported that interception of direct radiation is strongly determined by the leaf inclination angle. However, clouds influence, in addition to total PAR and diffuse PAR fraction, many other atmospheric factors such as temperature, moisture, turbulent heat fluxes and precipitation, which also have a direct or indirect influence on ecosystem carbon assimilation (Wild et al., 2012)

2. Effect on agricultural crop production: The net impact of surface solar radiation change on photosynthesis occurs through both the reduction in total radiation and the increase in the diffuse fraction (or vice versa) that have opposite effects on photosynthesis. For the tall and relatively dense forest canopies, the increase in photosynthesis with increasing diffuse fraction is the dominating effect that has been verified in numerous theoretical and observational studies. Opposite characteristics with a dominance of the total radiation effect have been found for grassland with low canopies. This means that grassland cannot profit from increased diffuse ratios, but rather responds with decreased productivity under reduced light conditions as prevalent under global dimming. The impact of changes in total radiation and the diffuse fraction on agricultural crop photosynthesis (and yields) is in the majority similar as for grassland, but is supposed to depend on the individual (complex) stand characteristics (Wild et al. 2012; Shao et al., 2020).

In addition, Changes in productivity associated with changes in radiation are often outweighed by the increase in crop yield associated with fertilization, improved varieties and more efficient management practices.

3. Effect on irrigation resources: The potential impact of global dimming on the water cycle is another matter of concern. Changes in solar radiation can effectively alter the energy available on Earth's surface to drive evaporation. It might have caused the droughts in Ethiopia in the 1970s and 80s where millions died, because the northern hemisphere oceans were not warm enough to allow rain formation (Wild et al. 2012).

Strategies for Minimizing the Effect of Global Dimming on Agriculture

1. Control environment pollution: Global dimming can be reduced by cleaning up the emissions from vehicles and burning fossil fuels. A shifting towards the use of clean fuels and renewable energy sources (Solar, wind, biogas, bio fuels etc.) is another way to reduce the emission of particulate matter.

2. Photo insensitive crop variety: Photo insensitive crop variety performs better under low light intensity. They can efficiently harvest as much as light energy as it reaches to crop canopy. Hence, developing photo insensitive crop variety can be a possible way out from the adverse effect of global dimming.

3. Improved management practices: Cultivation of crops under green houses, improved crop and grazing land management to increase soil carbon storage, restoration of cultivated peaty soils and degraded lands, better management of waste land, reduced desertification, livestock and manure management to reduce CH_4 emissions, improved nitrogen fertilizer application techniques to reduce N_2O emissions, dedicated energy crops to replace fossil fuel use and improved energy efficiency etc. management strategies can be followed.

Conclusion

To conclude, from the agricultural perspective the global dimming is harmful and may results into substantial reduction in food production. Thus, climate change which includes both global warming and global dimming might have negative impact on agriculture. Hence global dimming should also be given due consideration, to minimise or nullify its impact on agriculture.

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Honey Bee and their Disease Management

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Summary of the Article

Honey bee, an important insect in respect to generating income through its scientific cultivation known as “Apiculture”. There are mainly four types of honey bee present in India yielding honey among them *Apis mellifera* is cultivated widely. Various bacterial, viral, amoebic and acarine disease were reported from honey bee among them Tracheal disease, American foul brood, sac brood disease gained significant importance due to having the potentiality to cause havoc loss.

Introduction

Bees of the *Apis* genus are distributed throughout the world in highly diverse climates. They are considered as one of the most important beneficial insects having the capacity to generate income among the farmers (Hoffman et al., 2019). The production of honey in India increased significantly towards the late 1990s and it was reported that 70% of honey production comes from informal segments. As a major exporter of honey, India is lagging behind China, Argentina, Germany, Hungary, Mexico and Spain. During 2005, India's honey exports attained a value of US$ 26.4 million. At present approximately there are about 1.5 million bee colonies in India, which produce 55,000 tons of honey annually. India is one of the honey exporting countries. The major markets for Indian honey are Germany, the USA, UK, Japan, France, Italy and Spain (Ramchandra et al., 2012).

Major Honey Bee Species from India

There are four major species of honey bee has been reported from India producing honey. They are:

1. Little honey bee (*Apis florea*): They are actually wild honey bee species produce very small vertical comb in trees and shrubs. Their sting is very weak and incapable to penetrate human skin that’s why their hive can be handled very easily with minimal protection. They produce 1 kg honey per comb. Due to their high absconding tendency they cannot kept in artificial hive. *Apis florea* can be identified very easily for their hissing sounds when they see their predator. This hissing sound is audible to human ear (Hepburn and Radloff, 2011).

2. European honey bee (*Apis mellifera*): They are most commonly domesticated species originated from Italy. The average honey production is 50-60 kg per hive. Swarming tendency is very less and commercially used throughout the country (Otis, 1990).

3. Indian honey bee (*Apis cerana indica*): The Indian honey bee species makes parallel comb on trees and rocks and produces 8-10 kg honey per hive. They are easily domesticated and swarming tendency is very high. They are very much susceptible to attack of wax moth (*Galleria mellonella*) and *Achroia grisella*. Absconding tendency is very common (Ramchandra *et al*., 2012).

4. Rock bee or Giant bee (*Apis dorsata*): Considered as efficient pollinator for agricultural and horticultural crops. They produce 35-40 kg honey per comb and showing high swarming tendency. They cannot be kept under artificial hive condition (Ramchandra *et al*., 2012).

Honey Bee Disease and their Management

1. Acarine disease: Caused by small parasitic mite *Acarapis woodi*. Mite punctures the tracheal tube walls and feed the haemolymph.

Management: Cotton soaked in methyl salicilate and kept under the hive in a flat perforated lid and destruction of affected bee colonies.

2. Amoebic disease: Causal organism is *Malphigamoeba melliifera*. The amoeba cyst passes through within the intestine and contaminate the healthy bees and caused dysentery.

Management: Sterilization of brood box and frames with glacial acetic acid or 40% formalin.

3. Nosema disease: Caused by *Nosema apis*, a small microsporidian. It invades the intestinal tracts of adult bees and causes nosemosis and dysentery.

Management: Sterilization of brood box and frames with glacial acetic acid or 40% formalin and increase the ventilation facility within the hives.

4. American foul brood: Most destructive disease of honey bee caused by *Paenibacillus larvae*. Infected larvae turn dark brown and later changes into sticky mass-producing foul smell.

Management: Use of antibiotics such as oxytetracyclin hydrochloride and Tylosin Tartarate; Dipping the infected hive with hot paraffin wax or 3 % sodium hypochlorite solution.

5. European foul brood: Causal agent is *Melissococcus plutonius*. The diseased larvae turn yellow and then brown and tracheal system is visible.

Management: Use of antibiotics such as oxytetracyclin hydrochloride and Tylosin Tartarate; Application of "Shook Swarm" technique will be helpful for managing the disease.

6. Chalk brood: It is the fungal disease caused by *Ascosphaera apis*. The fungus consumes the larval body causing it to appear white and chalky.

Management: Increasing the ventilation facility within the bee hive.

7. Stone brood: Another fungal disease caused by *Aspergillus flavus*, *Aspergillus fumigates* and *Aspergillus niger*. Dead larva turns black and become difficult to crush. Fungal fruiting bodies erupt from the dead larval body and cover the body by whitish fungal spores.

Management: Sterilization of the bee hives by using formaldehyde solution.

8. Sac brood: It is the only viral disease reported from honey bee caused by *Morator aetatulas*. Affected larvae turns into dark brown to black and death occurs just before the pupation when they are n upright condition.

Management: Destruction of affected hive and sanitation of the bee hive.

Conclusion

Being an important social insect, emphasize should be given on its commercial production scenario and protect it from various deadly diseases. Apiculture is a promising income generating source which should be popularize throughout the country as well as globe by introducing different modern technology which could help its productivity.

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Bioenergy Crops: A Promising Alternative Energy Source

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Introduction

Bioenergy crops are those plants which are utilized for generating biofuels or transportation fuels. The biofuels can be either in liquid form-ethanol, biodiesel, or in gaseous form-biogas, hydrogen. The reliance on costly and uncertain imported energy sources can be reduced and thus, can increase the energy security, with added benefits of foreign exchange savings and rural employment generation through local production of biofuels, especially for a petroleum importing country like India. They are renewable sources of energy which can fix atmospheric CO_2 through photosynthesis. The 'National Biofuel Policy' of India has proposed the replacement of 20% diesel and 10-20% of gasoline with biodiesel and bioethanol, respectively.

Sugar crops like sugarcane, sugar beet, starchy crops like cassava and grain crops like corn, sweet corn, wheat can be utilized for bioethanol production. Ethanol obtained through fermentation is used along with gasoline or in pure form, to be used as motor fuel. Biodiesel can be generated from oil palm, cotton seed, oilseed crops like groundnut, sesame, soya bean, rapeseed etc. The liquid fuel extracted are either mixed with the conventional diesel or used in pure form. Since India is an importer of vegetable oil, importance is given to non-food oil yielding crops like Jatropha, Pongamia, which can even be raised in wastelands. Biofuels can be classified into three categories, based on the chemical and complex nature of the biomass.

First Generation Biofuels

It includes ethanol, biodiesel and vegetable oils produced from agricultural products, which contain starch, sugar or vegetable oil.

Some of the commonly used bioenergy crops for biofuel generation are:

1. Corn: One of the most commonly used feedstocks for ethanol production in United States. The kernels are ground, cooled with alpha and glucoamylase enzymes to convert starch to simple sugars, fermented with yeast, distilled to remove water and denatured to make ethanol undrinkable.

2. Sugarcane: It is the world's most significant energy producing crop. The juice extracted from sugarcane can be easily converted to ethanol. In India, molasses obtained after boiling the sugar syrup is the raw material for fermentation and distillation process to yield alcohol. It is also used to produce baker's yeast (*Saccharomyces cerevisiae*).

3. Sweet sorghum: It is a promising crop for bioethanol production. It is a C_4 crop with low input requirement, high biomass production and can accumulate higher amount of sugar in stalk and seed. It meets the food, feed and fodder requirement and is highly compatible to be raised along with sugarcane, with respect to the management practices as well the infrastructural facilities required for biofuel production.

4. Rapeseed (canola) and soybean: Canola and soybean are the most important feedstocks for bioethanol production, in Europe and USA, respectively. Biodiesel is generated through transesterification. The oil is mixed with alcohol to remove glycerine. Since the saturated fatty acid content of canola is low, it avoids the problem of ice crystal formation at low temperature.

4. Jatropha: Being the largest producer of Jatropha (*Jatropha curcas*), the biodiesel industry of India is mainly revolving around this crop. The crop can grow well, even in marginal/wastelands, propagates easily, require very less quantity of water and is resistant to pest attack and weed infestation. It helps in soil erosion control, can be raised as a hedge crop, has high seed oil content (40%) and has many medicinal properties (anti-microbial, anti-inflammatory, anti-hypertensive, anti-cancer etc.). The oil can be extracted from kernel, seed husk, wood and fruit shells. The oil cake has high protein and nutrient content and thus can supplement animal feed. The oil can be used as a lubricant and for making soap. Increased Jatropha oil production can reduce nation's fossil fuel import bill for diesel production. Being a carbon-neutral fuel, it can improve the country's carbon emission profile through its large-scale production and use. The National Biodiesel Mission, launched in December 2009, identified Jatropha as the most suitable tree borne oilseed crop for biodiesel production.

5. Oil palm: Biodiesel generated from oil palm has similar properties as that of diesel oil and has significant potential to be used in compression ignition (CI) engine. Over the last few decades, the area under oil palm cultivation has been increasing which has raised many environmental concerns due to widespread forest losses, especially in South East Asian countries.

6. Cassava: Because of high productivity and excessive starch content of tubers, cassava can be considered as a great crop for ethanol production. The tubers, peel, stem, leaves as well as bagasse can be used for ethanol production. The tubers are ground, mixed with water, starch is converted to sugar in presence of glucosidase enzyme, fermented with yeast to produce CO_2 and ethanol, and distilled to purify the alcohol.

7. Sugar beet: It is another sugar yielding crop with high potential in augmenting sugar production at lower cost. The molasses can be used in fermentation industry as well as for the manufacture of citric acid yeast and antibiotics.

But it is difficult to produce them in enormous quantity without threatening the food security. This led to the need of searching for other sources in the form of 2^{nd} generation biofuels.

Second Generation Biofuels

It includes bioethanol and hydrogen generated from ligno-cellulosic materials such as trees, forest by-products, waste products from crops, grasses, wastes from wood processing industries, municipal solid wastes and others. They are more sustainable, environment friendly and affordable forms of energy.

Third Generation Biofuels

Generated from marine resources, seaweeds, cyanobacteria. The possibilities of using algae for biodiesel generation have been explored recently. Algae can be microalgae (BGA, dinoflagellates, diatoms) or macroalgae (seaweeds-green, brown, red algae). Lipid accumulation in algae (generally produced during environmental stress conditions) can be enhanced by increasing the activity of enzyme acetyl CoA carboxylase (ACCase) via genetic engineering. Microalgal biodiesel can be produced on a large scale in photobioreactors or raceway ponds using freely available sunlight and thus, can minimise the expenses associated with it. Macroalgae have high cellulose, but less lignin content. High growth rate and non-requirement of land or fresh water for production are the major advantages regarding the exploitation of these organisms for biofuel production. The 3rd generation biofuels are less stable than the other two.

Challenges

1. Water is a limiting factor for the production of biofuels, since the entire process of biofuel production is highly water intensive, starting from the crop production. The Indian distilleries require about 36.5L of water to generate 1L of ethanol from molasses.

2. Intensive monoculture of many of the biofuel crops (excluding Jatropha which helps in soil conservation) has led to extensive application of chemical fertilizers. This has led to huge release of nitrous oxide with high greenhouse gas potential and also, eutrophication of water bodies, making it difficult for the aquatic organisms to survive.

3. High cost of commercial enzymes, handling and establishment of pre-treatment reactors, and high feedstock size.

4. The costs involved in the production of biofuels and in retrofitting the existing vehicles and power plants to work using it is not cheap.

5. Intensive cultivation of biofuel crops like oil palm has led to widespread clearing of rain forests resulting in serious soil erosion, loss of habitat to many endangered species, release of huge amount of CO_2 to atmosphere and loss of biodiversity.

6. India already being an importer of cereal grains and vegetable oil, focusses mainly on bioethanol production from molasses, since it may otherwise raise many food securities concerns. Even sugarcane juice is not used as raw material, since we cannot afford to utilize such a water intensive crop (water requirement

of about 2,500 mm), amidst of the serious water scarce conditions in the country. The possibilities of displacement of area currently devoted to food crop production by bioenergy crops proves to be a threat to the food security of the country.

Possibilities

The threats associated with bioenergy production can be brought down by efficient utilization of wastelands/fallows spread over an area of 25 million ha for raising less input requiring biofuel crops. Reclamation of degraded lands could be achieved by giving boost to the cultivation of these crops in the wastelands, with proper attention and care, as in the case of Jatropha which helps in soil reclamation and conservation. Many food and non-food crops in the tropics have potential to be used as biofuel feedstock, which need to be explored. A new crop with biofuel potential introduced in India is Camelina/False flax *(Camelina sativa)*. It is an under exploited oilseed crop belonging to Brassicaceae family, with a seed oil content of 40%. It is a short duration crop, tolerant to frost and weed infestation, and the oilcake proves to be a nutritious feed for animals. So, year-round supply of raw materials for biodiesel production in India can be assured by intercropping Camelina in Jatropha plantations of North India during winter months, when Jatropha sheds its leaves.

Conclusion

Biofuels can bridge the wide gap between the global demand and supply of fuels and therefore, can check the habitual hike in fuel prices. Hence, there is a huge potential for biofuel market in the global economy, as well as in enhancing the quality and sustainability of the environment.

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Jatropha curcas	***Camelina sativa***	***Molasses from sugarcane***

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Tropical Tuber Crops: Miracle Underneath the Earth

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Introduction

Tuber crops are known as the energy banks of nature, serving either as primary or secondary staple food to meet the calorie needs of about one fifth of the world's population. They are the third important food crops after cereals and grain legumes. Tuber crops are well adapted to diverse soil and environmental conditions, can come up even in marginal lands without much care and attention and can withstand adverse biotic and abiotic stresses. The carbohydrate is stored in the underground stem or roots in the form of starch.

Major Tuber Crops

1. Cassava / Tapioca (*Manihot esculenta*):

Family: Euphorbiaceae.

Cassava is the fourth most important food crop of the world, widely cultivated in Asian and African countries. It is a native of Tropical America. It is a perennial crop with indeterminate growth habit, but is commonly cultivated as an annual crop. The duration of the crop varies between 6-12 months, depending on the growing conditions and the cultivar. The crop is vegetative propagated through 15-20 cm long three nodded cuttings termed as setts, derived from stem collected from the previous crop. The setts produce many adventitious roots, but only some of the roots develop into tubers by secondary thickening and the remaining roots help in absorption of nutrients and water. The tubers are highly perishable and should be processed within 24 hours for starch extraction and within 3-4 days for culinary purposes. The tubers can be eaten boiled, baked, steamed or fried. They are used in a variety of food products like sago, noodles, chips, pudding etc. Leaves and tubers can be used as an animal feed. The tubers can also be used in the industries for the production of starch, liquid glucose, dextrin etc.

2. Sweet Potato (*Ipomoea batatas)*

Family: Convolvulaceae.

Sweet potato is an herbaceous perennial vine cultivated as an annual throughout the tropics and warm temperate countries. The tubers are modifications of adventitious roots and can be stored after harvest. It is propagated by means of 20-25 cm long vine cuttings on ridges 60 cm apart at plant to plant spacing of 15-20 cm. Curing of sweet potato is done after harvest to promote wound healing, reduce microbial spoilage and to improve the culinary characteristics such as colour, texture, aroma and fibre content.

3. Aroids: The members of aroids belong to araceae family. This includes:

- **a. Colocasia / Taro/Old cocoyam (*Colocasia esculenta):*** It is an herbaceous perennial, cultivated as annual. The tubers, leaves and petioles are used for vegetable purpose. The tuber is underground stem modification. The cylindrical corm represents the main stem, while the cormels represent lateral branches of the main stem. The plant parts contain calcium oxalate crystals which account for itchiness when uncooked. The crop is ready for harvest in 7-9 months of planting.
- **b. Xanthosoma / Tannia / New cocoyam (*Xanthosoma sagittifolium):*** Like taro, tannia is also a perennial herb with stem modified underground tuber. The plant is usually larger than taro, the leaves are sagittate and the plant parts are acrid. Cormels, leaves as well as petioles are used for consumption.
- **c. Elephant Foot Yam (*Amorphophallus paeoniifolius):*** It is an important vegetable tuber crop, widely distributed in Philippines, Malaysia, Indonesia, Sri Lanka, South East Asian subcontinent and many parts of India. It is also an underground stem tuber. Cut pieces of tuber, weighing about 750 to 1000g are used for planting.

4. Yams: The group comprises a large number of species belonging to Diooscoreaceae family. Taxonomically, the genus Dioscorea is divided into two- Enantiophyllum (vines twining clockwise/right)

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and Lasiophyton (Twining left/anticlockwise). Yam is a very important crop for food security because of its excellent storage properties and high carbohydrate content calorific value. Yam tuber is neither a root nor a stem modified structure. It rather originates from the transition zone between the stem and the roots (hypocotyl).

a. Greater yam/ water yam (*Dioscorea alata*): It is the most widely distributed species of yam. The vine is stellate or star-like in cross section because of the wings. Produces a single large tuber with white or purplish flesh, lose or watery in texture. The vines twine in right direction. The crop becomes ready for harvest within 8-9 months after planting, when the vines completely dry up.

b. Lesser yam/Asiatic yam (*Dioscorea esculenta*): The vines are thin, spiny, circular in cross section, twines to the left and bears cordate, light green leaves. Produces a bunch of cylindrical tubers with white flesh, at the base of the vine. The crop is ready for harvest by about 7-8 months.

c. White yam/Africa yam (*Dioscorea rotundata):* It is the yam species grown on a greater acreage compared to others. The stem is wingless and is circular in cross section. The tuber skin is smooth and the flesh is white and firm.

Minor Tuber Crops

1. Coleus / Chinese potato (*Solenostemon rotundifolius*):

Family: Lamiaceae

Coleus is one of the minor tuber crops grown for its edible tubers, used as vegetable. The tubers are characterized by their particular aroma and taste. They are rich in carbohydrates, minerals like Ca, Fe, vitamins like thiamine, riboflavin etc., but low in protein content. The plant is a bushy annual herb with either prostrate or ascending stem. And has thick, succulent leaves with aromatic smell. Small heteromorphic tubers are produced in clusters at the base of the stem. Stem or vine cuttings are used as planting material.

2. Arrowroot / West Indian arrowroot (*Maranta arundinaceae*):

Family: Marantaceae

The crop is known so because of the pointed arrow shape of the tubers and also due to its property to cure arrow poisoning. The crop is primarily grown for its quality starch, used as food for infants and invalids. The starch is used in treatment of intestinal disorders and the fibrous residue after starch extraction is used as a cattle feed. The starch is also used for making various bakery products (such as stabilizer in ice cream), biscuits, glue, face powder etc.

3. Queensland arrowroot (*Canna edulis*):

Family: Cannaceae

Canna is a minor tuber crop grown for its branched and fleshy rhizomes that can be eaten raw or cooked. They are of two types- ornamental types (with large and beautiful flowers) and edible types (with more fleshy rhizomes). The starch is easily digestible and thus can be used in bay foods.

		
Coleus	**Arrowroot**	**Yam bean**

4. Jerusalem artichoke (*Helianthus tuberosus*):

Family: Asteraceae

Also called sunchoke, the tubers are rich source of levulose used as sweetening agents for diabetic patients. They are also used for the preparation of industrial alcohol, beer etc. The tubers are sometimes used as a substitute for potatoes. Leguminous tuber crops

5. Yam bean / Potato bean / *Mishrikand* (*Pachyrrhizus erosus*): The yam bean tubers are turnip shaped and the flesh is white, crisp and juicy with sweet taste and is a good source of ascorbic acid. Tender tubers can be eaten raw, cooked as vegetable, used in salads or made into pickles. The pods are poisonous due to the presence of rotenone and related toxic compounds, while the immature pods can be used as vegetable.

6. Winged bean / Goa bean / Dragon bean (*Psophocarpus tetragonolobus):* It is a nutrient rich crop and all the parts are edible. The nutrient rich tuberous roots have a nutty flavour and can be eaten raw or cooked. They have more protein than any other root vegetable crop. It is a low-cost protein source for livestock.

Conclusion

Tuber crops are cheap and climate resilient alternative sources of energy which have been neglected by the Indians. The major constraints faced in the utilization of these crops are the perishability and post-harvest losses. These can be ruled out by developing low cost techniques for improved storage and processing of the tubers. The starch obtained from under exploited tuber crops should be utilized for industrial applications.

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Majestic Mangroves

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Introduction

Mangroves are the valuable biomes which play a pivotal role in the maintenance of equilibrium of the estuarine region. Its importance was realised when the areas with mangroves cover were spared from the havoc created by Indian Ocean tsunami waves which hit the southern shores of India on 26 December, 2004.

A mangrove is a shrub or a small tree which can grow in saline or brackish water and thus are adapted to survive in harsh coastal conditions of tropics and subtropics. The word 'mangrove' has probably originated from the Portuguese word '*mangue*', Spanish word ' *mangle*', with the association of English word 'grove'. They belong to the genus *Rhizophora* of the family Rhizophoraceae.

They are ecologically distinct group of halophytic plant communities which are one of the most productive and biologically important ecosystems of the world. There are about 153 mangrove species in India, among which 36 species are true mangroves and the rest are mangrove associates.

Mangroves are seen in every continent, in the region between Tropic of Cancer and Tropic of Capricorn. Indian mangroves occupy about 3.1% of the total global mangrove cover, with a total coverage of 4662.5 sq. km and are distributed along the coastlines of Gujarat, Goa, Maharashtra, Kerala, Tamil Nadu, Andhra Pradesh, Odisha, West Bengal and Andaman and Nicobar islands (not in Lakshadweep), of which those in West Bengal and Andaman and Nicobar islands are very dense.

The Sundarbans in WB is considered as the largest mangrove in terms of richness in biodiversity and contribution to coastal fisheries. It has also been included in the World Heritage category since it is the only tiger reserve in saline marshy mangrove habitat. Mangroves in Gujarat occupies second position (1058 sq.km) after West Bengal (2155 sq. km).

The members of a mangrove community have to be tolerant to saline, low O_2 conditions, hot and humid climate, and also many extreme environmental phenomena and thus very few species make up to that. The red mangroves (*Rhizophora mangle*) can thrive in O_2 deficient conditions with the aid of lenticels in their bark, through which they can absorb air. The aerenchyma cells in the roots also help them to survive in inundated environment.

According to Thom's classification of estuarine habitats, India's mangroves can be broadly classified into:

1. Deltaic: Found within the deltas of Ganges, Brahmaputra, Mahanadi, Godavari, Krishna, Cauvery rivers, along the east coast.
2. Backwater-Estuarine: In the estuaries of Indus, Narmada and Tapi rivers. Found along the west coast
3. Insular types: Found in Andaman and Nicobar Islands.

Relevance of Mangroves

The ecosystem of mangroves, called '*mangals*' are highly productive and support more than 80% of the marine catches. They harbour a number of faunal species including fishes (mud skippers, carangids, mullets, tilapia, milkfish, hilsa and others), praws, shrimps, snails, molluscs and even support migratory and resident birds, estuarine crocodile (*Crocodilus porosus*) and the famous Royal Bengal Tiger, in the Sundarbans of West Bengal.

Large number of terrestrial, semi aquatic, arboreal and aquatic organisms depend on this vegetation for feeding as well as for breeding purposes. Since mangroves are located in the edge of sea and land, they can act as live protective barriers against tsunami and tropical storms.

The thick, impenetrable network of roots help them to act as efficient natural buffers against the storm surges, thus protecting the shoreline communities. Mangroves are skilled at trapping the pollutants and excess sediments from the river water before it reaches the ocean.

Mangroves play a prime role in the removal of CO_2 from atmosphere by sequestering large amount of carbon below the ground. They can accumulate about 50 times more carbon than the tropical terrestrial forests.

They provide livelihood to the people living around them in the form of timber, wood, plant extracts with medicinal value, leaves for forage purpose, young shoots and fruits as vegetables, and many more. They have great potential in generating income for the local inhabitants through sustainable ecotourism.

Major Threats Faced

Mangroves are under threat nearly everywhere, but the problem is more acute in Myanmar, where the rate of deforestation is 4 times the global average. In India, overexploitation of resources and increased rate of land reclamation has resulted in shrinkage of mangroves, especially in Kerala and West Bengal.

1. The mangroves are destroyed and reclaimed with rainwater to reduce the soil salinity and the areas are used for raising coconut plantations or paddy

2. Expansion of human settlements, salt making lands, industries, ports resulted in degeneration of Indian mangroves

The mangrove vegetation is ruined for the purpose of aquaculture expansion. The local fishermen in coasts of Kerala collect fish seeds from the mangroves. The fry and fingerlings of *Etroplus suratensis* (Pearl spot) can be obtained throughout the year with a peak during April-July.

3. They are cut annually for utilization as firewood, timber, charcoal and as raw material for clipboard, paper and tannin industry

4. Reduction in fresh and tidal water inflow due to dam and barricade construction as upper portion of rivers increase the salinity of these areas resulting in reduced germination, growth and regeneration of mangroves. Pollution is the major peril associated with the survival of mangrove patches in the cities.

5. Climate change affects the germination, growth and propagation of mangrove vegetation as well as the behaviour and survival of the organisms associated with it.

Recommendations for Restoration

1. Unlawful encroachment, collection of mangrove products, conversion of mangrove lands for other purposes, overexploitation of mangroves for seed collection for aquaculture and overdependence of local people for livelihood must be strictly prohibited/regulated through strict enforcement of forest rules.

2. Proper steps should be taken to mitigate the entry of pollutants in the wetland ecosystem and the shorelines should be lined with bricks or stones to control shoreline erosion.

3. Awareness campaigns, seminars, symposiums regarding the conservation and sustainable management of mangroves with effective participation of coastal people should be intensified, with the aid of local languages. Making available magazines, posters, pamphlets, documentaries, exhibitions, bird watching tours, competitions on mangrove conservation can be considered.

4. Regular afforestation programmes should be carried out under the guidance of government organizations, universities and other agencies.

5. Conservation of these forests through traditional means can be practised through sacred groves, which are based on some religious or folk beliefs.

Conclusion

Mangrove forests are vital for healthy coastal ecosystems of the world. Realising their importance, July 26 is widely observed as International Mangroves Day. But mangroves are declining rapidly as they are getting degraded for agriculture, tourism, urban development and overexploitation.

If there are no mangroves, the sea will be like a tree without roots. Helping the wetlands to help us can undoubtedly save the mankind for the years to come.

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Mangroves of Kerala	**Massive root system of mangroves**

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Improved Production Techniques of Coriander (*Coriandrum sativum* L.)

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Introduction

Coriander is an annual herb, mainly cultivated for its fruits as well as for the tender green leaves and belongs to the member of Apiaceae family. It is native of the Mediterranean region and is now commercially grown in India, Morocco, U.S.S.R, Hungary, Poland, Rumania, Czechoslovakia, Guatemala, Mexico and the U.S.A. In India, it is grown in Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan and Madhya Pradesh. The fruits have a fragrant odour and pleasant aromatic taste. The odour and taste are due to the essential oil content which varies from 0.1 to 1.0 percent in the dry seeds. These essential oils are used for flavouring liquors, cocoa preparations in confectionary and also to mask the offensive odours in pharmaceutical preparations. The dried ground fruits are the major ingredient of the curry powder. The whole fruits are also used to flavour foods like pickles, sauces and confectionary. The young plants as well as the leaves are used in the preparation of chutney and are also used as seasoning in curries, soups, sauces and chutneys. It has medicinal properties too. Fruits are said to have carminative, diuretic, tonic, stomachic and aphrodisiac properties.

Uses

All parts of the plant are edible, but the fresh leaves and dried seeds are the parts most traditionally used in cooking, Coriander is used in cuisines throughout the world.

Varieties

Co.1:

a. Superior variety of germplasm selection (TNAU).
b. Dual purpose, 110 days, Tolerant to grain mould.
c. Seed yield of 800 kg/ha (rainfed conditions) and 2000 kg/ha (irrigated conditions).

Co.2:

a. Reselection from the type P2 of Gujarat.
b. High yielding dual purpose variety, tolerant to drought.
c. 90-100 days, yield (600-700 kg/ha).

Co.3:

a. Pure line selection from Acc. No. 695, IARI.
b. Dual purpose, less susceptible to wilt and grain mould.
c. Duration is 90 days, yields (650-700 kg/ha).

Co(Cr.4): It is a newly released multi cut type yields better than Co.3.

CS 287:

a. Recurrent selection from CS.6.
b. Small, bold grain, tolerant to wilt and grain mould, suit for rainfed tracts.

Karan:

a. Developed through recurrent selection, based on progeny testing.
b. Small seeded, highly resistant against wilt and stem gall disease (Sharma and Bhatti, 1986).

CIMPOS-33: An improved strain developed by intensive selection from Bulgarian material

CS.2:

a. Selection from the germplasm collection Warangal
b. Medium to tall, more branching, bushy type with 83 cm height.
c. Yield of 1,350 kg/ha.

Other varieties are GAU1, UD1, 2, 20 and 21.

Field Preparation and Sowing

Prepare the main field to a fine tilth and form beds and channels (for irrigated crop). Sow the split seeds at a spacing of 20 x 15 cm. The seeds will germinate in about 8-15 days. Presowing seed hardening treatment with Potassium Dihydrogen Phosphate @ 10g/lit of water for 16 hours is to be done for rainfed crop. Seeds are to be treated with Azospirillum @ 3 packets/ha. Seed treatment with Trichoderma viride @ 4 g/kg of seed has to be done to control wilt disease.

Seed Rate

1. 10 - 12 kg/ha (Irrigated crop).
2. 20 – 25 kg/ha (Rainfed crop).
3. Whole seed will not germinate and hence the seeds are split open into halves before sowing for more germination percentage.

Seed Treatment

1. Soak the seeds in water for 12 hours. Treat the seeds with Azospirillum @ 1.5 kg /ha for better crop establishment + Trichoderma viride @ 50 kg/ha to control wilt disease.
2. Pre sowing seed hardening treatment with Potassium Dihydrogen Phosphate @ 10 g/lit of water for 16 hours is to be done for rainfed crop.

Manuring

1. Basal: FYM 10 t/ha; 10 kg N, 40 kg P and 20 kg K for rainfed and irrigated crops.
2. Top dressing: Top dressing may be done at 10 kg N/ha 30 days after sowing for the irrigated crop only.

Irrigation (for Irrigated Crop Only)

First irrigation should be given immediately after sowing and the second on the third day and subsequent irrigations at 7-10 days interval.

After Cultivation

Pre-emergence spray of herbicide Fluchloralin 700 ml in 500 lit/ha. Thinning is done 30 days after sowing. Subsequent weeding is done as and when necessary. Leave 2 plants per hill. Spray CCC @ 250 ppm one month after sowing for inducing drought tolerance in rainfed crops.

Plant Protection - Aphid

Aphids can be controlled by spraying Methyl demeton 20 EC @ 2 ml/lit or Dimethoate 30 EC @ 2 ml/lit.

Powdery Mildew

Seed treatment with Pseudomonas fluorescens (Pf 1) @ 10 g /kg and foliar spray of Pf1 2 g/lit or Spray Wettable sulphur 1 kg/ha or Dinocap 250 ml/ha at the time of initial appearance of the disease and 2nd spray at 10 days interval. Neem seed kernel extracts 5 % spray thrice (1st spray immediately after the appearance of disease, 2nd and 3rd at 10 days interval).

Wilt

Seed treatment with Pseudomonas fluorescens @10g /kg followed by soil application of Pf1 @ 5 kg /ha.

Grain Mould

Grain mould can be controlled by spraying Carbendazim 0.1% (500 g/ha) 20 days after grain set.

Harvest

The plants are pulled just when the fruits are fully ripe but green and start drying. The plants are dried and thrashed with sticks, winnowed and cleaned. For leaf, pull out the plants when they are 30-40 days old.

Yield

1. Rainfed Grain yield: 300-400 kg/ha.
2. Irrigated: 500-600 kg/ha.
2. Leaf yield: 6-7 t/ha.

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Allele Mining in Crops

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Introduction

A significant portion of beneficial/ superior alleles were not utilized till date in plant breeding as these were left behind during evolution and domestication. This untapped genetic variation existing in wild relatives and land races of crop plants could be exploited gainfully for development of agronomically superior cultivars through the introgression of novel gene from wild relatives.

With rapid accumulation of sequence and expression data in various genomic databases, accelerated discovery and annotation of new genes can be expected which would enable the development of allele-specific markers. Based on gene and genome sequences, polymerase chain reaction (PCR) strategies are devised to isolate useful alleles of genes from a wide range of species.

This capability enables direct access to key alleles conferring resistance to biotic and abiotic stresses, greater nutrient use efficiency, enhanced yield and improved quality. Using novel genomic tools, similar alleles responsible for a given trait and their variants in other genotypes can be identified. This is often referred to as 'dissection of naturally occurring variation at candidate genes/loci' or simply 'allele mining'.

Identification of allelic variants from germplasm collections not only provides new germplasm for delivering novel alleles to targeted trait improvement but also categorizes the germplasm entries for their conservation. Mutation is considered as an evolutionary driving force, which underlies existing allelic diversity in any crop species either, by creation of SNPs or INDELs.

Initial studies of allele mining have focused only on the identification of SNPs/InDels at coding sequences or exons of the gene, since these variations were expected to affect the encoded protein structure and/or function. Recent reports indicate that the nucleotide changes in non-coding regions (5′ UTR) including promoter, introns and 3′ UTR) also have significant effects on transcript synthesis and accumulation that in turn alter the trait expression.

Two major approaches are available for the identification of sequence polymorphisms for a given gene in the naturally occurring populations. They are:
1. Modified TILLING (Targeting Induced Local Lesions in Genomes) procedure called EcoTilling
2. Sequencing-based allele mining.

Modified Tilling

While TILLING is a technique that can identify polymorphisms (more specifically point mutations) resulting from induced mutations in a target gene by heteroduplex analysis. EcoTilling, represents a means to determine the extent of natural variation in selected genes in crops. The mutations are not induced artificially and are detected from naturally occurring alleles in the primary and secondary crop gene pools. Like TILLING,

EcoTilling also relies on the enzymatic cleavage of heteroduplexed DNA (formed due to single nucleotide mismatch in sequence between reference and test genotype) with a single strand specific nuclease (i.e., Cel-1, mung bean nuclease, S1 nuclease, etc.) under specific conditions followed by detection through Li-Cor genotypers (Li-Cor, USA). At point mutations, there will be a cleavage by the nuclease to produce two cleaved products whose sizes will be equal to the size of full-length product.

The presence, type and location of point mutation or SNP will be confirmed by sequencing the amplicon from the test genotype that carry the mutation. Although TILLING and EcoTilling were proposed as cost effective approaches for haplotyping and SNP discovery, these techniques require more sophistication and involve several steps starting from making DNA pools of reference and test genotypes, specific conditions for efficient cleavage by nuclease, detection in polyacrylamide gels using Li- Cor genotyper and confirming through sequencing.

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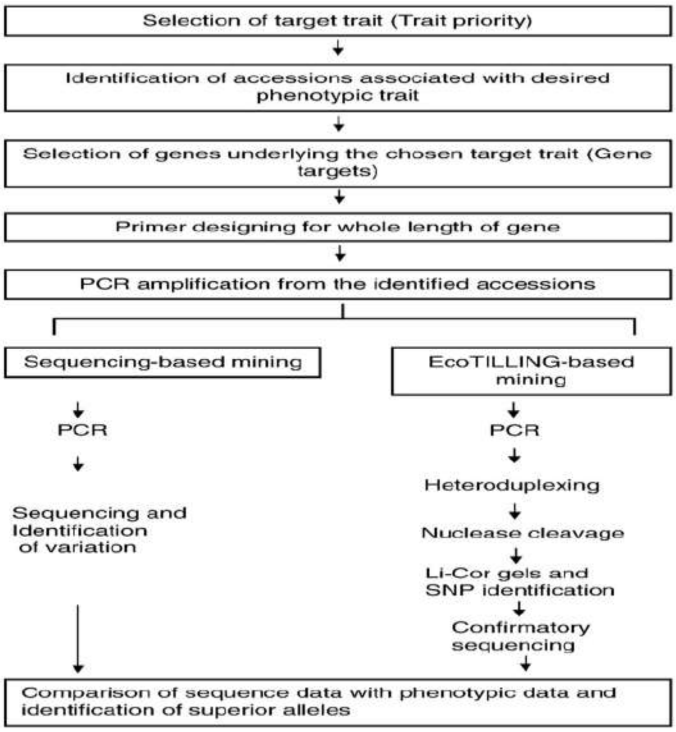


Steps involved in allele mining

Sequencing-Based Allele Mining

This technique involves amplification of alleles in diverse genotypes through PCR followed by identification of nucleotide variation by DNA sequencing. Sequencing-based allele mining would help to analyze individuals for haplotype structure and diversity to infer genetic association studies in plants. Unlike EcoTilling, sequencing-based allele mining does not require much sophisticated equipment or involve tedious steps, but involves huge costs of sequencing.

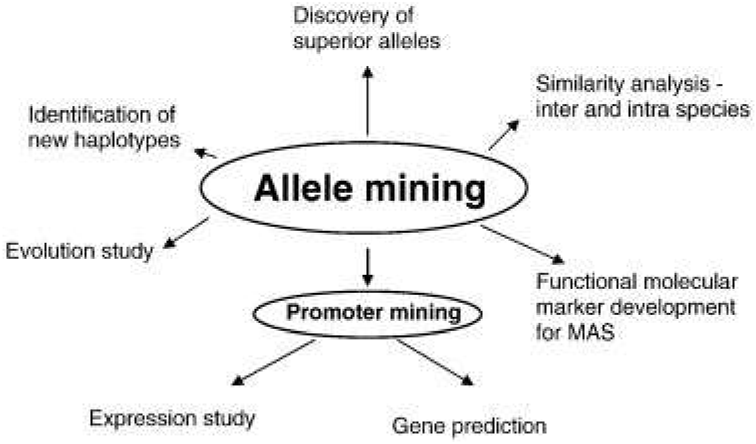
Despite the claim that EcoTilling can be done at a fraction of the cost of SNP/haplotyping methods, the elaborate equipment and expertise required and the need for confirmatory sequencing in EcoTilling procedure, draws reconsideration for its wide applicability. The development of ‘next generation’ sequencing platforms with increased throughput and accuracy. The first of this kind was commercialized by 454 Life Sciences and this technique relied on pyrosequencing while eliminating the need for cloning. With this 454-sequencing platform, it was possible to produce 100 Mb of sequence with 99.5% accuracy and increased read length averaging over 250 bases.

Another massively parallel sequencer, Illumina/Solexa genome analyzer has been developed and this is capable of sequencing one billion bases (1 Gb) of 30–40 base sequence reads in a single run in a short timer period of 3–4 days. In addition to the above, Applied Biosystems Inc (USA) has also developed massively parallel sequencer using supported oligonucleotide ligation and detection system (SOLiD). This system, despite its shorter read length of about 25–35, can generate 2–3 Gb of sequences per run. Recently, Helicos Heliscope has commercialized a new massively parallel system based on single molecule sequencing (SMS) technology.

SMS technology is much faster and cheaper than second generation sequencing technologies of Applied Biosystems and Illumina and has been described as third generation or next to next generation sequencing technology. Another such third-generation sequencing technology is expected to be commercialized by Pacific Biosciences SMRT in early 2010. As advances in DNA sequencing technologies progress towards long envisioned “US$ 1000 genome” (or sequencing a human genome for US$ 1000), and as the sequencing costs are reduced by a factor of two or three each year, sequencing at a lower cost would soon become a reality. Given the availability of low cost, more read length and high throughput sequencing platforms, sequencing-based allele mining in future, would result in faster generation of allelic data at a cheaper cost. In addition, sequencing based allele mining of specific genes in identified accessions and their association with phenotypic variations will give a tremendous impetus to precision breeding programs in crop plants.

Considerations for Allele Mining

1. Availability of existingenetic base and the genome and gene sequences information of a particular crop species along with wild relatives.
2. Availability of efficient and reliable phenotyping techniques; genomic resources.
3. Availability of high throughput techniques for quick and easy generation of allelic data points; cost-effective sequencing platforms; efficient bioinformatics tools for identification of nucleotide variation and molecular marker construction technologies for marker-assisted selection (MAS).



Applications of allele mining

Perspective

1. A vital link between effective utilization of genetic and genomic resources
2. Keep pace with ever-increasing sequence data in GenBank and ever-expanding crop gene banks.
3. Develop tools and strategies should be equally focused on handling both genetic and genome resources.
4. As efficient tools for data mining and cost-effective and high throughput sequencing platforms become available, it is certainly expected that sequencing-based allele mining would emerge as a method of choice in revealing natural variations and in providing novel and effective alleles and would take centre stage for all crop improvement activities.

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Novel Techniques in Value Addition of Okra

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Introduction

Value addition is the process in which for same volume of a primary product, a high price is realized by means of processing, packaging, upgrading the quality or other such methods. Value-Added is defined as the addition of time, place, and/or form utility to a commodity in order to meet the tastes/preferences of consumers. Value addition in food products will result in nutrient-rich products which have a higher degree of quality, meet the standards set by different authorities and are safer for consumption. Sometimes, value addition can be done in any food products using different methods and one such food product is okra. Okra, scientifically known as *Abelmoschus esculentus* L. Moench which belongs to family Malvaceae having chromosome no, 2x =130. Okra is a multipurpose crop valued for its tender and nutritious pods. Okra per 100g of edible fruits it consists of dry-matter 10.4g, energy 3100 calorie, protein 1.8g, calcium 90mg, iron 1.0mg, thiamine 0.07mg, riboflavin 0.08mg, niacin 0.08mg, vitamin C 18mg, the dry seeds contain 13-22% edible oil and protein 20-24%. It has many medicinal properties like reducing blood glucose levels, lowering cholesterol levels, reducing the risk of colon cancer, immune system booster etc. Here in this article, new techniques of value addition in okra which is the most important vegetable crop of the tropical and subtropical regions of the world will be enlightened.

Conventional Methods

Usually okra can be subjected to value addition by various methods, some traditional methods followed earlier are as below:

1. Drying / Dehydration: Drying is the removal of a liquid from a solid by evaporation, the necessary heat of vaporization being provided by conduction from a solid surface, convective from a hot gas, or radiation whereas Dehydration is the process of removal of moisture by application of artificial heat under controlled conditions of temperature, humidity and air. The methods used here are Open-sun drying, Hot air drying, Vacuum drying, Infrared drying, Methods of drying, Microwave drying.

2. Freeze drying/ Lyophilization of Okra: Removal of ice or frozen solvent from a material through the process of sublimation and removal of bound water molecules through the process of desorption.

3. Canning of Okra: Canning is the process of sterilizing and sealing food in airtight containers to preserve them and to retain nutrients and quality.

Non-Conventional Methods

The details about non-conventional or novel methods of value addition okra is presented below:

1. Fibre extraction: The method used here is stagnant water retting. This process of retting removes the waxy epidermal tissue, adhesive pectin and hemicelluloses that bind the fibre bundles to each other. The okra plants were bundled comprising of 350-400 plants, each of these bundles were immersed in a concrete tank containing soft water for ten days. Later the stalks of the plant were tapped slightly with wooden hammer for removal of soft pulp. In order to separate the pulp, it was scrapped with the help of a knife. This is once again immersed and left in the tank for five days. Then the fibres will be separated thoroughly from the pulp, washed, combed and exposed to sunlight for two days until the odour is removed from fibres. Fibre yield is only four percent of the weight of green plant. The retting process required 10 days for initial soaking and 5 days for final retting. For drying it takes 2 days in bright sun light and open air. So, the complete fibre extraction process requires 17 days. About 200 litres of water and 9 labours may be needed for the complete process of seventeen days.

2. Seed oil extraction: Most commonly followed method for seed oil extraction of vegetable seed oil is solvent method using soxhlet apparatus on a heating mantle. The solvent used is n-Hexane. The milled okra seeds were packed in a muslin cloth placed in a thimble of soxhlet extractor. A round bottom flask containing hexane is fixed to the end of the extractor and the condenser was tightly fixed to the bottom end of the extractor. The extractor should be heated at 60ºC with the use of an electric mantle. The solvent will be vaporised and condensed into the evaporator. The mixture obtained (solvent and oil) moves directly into the round bottom flask. The process is continued for the specified time. Oil is recovered by distillation process using the same apparatus. The obtained oil will be stored in a bottle.

3. Pectin extraction from Okra: The plant materials are cleaned and the okra pulp (fruit without seed) is separated manually from the seeds. Then, they are immediately freeze-dried for 96 hr using a freeze drier. Fractionation of alcohol-insoluble solids. Leaves, pulp and seeds are homogenized twice with 70% (v/v) aqueous ethanol at room temperature for 1 hr. After filtration, the insoluble residues are pooled together and soaked in chloroform/methanol (1:1 v/v) with a gentle stirring for 30 min to remove low molecular weight (coloured) compounds. Then, the residues are washed with acetone and air dried to obtain alcohol-insoluble solids (AIS). Sequential extraction of okra AIS were extracted using 600 ml of the following extractant used is 0.05 M sodium acetate buffer, pH 5.2 (hot buffer, HB) at 70°C. After 30 min of extraction, the extract is separated from the insoluble residue by centrifugation at 18,500 x g for 25 min. Then, the supernatant is coagulated with isopropanol and lyophilized.

4. Mucilage or gum extraction: 1 kg of unripe and tender Okra fruits (pods) is obtained from the local market. The seeds are removed as they do not contain any mucilage. The fruits are washed and sliced thinly with a knife. The sliced mass is soaked in distilled water overnight to extract out the mucilage. After soaking, a white muslin cloth is used to filter out the viscous gum extract (mucilage). Acetone is added to precipitate the gum at a ratio of 3 parts of acetone to 1 part of the gum extract. Then, the precipitated gum was dried in a desiccator containing anhydrous calcium chloride for approximately 2 weeks. Size reduction and screening of the dried gum were carried out using a stainless-steel grinder and no. 30 stainless steel mesh sieve. Airtight powder bottles are used to store the undersized fractions.

Conclusion

Value addition has become a key word of success in agricultural trade in international market, value addition helps in avoidance of post-harvest losses, increases product diversification, foreign exchange, employment generation, export and easy marketing of product. It is therefore appropriate time to come out of primary processing and get into newer product development and marketing of ready to use products through value addition.

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RNA Interference: New Approach of Gene Silencing in Plants

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RNA interference (RNAi) is a naturally occurring mechanism that leads to the "silencing" of genes. In consequence, the respective protein is no longer synthesised. In nature, this mechanism is used for the regulation of specific genes and is also applied as a defence against viruses. RNA interference (RNAi) is a form of post transcriptional gene regulation in which non translated double stranded RNA (dsRNA) molecules called small interfering RNA (siRNA) mediate sequence specific degradation of target messenger RNA (mRNA). RNA silencing is a novel gene regulatory mechanism that limits the transcript level by either suppressing transcription (TGS) or by activating a sequence- Specific RNA degradation process [PTGS/RNA interference (RNAi)]. The silencing effect was first observed in plants in 1990, when the Jorgensen laboratory introduced exogenous transgenes into petunias in an attempt to up-regulate the activity of a gene for chalcone synthase, an enzyme involved in the production of specific pigments (Agrawal et al., 2003). The natural function of RNAi is referring to the mechanism involved in cellular defence against viruses, genomic containment of retro-transposons, and post-transcriptional regulation of gene expression. RNAi can specifically silence individual genes, creating knockout phenotypes, either in transformants that can produce the required hairpin RNAs, or upon infection with recombinant RNA viruses that carry the target gene (VIGS, viral-induced gene silencing) (Tenea, 2009).RNAi is a multistep process involving the generation of small interfering RNAs (siRNAs) in vivo through the action of the RNase III endonuclease 'Dicer'. The resulting 21- to 23-nt siRNAs mediate degradation of their complementary RNA (Zou et al., 2005).

Process of RNAi

In general, RNAi is triggered by double stranded RNA, which may be produced naturally in a cell or may enter the cell exogenously. An enzyme, called Dicer, cuts the long double stranded RNA into small pieces of approximately 21 nucleotides length. These small pieces could be miRNA (micro RNA; originating from endogenous long dsRNA) or siRNA (small interfering RNA; originating from exogenous sources). These RNAs then bind to the RNA-induced silencing complex (RISC). After binding, one strand of the double stranded RNA is removed, leaving the remaining strand available to bind to messenger RNA target sequences. This strand is complementary to the sequence of the target mRNA. RNA Induced Silencing Complex (RISC) cleaves mRNA or represses their translation by homology dependent mRNA degradation, which effectively silences the gene. The use of RNAi has been extensively reported for modifying plants to enhance their nutritive value, pathogen and pest resistance, decreasing amount of unwanted metabolite production, etc.

Recently two RNAi based crops have been given regulatory approval for commercial production and sale. These are the non-browning Arctic apples and the non-browning Innate potatoes. The firms producing these crops claim that the idea behind producing the non-browning apples and potatoes is not only to improve the look of the product, but it is also intended to increase the consumption of the raw fruits along with reducing naturally occurring carcinogens (as in the case of innate potatoes). While the science behind both these products is a little complicated as both are RNAi based, in simple way it can be put as both apples and potatoes have certain genes suppressed. Both of them, though genetically modified, are grown the same way as conventional varieties. These products are likely to find a place of attraction in the fresh-cut product sales.

Mechanism of RNAi

1. The entry of long double stranded RNA, such as an introduced transgene, a rogue genetic element or a viral intruder, triggers the RNAi pathway of cells. This results in the recruitment of the enzyme Dicer.

2. Dicer cleaves the dsRNA into short, 20-25 base pairs long, fragments, called small interfering RNA (siRNA).

3. An RNA induced silencing complex (RISC) then distinguishes between the two siRNA strands as either sense or antisense. The sense strands (with exactly the same sequence as the target gene) are degraded.

4. The antisense strands on the other hand are incorporated to the RISC. These are used as guide to target messenger RNAs (mRNA) in a sequence specific manner.

5. Messenger RNAs (mRNA), which codes for amino acids, are cleaved by RISC. The activated RISC can repeatedly participate in mRNA degradation, inhibiting protein synthesis.

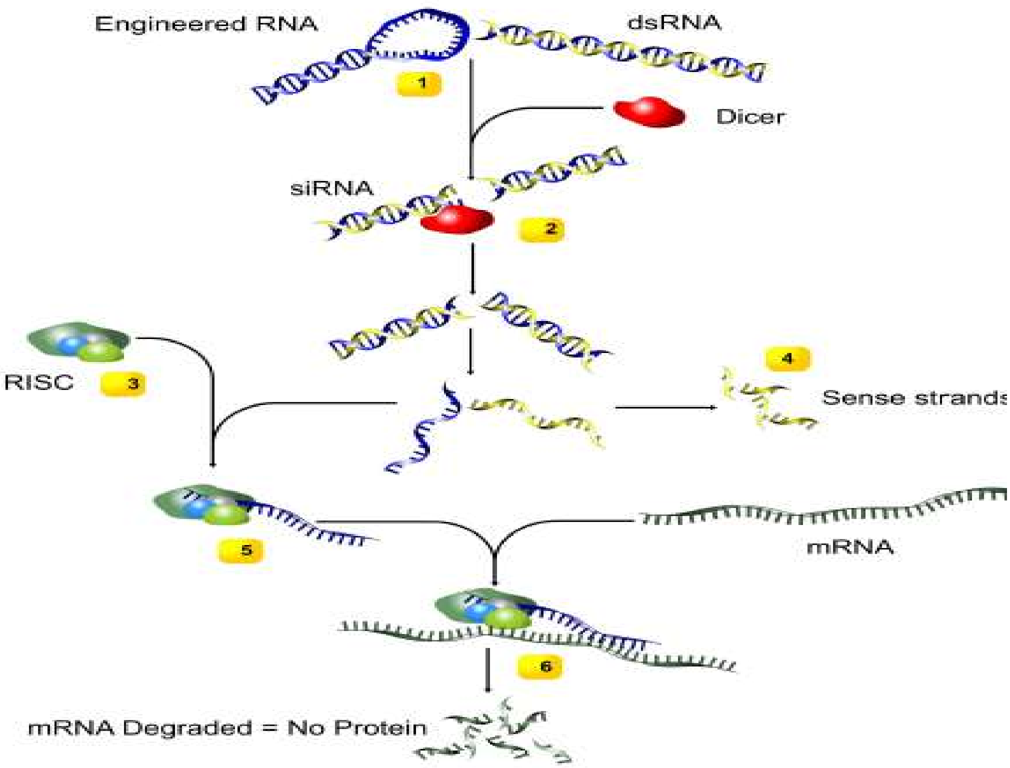

Figure 1. Mechanism of RNAi.

Application of RNAi Technology

1. In plant system, it provides defence mechanism to protect against infection by viruses, transposons and other insertional elements.

2. RNAi also plays a role in regulating development and genome maintenance.

3. Development of male sterile plants in rice.

4. Recently two RNAi based crops have been given regulatory approval for commercial production and sale. These are the non-browning Arctic apples and the non-browning Innate potatoes. The firms producing these crops claim that the idea behind producing the non-browning apples and potatoes is not only to improve the look of the product, but it is also intended to increase the consumption of the raw fruits along with reducing naturally occurring carcinogens (as in the case of innate potatoes). While the science behind both these products is a little complicated as both are RNAi based, in simple way it can be put as both apples and potatoes have certain genes suppressed. Both of them, though genetically modified, are grown the same way as conventional varieties. These products are likely to find a place of attraction in the fresh-cut product sales.

Application in Improvement of Nutritional Value

1. RNAi technology used to produce cotton seed containing lower level of decadiene Synthase which is key enzyme in gossypol production.

2. RNAi method were used in cotton to down regulate two key fatty acid desaturase gene encoding stearoyl acyl career protein D9 desaturases and Oleoyl phosphatidylcholine w6 desaturase. Knockdown of these genes in cotton led to increase of nutritionally improved high oleic (HO) and high stearic (HS) cottonseed oil that is more suitable for human consumption.

3. In maize, RNAi technology has been used to reduce phytic acid by silencing MRP4 ATP binding cassette (ABC) transporter.

4. In soybean, Silencing of Omega3 fatty acid desaturase gene in soybean using RNAi reduce alinolenic acid and improve oil stability and flavour.

5. Using RNAi technique, varieties of barley developed which are resistant to BYDV (barley yellow dwarf virus).

Advantages of RNAi

1. This technology is highly gene specific.
2. High gene silencing efficiency.
3. Screening targeted plants takes less time.
4. It is highly inducible.

Disadvantages of RNAi

1. It does not knockout a gene for 100%.
2. siRNA tends to activate unwanted pathways.

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Mitigation Strategies for Decreasing GHGs from Paddy *(Oryza sativa)* Fields

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Abstract
The Greenhouse gases (GHGs) emissions from agriculture and allied sectors are mainly CH_4, N_2O, and CO_2. Rice occupies 11% of the global arable land and it is responsible for 10.1% of total agricultural emissions. In rice systems, it has been shown that CH_4 emissions are high relative to N_2O emissions and therefore the focus should be on reducing CH_4 emissions. Emissions during the growing season of rice can be reduced mostly by water management, nutrient management, tillage management, cropping system management and integrated farming. Rice straw is the primary source of C for CH_4 production during the early growth period of rice plants. Management practices for minimizing N_2O emissions from rice paddy soils and increase Nitrogen Use Efficiency (NUE) include: better matching of N supply to crop demand, using improved fertilizer management techniques including controlled release fertilizers, use of nitrification inhibitors and timing of fertilizer application.

Keywords: Greenhouse gases (GHGs), CH_4, N_2O, nitrification inhibitors.

Introduction
In the global context of addressing climate change, the key GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and chlorofluorocarbon (CFC). The GHG emissions from agriculture and allied sectors are mainly CO_2, CH_4, and N_2O. The CO_2 released from agriculture is considered neutral due to photosynthesis and fixation. The high level of GHG emissions from agriculture is due to application of different sources of nutrients for raising crop production, high rate of decomposition of biomass and plant residues, plant respiration, livestock rearing, enteric fermentation in ruminants, manure handling, and burning of crop residues. Globally, 50.1 Gt CO_2 eq GHGs are emitted from anthropogenic sources in which agriculture (direct sources) accounts for about 5.0-5.8 Gt CO_2 eq (~10-12%). Including indirect sources is likely to account for a further 3-6% of the global emissions. Amongst the agricultural crops, rice (*Oryza sativa*) accounting for 11% of the global arable and the world's second most produced staple crop is responsible for 10.1% of total agricultural emissions and about 1.3%-1.8% of the global anthropogenic GHG emissions. Rice production is the second largest anthropogenic source of CH_4 with a global warming potential (GWP) of 25 and N_2O with a GWP of 298. By 2050, there will be nine billion people which will necessitate a rise of 60% agricultural production (including rice). About 80% of yield increase will come from intensification (use of more fertiliser, pesticides and water inputs, multiple cropping, shorter fallow periods and improved seed varieties) and another 20% from extensification. Both intensification and extensification are likely to demand more farm inputs, thus generating a larger proportion of GHG emissions. About 75% of the world's paddy is produced in continuously flooded condition. However, flooding results in anaerobic conditions and therefore promotes methanogenesis and methane emissions whereas decreases N_2O emission. Therefore, paddy cultivation is one of the chief sources of CH_4, accounting for about 11% of global CH_4 emissions (493-723 Mt CO_2 eq) in 2010. Moreover, rice stubble is either left on the ground to decay or burnt to ashes hence, produces both CH_4 and N_2O emissions. Therefore, this calls for certain mitigation practices to lower the level of GHGs emission from paddy fields.

Mitigation Strategies
In rice systems, it has been shown that CH_4 emissions are high relative to N_2O emissions and therefore the focus should be on reducing CH_4 emissions. Mitigation strategies should be selected based on their effect on CH_4, N_2O and CO_2 emission and their total GWP. Mitigation potentials for CO_2 represent the net change in soil carbon pools, reflecting the accumulated difference between carbon inputs to the soil after CO_2 uptake by plants, and release of CO_2 by decomposition. Emissions during the growing season of rice can be reduced mostly by water management, nutrient management, tillage management, cropping system

management and integrated farming. Emissions during the non-growing rice season or fallow period can be mostly reduced by keeping the field dry especially for those fields which are in waterlogged conditions. Some of the strategies are discussed here in detail:

1. Water management: It can be achieved by intermittent flooding or alternate wetting and drying or mid-season drainage. Methane emission patterns vary with the drainage systems. In the continuous flooding system, CH_4 emission rates are low at the early vegetative growth stage, gradually increased with the development of soil reductive conditions and plant growth, and peaked between the maximum tillering and the reproductive stages of plant growth. Thereafter, the CH_4 emission rates gradually drop during the grain maturation stage. The midseason drainage practice at the highest CH_4 emission period significantly increases soil Eh values and drastically reduce CH_4 emission. Further, intermittent flooding decreases CH_4 and CO_2 emissions but emission of N_2O increases. Since N_2O possesses higher GWP, the increased N_2O nullifies the benefit obtained by decreasing CH_4 and CO_2 fluxes. Thus, water management strategies for mitigating N_2O emissions from rice fields may increase CH_4 emission, and vice versa. However, if application of mid-season drainage does not coincide with high NH_4^+ in soil, then it may reduce both CH_4 and N_2O emissions.

2. Crop residue management: Rice straw is the primary source of C for CH_4 production during the early growth period of rice plants. Hence when rice straw is incorporated to the soil, the emissions of CH_4 can increase during the rice-growing period. The timing of residue incorporation, however, can be managed to reduce CH_4 emissions during the rice growing season. The potential of N_2O emissions increases when the amount of N available for microbial transformation is enhanced through crop residue application (Eichner, 1990). But it has also been reported from China that straw application decreased N_2O emission and increases soil carbon (C) sequestration, but the magnitude of its effect on CH_4 increase is so high that the GHGs benefit with decreased N_2O emission or SOC sequestration is negated. Thus, application of intermittent irrigation in combination with straw incorporation can prove to be an effective mitigation tool in comparison to continuous flooding and straw application (Nayak *et al.,* 2015).

3. Conservation tillage: Changing from conventional to conservation tillage which aims at reduced tillage and soil disturbance in rice based cropping system can result in higher C sequestration. No-till farming in monoculture paddy soils greatly suppress the emission of CH_4 for short terms but increases its emission upon practising for a longer time.

4. Nitrogen management: Management practices for minimizing N_2O emissions from rice paddy soils and increase NUE include better matching of N supply to crop demand, integrating more closely crop residue management with crop production and using improved fertilizer management techniques including slow release fertilizers, nitrification inhibitors and timing of fertilizer application. N fertilizer generally increases plant growth in turn increasing carbon supply for methanogens and providing a larger aerenchymatous cell pathway for transport of CH_4 from the soil to the atmosphere. At the biochemical level, NH_4^+ inhibits CH_4 consumption which is thought to occur because CH_4 and NH_4^+ are similar in size and structure and as a result, CH_4 monooxygenase (the enzyme that oxidizes CH_4) binds and reacts with NH_4^+ instead of CH_4. However, at the microbial community level, N fertilization stimulates the growth and activity of methanotrophs leading to a reduction in emissions. Fertilizer N source influences both CH_4 and N_2O emissions. The use of sulphate containing fertilizers or amendments has been proposed as a means of mitigating CH_4 emissions. Three possible mechanisms as to how sulphate (and other electron acceptors) could suppress methanogenesis were proposed. First, the reduction of electron acceptors could reduce substrate concentrations to a value that is too low for methanogenesis. Second, the presence of electron acceptors could result in a redox potential that is too high for methanogenesis. Third, electron acceptors could be toxic for methanogens (Segers, 1998).

5. Use Nitrification inhibitors or slow release fertilizers: Include N fertilizers with nitrification and urease inhibitors as well as slow-release N fertilizers. They are applied to increase N use efficiency and minimize N losses associated with ammonia volatilization, nitrification and leaching. Nitrification inhibitors are compounds that delay bacterial oxidation of NH_4^+ and include compounds such as dicyandiamide (DCD), thiosulfate, calcium carbide, and neem (various products including nimin from *Azadirachta indica*). Urease inhibitors such as hydroquinone are compounds that delay the hydrolysis of urea by suppressing the enzyme urease which transforms amide-N in urea to ammonium hydroxide and ammonium ions. Finally, coated or encapsulated N fertilizers are conventional soluble mineral N fertilizers with a protective, water insoluble coating to control dissolution, nutrient release and duration of release.

6. Direct Seeding of Rice: Direct-seeding of rice (DSR) could be a potential option for reducing CH_4 emission. CH_4, as already stated above, is emitted from soil when it is continuously submerged as in case of conventional puddled transplanted rice. However, the DSR crop does not require continuous soil submergence, thereby reducing or totally eliminating CH_4 emission when it is grown as an aerobic crop. As the DSR reduces CH_4 emission drastically it has considerable potential to reduce the GWP (about 75%) compared to conventional puddled transplanted rice.

7. Integrated rice-fish farming: Integrated rice-fish farming can reduce CH_4 emissions by 23% and increase N_2O emissions by 4% compared to rice monoculture (Nayak *et al.,* 2015). With numerous other advantages, such as greater yield, pest and weed control, disease resistance, increased nitrogen efficiency, integrated rice-fish could deliver GHG benefits as well as economic benefits. Mineralization of the forage residues in the field increase soil NH_4^+ contents which can facilitate CH_4 oxidation. The increased soil NH_4^+ contents by feeding can boost nitrification, thus increasing N_2O emissions. Moreover, feeding can boost the foraging activity of fish, and thus accelerate the gas exchange among soil, water, and atmosphere, which would result in the increase in soil Eh. The increase in soil Eh would decrease the activities of soil methanogens to reduce CH_4 emissions.

8. Organic manure application: Application of fermented biogas residue emits less CH_4 emission as compared to unfermented manure. With the additional carbon benefits acquired by displacement of conventional fossil fuel energy with biogas, use of biogas residue in rice field can provide soil fertility with less CH_4 emission. Application of livestock manures decrease N_2O emission whereas application of green manure increases N_2O emission. Increase in CH_4 emission with livestock manure depends on water regime. Livestock manure application has a significant negative effect on N_2O emission, positive effect on CH_4 emission and SOC sequestration.

9. Use of biochar in rice fields: Application of biochar produced by pyrolysis of rice straw increase the sequestration of carbon in soil. At the same time, it decreases CH_4 emission from rice field due to an increase in the population of methanotrophic bacteria and a decrease in the ratio of methanogens to methanotrophs. However, the emission of N_2O from rice fields on application of biochar varies with the water filled pore spaces in the soil. With higher water filled pore spaces the emission of N_2O is high and vice versa. This is due to the presence of N as NH_4^+ in waterlogged paddy fields and during drainage periods nitrification of NH_4^+ occurs. However, the mechanisms governing the emission of N_2O due the application of biochar needs further investigation since long term impacts of biochar are still unknown.

Conclusion

Water management through alternate wetting and drying or intermittent irrigation or mid-season drainage proves to be an effective mitigation tool to reduce CH_4 emissions on the other hand it increases N_2O emission. Management of nitrogenous fertilizers through nitrification inhibitors or slow release fertilizers or right source of fertilizer reduces the emission of N_2O. Incorporation of rice straw in rice fields increases the emission of CH_4. Biochar application in rice is effective in reducing GHG emissions for short term basis only. Integrated rice-fish farming increases or decreases the emission of CH_4 and N_2O depending on the foraging habit of the fish.

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Molasses: An Organic Substance for Improving Crop Yield, Soil Fertility and Plant Health

Article ID: 31189

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Introduction

Molasses, an adhesive brown liquid organic material with a specific gravity of 1.4, is a by-product in the industrial process of producing crude sugar from *Saccharum officinarumand* Beta vulgaris. It is the most easily decomposable organic substance and source of alcohol and other chemicals. It is an important constituent of animal feeds. The use of sugar beet molasses in agriculture stimulates nutrient elements uptake efficiency and soil biological activity. Several studies have shown that the molasses, organic acids, amino acids, humic and Fulvic acids have significant effects on plant growth. Sugar beet molasses contains different amounts of humic, fulvic and amino acids (Samatav and Samatav, 2014). Humic substances are the major components of soil organic matter, and they are used in various areas of agriculture such as soil chemistry, fertility, plant physiology, as well as environmental sciences, because of multiple ways in which these materials can greatly benefit the plant growth (Lobartini et al., 1997). Molasses sterilize soil partially and increase nitrogen fixation (Rouillard, 1954). The majority of sugar producing countries have found more profitable outlets for their molasses and do not use much on the land. it may be concluded from work in these, and other countries, that where soils are deficient in potash and of poor structure, the application of molasses is highly beneficial. In the past molasses has been used as a fertilizer and soil improver particularly on sandy soil and soil of poor structure (Barnes, 1954). Molasses supplies carbohydrates and alters C: N ratio which affects soil microbial ecology and lowers plant parasitic nematodes as well as provides other favourable effects on plant growth (Schenck, 2001). Filter mud cake, FYM and molasses increased NPK uptake and yields (Abo-Baker, 2017). Molasses improves soil aggregation and reduces surface crusting in hard-setting soils (Wynne and Meyer, 2002). In the soils, high in potash with good physical properties, the response appears to be proportional only to the nitrogen content of the molasses, and can be equalled by the application of ammonium sulphate or any other form of nitrogen. The effect of molasses on the soil is firstly to supply considerable quantities of plant food, particularly potassium, but also appreciable amounts of nitrogen, magnesium, phosphate and calcium. It improves the tilth of soil and bring about an increase in the number and stability of the soil aggregates.

What is Molasses?

Molasses is a highly viscous and dark coloured organic substance produced in the process of sugar refining. It is made by boiling down sugar cane or sugar beet juice into a thick syrup. Once sugar crystals are extracted, a syrup that remains is called molasses. Different types of molasses are available, they vary in sweetness and in the way they are extracted. Molasses made from sugar cane is often made into sweeteners or used as a flavouring for foods. Sugar beet molasses, on the other hand, has an unpleasant smell and is unpalatable, so it is normally used as an animal feed additive. Not all types of molasses are suitable for soil application. Only the organic molasses is suitable for crop production.

Types of Molasses

There are different types of molasses, from light coloured molasses that is pure sugarcanesyrup, to dark molasses and then blackstrap molasses which is denser and thicker than the other types. Blackstrap molasses has undergone multiple boiling and extraction processes, so that it has the highest concentration of vitamins, micro and macro elements. It is very rich in calcium, iron, magnesium, potassium and other valuable elements.

Table 1: Advantages and Disadvantages of Using Molasses as a Fertiliser

Advantages	Disadvantages

• Molasses is a good source of potassium. • Increased organic matter and microbial activity improves nitrification. • There are numerous trace elements in molasses in appreciable amounts. • Molasses improves soil aggregation and reduces surface crusting in hard setting soils. • Potential 5 to 10% response in cane yield on low fertility soils.	• Difficult to handle and apply – machinery implications. • Only suitable for flat and undulating terrain but can be applied on steeper lands. • Molasses needs to be collected rateably from the mill but is not necessarily applied rateably to the fields – storage implications. • Nutrient composition of molasses varies and the evenness of application is questionable. • Risk of soil and water pollution if not properly applied.

Composition of Molasses

The composition of molasses varies according to numerous factors that include the maturity and variety of cane milled, climatic conditions, soil type, fertiliser history and process of manufacture (Baker, 1975). In general molasses comprises about 20% water and 80% solids of which 55% is sucrose, 25% non-sugars and 10% mineral constituents usually represented as sulphated ash. The fertiliser value of molasses is due mainly to about seventy per cent of the potassium in the cane crop entering the mill, going into solution with sucrose in the juice and reappearing in the inorganic fraction of molasses.

Effect of Molasses on Soil

Soil application of molasses on sugar beet growth was more effective than foliar applications. Apart from supplying nutrients, some of the other beneficial effects of molasses reported by researchers included a physical improvement in soil structure and an increase in the biological activity of beneficial micro-organisms such as soil fungi, following partial sterilization of the soil (Wynne and Meyer 2002). Pyakurel et. al. (2019) reported that the maximum pH was found on controlled soil (5.96) and the least was found on soil application of molasses (5.54). Molasses stimulate the production of organic acids in the soil which helps to decrease pH of the soil (Abo-Baker, 2017). The decomposition of molasses produces carboxylic groups which, after dissociation may decrease soil pH. The maximum SOC was found on combined application of molasses and organic fertilizer in soil (4.51) which was statically similar to soil and foliar application of molasses and least SOC was found on controlled soil (3.76).Molasses is used primarily as a source of K. It also contains secondary elements in small quantities such as P, S, Ca, Mg and numerous trace elements. Molasses also contains different amounts of humic and fulvic acids and amino acids exhibiting hormone-like activity (Leventoglu and Erdal, 2014).

Effect of Molasses on Crops Performance

Molasses increased root and shoot length, and also root and shoot dry weight (Suliasih and Widawati, 2017). Sanli et. al.(2015) reported that root and polar sugar yield can be increased (more than 20%) with molasses applications and 50 kg/ha molasses application to soil gave the best results. Further research is required in diverse planting environments to determine economically feasible application level of molasses while comparing it with other manures and organic fertilizer sources. Pujar (1995) reported that foliar application of molasses increased uptake of Zn, Cu, Fe and Mn in corn and wheat. Chandraju et al. (2008) reported that the use of a diluted solution of molasses will increase nutrient uptake and yield of leafy vegetables. Makela et al.(1998) stated that the Glycinebetaine, product from sugar beet, is purified from molasses during sugar processing, increased the yield and the number of tomato fruits and increased the rate of net photosynthesis of tomato plants. Molasses contains high levels of sugar and its fermentation causes productions of CO2 (Mweresa et al., 2014).

Conclusion

Molasses is used as both nutrient and insecticide. It helps in keeping pests away from plants for ensuring the speedy growth. It used primarily as a source of K. It also contains secondary elements in small quantities such as P, S, Ca, Mg and numerous trace elements. In the soil it can feed microbes to stimulate the conversion of nitrates to the more efficient NH2 to synthesize protein more directly by the plants. The roots can directly absorb some of the sugars into the sap stream to supplement the leaf supply to fruit where it is most needed, and directly feed the roots for continued productive growth.

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All-in-One Roto Seed Drill for Efficient and Economic Operations in Indian Agriculture

Article ID: 31190

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Summary

Rotavator means use of rotary power for doing work. It is a tractor mounted PTO operated machine which is used for both primary and secondary tillage operations. It uses the tractor engine power directly to the soil by means of PTO with reduced slippage. The all in one rotary tiller does several operations at a time. It helps in opening up of any type of land (dry, wet, sticky), pulverizes the soil to provide good tilth and levelling the soil at the same time. Besides, seed cum fertilizer drill is used for both sowing the seed and fertilization process after seed bed preparation. The seed drill effectively sows seeds at equal distances and drops the fertilizer at proper depth and helps to avoid wastage. This is used for sowing different types of seeds. Rotavator is used for land preparation and seed cum fertilizer drill is used for sowing the seed along with the fertilizer application. Both the operations are done by using different implements one after another. Rotovator and seed cum fertilizer drill together combined as roto seed drill for doing two different operations simultaneously at the same time. This not only reduces the operating time but also increases the efficiency, beside making the operation so economical.

Introduction

Roto seed drill is a machine which is specially designed for direct sowing of seed after harvesting of paddy or any other crop besides, crushing and pulverizing the soil by mixing the stubbles of previous crop. Hence this can be called as all-in-one agricultural implement which helps in land preparation for good seed bed and sowing of seeds simultaneously at the same time by maintaining proper spacing and placing the fertilizer at proper depth without wasting the seed and fertilizer. This reduces the operating time and increases the efficiency beside making the operation so economical.

Principle of Operation

Roto seed drill works by means of rotary power which is generated by the blades used on each flange clamped together to the rotor shaft for generating the required power. More the number of blades on the flange and less the distance between the blades results in efficient pulverization and better crushing of clods of the soil, besides, the seed cum fertilizer drill consists of a seed box (for placing the seeds), fertilizer box (for placing the fertilizer), seed and fertilizer metering mechanisms, seed tubes, furrow openers, adjusting lever for seed and fertilizer rate and power transmitting wheel or transportation wheel. The fluted rollers inside the seed box, which are driven by a shaft that gets power from wheels. Fluted rollers fastened within the seed box, receive the seeds into longitudinal grooves and drop them in the seed tube which is connected to the furrow openers. By shifting the rollers sideways, the length of the grooves exposed to the seed, can be adjusted and hence the total amount of seed sown can be varied. Based on the different field conditions, the working width of the roto seed drill can be increased or decreased according to the necessity. The speed of the rotor can be reduced or increased by the changing the size of the gears available within the gear box according to different field conditions. Different working widths of Roto seed drill are available for different field conditions. Matching the horse power of the tractor with working width gives efficient work. Change in working width of the machine also changes the number of blades on the rotor shaft and number of furrow openers of seed drill.

Benefits of Roto Seed Drill

Roto seed drill is the combined version of rotavator and seed cum fertilizer drill for superior pulverization of the soil and better soil tilth condition for sowing the seeds and dropping the fertilizer at a desired depth for better seed germination in a single pass.

The following features makes Roto seed drill as all-in-one agricultural implement.

1. Preparation of fine seed bed, sowing of seeds, dropping the fertilizer in a single pass.

2. It saves consumption of fuel and reduces the operating time
3. It is precise in operation by maintaining proper spacing between the rows as well as incorporating proper amount of fertilizer at desired depths.
4. The size of the blade is bigger for better crushing and mixing of soil.
5. Anti-loosening of nuts and bolts for safe operations.
6. Strong and reliable in operation.
7. Works satisfactorily in both wet and dry field conditions.
8. Multi depth operations for different field conditions.
9. Rotor speed can be varied as per the tilth quality required and the soil condition available.
10. Reduced noise during operation.
11. Saves more time and prevents tractor from wear and tear.
12. Heavy duty gear box which helps the machine to work smoothly and efficiently.
13. It is very helpful in paddy, sugarcane, banana and vegetables.
14. It mixes effectively, the stubbles of previous crop which fertilizes the soil.
15. The seed drill attachment can be detaching easily and use both rotavator and seed drill separately.

Conclusion

Roto seed drill can be best suitable for almost all types of field condition. Instead of using two different implements/machineries for seed bed preparation as well as for sowing the seeds along with fertilizer application, it is desirable to use a single machine which works satisfactorily in desired depth and soil conditions in a single pass. It reduces labour, time, fuel and increases efficiency of the operation besides being economical in operation. But the right thing to achieve desirable field conditions is to match the available tractor horse power with the roto seed drill size and the blades along with furrow openers required for different field conditions.

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Emerging Technology in Fertiliser Recommendation for Horticultural Crops

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Introduction

There are countless models and decision support tools currently under development or already available for describing and predicting the effects of land management practices on soil nitrogen dynamics. While many of these models have been used effectively for modelling soil Nitrogen (N) dynamics in research situations (Paustian et al., 1992). Soil N models must meet specific criteria in order to be useful as decision support tools for farmers, especially farmers who are striving to comply with the Nitrates Directive.

Computer models is a broad term used to describe a variety of computer programmes, which can be conceptual, analytical or numerical, and help to identify, explain and tackle problems (Defra, 2006). Decision support tools (DST) are software packages based on models that present key information in a "decision appropriate fashion using computer power to search through many thousands of options for viable management solutions" (Defra, 2006).

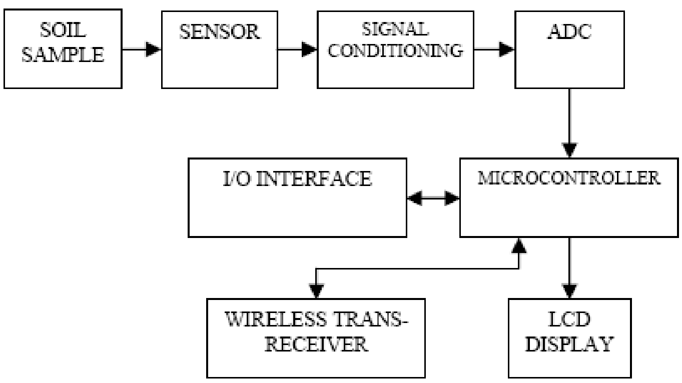
Technologies

1. Precision agriculture - mapping soil fertility in a field through the use of Global Positioning System (GPS) -based maps and use of variable rate application equipment.
2. Site-specific management.
3. Remote sensing - electromagnetic energy that is emitted or reflected from plants and convert this energy into data that can be used in soil fertility evaluation.

The ultimate value of these increasingly sophisticated technologies, however, lies in our ability to interpret the results. An ideal recommendation system would need the following to be adopted by farmers:
1. Show financial / environmental benefits of saving on N applications.
2. Needs to be easy to understand / implement / no extra work load.
3. Needs to be low cost.
4. An effective tool for technology transfer is required, for example Ireland BETTER farms / discussion groups (theory into practice).
5. Link up with industry partners and train / understand new technology.
6. A range of dissemination methods.
7. Provide technical support / website / iPhone etc.
8. Monitor and fine tune the system to meet crop requirements.

Models for Horticultural Crops in India and Other Countries

1. India:



Automated Soil Testing Device: Automated Soil Testing Device is an electronic device, which can be used to measure N (Nitrogen) P (Phosphorous) K (Potassium) & pH (Potenzy hydrogen) values to ensure the fertility of soil in the field of agriculture to select the suitable crop and also the type of fertilizer to be used. Automated Soil Testing Device is a simple & user-friendly device so that any person can test the soil without the presence of an operator. The system also provides the information about the crops that can be grown in respective soils. Wireless communication system has been incorporated for interacting with the experts (Suresh et al., 2013).

2. Spain:

In Spain there is no DST that farmers use directly themselves for N management at a farm level. Nevertheless, in each region (Spain is divided in 17 Regions) there is a farm advisory service. These advisers use DSTs and supply information to farmers electronically. In many cases, the farmers fill in farm-specific information on-line, and receive recommendations electronically. Examples of these DSTs are GIN and SIAR.

a. SIDDRA: The software tool SIDDRA generates N recommendations for garlic, onion, lettuce, olives, orange trees, pear, peach, and many others crops common in the Mediterranean region. It is available throughout Spain and Portugal. The foliar interpretation systems considered by the system SIDRA are: the normally accepted range; the standard deviation index (IDS); Integrated diagnosis and recommendation system (DRIS); Modified Integrated diagnosis and recommendation system (M-DRIS); and Nutrient composition diagnosis (CND). SIDDRA allows elaborating new tables of references for new crops or interpretation systems. With this system the creation of a data base is intended to diagnose and understand more effectively the foliar, soil and water analysis in order to determine the nutritional requirements for plants, ensuring the sustainability. Website: http://www.fertiberia.es/templates/SP.aspx?M=235&F=163.

b. GIN (Gestión Integral del Nitrógeno): It is a decision support tool specific to the Castilla-La Mancha región of Spain. Farmers do not download the software directly, rather they fill in a brief questionnaire with data from their farm (reference number, crops, expected yield, soil type and analysis) and the advisory service (ITAP) provides them with a fertilizer recommendation with details about the N balance at their farm. The questionnaire can be found at: http://www.itap.es/ITAP-SAF/2analisis/1Analisis_Consultas.asp. The software has been validated for: grain corn, silage corn, barley, wheat, garlic, onions, oats, rapeseed, sunflower, poppyseed, and grapevines.

c. SIAR (Servicio Integral de Asesoramiento al Regante): It is a support system developed mainly for irrigation management. The main goal is to supply farmers with information (meteorological, crop and soils) and advice to adapt water application to crop needs. In addition, it provides advice about fertilizer applications, particularly nitrogen recommendations based on a simple balance method. SIAR has been validated for cereals (wheat, barley, maize, etc.), legumes (beans, faba beans, peas, soya, etc.), horticultural crops, and many others. It is applicable for all 15 regions in Spain that include irrigated crop land. Sample questionnaires of Spain are found at: http://crea.uclm.es/siar/fertilizacion/localiza.php for fertilizer

d. CROPSYST (Cropping System Simulation Model): This model has been validated for cereals (wheat, barley, maize, etc.), legumes (beans, faba beans, peas, soya, etc.), horticultural crops, and many others. It is applicable in the Iberian Peninsula and many other countries in Europe and the world. The model can be downloaded for free by the users at: http://www.bsyse.wsu.edu/cropsyst/

e. FertOrgaNic (http://www.fertorganic.org/DSS/DSS.asp): It was developed in an EU-FP5 project that focused on improved organic fertilizer management for high nitrogen and water use efficiency and reduced pollution in crop systems. This work was focused on irrigated potato systems where the timing of water inputs controls the mineralisation of nitrogen from organic inputs.

3. United Kingdom: Fertilizer recommendations for field and horticultural crops in the UK are included in the Defra publication commonly referred to as RB209 (Ministry of Agriculture Fisheries and Food, 2000). This provides recommended rates of N fertilizer application for a range of crops, taking into account the soil nitrogen supply (estimated from the management history of the field, or by soil testing). Requirement for a DST used for fertilizer recommendations to farmers in the UK should be that it is based on the recommendations included in RB209.

a. WELL-N: It was developed by HRI (Horticulture Research International) at Wellesbourne, UK. It evolved from a research model (N-ABLE). It is a dynamic simulation model that incorporates generalized relationships for growth based on temperature and N concentrations of the plant. WELL-N is only designed to make fertilizer recommendations for single year crops.

b. PLANET: The Fertiliser recommendations for field vegetable crops in England Wales and Northern Ireland (In RB209), also known as "The Fertiliser Manual". The PLANET (Planning Land Applications of Nutrients for Efficiency and the environment) Field-level Planning and Record Keeping module is a computerised version of Defra's 'Fertilizer Recommendations (RB209)' publication (7th edition, December 2000) developed by ADAS (formerly the UK Agricultural Development Advisory Service) for farmer and advisor use. It is a static DST that provides a quick and easy way of obtaining RB209 recommendations for arable, horticultural or grassland crops in each field, each year. It will allow the user to develop a nutrient application plan for a group of fields covering the use of nitrogen (N), phosphate (P_2O_5), potash (K_2O), magnesium (as MgO), sulphur (as SO_3), sodium (as Na_2O) and lime. This framework has been utilised to provide recommendations for 21 crops in the new fertiliser manual.

4. Germany:

Germany – N Expert System: The computer program N-Expert calculates field specific fertiliser recommendations for vegetable crops. Since the calculation is based on simple plant growth- and soil-models, which need only few input data, the program can be used by both growers and advisers. http://www.igzev.de/publikationen/n-expert-a-decision-support-system-for-vegetable-fertilization-in-the-field/

5. Netherlands: Dutch scientists were among the early pioneers contributing to the initial development of ecological models during the 1960's (Bouman et al., 1996). NDICEA is currently one of the few models that is effectively being implemented as a DST (van der Burgt et al., 2006). The development of the NDICEA model, which was originally developed for improved N management in organic production systems, may be an instance of this technology transfer process.

a. NDICEA: NDICEA (Nitrogen Dynamics in Crop Rotations in Ecological Agriculture) model is more geared towards processes at a field level and it captures both short term N dynamics as well as annual nutrient balances for arable crops. The model has been used and tested for a large number of field-grown crops in the Netherlands including agronomic crops (e.g. potato, rye, wheat, barley, beets), vegetables (e.g. spinach, lettuce, cabbage, carrot, leek) and flower crops (mainly bulbs such as tulips and daffodils). The model can be downloaded from the internet from the official NDICEA site (http://www.ndicea.nl/).

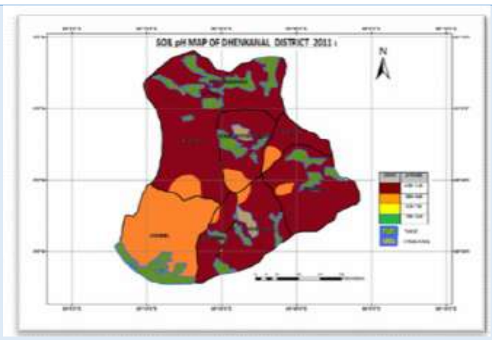
b. DST for management of organic matter in organic greenhouse production: The DST designed for organic greenhouses was a follow up on the "organic greenhouse nutrient application standard" *(Biokas bemestingsrichtlijn)* DST that was developed previously. This DST assessed mineralization rates from soil organic matter and different pre-plant applied organic amendments during the growing season(e.g. manure tea or feather meal). This model has been validated for peppers and tomatoes in three commercial greenhouse operations in the Netherlands (Visser et al., 2006)). The model is operational for tomatoes, peppers, cucumbers, lettuce, radishes, beans and chrysanthemums). It is applicable to greenhouse operations in NW Europe. The language interface is Dutch and it is programmed using Delphi. The model is freely available from the developers (leo.marcelis@wur.nl).

Needs for Future Research and Dissemination (Rahn, 2013)

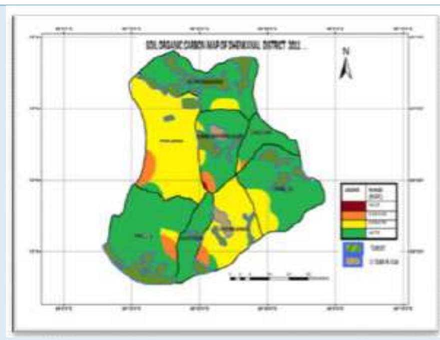
1. Core funding for satisfying basic technology (not necessarily innovative) is urgently needed before the expert's base disappears.
2. Pooling of data on nutrient uptake of optimally fertilised crops such as used in the UK RB209, KNS System, SIDDRA.
3. Use of Models to improve understanding in this area.

Conclusion

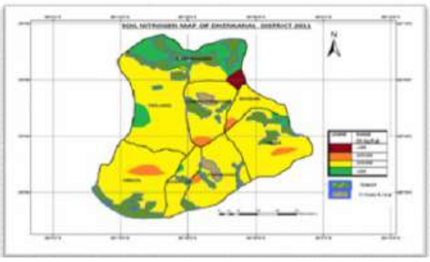
Decision support tools must meet specific criteria in order to be useful for farmers and advisors at the farm level. In particular, they must be easy to use and provide fertilizer recommendations that are reasonably accurate - N recommendations that are too high (e.g. when target yields are unrealistically high, or when soil levels of mineral N are underestimated) can lead to problems with nitrate leaching. Accuracy of decision support tools is improved when they include actual measured values for certain parameters (e.g. soil mineral N, manure total N) when they are available. The effectiveness of this approach including: farmer acceptability, effects on soil and water nitrate levels and effects on crop productivity.



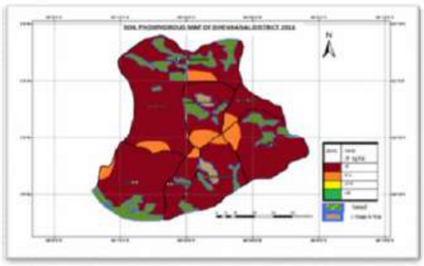
GPS and GIS based soil pH map



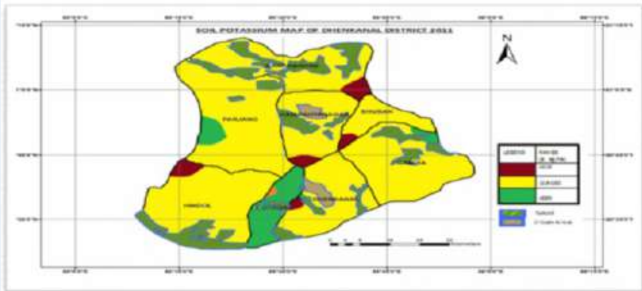
GPS and GIS based soil organic carbon content map



GPS and GIS based soil available nitrogen content map



GPS and GIS based soil available phosphorous content map



GPS and GIS based soil available potassium content map

"Upon handful of soil our survival depends. Husband it and it will grow our food, our fuel, and our shelter and will surround us with beauty. Abuse it and the soil will collapse and die, taking humanity with it. — Atharava Veda, the Sanskrit Scripture, 1500 BC."

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Development of Disease Resistance in Plant Using a Novel Technique CRISPR / CAS9

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The challenge for all disciplines of agriculture is to increases production and improves the quality of produce. As a global scenario, plant diseases are a major challenges and biotic constraints which leads to significant crop yield losses in terms of both quantity and quality of the produce. Over the past few decades, the excessive & unnecessary use of chemical pesticides was the dominant form of disease control and subsequently created many problems such as the frequent emergence of fungicide resistance in pathogens and the harmful effects of fungicides to human health and negative impact on plants and environment. To overcome all these problems, adopting integrated disease management strategy as a alternative tools for disease management. Integrated disease management (IDM) is a sustainable approach which combines all the suitable techniques such as biological, cultural, physical and chemical control strategies in a holistic way rather than using a single component strategy proved to be more effective and sustainable and minimizes economic, health and environmental risks. But in current scenario, due to the changing climatic conditions, the plant pathogenic organisms have developed the different types of resistance mechanisms against pesticides and also emergence of new race of the pathogens in environment through which diseases caused by the pathogens has become resistant which is very difficult task to manage it effectively by adopting the traditional approaches including IDM. So, for this, scientists have evolved a novel, emerging and latest and most popular technique known as CRISPR/CAS9 based genome editing technology through which plant disease can be managed by developing disease resistance in plants at genetic level. CRISPR/CAS9 is an important tool for genome editing in an organism. Genome editing is a technology which can produce modifications such as insertion/deletion/substitution at specific sites in the genome of an organism.

CRISPR stands for clustered regularly interspaced palindromic repeats. It is an array of short repeated sequences separated/ interspaced by spacers sequence derived from foreign DNA with unique sequences. First report of CRISPR clusters by Ishino et al. in E. Coli bacteria in 1987. CRISPR is a defence system in bacteria which fight against the phage infection and provide sequence-specific adaptive immunity acts by integrating short virus sequences in the cell's CRISPR locus, allowing the cell to remember, recognize and clear infections. There are different tools for genome editing process which includes Meganucleases, Zinc Finger Nucleases (ZFNs), Transcription Activator Like Effector Nucleases (TALENs), CRISPR/Cas9 and CRISPR/Cas12a (also called CRISPR/Cpf1). Among these, CRISPR/Cas9 is most popular and efficient technique. It has two components such as Cas9 protein and a guide RNA (cr-RNA). RNA (cr-RNA) guides the Cas9 protein to the complementary sequence on target DNA which is subsequently cleaved by Cas9 proteins. The mechanisms of the CRISPR/Cas9 system can be easily understood by three different stages. The first stage is adaptation, which leads to insertion of new spacers in the CRISPR locus. In the second stage, expression, the system gets ready for action by expressing the cas genes (cas operon) and transcribing the CRISPR into a long precursor CRISPR RNA (pre-crRNA). The pre-crRNA is subsequently processed into mature crRNA by Cas proteins (endo-nuclease activity) and accessory factors. In the third and last stage, interference, the combined action of cr-RNA and tracr-RNA(transactivating cr-RNA) fused into single sg-RNA(small guide RNA) which interact with their target DNA through complementary base pairing and Cas proteins associated with it, recognized the PAM (Protospacer Adjacent Motif) region in target DNA and ultimately degrade/destroy the target DNA and make them inactive. The application of CRISPR/Cas9 is being used at molecular level like gene deletion/ insertion/ replacement, base editing, transcription modulation and DNA labelling, etc and as a practical application level, it is being used in biological research, human medicine, biotechnology and agriculture. In agricultural application, being used as improved yield, pest and disease resistance, herbicide tolerance and improved nutritional quality.

It is simple and cost effective and has got broad spectrum applications in agriculture including plant disease management in future. As a future prospective point of view, to improve the specificity of CRISPR/Cas9 system to prevent off-target mutations and identifying smaller and more efficient Cas9 variants with distinct specificities. Scientists should be focused on more detailed studies on Homology Directed Repair mechanisms and also development of more safe and efficient delivery mechanisms for Cas9/sg RNA into organisms and exploring more potential applications of CRISPR/Cas System. There is a need to overcome the ethical and political barriers through proper awareness of the society.

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Development of Disease Resistance in Plant Using a Novel Technique CRISPR / CAS9

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It is simple and cost effective and has got broad spectrum applications in agriculture including plant disease management in future. As a future prospective point of view, to improve the specificity of CRISPR/Cas9 system to prevent off-target mutations and identifying smaller and more efficient Cas9 variants with distinct specificities. Scientists should be focused on more detailed studies on Homology Directed Repair mechanisms and also development of more safe and efficient delivery mechanisms for Cas9/sg RNA into organisms and exploring more potential applications of CRISPR/Cas System. There is a need to overcome the ethical and political barriers through proper awareness of the society.

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Use of Traps for Control Insect-Pest

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Introduction

Traps to capture insects vary greatly, depending on the target, location, and purpose. Traps may be simple interception devices that passively capture insects, contain lures or baits, or have specific designs and colours to attract a particular type of pest. Traps may be inexpensive and disposable, or more complex. Insect traps are useful tools in pest management programs. For the most part, they are used to monitor the appearance of specific stages of various pests. These monitoring traps do not provide control but instead are used to predict optimal timing of treatment. There are a few cases such as with bagworms and pine shoot that the traps can be used to reduce the populations of the insects.

Flypaper / Ribbon Trap

Flypaper (also known as a fly ribbon, fly strip, fly capture tape, or fly catcher) is a fly-killing device made of paper coated with a sweetly fragrant, but extremely sticky and sometimes poisonous substance that traps flies and other flying insects when they land upon it. Fly paper is considered a pest control device, and is subject to regulation in many countries. A flypaper can be made from strips cut from a thin plastic material (such as grocery bag) covered with a viscous honey or sugar solution. Once dried, the sticky strips can be hung up in locations where flies are most active.

Bottle Funnel Trap

A simple inexpensive bottle funnel trap can be made using an empty plastic drinking container. The top is cut just below the neck, inverted into the body as a funnel, and attached with tape or glue. Small holes cut in the side allow the trap to be hung up. The trap can be baited with various foods or other attractants and placed indoors or outdoors in locations Water containing a drop of liquid detergent or oil to reduce surface tension can be added to drown caught flies. Small flies, such as fruit flies, can be trapped or monitored with a jar or cup baited with apple cider vinegar and a drop of soap. The container is covered with plastic food wrap sealed with a rubber band and holes poked in the top allow odour to escape and flies to enter. Commercial fly traps come in various forms including cups and disposable bags and include dissolvable baits that are mixed to form a drowning solution.

CO_2 Trap

A thermos flask containing dry ice (see Yellow Pages for suppliers) or a bottle containing a solution of yeast, sugar, and water releases a steady stream of CO_2. For the latter, mix ¼ cup sugar and 1 gram brewer's yeast per cup of non-chlorinated or pre-boiled water. After a few hours, a steady stream of CO_2 will be released through the funnel. Because CO_2 is heavier than air, it concentrates at the base of the trap near the floor. Put the container on top of an inverted plastic pet dish or similar container. Cover the outer sides of the dish in fabric or masking tape to allow approaching bed bugs to climb inside, but leave the inside surface clean so that the bugs cannot escape. A thin dusting of talcum powder placed inside the dish ensures trapped bed bugs cannot escape. Traps should be set at night individually near the bed or suspected infestation area. The CO_2 sources are temporary and will need to be replaced for each subsequent monitoring periods.

Glue-Boards or Sticky Cards

1. How to make to make?

a. Flying insects are attracted to bright yellow, blue, and white colours. Traps, consisting of square pieces of cardboard or hard plastic coated with sticky substances placed throughout the growing area among the plants, attract them. Strips of yellow or blue sticky plastic can also be used around or inside the growing ranges.
b. Cut plywood or sturdy cardboards, 3 inches wide x 5-7 inches long.
c. Make experimentations on the sizes and forms of your board traps.
d. Paint boards with yellow or blue or white depending on the pests you want to monitor and trap.

2. How to use:

a. Fasten boards to stakes with nails or staples or papers clips or hang them from wire supports.
b. Spread used-motor oil, or plant resin, or vegetable oil, or petroleum jelly directly on your board. Leave a small space uncoated for easy handling.
c. Place traps near the plants, preferably 25 cm away from the plant to ensure that the leaves will not stick to the board, but not facing direct sunlight.
d. Hang and position the traps at 50-75 cm zone above the plants.
e. As a general rule, place 1 to 2 sticky cards per 100 square meter growing area. Replace traps at least once a week. It is difficult to determine the population of newly trapped flies/moths on a sticky card to those previously trapped ones.

Yellow Sticky Traps

Bright yellow sticky traps are used for monitoring/controlling of the following pests:

1. Aphids
2. Cabbage root maggot
3. Carrot rust fly
4. Cabbage white butterfly
5. Cucumber beetle
6. Fungus gnat
7. Onion fly
8. Thrips
9. Whiteflies

10. Castor oil smeared yellow colour empty tins or plates are kept in the field. White flies get trapped on these sticky traps. These are wiped out every day and castor oil are applied again.

Blue Sticky Traps
Bright blue traps are for monitoring thrips.

White Sticky Traps
Bright white traps are for monitoring flea beetles and tarnished plant bugs.

Pheromone Traps

How to make	How to use
• Make 10 to 12 holes into an old 1 liter plastic bottle or 3 holes on each side of 1 liter ice cream container, to allow moths to enter. • Heat a small piece of metal to make the holes easily. • Put a wire from the cover to suspend the bait. • Secure the pheromone dispenser align with the entrance holes inside the trap. • Make a rectangular opening into the lower part of the container for removing the moths caught.	• Half-fill the trap with soapy water. • Put bait in the pheromone dispenser or suspend the pheromone capsule from the lid using string or wire. • Close the container. • Attach the trap to a bamboo or wooden stake or hang on branch of a tree. • Place traps for different pests at least 3 meters apart. If traps are used for monitoring the pests, 2-3 traps are enough for 1 ha field.

Pests Controlled Reminders While Ups
1. Cabbage looper.
2. Cotton bollworm.
3. Cotton boll weevil.
4. Corn earworm.
5. Diamondback moth.
6. Fruit fly.
7. Hornworm.
8. Leaf folders.

Light Trap
Light trap is a device used at night in the field to collect moths and other flying insects such as:
1. Armyworm.
2. Bugs.
3. Cutworm.
4. Flies.
5. Gnats.
6. Heliotis / Helicoverpa.
7. Leafhoppers.
8. Planthoppers.
9. Stem borers.

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Phanerogamic Parasites Diseases

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Introduction

Certain flowering plants (Phanerogams) also parasitize the crop plants in addition to the microorganisms. They mostly belong to Loranthaceae, Convolvulaceae, Scrophulariaceae, Orabanchaceae, Lauraceae, Santalaceae and Balauophoraceae. They produce flowers and seeds and parasitize their host by drawing nutrition and water. Some phanerogams have green leaves, roots and they have the ability to synthesis food materials but they obtain only the mineral constituents of food from the host, then they are called hemiparasite/waterparasite/partial parasite. Some of the phanerogams which do not have any chlorophyll completely depend on host for water and all minerals.

They are called as holo parasite or complete or total parasite. The phaneroganic plants are divided into.

1. Stem parasite:

a. Total parasite - Cuscuta
b. Semi-parasite- Loranthus

2. Root parasite:

a. Total parasite - Orabanche
b. Semiparasite - Striga

Phanerogams have haustoria as absorbing organ, which are sent deep into the vascular bundle of the host to draw water and nutrients. The haustoria in general secrete some pectolytic and cellulolytic enzymes which soften the host tissue. Haustoria have higher osmotic pressure than that of host tissue which facilitates easy absorption of nutrients. The affected plants show stunting, chlorosis and death.

Stem Parasite

1. Complete / holo / total stem parasite: *Cuscuta* sp.

a. *C. campestris, C. trifoli, C. planiflora Dodder C. indicora.*

i. Commonly known as gold thread, hellvine, hair weed, devil's hair and love vine.
ii. Attacks alfalfa, clover, onion, flax, sugar beet, potato, chillies many ornamentals etc.
iii. It is a yellow or orange vine strand which grow and twin the plant. They do not have leaves but bear only very minute scale leaves.
iv. Dodder produces flowers and fruits. Flowers are white, pink or yellowish, which form seed.
v. On severe infection, they form a dense and tangled mat on the crop.
vi. Seeds of dodder overwinter in the infested soil, germinate to produce a slender yellow shoot, make contact with the susceptible host plant, encircle and send haustoria into the vascular bundle of the host.
vii. It does not produce any roots. As soon as the dodder is established with the host, base of the dodder shrivels, dries and cut off from the ground. Thus, it completely depends upon the host for nutrients and water.
viii. Thus the affected plants get weakened and yield poorly.
ix. Seeds of cuscuta are mainly spread by animals, water and implements.

b. Partial / semi / hemi stem parasite: Commonly known Loranthus ,Giant mistletoe, Banda. *Dendrophthae flacata* (Order: Santalales; Family: Loranthaceae)

i. Attacks mango, citrus, apple, rubber, guava etc.
ii. Partial parasite of tree trunks and branches with brown stem, dark green leaves but no roots.
iii. Stem of the parasite is usually thick, and flattened at the node, appears in clusters at the point of attack which can be easily spotted on the trees.

iv. At the point of attachment with the tree, it shows swellings or tumorous growth where the haustoria are produced.

v. This parasite produces flowers which are long, tubular, greenish white or red and borne in clusters.

Dodder parasites on leaf

It spreads on entire plant

On stem and leaf

Whole tree attacked by Cuscuta

Total stem parasite - Cuscuta sp.

Dendrophthoe falcata var. falcate

Dendrophthoe falcata var. coccinea


Development of woody, round abnormal structures on host

Interaction between haustorial roots and host tissue

Development of new branches of Loranthus

Partial stem parasite - Loranthus

vi. It produces fleshy fruits with single seed. The affected host plants become stunted in growth with few small chlorotic leaves.

vii. Dispersal of the seed is mostly through the birds and to some extend by animals.

2. Root parasite:

a. Total/ holo /complete root parasite: Commonly known as Broom rape or *Tokra. Orobanche. cernuva* var . *dessertorum, O. robancre ramosa, O.minor, O. crenata* (Order: *Orchidales,* Family: *Orabanchaceae).*

i. It is a serious parasite in tobacco, tomato, brinjal, cabbage, cauliflower etc.

ii. It is an annual fleshy flowering plant growing to a height of about 10 - 15" with pale cylindrical stem, thickened at base and covered withbrown scaly leaves that end in spikes.

iii. Plants lack chlorophyll, flowers arise from axils of the scale leaves.

iv. Flowers have well developed lobed calyx, tubular corolla, superior ovary, numerous ovules and large four lobed stigmas. Fruits are capsules containing small black reticulate and ovoid seed.

v. Seeds remain dormant in the soil for many years and they germinate due to a stimulant (benzopyran derivatives) present in the root exudate of susceptible host plant Ethylene, gibberellin and coumarins also induce the seed germination.

vi. In tobacco it appears in clusters of 50 - 100 shoots around the base of a single plant 5 - 6 weeks after transplanting. Affected tobacco plants are stunted, show withering and drooping of leaves leading to wilting.

b. Hemi / partial / semi root parasite: Commonly known as witch weed or striga. *S. asiatica* parasite sorghum, maize and sugarcane. *S. densiflora* parasite sorghum and sugarcane.

i. Mostly affect the monocots
ii. It is a small plant with bright green leaves grows upto a height of 15 - 30 cm.
iii. It occurs in clusters of 10 - 20/host plant.
iv. *S. asiastica* produces pink flowers while *S. densiflora* produces white flower with a pronounced bend in corolla tube.

	
Broomrape	**Host and their root parasite**
	
Purple or yellow turft at the base of plant	**Its attached to host and absorb essential mineral element from host**
	
Oranbanche dominated the field	**Presence of broomrape on sunflower field**

Complete root parasite – Orobanche

	
***S. asiatica* – Pink flower**	***S. densiflora* – white flower**
	
Striga on the corn field	**Striga parasites on host root**
	
***S. asiatica* infecting all field**	***S. dendiflora* on corn field**

Partial root parasite – witch weed or striga

v. This phanerogam lack typical root hairs and root cap.
vi. Fruits contain minute seeds in abundance which survive in soil for many years.
vii. Seeds germinate after post-harvest ripening of about two weeks, in response to the host stimulant viz., strigol ethylene, cytokinin, gibberellin and couma in strigol.

viii. This parasite slowly attach to the host root by haustoria, grow below the soil surface and produce underground stem and roots for about 1-2 months. Then it grows faster and appears at the base of the host plant.

ix. Severe infection of striga causes yellowing and wilting of host leaves. Sometime the host plant may die.

Conclusion

A Phanerogams parasitic plant is a plant that derives some or its entire nutritional requirement from another living plant. All parasitic plants have produced flowers and seeds and parasitize their host by drawing nutrition and water. Some phanerogams have green leaves, roots and they have the ability to synthesis food materials but they obtain only the mineral constituents of food from the host, then they are called hemiparasite / water parasite / partial parasite. The haustoria in general secrete some pectolytic and cellulolytic enzymes which soften the host tissue. Mistletoes cause economic damage to forest and ornamental trees.

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Locusts Pose Severe Threat to Agriculture in India

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A moderate infestation from across the border chomped through crops in an estimated 300,000 hectares in Rajasthan and Gujarat in January. The locusts are currently active in Rajasthan, Gujarat, Maharashtra, Uttar Pradesh and Madhya Pradesh. Rajasthan is the worst-affected state, according to the union environment ministry.

Locusts, which look like common grasshoppers, come in swarms during dry spells and can destroy massive swathes of vegetation within days. The Food and Agricultural Organization of the UN had also warned that the impact of the locust attack could be far more serious this year than last year. Some countries in East Africa have already declared an emergency because of the loss caused by locusts.

Armies of locusts swarming across continents pose a “severe risk” to India’s agriculture this year, the UN has warned, prompting the authorities to step up vigil, deploy drones to detect their movement and hold talks with Pakistan, the most likely gateway for an invasion by the insects, on ways to minimise the damage.

Locust attacks are known to cause a considerable drop in agricultural output. Authorities at the national plant protection office said the country was prepared and deploying a wide range of measures. But large-scale invasions could still prove challenging given that India lacks equipment like large sprayer aircraft, experts said. A moderate infestation from across the border chomped through crops in an estimated 300,000 hectares in Rajasthan and Gujarat in January. The authorities say they are preparing to conserve crops during the upcoming summer-sown kharif season, which is most at risk. An upsurge in locust attacks since last year is being attributed to favourable breeding weather caused by a large number of cyclones in East Africa. India, China and Pakistan face the most risk in Asia. Pakistan has already declared an agricultural emergency, according to an Indian official. Locusts can fly up to 150km in a day and a one-square-kilometre swarm can eat as much food as 35,000 people, in terms of weight, in a single day, according to the Food and Agriculture Organization (FAO)’s Desert Locust Information Service bulletin.

A report of a senior locust forecasting officer of the FAO to the government noted that “swarms would be present in Haryana and Punjab, moving east towards Bangladesh similar to 1950 when there were devastating plagues that lasted up to 14 consecutive years.” The situation remains extremely alarming in the Horn of Africa, specifically Kenya, Ethiopia and Somalia, where widespread breeding is in progress and new swarms are expected to form in the coming weeks,” an FAO alert issued to nearly 53 countries, including India, agriculture secretary Sanjay Agarwal chaired a high-level meeting on desert locust control with officials from Rajasthan, Gujarat, Punjab and Haryana, the external affairs ministry and the Hindustan Insecticides Limited.

The Union government has decided to conduct awareness campaigns and training for farmers and officials from these states. According to analysts, such disruptive events create awareness among farmers and provide stimulus to the use of agrochemicals. Though many insecticides or combinations are used to control locusts, considered one of the most destructive pests in the world, chlorpyrifos is one of the key insecticides. While most agrochemical companies generate some revenues from chlorpyrifos, Gharda Chemicals, an unlisted company, is one of the major players in India. However, shortage of agrochemicals in trade due to lockdown post covid-19 and logistics and transportation issues may not allow faster access of agrochemicals to farmers. As India’s rabi season gets over in March and kharif season commences in June, there is negligible farming in India in this period. Hence, analysts believe that there is no immediate impact on Indian agriculture but if the pest attack remains after June, there will be threat to kharif crops in 2020.

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Air Blast Sprayers for Orchard and Vineyard

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Summary

Chemical pesticides have played and will continue to play a major role in the rapid advancement of agricultural production. With time, the quality of the crop as well as yields have been improved and the use of chemical pesticides, herbicides has greatly reduced labour requirements for controlling insects on plants, controlling plant diseases and for controlling the weeds.

But the wide spread use of pesticides has resulted in some serious health problems mainly to the user. Hence improvement of application equipment and techniques to permit the effective use of smaller dosages of chemicals and to reduce drift and harmful residues has become increasingly important as one means of minimizing the problems associated with the use of chemical pesticides.

Present day agricultural pest control equipment includes air blast sprayers, which utilizes an air stream as a carrier for sprays mainly for orchards and vineyard.

Introduction

In recent years there has been a trend towards reduced liquid application rates per hectare, using high concentrations of active ingredient, primarily to reduce the amount of water that must be hauled and handled. Air blast spraying includes mainly Ultra low volume (ULV) spraying, which is defined as the application of undiluted, technical grade, liquid pesticides (i.e., no water added). ULV applications of several pesticides with air blast sprayers gave excellent control of insects, mites in orchard crops.

Air blast sprayers are mainly divided in three categories mainly:
1. Airotec turbo sprayers.
2. Bullet sprayers.
3. Airotec cyclone 1500.

Airotec Turbo Sprayers

Airotec turbo sprayers can be trailed or mounted on tractors thus being recognized as tractor trailed sprayers as well as tractor mounted sprayers. Air Blast technology is being employed in these sprayers to supply adequate air output for orchards/vineyards. Air blast sprayers turn out a mist of fine droplet sizes that are optimized for delivery of plant protection and plant enhancement chemicals. Hence, they are also recognized as Mist blowers. Air blast technology uses axial fans especially suited for different sizes of canopy and air Assisted Sprayer technology works as an atomizer and provided complete coverage to the orchards and vineyards.

Some of the Airotec turbo sprayers which are currently available in market and used in vineyard and orchads:
1. Grape master blast plus (vineyards, pomegranate).
2. V4 616 Grape master blast (Vineyards).
3. Grape master eco plus plus (Air assisted vineyard sprayer).
4. Pome master eco plus plus (Pomegranate plant).
5. Pome master rocket sprayer (Pomegranate plant).
6. Pome master rocket plus plus sprayer (Pomegranate plant).
7. Pome master Linear plus (Pomegranate plants and farms).
8. V4 616 Orange master blast sprayer (Orange plants).
9. Orange master blast plus sprayer (Orange plants).
10. Mango master blast plus vineyard sprayer.
11. Airotec turbo 600 sprayers (Orchard crops and vineyards).
12. Airotec super turbo 1000 sprayer (Spraying for Pomegranate, Orange, Mango, Sapota).

Main Features of Airotec Turbo Sprayers

1. They are compact, light in weight and have strong design.
2. It has multi-purpose applications like spraying, dipping in all orchard and vineyard and it performs equally well in Y-shaped and mandap shaped vineyards.
3. It has 3-way adjustable tyre (Track width, height and tyre position adjustment).
4. Lowest turning radius.
5. Provision of air conveyor in rear side which provides highest air output with perfect air balancing with lowest power consumption.
6. It is available in 3 different variants (600L, 1000L, 1500L)
7. It requires 24 hp and above tractor.
8. It works with tractor PTO having 540 rpm.
9. It contains 20L hand wash tank and 70L rinse tank.
10. Provision of LED projection light for better vision while spraying at night times.

Bullet Sprayers

Bullet sprayers are tractor mounted sprayers. These are light in weight, compact in design and sturdy design and performs well with tractors having 18 hp or more.

Some of the bullet sprayers which are currently available in market and used in vineyards and orchids are
1. V4 616 Grape master bullet sprayer (Grape, pomegranate).
2. V4 550 Grape master bullet sprayer (Grape, pomegranate).
3. Grape master eco plus (Air assisted orchard sprayer).
4. Pome master eco plus sprayer (Pomegranate).
5. Pome master rocket plus sprayer (Pomegranate).
6. V4 616 orange master bullet sprayer (Orange plants).
7. Orange master eco plus plus (Orange plants).

Main Features of Bullet Sprayers

1. It has multi-purpose applications like spraying, dipping in all orchard and vineyard and it performs equally well in Y-shaped and mandap shaped vineyards.
2. Provision of inlet vanes and air recovery duct for achieving the perfect air balancing.
3. Safety devices like pressure relief valve, rear bumper etc. are provided.
4. It works with tractor PTO having 540 rpm.
5. It requires 18hp and above tractor.
6. It has 200L tank capacity and trailer tank can also be attached.
7. Provision of LED projection light for better vision while spraying at night times.

Airotec Cyclone 1500 Sprayers

Airotec cyclone 1500 sprayers, is an air blast sprayer, developed for fruit and vegetables. It performs equally well on fruits like mango, cashew nuts, coconut as well as vegetables. Compact, Lightweight and strong in design. It requires tractor having 35-55 hp range. These are hydraulic operated sprayers.

Some of the Airotech cyclone 1500 sprayers which are currently available in market and used in mangoes are:
1. Mango master cannon orchard sprayer (Mango trees and farm).

Main Features of Airotech Cyclone 1500

1. It is mainly useful for spraying of tall trees like Mango, coconut, cashew nut etc.
2. Hydraulic actuation is provided for spray direction adjustment (both front and rear air duct) as per height of the plant.
3. Back side dual centrifugal impeller system is provided for high air output with lowest power consumption.
4. Axial fan is provided for producing high Air velocity with comparatively very less power consumption, leads to proper penetration & spray coverage
5. It is available in 2 different variants (1000L, 1500L)
6. Water level indicators are present on both front and side.

7. It requires 35hp to 55hp and above tractor.
8. It works with tractor PTO having 540 rpm.

Benefits of Air Blast Spraying

1. It saves labour and time.
2. Wastage of chemical pesticide is less.
3. Five-mode controller and Two-way nozzles provide accurate delivery of chemical.
4. Agitators are provided for constant chemical concentration while spraying.
5. Diaphragm pump is provided to avoid pulsation in sprayer.
6. Uniform coverage giving best crop protection.

Conclusion

Improvement of application equipment and techniques is important so as to permit the effective use of smaller dosages of chemicals and to reduce drift and harmful residues has become increasingly important as one means of minimizing the problems associated with the use of chemical pesticides. Present day agricultural pest control equipment includes air blast sprayers, which utilizes an air stream as a carrier for sprays mainly for orchards and vineyard.

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Sericulture: A Profitable Business

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Introduction

"Sericulture is an agro-based business, in which we raise silk insects for the production of raw silk. In order to boost agricultural production, there are other businesses or industries in India, such as crop production, horticulture production, dairy production, poultry farming, which also support their participation to boost the economy of India. One of them is "sericulture", which we can establish from small to large scale and earn profits of millions at the least cost. In silkworm rearing, an insect, which produces a large number of silks, is reared for silk production. It is a business that makes the most profit at the least cost. We can develop this business easily with any other business. If we talk about silk production, China is the largest producer of silk. India stood second in the production of silk. About the 80% of the silk produced in the country is of mulberry silk, majority of which is produced is the three southern states of Karnataka, Andhra Pradesh and Tamil Nadu followed by West Bengal and Jammu & Kashmir. Silkworm is mainly the second profitable insect after honeybee, which benefits the entire human race, as silkworm helps in increasing the availability of textiles. If we talk about ancient times, China sold silk moth equal to the weight of gold, but if we talk about today, then four varieties of silk are produced in our country as - Mulberry, Tassar, Eri and Muga because with time the demand for silk clothes is increasing. In view of this demand, Farmers is showing his interest in sericulture and is moving towards silk cultivation, due to which farmers are also getting more profit. In today's time, if we want to get more income along with crop production, then we can opt business related to sericulture and then we will be able to increase income of our farmers as well as we can increase the economy of our country.

Why Should We Do Sericulture?

1. There is maximum employment potential in this type of business.
2. Provides Vibrancy to Rural Economies.
3. It provides maximum return on minimum investment.
4. It is a women friendly business.
5. Ideal Programme for the Weaker Section of the Society.
6. Eco-Friendly Activity.
7. Proper Facilities for Seri-Culturists.

What is Silk?

Silk is the secretion from the salivary glands which are found on both sides of the alimentary canal of silk worm larva and this secretion harden into fine threads called silk. The cocoons with which pupae are covered by the worms are utilized for silk production.

Silkworm Insect

Scientific Name of silkworm insect is *Bombyx mori*, Order-*Lepidoptera*, Family- *Bombycidae*. Mulberry main host tree for the cultivation of silk insect.

Biology / Life History of Silkworm

There are four developmental stages of silkworm such as egg, larva, pupa and adult.

1. Egg: Silkworm female eggs are laid in the night in clusters on the under surface of the mulberry leaves. A female lay about 300- 400 eggs popularly called as silk-seeds. The eggs are small, pale white and seed like in appearance. At the time of hatching they become black and hatch in 10-12 days during summer and 30 days during winter.

2. Larva: The caterpillar on hatching is white to dark green in colour and about 3mm in length. There are 3 pair of thoracic legs and 5 pair of abdominal legs. Young caterpillars are reared in trays on tender mulberry leaves at 25- 270C. Each day, the feed is to be given 3-4 times with small quantity of leaves. The full-grown caterpillar is creamy white and greenish in colour and about 75mm long. The larva moults 4-5 times after every 6-7 days and become mature in 30-35 days. The matured worms are picked up and kept it cocooning baskets. The make cocoons generally within 25 hours. Fifth larva makes quick round movement of its head at the rate of 65 movements per minute while spinning its cocoon. It has been estimated that about 40-50 thousand caterpillars hatch out of 28 gm of silk seed and they require about 337-406 kg of leaves during their development.

3. Pupa: This is third stage of silkworm insect. The pupas cocoon is 38 mm. in length and 19 mm in breadth, oval in shape and white or yellow in colour. A caterpillar can to produce nearly 1000-1500 meters of silk thread in this manner. The pupas are inside the cocoon is reddish-brown in colour and measures 25mm. X 7mm. long. The pupal period lasts for 10-15 days. At the time of emergence of adults, it secretes an alkaline fluid which pierces the cocoon and it comes out. To obtain good quality of silk the moth is not allowed to emerge but the pupae are killed inside the cocoons either by sun heating or them in boiling water after 10 days of cocoon formation. This process is known as Stifling.

4. Adult: The Silk worm is moth of creamy white colour measures about 30 mm in length and with a wing span of 40- 50 mm. The male is smaller than female. The head is small and bears a pair of black compound eyes and bipectinate antennae. The mouth parts are vestigial; therefore, do not take food and lives only 2-3 days. The fore wings are provided with dirty dark coloured stripes and body is covered with hairs.

Types of Silk Worm / Species of Silk Worms

1. Mulberry silk worm: Mulberry silk worm is found in Karnataka West Bengal, and Assam. Its caterpillar feeds on mulberry leaves. The cocoons are white in colour from which best quality of silk is obtained.
2. Tassar silkworm: Tassar silkworm is generally found in the forests of Bengal, Assam, and Uttar Pradesh and is not domesticated. The important host trees are Asan, Sal, Ber, and Arjun. The cocoons are hard light brown to dark in colour.
3. Eri silk worm: Eri silk worm was mainly found in the forests of Assam. Its caterpillar feeds on Caster *(Ricinus communis)* leaves. The cocoons are white in colour.
4. Muga silkworm: Muga silk worm found is Bihar, West Bengal, Orissa, and Assam and not be domesticated. The caterpillar feed on the leaves of cinnamon and matchilis plants. The cocoons are yellow in colours which produce of silk of golden yellow colour.

Rearing of Silkworms

The silkworms are reared in places which should avoid dampness stagnation of air, exposure to bright sunlight and strong winds. The temperature should between 25-300C and humidity should never drop below 70% and proper ventilation should be ensured for highest productivity. The size of the rearing house depends upon the quantum and type of rearing. To cultivate silkworm, first of all we should take a good variety of seeds. Those seeds should be taken from a trusted institution only. The centres that provide seeds are called grain age. To rearing the seeds, spread them on a paper in a tray and place a mesh cloth over the eggs and when the caterpillar starts coming out, some finely chopped leaves should be placed on the tray. And gives them mulberry leaves as food. The first and second stages of the caterpillar are given a softly cut leaf. And when the caterpillar becomes mature and threads come out of the mouth, remove them from the tray and place them in the basket where they are made. No more insect should be kept in a basket of cocoon because two cocoons get entangled in such a situation. Entangled cocoons are called dupionis, they do not remove thread.

Material for Rearing of Silkworm

1. Rearing stands: These are wood or bamboo stands of frames on which rearing trays are placed.
2. Rearing trays: Rearing trays are made up bamboo or plastic used for rearing of silkworm caterpillar. Since, young larvae i.e., 1st and 2nd instars larvae are very delicate and susceptible paraffin paper is used to cover bottom and top of the rearing trays. Paraffin papers are used to maintain humidity and prevent withering of leaves.

3. Nets: These are small nets of cloth that prevent the caterpillar from going outside and protect the birds and bees.
4. Chop sticks: These are tapering bamboo rods required for picking up younger larvae.
5. Feathers: Bird feathers preferably white and large are important items of silkworm rearing room. These are used for brushing newly hatched worms to prevent injuries.
6. Baskets: Baskets made of bamboo or plastic are needed to fetch mulberry leaves.
7. Chopping boards: Chopping board on which leaves are cut is made up of soft wood and placed on mat.
8. Leaf Chambers: These are chambers of wooden strips used for storing mulberry leaves meant for feeding larvae.
9. Knife: These are required to cut the mulberry leaves into fine pieces.
10. Refrigerator: Refrigerator is required to store the eggs. Other appliances include thermometer, Hydrometer, heater and cooler to maintain the required temperature, and formalin used to sterilize the tools.

Harvesting, Stifling and Reeling

Fully prepared cocoons should be taken out of the basket and separated. The pupa must die before the adult moth is released because the cocoon is cut off by the adult moth. Such cocoons are called pierced cocoons. The thread comes out in pieces. Therefore, after about 10 days of cocoon formation, they are kept in boiling water or exposed to hot rays of sun to kill the pupae inside and thus prevent the cutting of the silk thread into numerous pieces this process is known as Stifling.

Reeling

The process of removing the threads from killed cocoon is called as reeling.

Boiling

It is common practice for swelling, softening and to some extent dissolution and removal of sericin and gum. It is purified by acid and fermentation.

Brushing

By brushing the outer surface of cocoons mechanically, the free and of silk filament is recognized. It is the essential operation for reeling the entire intact thread.

Utilization of Silk and Mulberry Plant and Cocoon

1. Sericulture has other uses besides clothing.
2. The oil is extracted from the cocoon of tassar silk worm and used in preparation of some important medicines.
3. The juice is also prepared by the mulberry plant.
4. It's used as operational thread in hospital.
5. In sports cycle, thread can use for preparing rubber wheel.
6. It's used as thread in parachutes and rocket.
7. From Cocoon, protein extracted that can be used for cosmetics, medicine and value-added products.
8. Aesthetic materials made from waste cocoons-Flower vase, Interior decoration, Flower pot, Greeting cards, Animal toys, Garland etc.

Conclusion

Silk which is the secretion of salivary gland of silk worm can be a very good alternate for Indian farmers in increasing their farm income as require an Investment of only Rs. 12,000 to Rs. 15,000 (excluding cost of land and rearing space) for mulberry cultivation and silkworm rearing in one acre of irrigated land can generate net income levels up to Rs. 30,000/acre/ annum which is comparatively higher than traditional crop cultivation. Along with higher incomes silk growing is also more resource friendly because Mulberry takes only six months to grow for starting silkworm rearing and once planted it can support five crops in one year under tropical condition.

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Extent of Land Degradation and Options for its Management

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Soil Degradation?

It is defined as change in the soil health status resulting in a diminished capacity of the ecosystem to provide good and services. -- By FAO Process that leads to decline the fertility or future productive capacity of soil as a result of human activity. (United Nations Environment Programme,1993). It occurs whenever the natural balances in the landscape are changed by human activity through misuse or overuse of soil. Degraded soils results in poor or no production. Have poor life sustaining property. Out of 100 per cent potentially active lands only 44 per cent are available for cultivation and 56 per cent of land are non-available for cultivation. Soil degradation is a wide spread problem in India. Total geographical area of India is 329 mha, Estimates of land area. affected by different soil degradation process include 33 mha by water erosion. 11 mha by wind erosion, 3 mha by fertility decline, 8 mha by water logging and 7 mha by salinization. It causes soils physical, chemical and biological properties are badly hampered.

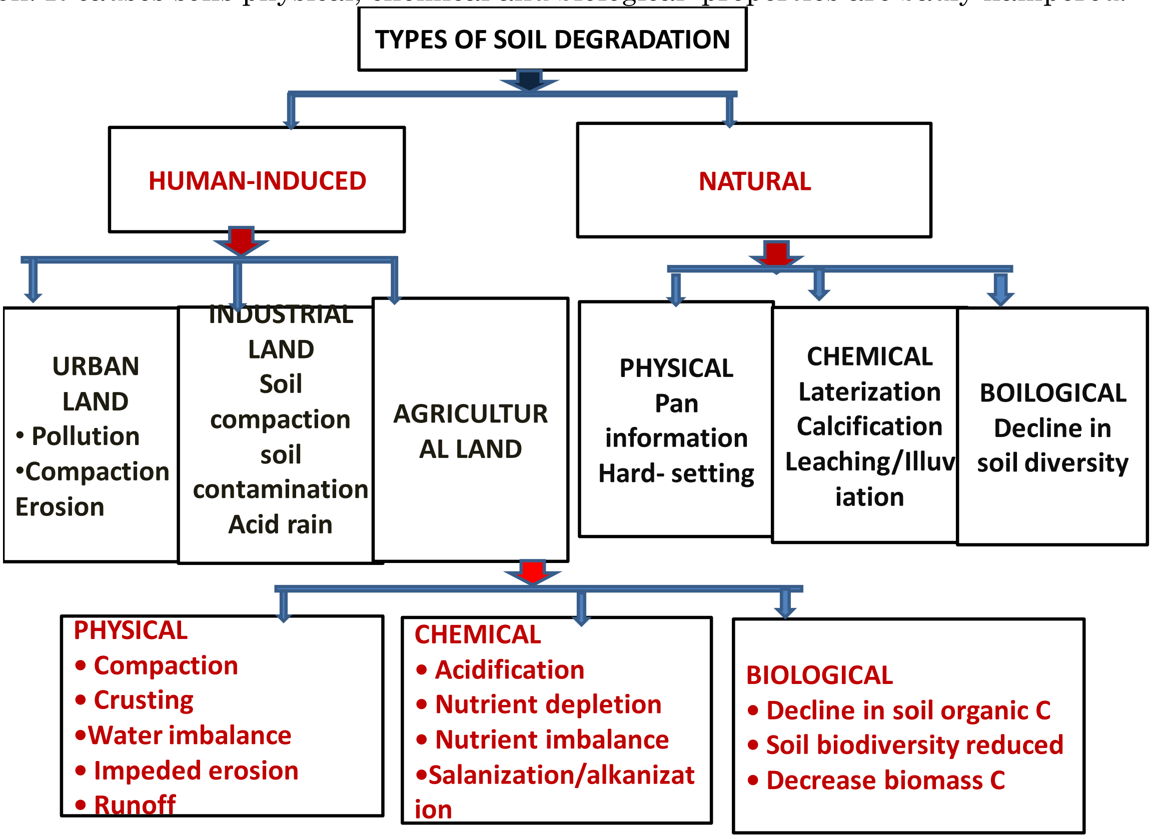

Table 1: Extend of Land Degradation in India, as Assessed by Different Organizations

NBSS&LUP	1994	187.7
NBSS&LUP (revised)	2004	146.8
National Remote Sensing Agency, Balanagar, Hyderabad	2006	47.22
ICAR, New Delhi	2010	120.4

Causes of Soil Degradation

1. Nutrient disorder.
2. Water-logging.
3. Salinity.

4. Erosion.
5. Biological degradation.
6. Other causes.
    a. Industrialization.
    b. Mining.
    c. Deforestation.
    d. Over grazing and pasture land.
    e. Unsustainable agricultural practices.
    f. Urban expansion.

Table 2: Land Degradation by Various Causes

Causes of degradation	Area (million hectares)	Percentage of total area
Water erosion	107.12	61.7
Wind erosion	17.79	10.24
Ravines	3.97	2.28
Salt-affected	7.61	4.38
Water logging	8.52	4.90
Degraded land due to shifting cultivation	4.91	2.82
Degraded forest lands	19.49	11.22
Special problems	2.73	1.57
Coastal sandy areas	1.46	0.84
TOTAL	**173.64**	**100.0**

Source : Ministry of Agriculture, Government of India (1985).

Management Strategies for Water Logged Soil

1. Levelling of land.
2. Drainage.
3. Controlled irrigation.
4. To check seepage in canal and irrigation channel.
5. Flood control measure.
6. Submergence tolerant crop.

Management Salt Affected Soil

1. Proper irrigation and Agronomic management practices.
2. Leaching.
3. Selection of salinity tolerant plant.
4. Soil/ water amendments.
5. Irrigation water quality assessment.
6. Use of cropping model.
7. Use of Gypsum.

Impact of Soil Degradation

1. Decline in the chemical, physical and/or biological properties of soil.
2. Reduced availability of potable water.
3. Lessened volumes of surface water.
4. Impacts on livestock and agriculture e.g. loss of animals due to dehydration, reduced yields.
5. Decline in productivity .
6. Water and food insecurity.
7. Biodiversity loss.

Strategies to Mitigate Soil Degradation

1. Soil Erosion Control.
2. Water Harvesting (Watershed Approach), Terracing and Other Engineering Structure.
3. Intercropping and Contour Farming.

4. Integrated Nutrient Management and Organic Manuring.
5. Reclamation of Acid and Salt Affected Soils and Drainage (Desalinization).
6. Water Management and Pollution Control.
7. Vegetative Barriers and Mulching and Diversified Cropping.
8. Agro forestry.
9. Conservation Agriculture (CA).
10. Disaster (Tsunami) Management.

Crop Residues as a Surface Mulch

1. Mulch improves the soil water storage and reduces evaporation losses.
2. Mulch helps in moisture conservation and minimize soil temperature.
3. Crop residue is an effective mean of runoff, erosion and transport of sediment to stream.

Mulching

1. Mulch influences reflectivity of heat and water transmission characteristics of mulched soil.
2. Mulch also improves the soil water storage and reduces evaporation losses.
3. Mulch helps in on moisture conservation and minimize soil temperature.
4. Crop residue is an effective mean of runoff, erosion and transport of sediment to stream.

Green Manuring

1. Green manuring crops contains sufficient nutrient (N, P, K, Ca, Mg) and also biological fixation of nutrients adds to improve fertility status of the soil.
2. Increases the availability of Zn and Significant effect on Cu and Mn availability in soil.
3. Crop residue incorporation and green manuring adds a substantial amount of C to the soils.
4. Sustainability in crop production can be achieved.

Afforestation

1. Forest growth exerts ameliorative effect on the soil by loosening subsoil, improving permeability and adding organic matter.
2. Carbonic acid produced through root activity mobilize calcium for replacement of exchangeable sodium.

Crop Rotation

1. Crop rotation.
2. Offer diverse "diet" to the soil micro- organism.
3. Exploring different soil layer for nutrients.
4. Diversity of crops.
5. Leads to a diverse soil flora and fauna.

Inter Cropping

Intercropping provides an insurance against calamities and helps in the maximization of productivity and profit by efficient utilization of natural resources like land, light and water. Growing of some crops on conserved soil moisture performs better under intercropping system.

Conclusion

1. Soil degradation reduce through the adoption of various methods Mulching improve the physical, chemical properties of soil. Ultimately yield of various crop increase.
2. Continuous recycling of green manuring and FYM application enhance the organic matter content, also supply the nutrient pool of soil impact on increase productivity fertility and yield.
3. Overcoming the salinity and water logging problem through the adoption of sub-surface drainage. Integrated approach on application of organic and inorganic sources of plant nutrient which can maintain higher productivity by alleviating nutrient deficiency.

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Zero Budget Natural Farming- A Holistic Alternative Towards Sustainable Agriculture

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Summary

Zero budget natural farming (ZBNF) is a grassroots movement attempting to improve India's capacity to produce its own food by farming with nature and ending farmers' reliance on purchased inputs and credit. In the long run it might be profitable but as of now, completely depending on it for profit is not feasible (particularly for those owning more than 5 acres).

After the Green revolution, Indian agriculture had shifted from self-sufficiency, towards increased inputs into a piece of farmland that could not consistently breed well from generation to generation. As ZBNF is suitable for small-scale but not for intensive farming, the best option is to combine chemical-based farming, organic farming and ZBNF and slowly, over years reduce the proportion of land under chemical farming.

Introduction

Green revolution on one hand, helped India in achieving self-sufficiency in food production by introducing high yielding varieties, high analysis fertilizers, pesticides, irrigation etc. but on the other hand, destroyed the traditional self-sufficient natural farming system by making it input-dependent. To feed such a large population, increased production is urgently needed but high costs and volatile prices are driving farmers into debt (Smith et al., 2020).

In the Union Budget 2019-20, the Indian Finance minister focused on Zero Budget Natural Farming (ZBNF) with an aim to break the input cost burdens on farmers. The current trend in Indian agriculture is to achieve higher yields of farm produce without disturbing the nature of the soil since the area under cultivation is drastically reduced due to rapid urbanization. This comprehensive approach is emerging due to socio-environmental issues such as climate change, deteriorating soil health, migration of the younger generation away from agriculture and lack of food security, which leads to the growing awareness about organic agriculture and various other forms of natural farming. ZBNF is one among these various types of natural farming that are being practiced across India.

What is Zero Budget Natural Farming?

Zero Budget Natural Farming (ZBNF) is one such low-input, climate-resilient farming that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/chemical fertilisers and industrial pesticides. This concept was popularized by Padmashri award winner Subhash Palekar from Maharashtra.

It reduces farmers' costs through eliminating external inputs and utilising in-situ resources to rejuvenate the soil, simultaneously increasing incomes, restoring ecosystem/soil health and climate resilience through diverse, multi-layered cropping systems. The term 'Zero budget' does not literally mean that costs are 'zero', but it implies that the need for external financing is zero, and that any costs incurred can be offset by a diversified source of income which comes via farm diversification rather than dependence on one monoculture (Palekar, 2006).

What Makes ZBNF 'Need of the Hour'?

India's agricultural economy is facing a crisis. Farmers, the backbone of our country, are not getting remunerative prices on one hand and the cost of inputs is galloping, resulting in their indebtedness. Due to various dynamics and abnormal situations today, the farmer is caught in a vicious circle. The net result is a deadly combination of debt, crop failures, suicides, poverty and migration to urban areas that have drastically curtailed the quality of rural lives. For example, though 55-60% of India's workforce is engaged

in agriculture, it contributes only 16% of India's GDP. In a nutshell the factors which made ZBNF the 'need of the hour' are:
1. Rising cost of faring inputs.
2. Volatile market price.
3. High labour wages.
4. Fragile ecosystem and unpredicted monsoon.
5. Large numbers of suicidal cases of farmers.
6. Rising environmental concerns.
7. Change in consumers' preference towards safety food etc.

Initiatives like ZBNF uses natural methods to retain and improve soil health, control pests and increase yields. A farmer will also be able to produce his own seed and natural fertilizers are created using cow dung, cow urine and other materials.

How ZBNF Works?

Basically, ZBNF aims at cultivating crops by promoting self-reliance of farmers while protecting the environment and stimulating harmony between humans, animals and plants for a sustainable development (Palekar, 2006). This practice is self-nourishing and symbiotic in nature which claims that there is no need of extensive inputs such as chemical fertilizers and pesticides and it can be substituted through natural inputs. It consists of four principles, also known as four wheels of ZBNF which are presented in Table 1 (Khadse and Rosset, 2019).

Table 1. Four Wheels of ZBNF

Four Wheels of ZBNF	Benefit
Jeevamrita: A fermented microbial culture derived from cow dung and urine, jaggery, pulse flour and soil.	Stimulate microbial activity to make nutrients bioavailable; protect against pathogens.
Beejamrita/ Seed nectar: A microbial coating for seeds, based on cow dung, urine and lime.	Protects young roots from fungus and seed borne or soil borne diseases.
Acchadana/ Mulching: Covering the top soil with cover crops and crop residues; e.g., soil mulch, straw mulch and live mulch.	Produces humus, conserves top soil, increases water retention, encourages soil fauna, prevents weeds.
Whapahasa/ Soil aeration: represents the changes in water management brought about by improved soil structure and humus content.	Increase water availability, water use efficiency and increase resilience to drought.

Other important principles of ZBNF are as follows:
1. Intercropping / multi-cropping / mixed cropping: In a same piece of land combination of monocot and dicot plants or, long and short life-span species with a definite arrangement. It protects the soil from nutrient and moisture exhaustion as well as minimizes the risks for the farmer who is able to enjoy continuity of yield throughout the year. In case of a crop's failure he can also rely on the other crops.

2. Contours and bunds: It helps to harvest and preserve rainwater and promote maximum efficacy for different crops.

3. Local species of earthworms: The revival of local deep soil earthworms through increased organic matter is most recommended in ZBNF than vermicomposting.

4. Cow dung: The dung and urine of indigenous humped cow have a greater concentration of microbes and are beneficial compared to European cow breed like Holstein.

Insect-Pest Management in ZBNF

Using local available inputs which are always available in farmers' farm free of cost, pests like leaf roller, stream borer, fruit borer, pod borer, sucking pests and mealy bug etc. are controlled by the following methods under ZBNF:
1. Neemastra: It is used against sucking pests and mealy bugs and composed of local cow urine (5 L), cow dung (5 kg) and neem leaves and pulp (5 kg) fermented for 24 hours.

2. Agniastra: It is effective against leaf roller, stem borer, fruit borer, pod borer etc. and composed of local cow urine (10 L), tobacco (1 kg), green chilli (500 g), local garlic (500 g) and neem leaves pulp (5 kg) crushed in cow urine.

3. Brahmastra: It is effective against all type of sucking pest, fruit borer, pod borer etc. and prepared using crushed leaves of neem, custard apple, guava, lantern camellia, pomegranate, papaya and white datura boiled in cow urine.

Benefits and Limitations of ZBNF

Table 2. Benefits and limitations of ZBNF:

Benefits of ZBNF	Limtations of ZBNF
• No need to spend money or take loans for external inputs, the cost of production could be reduced and farming made into a "zero budget" exercise. • It can break the debt cycle for many small farmers and help to envisage the doubling of farmer's income by 2022. • It promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching and discourages intensive irrigation and deep ploughing. • It suits all crops in all agro-climatic zones. • Citing its benefits, in June 2018, Andhra Pradesh rolled out an ambitious plan to become India's first State to practise 100% natural farming by 2024.	• There is no special market to sell. Minimum Support Price (MSP) of crops should be fixed by Commissions for Agricultural Crops and Prices (CACP) in accordance with the cost of cultivation. • Takes long conversion period. Many farmers have reverted to conventional farming after seeing their ZBNF returns drop after a few years. • It is highly localized farming and practiced in fewer parts of India. • ZBNF advocates the need of an Indian breed cow, whose numbers are declining at a fast pace. • It is practised in negligible area. Its long-term viability is not yet clarified.

Future Aspects of ZBNF

Scientists of National Academy of Agricultural Sciences (NAAS) suggested that there is no need for the government to promote ZBNF unless there is proper scientific validation so more work needs to be done on its sustainability, economic viability and ecosystem services in long run. Smith et al. (2020) identified some sections (Table 3), where more research is needed to improve understanding of the impacts of ZBNF on nitrogen available to plants and changes in soil carbon.

Table 3. Additional evidence needed to improve understanding of the impacts of ZBNF:

Section	Additional evidence needed
Whole system	• Survey of practices used and impacts on farm income • Controlled, replicated and randomized trials on short- and long-term changes in yield, nutrients and soil carbon (e.g., long-term sites exist at Gurukul Kurukshetra, India) • Impact of earthworms and other soil fauna on cycling of nutrients from deep in the soil profile
Jeevamrita (soil inoculum)	• Impact on microbes, earthworm activity, fungal and bacterial diseases • Impact on heterotrophic decomposition of organic matter • Survival and action of Heterotrophic microbes in the soil after inoculation • Nitrogen-fixing microorganisms and their survival and action in the soil after inoculation
Beejamrita (seed treatment)	• Impact on microbes, earthworm activity, fungal and bacterial diseases • Impacts on germination, seedling length and vigour, yield and nutrients captured by the plant
Acchadana (mulching) and Whapahasa (soil aeration)	• Long-term impacts of tillage to only 15 cm depth on soil nitrogen, carbon and water • Impact of Jeevamrita on release of nutrients from dried biomass mulches

	• Long-term experiments on soil organic matter retention with incorporation of crop residues in Jeevamrita-treated soils

Conclusion

ZBNF is particularly suitable to small and marginal farmers having no financial resources but its wider adoption may have an impact on India's ability to feed its rising population. Following the stagnation or even downfall in crop productivity in farms using modern technologies and tonnes of pesticides and fertilizers, natural farming proves to be more productive on a sustainable way ensuring every farmer its livelihood. Despite having potential, more research is required to examine its scalability and variation. While presenting the Union budget 2020-2021, Government of India has emphasized on balanced use of all types of fertilizers, including traditional organic and other innovative varieties (e.g., biofertilizers, city compost etc.) to bring about a change in the prevailing regime that encourages excessive use of chemical fertilizers. Standing at a crossroads in the history of time, we must abandon our inclination to focus on risk and start embracing the opportunities for a sustainable and prosperous society. As any ecological change does not happen instantaneously, the sudden shift from chemical farming towards completely organic or natural farming may not be able to meet the country's food demand. Being a developing as well as world's second most populated country, India can start with semi-organic farming, i.e., immediately losing pesticides, but gradually phasing out chemical fertilizers.

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Push-Pull Strategy of Insect Pest Control

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Introduction

Push-pull strategy is used for controlling agricultural pests by using repellent "push" plants and attractant "pull" plants. It is mainly used in cereal crops like maize or sorghum which are often infested by stem borers. The grasses are planted in the border around the maize and sorghum fields where invading adult moths become attracted to chemicals emitted by the grasses themselves. Instead of landing on the maize or sorghum plants, the insects head for what appears to be a tastier meal. These grasses provide the "pull" in the "push-pull" strategy. The "push" is provided by the plants that emit chemicals called kairomones which repel stem borer moths and drive them away from the main crop i.e. maize or sorghum.

Principle of Push-Pull Strategy

Push-pull strategy, pests are repelled or deterred away from the main crop (push) by using stimuli that masks host appearance or are repellent or deterrent. Pests are simultaneously attracted (pull) using highly apparent and attractive stimuli to other areas such as traps or trap crops where they are concentrated, facilitating their control.

Mechanism Push-Pull Strategy

The push-pull strategy undertakes a holistic approach in exploiting chemical ecology and agrobiodiversity. It involves the behavioural manipulations of insect pests and their natural enemies by the use of behaviour modifying stimuli which makes the main crop comparatively unattractive and unpalatable to the pests (push) while diverting them to the more attractive sources (pull) from where the pests are subsequently removed.

It involves release of attractive volatiles from the trap plants and repellent volatiles from the intercrops. Push-pull strategies maximize efficacy of behaviour manipulating stimuli through the additive and synergistic effects of integrating their use. It uses behaviour modifying stimuli to manipulate the distribution and abundance of stemborers and beneficial insects for management of stemborers. It is based on understanding of chemical ecology, agrobiodiversity, plant-plant and insect-plant interactions and involves intercropping a cereal crop with a repellent intercrop. Gravid stemborer females are repelled from the main crop and are simultaneously attracted to the trap crop.

Plants that have been identified as effective in the push-pull includes napier grass, sudan grass, molasses grass and desmodium. Napier grass and Sudan grass are used as trap plants whereas molasses grass and desmodium repel ovipositing stemborers. Molasses grass when intercropped with maize, not only reduced infestation of the maize by stemborers but also increased stemborer parasitism by a natural enemy, *Cotesia sesamiae*. The strategy is a useful tool for integrated pest management programs reducing pesticide input.

Advantages of Push-Pull Strategy

1. Attract both immature and adult stage.
2. Increased yield of crop due to stem borer control.
3. Simple, commercially available and cheap components.
4. Increased efficiency of individual push and pull components i.e. population reducing.
5. Improved potential for use of antifeedants and oviposition deterrents.
6. Increased fodder production which leads to improved dairy and FYM production.
7. Nitrogen fixation and reduced soil erosion.
8. Increased forage seed production.

9. Conservation of biodiversity.
10. Resistant management.

Limitation of Push-Pull Strategy

1. Limited specificity.
2. Less effective to compete with abundant surrounding odour sources for attraction.
3. Limitation to development:
    a. Development of semiochemical component.
    b. Understanding of behavioural and chemical ecology of the host pests.
    c. Insufficient knowledge, control breakdown.
4. Limitation to adoption:
    a. Integrated approach to pest control which is very complex.
    b. More insecticide and low knowledge of biological control agent.
    c. Requiring monitoring and decision system.

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Semiochemicals: Role in IPM

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Introduction

Semiochemicals are the chemicals which are involved in communication. Semiochemical communication can be divided into two broad classes:
1. Communication between individuals of the same species i.e. intraspecific (pheromones)
2. Communication between different species i.e. interspecific (allelochemicals).

Pheromones

A substance that is secreted by an organism to the outside environment and causes a specific reaction in a receiving organism of the same species. Pheromones are further divided into two categories i.e. primer, which initiates changes in development and releaser, which induces an immediate behavioural change.

1. Sex pheromone: These are among the most powerful of chemical attractants. These chemicals have great potential as pest control agents. It is produced mainly by females to attract the males for the purpose of mating. Sex pheromones are released from specialized glands which opens on the terminal segment of the female abdomen and are perceived by the chemosensillary of the male antenna. Examples: Gossyplure of *Pectinophora gossypiella*, Helilure of *Helicoverpa armigera*, Grandlure of *Anthomonus grandis*.

2. Alarm pheromone: A substance produced by an insect to repel and disperse other insects in the area. An individual also releases them when an enemy attack. It is reported in homoptera, Isoptera and hymenoptera.

3. Aggregation pheromone: A substance produced by one or both sexes that brings both sexes together for feeding and reproduction. These are the chemicals that allow insects to congregate for feeding and other activities. These are released by members of one sex only but elicit responses in members of both sexes of a species.

4. Trial marking pheromone: These are substances of low persistence that are released and perceived by individuals in a trial. These pheromones are specially found in social insects like Hymenoptera and termites. For example, ants use formic acid as trial marker.

5. Territorial pheromones: These pheromones are secreted by males of some species and attract both males and females. For example, males of bumblebees and carpenter bees demarcate the territory for foraging activity.

6. Epidiectic pheromone: These are compounds which function in the regulation of population density by controlling the dispersion of individuals.

7. Parapheromones: When a chemical not found in an insect or it is not naturally occurring in insect but has a pheromone like action, artificially synthesized, then it is often referred to as parapheromone.

Allelochemicals

Chemicals involved in interspecific communication are termed as allelochemicals. It is defined as non-nutritive substances originating from an organism may be plant or animal, which affect the behaviour, physiological condition or ecological welfare of organisms of another species. They affect the survival, growth and development of insects as well as their natural enemies.

1. Allomone: An allomone is any chemical substance released by an individual of one species that affects the behaviour of a member of another species to the benefit of the emitter but not the receiver.

2. Kairomone: A kairomone is a semiochemical, emitted by an organism, which mediates interspecific interactions in a way that benefits an individual of another species which receives it, without benefitting the emitter.

3. Synomone: A synomone is an interspecific semiochemical that is beneficial to both interacting organisms, the emitter and receiver.

4. Apneumone: A substance emitted by a non-living material which evokes a behavioural or physiological reaction that is adaptively favourable to a receiving organism but detrimental to an organism of another species that is found in or on the non-living material.

Advantages of Semiochemicals

1. They have adverse effects only on target pests.
2. They are relatively nontoxic.
3. They are required in low amounts.
4. They are non-persistent and environmentally safe.
5. They appear difficult for insects to develop resistance against.

Uses in IPM

1. For monitoring, mass trapping and mating disruption of pest populations to determine if control is warranted.
    a. Monitoring helps us to detect population and level of infestation. Developing trap baited with sex pheromones on a large scale can do the monitoring of the insect pests.
    b. Mating disruption by confusing insect to find their sexual counterparts for mating.
    c. Mass trapping by using a large number of pheromone traps to capture adult moths and thus reduce the number of males for mating.
2. To alter the behaviour of the pest or its enemies to the detriment of the pest.

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Farmer's Income Doubling through High Density Planting Technique

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Introduction

High density planting or orcharding is one of the improved and advanced production technologies to achieve the objective of enhanced productivity of fruit crops. Yield and quality of the produce are two essential components of the productivity of any fruit crop. HDP aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load of tree without impairing the plant health. High density planting is a new concept in orchard planting throughout the world which refers to the maximum utilization of available space by accommodating maximum number of fruit plants per unit area to achieve maximum production of quality fruits within short period of time with low growing cost. In HDP, fruit plants come into fruiting very early, often in second or third year after planting, as compared to standard trees which come into bearing 5-6 years after planting. Maximum utilization of land and solar energy can be done by accommodating a greater number of plants per unit area through different systems of density planting.

Concept of HDP and Meadow Orcharding

Accommodation of the maximum possible number of the fruit plant per unit area to get the maximum possible profit per unit of the tree volume without impairing the soil fertility status is called the high-density planting. Meadow orchard system is a new concept of planting which has been developed in guava for the first time in India at Central Institute of Sub tropical Horticulture, Lucknow. The meadow orchard is a modern method of fruit cultivation using small or dwarf tree with modified canopy. Better light distribution within tree canopy increase the number of well illuminated leaves. Fertilizer dose, spacing, growth regulation by the training and pruning, use of the mechanical devices etc. may also be tried either singly or coupled with other crop management practices concept. It also promotes rate of photosynthesis that leads to high yield per unit area. Basically, the availability of a dwarf plant is the first and foremost prerequisite for establishing any high density or meadow orchard.

Important Principles of High Density Planting

Chemicals involved in interspecific communication are termed as allelochemicals. It is defined as non-nutritive substances originating from an organism may be plant or animal, which affect the behaviour, physiological condition or ecological welfare of organisms of another species. They affect the survival, growth and development of insects as well as their natural enemies.

Advantages of Semiochemicals

1. To make best use of vertical and horizontal space per unit time.
2. To harness maximum possible returns per unit of inputs and available resources.
3. Increased capture sunlight per unit area.
4. Land use efficiency.
5. Appropriate vegetative and reproductive balance of the plants.

Advantages of HDP / Meadow System of Fruit Growing Over Traditional system

S. No.	Attributes	Traditional planting system	HDP/Meadow system
1.	Number of trees	Few large trees/ha (150-200 trees/ha)	Many small trees/ha (500-1,00,000 trees/ha)
2.	Bearing starts	After two-three years of planting	Starts from first year
3.	Yield	Lower yield	Higher yield
4.	Management	Difficult to manage due to large tree size	Easy to manage due to small tree size

5.	Labour requirement	Requires more labour	Requires less labour
6.	Production cost	Higher cost of production	Lower cost of production
7.	Harvesting	Difficult	Easy
8.	Quality	Large canopy, poor sunlight penetration and Poor-quality fruits.	Small canopy, better air and Sunlight penetration, minimum disease incidence and high-quality fruits with good colour development

Some Success Stories of High-Density Planting in India

Crop	Spacing	Planting density/ Plant per hectare	Yield t/hectare	% increase over traditional methods
Mango cv. Amarpali	2.5m x 2.5m	1600	19.2	250
Mango cv. Dashehari	2.5m x 3.0m	1333	22.2	250
Kinnow	1.8m x1.8m	3000	20	200
Banana	1.4m x1.4m	4444	145.44	250
Pineapple	25cm x35cmx90cm	6400	90.0	200
Guava	1m x 2m	5000	50	250

Methods of HDP

High density can be achieved by close planting which in turn is made possible through control of tree size or planting in a system which accommodates a greater number of plants. Manipulation of tree vigour is an important prerequisite for success of high-density planting in any fruit crop. High density of fruit orchards is generally achieved by controlling the size of tree or through improved planting system. Tree size can be controlled by applying different methods such as – Use of genetically dwarf scion cultivars, use of dwarfing rootstocks and inter stock Training and Pruning, use of growth retardants, Induction of viral infection, use of incompatible rootstock, and Use of genetically dwarf scion cultivars etc.

Training and Pruning

Training and Pruning are effective tools in HDP and meadow orcharding by virtue of their impact on shape and size control of the tree. Slow growing trees respond more favourably to pruning and training and can be maintained at a given size and shape without sacrificing yield. Mango, guava, litchi and most of the other fruit crops in India are evergreen and are seldom pruned. The training begins when the tree is first planted and continues throughout its productive life. Proper tree forms, branch angle and limb spacing in it aids in growth control. First training is done after one growing season. Each plant is allowed to maintain single stem with upward growth up to 60-80cm and then four scaffold branches are allowed in four directions to make the tree frame. Thereafter, two shoots arising from each primary branch at a distance of 60-75cm from main stem is allowed to form secondary and likewise the tertiary branches. After start of bearing in plants, shoot arising from secondary and tertiary branches are given 15-20cm deep pruning soon after fruit harvest. Spray of 01% urea combined with 0.2% Blitox-50 or any other copper fungicide should be done soon after pruning. Pruning is applied to regulate crop in guava, ber and fig, and rejuvenation of old orchards in mango. Tree size control through pruning is limited to grape, apple and some other temperate fruits. Spindle bush raised on M9, M7 and M4 rootstocks is a promising training system for HDP.

Crop	Dwarfing Rootstock
Apple	M9, M26, M27(Ultra dwarfing), Bud.9, P22 & Ottawa3
Ber	*Zizyphus rotundifolia*
Citrus	Citrangequat, Feronia and *Severinia buxifolia*, Trifoliate orange, Sour orange, Citranges
Guava	*Psidium friedrichsthalianum, P. pumilum*, Aneuploid-82
Mango	Vellaikolumban (Alphonso), Olour (Himsagar, Langra)

Pear	Quince C
Peach	Siberian C, St Julien X, *Prunus besseyi* and Rubira

Use of Growth Retardant

Use of Bio-regulators can prolong dormancy, reduce vegetative growth, delay flowering, reduce fruit drop etc. Commercially adopted growth retardants are CCC, Ancymidol, Paclobutrazol, B-9 (Phosphon D) and chloramquat. Paclobutrazol have gained commercial application in crop regulation in mango. Tree size can be reduced by inducing viral infection e.g. Citrus, apple, but not adopted commercially. In apple, virus free rootstock series East MaIling Long Ashton (EMLA) are vigorous than their infected counterparts.

Impact of HDP

In mango, Amrapali at 2.5x 2.5m in triangular system accommodation of 1600 plants and Dashehari at 3.0 x 2.5 m in square system 1333 plants per hectare, increase in yield per hectare was 2.5 times in Amrapali than that of the low-density orchards of vigorous cultivar. In Dashehari mango, the average yield in high density is reportedly 9.6 tonnes compared to 0.2 tonnes in low density planting. This yield can further be improved in alternate bearing cultivars like Dashehari, Chausa and Bombay Green through the application of growth retardant like Paclobutrazol. In Citrus, Kinnow on Troyer Citrange and Karna khatta rootstocks could be planted at1.8 x1.8.m and 3x3 m to accommodate 3000 and 1088 plants per hectare, respectively. In pineapple, population density of 63758 per hectare coupled with improved package of agro techniques result in increase in yield from 15-20 to 70-80 tonnes/ha.

Sr. No.	Crop	Normal spacing(m)	HDP spacing(m)	Meadow spacing(m)
1.	Mango	7.5 x 7.5-12.5 x 12.5	3 x 2.5-5 x 5	2.5 x 2.5-3 x 1
2.	Banana	2 x 2-2 x 3	1.5 x 1.5-1.8 x 1.8	1.2 x1.2-3 x 0.5
3.	Citrus	6 x 6-8 x 8	3-6 x 3-4.5	-
4.	Papaya	2 x 2-3 x 3	1.8 x 1.8	1.2 x1.2-1x1
5.	Guava	6 x 6-8 x 8	3 x 3-3 x 1.5	2 x 2-2 x1
6.	Sapota	10 x 10	5 x 5	-

Different Types of Planting

1. Low density planting: Non-intensive system, age old planting system, trees planted at wide spacing, accommodating about 100-250 plants/ha. Dwarfing rootstock not used. Tree acquires commercial production potential after 10-15 years of planting. Output from orchard during early 10-15 years is less. Less input and care intensive, hold popularity among growers.

2. Medium density planting: Highly minimized distance covering 250-500 plants/ha. Proper pruning undertaken to manage tree in desirable shape. More care, intensive labour requirement is more, obtained yield is more, lead in output reliable growers to produce amenable fruit crops like pomegranate, citrus, guava, papaya, banana etc.

3. High density planting: Very condensing planting with 500-10,000 plants/ha depending on fruit crop relies heavily on rigorous training and pruning. Maintenance of pruning is very heavy. Dwarfing rootstock and chemicals also used in this system. Yield as well as expenses per unit area is high, Medium high density 500-1500 plants/ha, Optimum High density 1,500-10,000 plants/ha and ultrahigh density 10,000-1,00,000 plants/ha.

4. Meadow orcharding: Meadow orcharding, also known as Ultra high-density planting i.e., growing 10,000-1,00,000 plants/ha. Plants intended to produce yield after two years.

Merits of HDP / Meadow Orcharding

1. Achievement of higher yield per unit area with quality fruits.
2. HDP facilitates better utilization of solar radiation and increase the photosynthetic efficiency of the fruit tree.
3. It also amenable to modern inputs application techniques such as drip irrigation, fertigation, mechanization etc.
4. Early economic returns to the farmers.
5. Induces precocity, increases yield and improves quality of the fruit.

6. Reduces labour cost resulting in low cost of production.
7. Facilitates more efficient use of fertilizers, water, solar radiation, fungicides, weedicides and pesticides.
8. Best utilization of land and resources can be possible through HDP.

Demerits of HDP / Meadow Orcharding

1. High initial establishment cost involve than conventional system.
2. Economic life span of the orchard becomes lower.
3. Chance of reduction in fruit size and their weight.
4. Intercultural operation becomes difficult.
5. Maintenance of plant architecture becomes a tedious job for an orchardist.
6. Lack of standardization of production technology and extension of technical knowledge to the farmers.
7. Lack of promising dwarfing rootstock in fruits like mango, guava, sapota, peach, sweet cherry etc.
8. In apple, commercial utilization of dwarf rootstocks for tree size control in HDP is restricted due to their poor anchorage, occurrence of sloppy, shallow and rain fed lands and low fertility.
9. High incidence of important diseases in HDP e.g. Sigatoka leaf spot and fingertip in banana causes hindering effect in HDP.

Conclusion

Advancing knowledge in fruit architecture, growth physiology and possibility of using growth retardants has enabled farmers to adopt technology such as closer planting and maintaining reachable canopy. It enables profitable cropping pattern, high regular yields and improved farm management practices, leading to higher sustainable productivity. High density planting technique is a modern method of cultivation involving planting of trees densely, allowing small or dwarf trees with modified canopy for better light interception and distribution and ease of mechanised field operations. HDP and meadow orcharding gives higher yield as well as returns per unit area due to increasing the number of tree/unit area. Control of pests and diseases, weeds and pruning of tree canopy can be carried out by machine. Irrigation and fertigation are automatically controlled. Such system produces precocious cropping, high and regular yields of good quality fruits and low labour requirement to meet ever rising production costs.

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Agricultural Census in India with Recent Updates

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Introduction

Agriculture plays an important role in India's economy. It provides gainful employment to a large section of population of the country, particularly, the rural population. In view of the importance of agriculture, the basic data on structure and characteristics of agricultural holdings, Govt. of India has been conducting comprehensive Agriculture Census as a part of the World Agriculture Census Programme.

Periodic Agriculture Censuses are the main source of information on basic characteristics of operational holdings such as land-use, cropping pattern, irrigation status, tenancy and dispersal of holdings etc. This information is tabulated by different size classes and social groups and serves as an input for development planning, socio-economic policy formulation and establishment of national priorities. The Census also provides basis for development of a comprehensive integrated national system of agricultural statistics.

Administration of Census

The Census is carried out by the States/Union Territories under the overall technical and administrative support from the Ministry of Agriculture. It is a Central Sector Scheme being financed completely by the Govt. of India. The field work is carried out by the Primary Reporting Agencies of the Revenue Departments in most of the States. In some of the States, primary staff of the Agriculture Department is also put on this job. Supervision of the field work is done by the supervisory officers of the Revenue/Agriculture/Statistics Departments, of the State Governments.

Classification of States for Census

For the collection of Census data, the States have been grouped into two categories viz., Land Record States and Non-Land Record States, where in different statistical techniques are adopted for data collection and estimation. About 90 percent of the operational holdings are covered by the Land-Record States and the rest in the Non-Land Record States.

Phases in Agricultural Census

The Agricultural Census is conducted in three phases:

1. In phase I operated areas with their list of holdings and social characteristics is prepared in land record on census basis in every states/UTs (covering around 86% of reported area) and on 20% sample villages in non-land record States/UTs. Data on area of operational holdings and number for different size classes (medium, small, semi medium, large, marginal), type of holding (individual, joint, institutional), gender (male, female) and social groups (scheduled castes, scheduled tribes, others) are collected.

2. In phase II collection of detailed data is done on agricultural statistics from 20% selected villages on a sample basis both in non-land record and land record states and a parameter has been set at Tehsil/District/State level. Data on terms of leasing, sources of irrigation, tenancy, land-use, number of wells and tube wells, irrigation-status, dispersal of land are collected from selected 20 percent villages in each Taluk/Block.

3. In phase III collection of detailed data is done on input use pattern from selected holdings from selected 7 percent villages on sample basis and a parameter has been set at Tehsil/District/State level. Collection of data is done on use of inputs like fertilizers, agriculture implements & machinery, fertilizers, institutional credit, manures, educational qualification, household size of the holder and use of improved seeds besides age, from selected 7 percent villages in each Taluk/Block.

Certain measures of improvement should be taken like improving infrastructural facilities by providing adequate numbers of computers with e-mail facilities, fax machines, etc. in states/UTs and sensitization of field workers towards importance of this data so that they devote sufficient attention to census work can be more helpful.

Recent Agricultural Census and Important Findings

So far, nine Agriculture Censuses since 1970-71 have been conducted in the country. The current Agriculture Census with reference year 2015-16 is tenth in the series.

The report contains historical background, organization of Agriculture Census, concepts, definitions, sampling design, estimation procedure, limitations of data besides analysis of All India and States data.
1. Total number of operational holdings were estimated as 18.35 million.
2. The total operated area was 159.59 million hectares.
3. The average size of the holding has been estimated as 1.15 hectare. The average size of holdings has shown a steady declining trend over various Agriculture Censused since, 1970-71.
4. The size Group wise percentage of number and area of operational holdings are given in the following table.

Sl. No	Size Group	Percentage of number of operational holdings to total	Percentage of area operated to total
1	Marginal (below 1.00 ha)	67.10	22.50
2	Small (1.00-2.00 ha)	17.91	22.08
3	Semi-medium (2.00-4.00 ha)	10.04	23.63
4	Medium (4.00 – 10.00 ha)	4.25	21.20
5	Large (10.00 ha & above)	0.70	10.59

5. The number of small and marginal agricultural land holdings in the country has registered a marginal increase of 2015-16 compared to 201-11, according to the tenth agricultural census. This means that there are more people who now own small parcels of agricultural land.

6. The percentage of land holders who are women has increased from 12.79% in 2010-11 to 13.87% in 2015-16, with a corresponding increase of 1.2 percentage points in the operated area. This shows that more and more females are participating in the management and operation of agricultural loans.

7. Small and marginal holdings (Below two hectares) constituted 86.21% of the total land holdings, an increase of 1.2 percentage points compared to 2010-11. Large land holdings account for only 9% of the total operational area.

Conclusion

The operational holding is the fundamental unit of decision making in agriculture and consequently for development of programmes aimed at improving the income and standard of living of cultivators, a census of operational holdings providing data on their numbers, tenure relationship, size, type of farming and farming practices assumes' special importance. Data from Agricultural Census are equally valuable for planning at various levels such as national, regional, block and individual farm. While it is not intended to describe exhaustively the various uses of agricultural census data, it may be worthwhile to point out a few areas where census results would be useful for policy decisions and for planning agricultural production programmes.

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Transcriptomics – Bridging Gap Between Genome and Gene Function

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Summary

The average surface temperature of earth will rise by 3-5˚c by next 50-100 years. This is concurrent with the increased frequency of abiotic and biotic stresses, which drastically affects the global agriculture. Additionally, rapid population growth increase pressure on global food demand. In order to mitigate the adverse effects and enhance crop yield to ensure food security, we must think beyond the conventional and molecular plant breeding approaches.

To develop the cost effective, eco-friendly strategy requires comprehensive knowledge on transcriptomics and its alteration patterns in varying environments. In recent decades, advent in high throughput transcriptome analysis, allows the scientists to study thousands of gene network together, this rapidly expands our understanding of relationship between transcriptome and phenotype. This also helps to identify the functional candidate genes, eQTLs and molecular markers.

Keywords: Transcriptome, gene expression, microarray, RNA-Seq.

Introduction

Even though all cells in the organisms has same genotype, they vary in their phenotype and function. For instance, Stomata cells different from the parenchyma cells. This variation is due to the differential expression of gene, the same gene may transcribe in multiple ways under various circumstances.

The gene expression is the dynamic process in which genetic information encoded in the DNA is converted into mRNA and to Proteins (Fig 1). Messenger RNA (mRNA) acts as transient intermediate and other non-coding RNAs namely rRNA, tRNA, miRNA, small nuclear RNA (snRNAs) and small nucleolar RNA (snoRNAs) execute diverse function in the cell, collectively called as transcriptome (Morozova et al., 2009). Understanding transcriptome is essential for interpreting the functional elements of genome and to know which gene is "turned on "and "turned off" in a cell at a given time.

Initially northern blot and quantitative polymerase chain reaction (qPCR) has been used for gene expression studies which are limited to analysing single transcript and low throughput. Over a decade, technologies have been evolved to study the quantification of gene expression at whole transcriptome level. Based on the principle, technologies have been classified as hybridization-based approach and sequence-based approach.

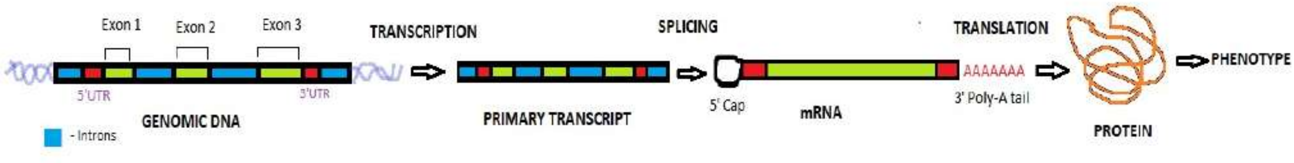

Fig 1. Pictorial representation of gene expression

Hybridization-Based Approach

Hybridization approach involves the microarray technology. First transcriptome study using microarray technology was done in Arabidopsis (Schena et al., 1995). Microarray analysis can be classified into two steps: probe production and sample (cDNA) preparation. Microarray consists of the oligonucleotides called probes are arrayed on the glass surface. The fluorescently labelled samples were allowed to hybridize on the probes (Fig 2.). The fluorescent intensity at each probe spot on the array depicts the transcript abundance (Royce et al., 2007). Microarrays are high throughput, relatively low cost and allows for the evaluation of large number of transcripts simultaneously. However, they have several limitations notably: it relies on the prior knowledge on sequence information, high background noise due to cross hybridization while analysing highly similar sequence.

Sequence-Based Approach

Sequence-based approach starts with the Expressed sequenced tags (EST) in which cDNA are sequenced using Sanger sequencing method, which is expensive, low throughput and not quantitative. To overcome the limitations of EST, a Tag-based method such as serial analysis of gene expression (SAGE) and cap analysis of gene expression (CAGE) were developed. Tag-based approaches are high throughput but their use is limited by cost, only analyse the portion of transcript and cannot distinguish the transcript isoforms (Lowe et al., 2017).

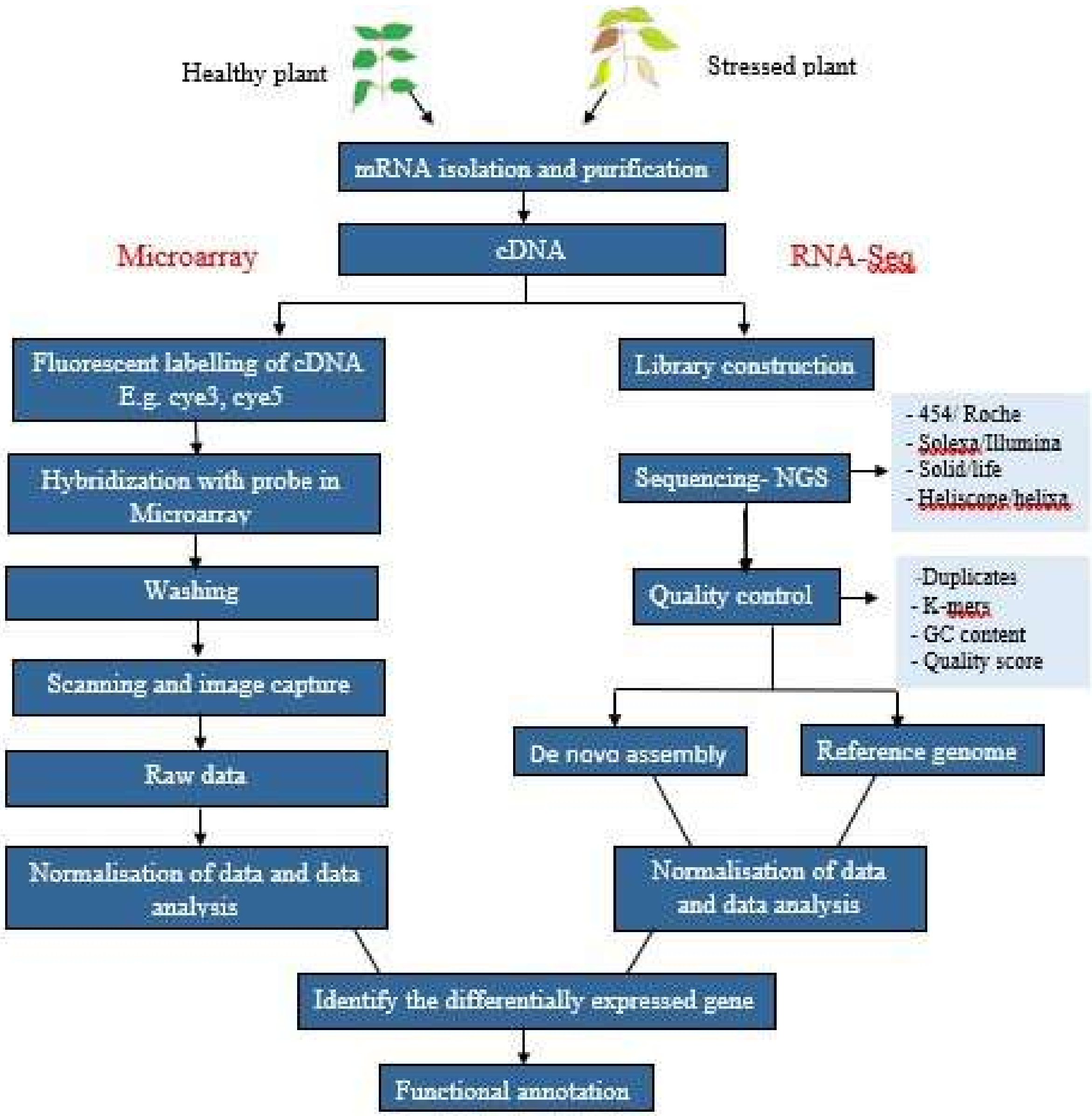

Fig 2. Schematic representation of microarray and RNA-Seq technology

Advancement in the next generation sequencing technology platforms has made the revolution in the transcriptomics by permitting the RNA analysis through complementary DNA (cDNA) sequencing. This is known as "RNA-Seq" (Wang et al., 2009). The sensitivity of RNA-Seq experiment can be increased by precise isolation of target transcript, depletion of off target transcripts and enrich the transcripts by amplification using PCR. The mRNA is isolated by targeting the 3' poly-A tail by using poly-T oligos covalently attached on the magnetic beads. Other small RNAs like microRNA are isolated by size using gel electrophoresis (Kukurba and Montgomery, 2015). Once, the transcript has been isolated, they are subjected to quality check and sequenced by either single end or paired end sequencing method. Then the reads are aligned against a reference genome or without reference genome (de novo assembly) which make the RNA-Seq advantageous over other methods by extending its use in non-model species (Fig 2.) (Grabherr et al., 2011). RNA-Seq also provides more detailed information on transcription boundaries in terms of

5'start site and 3'end, alternative splicing, transcript isoforms, transcript fusion, SNPs and other post-transcriptional modification.

Conclusion

Comparative transcriptome analysis, study of expression pattern of genes across species and integrating transcriptomics with other "omics" technology using more sophisticated approaches like system biology will help to resolve the gene function at subcellular level. This also play a vital role in dissecting out the molecular mechanism underlying the agronomically important complex traits which is of great use in genomic assisted breeding.

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Flood Stress in Fruit Crops

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The term flooding is termed as the soil condition, where excess water inhibits gas exchange of roots with the atmosphere. In addition, it refers partial or complete submergence of shoots. Due to flooding soil oxygen rapidly depletes and plant metabolism highly affected, thereby growth reduced. Response to flooding varies with the type of plant, with the duration and timing of flooding. Excess water than the optimum is otherwise called as flooding.

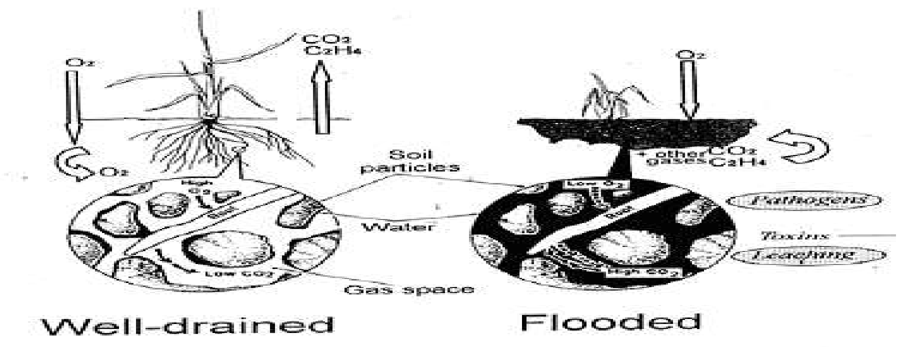
There is Always Three Aspects of Flooding

Flood responses among fruit crops directly relate to dramatic changes in Oxygen availability as well as the chemical and physical states of soil that occur after flooding. There are three aspects of flooding and its effect on subtropical and tropical fruit production:

1. The negative effect on plant processes (e.g. water and nutrient uptake, plant growth and fruit production).
2. The adverse effects on cultural practices (e.g. weed control and disease control).
3. The rare positive effect it may have on a few crops (fallow land flooding to reduce nematode populations prior to planting papaya and banana).

Symptoms of Water Logging

1. Leaf wilting and browning (scorching)
2. Suppression of root hair formation and branching of roots
3. Fruit drop and leaf chlorosis and leaf abscission (drop)
4. Stem dieback, limb dieback
5. Tree death.



Effect of Flooding

Decrease in net CO2 assimilation, stomatal conductance and transpiration is the very first symptoms of flooding stress (Schaffer et al., 1992). Therefore, to measure the degree of flooding stress leaf gas exchange characteristics is useful (Schaffer et al., 1992).

It would be influenced by number of factors viz.

1. soil type, porosity and chemistry
2. degree and duration of anaerobiosis
3. soil microbe and pathogen status;
4. vapour pressure deficits and root zones and air temperature
5. plant age, stage of development etc.

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Most tropical fruit crops are intolerant to flooding. Sensitivity to flooding ranges from intolerance to even 24 hours of flooding e.g., papaya, jack fruit, sugar apple and avocado; to moderately tolerant e.g., Persian lime, banana, mango, carambola; to tolerant, e.g., some grafted citrus.

Plant Responses to Flooding

1. Decreased net CO_2 assimilation.

2. Reduction of root respiration.

3. Reduction in photosynthetic rate.

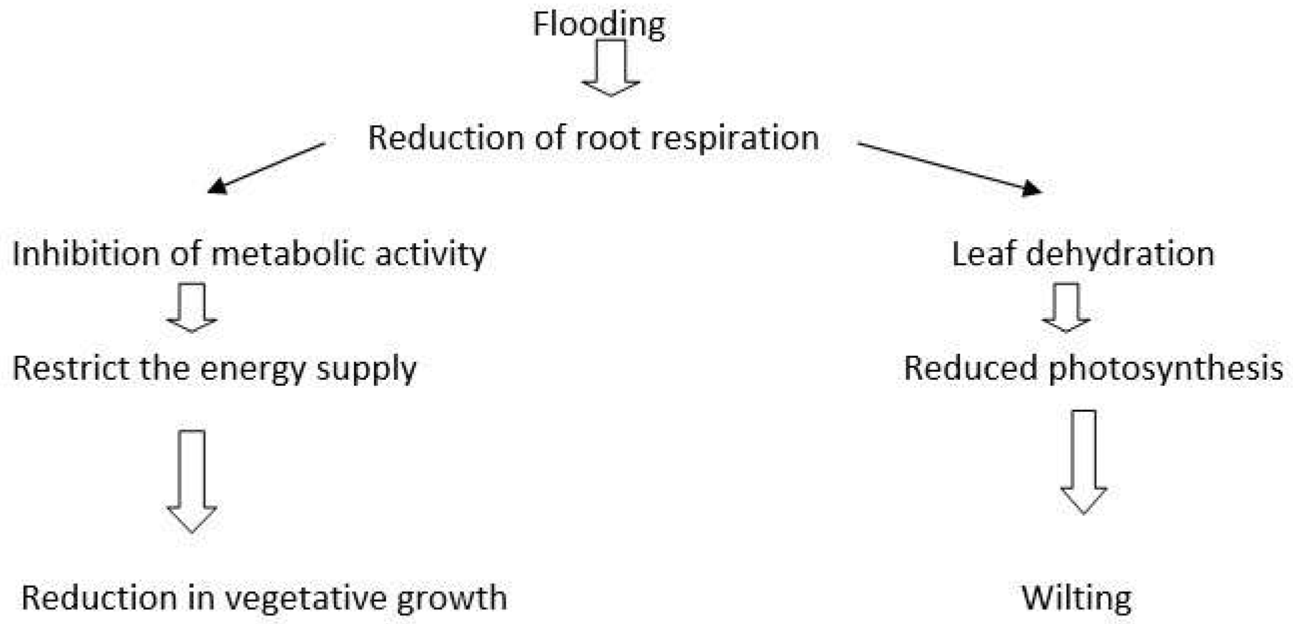
4. Reduction in both shoot and root growth are common responses to waterlogging. For flood-sensitive plants, flooding often results in damage and death of root tips. In apple trees flooded for one week during the spring had restricted root growth and developed small leaves which often desiccated on hot days. Shoot growth of apple abruptly declined when O_2 in the soil decreased below 12% and then gradually declined as oxygen concentrations were further decreased to 1.5 to 2%.,where another abrupt growth declined occurred.

5. Flooding has been shown to affect flowering, fruit set, yield and fruit quality of several fruit crops, both summer and winter flooding reduced fruit set, yield and fruit size of cranberry.

6. Decreased of stomatal conductance of sour orange seedlings four days after flooding.

7. Reduced conductance under flooded conditions may be due to an efflux of K^+ ions} from the guard cells associated with stomatal closure. Phytohormones, particularly ABA and cytokinins have been implicated in stomatal closure under waterlogging conditions.

Mechanism of Plants Response to Flooding



Neog et al. 2002

Table 1: Classification of Fruit Crops Based on their Flood Tolerance

Tolerant	Moderately Tolerant	Not Tolerant
• Grafted citrus • Pear • Sapota	• Apple • Banana • Carambola • Cherry • Citrus • Litchi • Mango • Persian lime	• Apricot • Custard apple • Fig • Loquat • Muscadine grapes • Peach • Pineapple • Pomegranate

Conclusion

1. At genetic level gene isolation that impart resistance to different types of water stresses in fruit crops need to be improved.
2. More ever the recent advances in science and technology enhances the drought and flooding monitoring capabilities and the availability of such information, which allows decision makers to make more knowledge-based decision to reduce the impact of drought as well as flood condition.

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Functions and Deficiency Symptoms of Nutrients

Article ID: 31207

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Nutrient

A nutrient element is one that is required to complete the life cycle of organism and relative deficiency produces specific deficiency symptoms.

Nitrogen

1. Functions:

a. It is constituent of proteins, nucleoproteins, nucleotides, phospholipids, alkaloids, enzymes, hormones, vitamins.

b. It is a constituent of important pigment (Clorophyll A, B). Nitrogen imparts dark green colour in plants + vigour growth of plants.

c. N also produces early growth and also results in delay in maturity. It pushes up for utilization of other elements as P, K and other elements. Supply of nitrogen is related in carbohydrate utilization.

2. Deficiency symptoms:

a. Plant having less than 1% N-content are usually regarded deficient in Nitrogen.

b. Symptoms appear on older leaves in the form of light green to pale yellow coloration (through proteolysis). Reduction in flowering, crop yield, Low protein content, stem will be erect, lateral buds will be suppressed and growing tall or spindle. Restricted root growth seems to be fibrous and reddish-brown colour.

Phosphorus

1. Functions:

a. P plays an important role in energy storage and transfer (ATP, ADP energy compounds). It is component of ADP, ATP, RNA, DNA, Phytin and phospholipids.

b. P is having important role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement etc.

c. It promotes early root formation and growth and there by helps to establish seedlings quickly. It improves quality of fruit, vegetables and grain crops and vital for seed formation. It brings about early maturity of crops mostly in cereals. It is constituent of majority of enzymes.

2. Deficiency symptoms:

a. Plant having less than 0.1 % or 1000 ppm P content are deficient in P.

b. Symptoms appear first on older leaves, tips or on the margin of leaves. Accumulation of carbohydrate result in dark-green colour leaves. Severe restriction occurs in the growth of plant tops and roots. P deficient plants are thin, erect and spindly with sparse and restricted foliage.

c. Developments of lateral buds are suppressed, making acute angle with the stem axis and foliage turns bluish-green. Under conditions of continuous deficiency older leaves become bronzed or develop reddish- purple tips and leaf margins.

Potassium

1. Functions:

a. It regulates salt-water balance in cells. It stimulates enzymes activity. It is used in storage and release of energy.

b. Role in cell division. It is required for formation of carbohydrates K is required in process of photosynthesis. It is required for translocation of sugar.

2. Deficiency symptoms:

a. Symptoms first develop on older leaves.

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b. Chlorosis along the leaf margins is followed by scorching and browning of tips of older leaves. Slow stunted growth of plants occurs and plant lodge rather easily. Potassium deficient seeds and fruits are shrivelled.

Calcium

1. Functions:

a. Ca^{+2} is essential to cell wall membrane structure and permeability.

b. It is important to N metabolism and protein formation by enhancing NO_{3-} uptake also provides some regulation of cation uptake. It is essential for cell elongation and division. It is essential for translocation of carbohydrates and nutrients.

2. Deficiency symptoms:

a. Usually plants having Ca-content less than 0.1 % are regarded as Ca deficient. It is immobile in plant; deficiency symptoms appear on younger structures.

b. Leaves become cup-shaped and crinkled and the terminal buds deteriorate with some break down of petioles. Desiccation of terminal buds and weakening of stem structure occurs.

Magnesium

1. Functions:

a. It is also necessary for formation of sugar from CO_2 and H_2O in sunlight and essential part of chlorophyll.

b. It regulates the uptake of other plant foods and it also acts as carrier of P in plants. It also plays an important part in translocation of starch and required for maximum activity of phospho rylating enzymes in carbohydrate metabolism.

c. It is common activator of enzyme concerned with energy metabolism.

2. Deficiency symptoms:

a. Mg is mobile in plant; deficiency symptoms appear on older leaves. Plant having Mg concentration less than 0.1 % are Mg deficient.

b. Interveinal Chorosis and streaked or patchy effects on older leaves. Affected leaves are usually small in final stages and curve upwards at margin. Under acute deficiency, the affected leaf tissues dry up and may even die.

Sulphur

1. Functions:

a. It is involved in synthesis of oil.

b. It is essential for formation of proteins and amino acids like methien, cystine, systein. It is constituent of some biologically active compound vitamins (thimine, biotine), Lipoic acid, coenzyme A, ferredoxin, gluten.

c. It also promotes nodule formation, required for chlorophyll formation.

2. Deficiency symptoms:

a. Plant having less than 0.1 to 0.2 % S content are deficient in S.

b. S is immobile in plants, deficiency first occur on younger growths. The fading of normal green colour of the leaves followed by Chlorosis is most common deficiency symptom. In brassicas , the lamina is restricted, leaves show cupping owing to the curling of the leaf margins and arresting to the growth points.

Iron

1. Functions:

a. Transfer of electrons between organic molecules and Fe provides the electrochemical potential for many enzymatic transformations in plants. Fe is a structural component of porphyrin molecules: cytochromes, hematin, ferrichrome, and leg-hemoglobin.

b. Fe-containing cytochromes in the chloroplasts function in photosynthetic reduction processes where ferrodoxin, and Fe-S protein, is an electron acceptor.

2. Deficiency symptoms:

a. Plant having less than 50 ppm of Fe are usually classified as iron- deficient.

b. Deficiency if iron results in Interveinal Chlorosis appearing first on younger leaves with leaf margins and veins remain green. Under conditions of severe fe deficiency growth cessation occurs with the whole plant turning necrotic.

Zinc

1. Functions:

a. Zn is involved in many enzymatic activities, but it is not known whether it acts as a functional, structural, or regulatory cofactor.

b. Zn is important in the synthesis of tryptophane, a component of some proteins and a compound needed for the production of growth hormones (auxins) such as indol acetic acid, involved in chlorophyll synthesis.

2. Deficiency symptoms: Plant having less than 15 ppm of Zn are usually classified as Zinc - deficient. Common deficiency symptoms of Zn are Interveinal Chlorosis, first appearing on young leaves. Reduction in size of young leaves which are often clustered or borne very closely, bronzing, and purple, violet reddish brown or brown coloration of the foliage.

Copper

1. Functions:

a. Photosynthesis and respiration involve the transfer of electrons that requires Cu.

b. Lignin formation in cell walls, several enzymes important to synthesis of lignin contain Cu. If photosynthesis is impeded by Cu deficiency during the vegetative growth stage, then carbohydrate production and plant growth are reduced.

2. Deficiency symptoms:

a. Plant having less than 5 ppm of Cu are usually classified as Copper - deficient.

b. Male flower sterility, delayed flowering and senescence are the most important effects of Cu-deficiency. Chlorosis of the younger shoot tissues, white tips, reclamation disease, necrosis, leaf distortion and die-back are the characteristics Cu- deficiency symptoms.

Manganese

1. Functions:

a. Mn is essential to photosynthesis reactions, enzyme activation, and root growth.

b. Most O2 in the atmosphere originates from Mn-facilitated electron transport in photosynthesis.

c. Cu, and Mn activates several enzymes that synthesis several amino acids and phenols important to lignin production. In addition to lignin, these compounds are used to synthesize phenolic acids and alcohols that provide resistance to infections by pathogens.

2. Deficiency symptoms:

a. Plant having less than 25 ppm of Mn are usually classified as Manganese - deficient.

b. Deficiency symptoms of Mn are severe on middle leaves than on the younger ones because Mn is preferentially translocated to younger tissues. Interveinal Chlorosis on dicotyledonous plants is characterized by the appearance of chlorotic and necrotic spots in the Interveinal Chlorosis.

Boron

1. Functions:

a. The primary function of B is cell wall structural integrity in plant. B provides cross links between cell wall polysaccharides that gives structure to the cell wall – important for cell expansion, regulation of H+ transport, retention of cellular Ca+2, and control of lignin production and cell expansion.

b. Thus, B deficiency commonly appears as a structural deformity in actively growing regions. Serious yield reductions in grains and elsewhere due to B deficiency causing male sterility, as exhibited by poorly developed anthers and non-viable pollen grains.

2. Deficiency symptoms:

a. Plant having less than 5-30 ppm of B are usually classified as Boron -deficient.

b. Internodes become short and give a bushy appearance. Increased diameter of stem and the petioles gives rise to the typical cracked stem of celery.

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Hydraulic Ram Use for Water Pumping in Hilly Areas

Article ID: 31208

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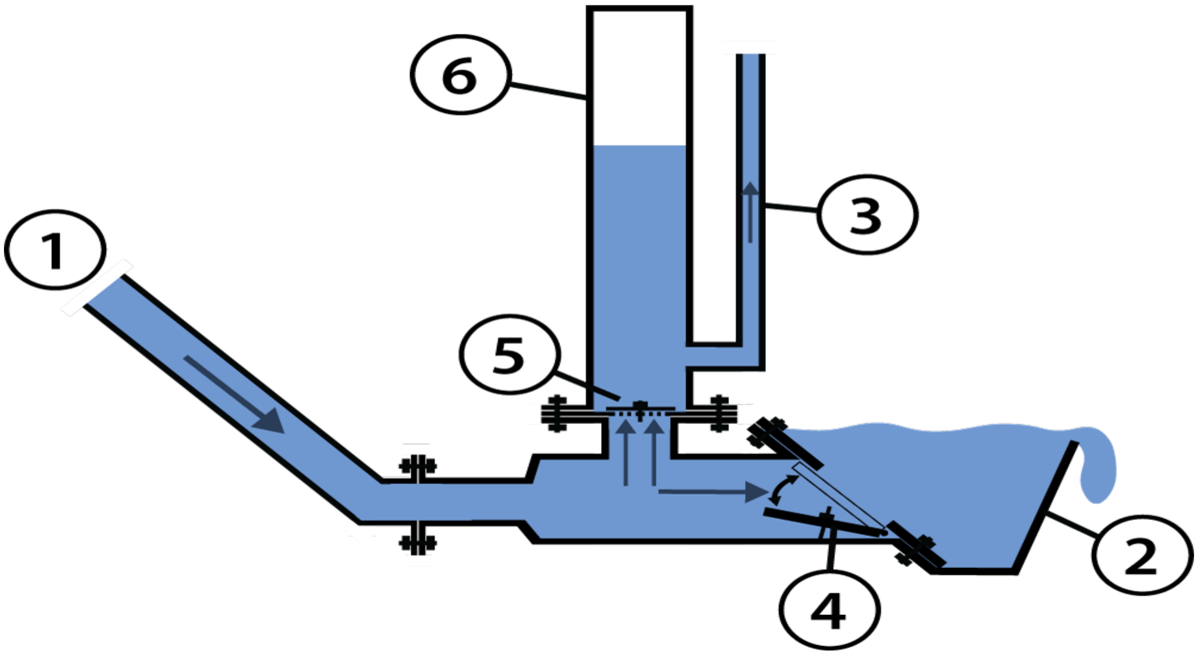
Introduction

Hydraulic ram pump or HYDRAM is an automatic device that uses the potential energy of flowing water such as stream of water or river to pump part of water to a height above that of the source with the continuous flow of water. Hydraulic ram pump or HYDRAM is a cyclic water pump powered by hydropower. It functions as a hydraulic transformer that takes in water at one "hydraulic head (pressure)" and flow rate, and output water at a higher hydraulic head and lower flow rate (Kherde et al 2020). The hydraulic ram is used in remote areas especially hilly areas and in the villages, which are located at the greater heights from altitude, where there is both a source of low-head water and a need for pumping water to a destination higher in elevation than the source. In this situation, the ram is often useful, since it requires no outside source of power other than the kinetic energy of flowing water. Hydraulic Ram Pump technology is unfashionable (Pathak et al 2016). The need for water has always been a basic motivation of mankind, which frequently had to be lifted from a lower height to an upper height. This ever-increasing need of water ultimately resulted in the development of various pumping aids. The increasing need of water is always being closely associated with the demands of domestic water supply for rural populations, irrigation etc (Mishra et al 2018). In recent years an increased interest in renewable energy devices and an awareness of the technological needs of a particular market in developing countries have prompted a reappraisal of hydraulic ram pump.

Working Principle

A simplified Hydraulic Ram Pump initially, the take a look at valve is opened and the delivery valve is closed. The water inside the power pipe starts to flow under the pressure of gravity and selections up pace and kinetic energy until the growing drag force closes the waste valve. The momentum of the water flow inside the deliver pipe against take a look at valve causes a water hammer that raises the pressure within the pump, open the transport valve and force some water to flow into the transport pipe. Because this water is being compelled uphill via the delivery pipe rather than its miles falling downhill from the source, the float slows; while the drift reverses; the delivery test valve closes.



Components of a hydraulic ram pump:
1. Inlet drive pipe.
2. Free flow at waste valve.
3. Outlet delivery pipe.
4. Waste valve.
5. Delivery check valve.
6. Pressure vessel, the bolt and nut in the waste valve is used to tune the pump.

Suitable Conditions

A hydraulic ram pump is powered by a body of water flowing downhill with a height difference. A general rule of thumb is that the water can be pumped 30 times as high as the available drive head (the height difference of the water driving the pump). So, a head of 1 m can be used to pump up water to ~30m, while a 7 m head can pump water up to 210 m.

The capacity of a hydraulic ram depends on the scale of the pump, which is often measured in the diameter of the tube delivering the water to the pump. Pumps exist in the range 1" up to 5". With height difference, the actual difference in vertical height is meant, not the length measured along the slope.

Criteria for Site Selection of Hydraulic Ram Installation

1. Available fall in the stream.
2. Quantity of water available in the stream during the cropping seasons and lean periods of flow.
3. Elevations of the water supply points in the area proposed to be brought under irrigation and/or the elevation of the water storage tank.
4. Distance of the ultimate delivery point of water from the proposed site of the Hydraulic ram.
5. Safe distance from the path of possible landslide and avalanches in snow-bound areas.
6. Existing and proposed cropping patterns of the area to be irrigated.
7. Estimated requirement of irrigation water.

Advantages

1. Use renewable energy sources.
2. Very effective in mountainous areas.
3. No prime mover is required because it runs itself.
4. Simple design.
5. Low repair cost.
6. Negligible running cost.
7. No electricity consumption.
8. It work continuously and, therefore gives regular supply.
9. Long life.
10. Reliable.

Disadvantages

1. It can pump only one tenth of the received water volume remaining being wasted through waste valve.
2. It must have a continuous source of supply at a minimum height of not less than 3 feet or 91 cm.
3. It cannot pump viscous fluids to a greater height. Usually used for pumping drinking water or portable water.

Application of Hydraulic Ram

1. To lift a part of the flow of hillside spring, stream or rivulet to irrigate adjacent sloppy lands.
2. To lift water for drinking water supply in village.
3. To provide water supply to small industrial establishments and fish ponds located in hilly areas.
4. To feed water to a high-level field channel by installing the ram downstream of a weir or drop structure in a canal system. This will increase the command area of a canal system.
5. To boost the discharge of lift irrigation schemes using engine or electric-motor-operated pumping sets, to take a part of the pump discharge to higher elevations for irrigation.

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Moringa: A Miracle Vegetable Tree

Article ID: 31209

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Abstract
Moring which is popularly known as Drumstick is truly magical vegetable tree. Because, it is a vegetable with a load of incredible health nutrients. Just add fresh or dried leaves to any of your dishes and strengthen your body and mind. It is not an essential nutrient but herbal supplement. So, there is no recommended dosage of drumstick as of now. As drumstick is a natural source of nutrients and more bioavailable than the other form of supplements. It doesn't take much to grow a tree either. It requires only 8 months with marginal soil and a little water and a bit of care. Our ancestors have consumed almost every part of this tree including seed pods (drumstick), leaves, fruits, seeds, and oil for thousands of years except the roots. Different preparation from Moringa leaves, flowers, and fruits are used in Indian subcontinent for various purposes.

Introduction
Moringa is one of those rare plant species whose seeds, flowers, leaves, and stems are edible and extremely nutritious. Moringa commonly referred to as drumstick is treated as a 'super plant' for its unique yet powerful properties that combat different ailments in our system. One of the most important health benefits of moringa is that it promotes a healthy bone structure due to the presence of high amount of calcium and iron that not only help build strong bones, but also prevents the loss of bone density, further increasing overall stamina and health.


Moringa belongs to mono generic family named Moringaceae, and this family includes 12 species of various type trees etc. (Olson, 2002) and is indigenous to Indian subcontinent and has become naturalized in the tropical and subtropical areas of the world. Tree occupies important position in the Indian vegetable industry. It is a drought tolerant, fast growing, perennial and easily adapted to diverse eco and farming systems. It is still supposed to be underutilized plant in family Moringaceae. Regional names of Moringa are Drumstick tree, Sajna, Horseradish tree, Mulangay, Kelor, Saijihan, and Benzolive, (Fahey, 2005).

Every street in Indian villages has a moringa tree (Moringa Oleifera Tree). And if we enter a kitchen, we will most certainly find the Drumstick vegetable (slender, long green seed pods). In India people swear by the health benefits of drumstick leaves, flowers and seeds. It is a long, bean-like vegetable, sometimes 30 – 45 cm long, that grow on very tall trees in South India and some other states of India. Moringa is grown in tropical and subtropical areas with annual rainfall of 760 to 2500 mm and temperature ranging from 18-28 °C. It grows in any soil type except waterlogged ones. Slightly alkaline clay along with sandy loam soils is considered ideal due to their good drainage properties (Abdul, 2007)

Drumstick is a valuable food crop, grows very fast and even beyond food it serves many benefits. It has been used to fight against malnutrition, especially among young ones and lactating mothers. Its various plant parts are used for different purposes. It is the richest plant source of Vitamins A, B, C, D, E and K. Minerals present in this tree include K, Mg, Ca, Mn, Zn, Cu, and Fe. Its various parts are used for the treatment of various diseases. It is resistant to drought duration because of long taproot system. Its cultivation is very simple and requires fewer efforts. It plays an important role in conservation of soil, water, and mitigating climatic change (Lovepreet Singh, Jyoti and Jatinder Singh, 2019). These are used to cure health related problems like sore throat, ear infections, sprain, hypertension, cough, anxiety, headache, hysteria, skin infections, epilepsy, for intestinal worms, respiratory disorders, joints pain, anemia, blackheads, pimples cholera, diarrhea bronchitis, lactation diabetes, abnormal blood pressure, swelling chest congestion conjunctivitis, asthma, fever, scurvy, tuberculosis and semen deficiency (Mishra et al., 2012). Moringa seeds in powdered form may contain cationic polyelectrolytes, which work as a natural flocculent to clarify even the most muddled water. This powder joins with the solids present in the water and settles down. By doing so, it may remove 90–99% of bacteria that contained in water (Omotesho et al., 2013).

Moringa leaf extracts have been used to manage hyperthyroidism and anti-Herpes Simplex Virus Type-1 (Lipipun et al., 2003). Moringa pod and seeds contains high nutrients, and phytochemical compounds such as amino acid, vitamins β-carotene, protein, minerals, and various phenolics (Farooq et al., 2007). According to Ayurveda, traditional medicine system Moringa can prevent more than 300 diseases (Ganguly et al., 2013). Moringa seed oil also known as Ben oil and resists rancidity. In modern times, this tree has been promoted as an outstanding primary source of digestible calcium, protein, vitamin c, and Fe, carotenoids for consumption in undernourishment is a foremost concern. Moringa quantitatively offers higher nutrients per gram of plant than other plants.

Conclusion

It can be concluded that moringa is an important medicinal plant in ayurvedic system. It can be proved by several scientific studies also. It has several medicinal properties like anti-oxidant, anti-microbial, anti-cancer, anti-diabetic, hepatoprotective, anti-inflammatory, anti-pyretic, analgesic activity, hypocholesterolaemia effect, cardio protective property, anti-asthmatic, water purification properties. It is proven in numerous cases that the moringa tree possesses a wide range of medicinal and therapeutic properties. The research on moringa is yet to gain importance in India. It is essential that the nutrients of this wonder tree are exploited for a variety of purposes.

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Micronutrient Seed Priming: Is it Pocket Friendly than Soil and Foliar Applications?

Article ID: 31210

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Introduction

Crop plants needs about 17 essential elements for better growth and development. When these minerals are required in relatively high amounts, they are called macronutrients and in trace amounts as micronutrients. While micronutrients are required in relatively smaller quantities for holistic plant growth, they are as vital as macronutrients. If even one of these elements is lacking in the soil or not adequately balanced with the other nutrients, it may result in growth suppression or even complete inhibition. Micronutrients often act as cofactors in enzyme systems and participate in redox reactions, additionally to having several other vital functions in plants. But most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration and their deficiency can choke these vital physiological processes and thus impacting yield gain.

'Hidden hunger' or mineral deficiency in edible food grains is a major health concern in a majority of developing countries. For example, dietary Zinc (Zn) deficiency may result in loss of immunity, poor wound healing and even dermatitis. Whereas an adequate amount of Zn nutrition helps to improve resistance to some infectious diseases such as diarrhoea and increase immunity.

Micronutrients are vital for both plant growth and human health. While, foliar and soil applications are the most prevalent methods of micronutrient addition, the initial cost involved and difficulty in obtaining high quality of micronutrient fertilizers are quite costly, which are important factors especially in developing countries.

Enhancing plant micronutrient status in circumstances where micronutrient nutrition is inadequately supplied from the soil has proven to increase yield. However, this requires application of higher doses of fertilizer to soils too because of low nutrient-use efficiency. In crop plants, micronutrients may be supplicated to the soil, foliar sprayed or added as seed treatments. Although the required amounts of micronutrients can be supplied by almost any of these methods, foliar sprays have been most effective in and grain enrichment and yield improvement. By the way, the more cost hastens a wider acceptability, particularly by resource-poor farmers. Plus, foliar application occurs at a later growth stages when crop stands are already established. On the other hand, micronutrient seed treatments, which include seed priming and seed coating, are an easy and cost-effective alternative.

Hence, seed treatment is a wiser option from an economical perspective as only a small amount of micronutrient is needed, is easy to apply and the seedling growth is improved.

Seed Priming

Seeds can either be treated with micronutrients or by soaking in nutrient solution of a specific concentration for a specific duration or even by coating with micronutrients. Seed invigoration is a relatively new term and is interchangeably used for two methods of seed treatment.

Methods of Seed Priming

In seed priming, seeds are partially hydrated to initiate metabolic events to require place without actual germination, then dried again (near to their original weight) to permit routine handling. Such seeds germinate much faster than non-primed seeds. In seed priming by micronutrient i.e. nutripriming, micronutrients are moreover used as osmotica. Primed seeds more or less have higher degree of better germination directing simply to a less hydration period and of germination-accelerating metabolites.

The four most common methods of Seed Priming are:

1. Hydro Priming: Hydro priming is a technique for initiating germination without the emergence of the plant. It involves soaking the seeds during a priming agent solution followed by drying. This technique accelerates germination significantly and reduced the time required for plants to emerge. It also improves the seed vigour.

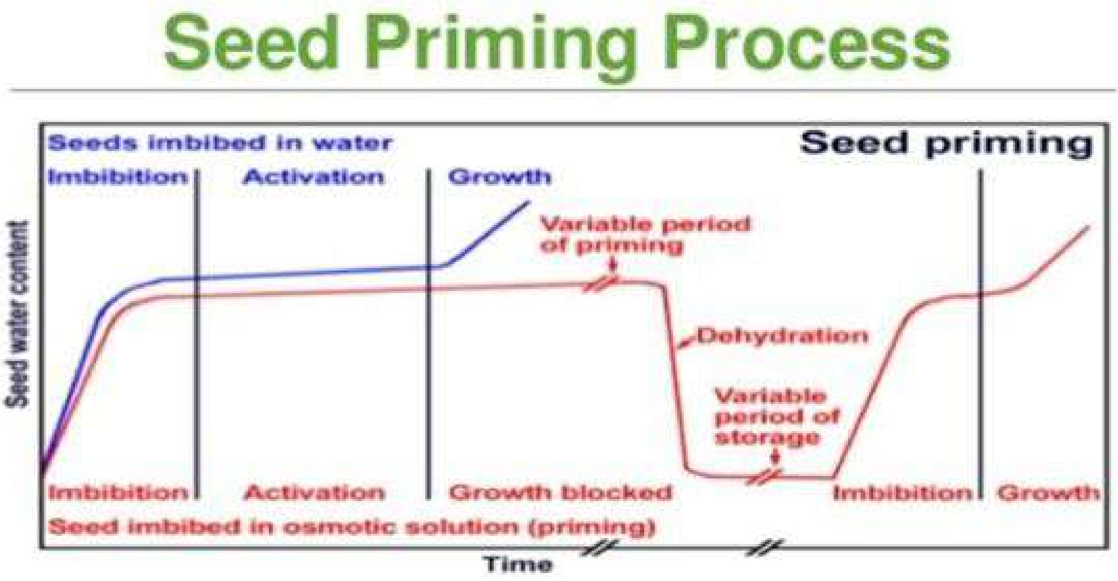
2. Osmotic Priming: In this technique, controlled hydration of seeds to a level that allows pregerminated metabolic activity but inhibits radicular emergence. It is achieved by immersing seeds in an aqueous solution of a chemically inert but osmotically active compound. The osmotic potential is adjusted to allow all the pre-germination processes while impeding cellular prolongation and plant emergence, even after weeks of contact between the seeds and the osmotic solution. This method increases the uniformity of germination and emergence seedlings to establish more rapidly in a field and the planning and allows for execution of cultivation and harvesting to be easily facilitated.

3. Solid Matrix Priming: In this method, the water uptake is controlled by suspending the seed in a defined medium (or matrix) of solids (which can be organic and/or inorganic) whose water holding properties are known. The seed and therefore the matrix then compete for the available water, coming to an equilibrium at precisely the proper point for seed priming to occur. The aeration and temperature are controlled with precision throughout the process. After the process is complete, the seed and matrix are separated and the seed is re-dried. It is perhaps the foremost versatile sort of seed priming and fewer risk prone.

4. Bio Priming: Bio-priming may be a new technique of seed treatment that has biological (inoculation of the seed with beneficial organism to guard the seed) and physiological aspects (seed hydration) for disease control. It is often used as an alternative method for controlling many seed and soil borne pathogens which can result in undesirable effects on plants.

For e.g., with an increase in the soil's pH level, Zinc's (Zn) solubility in the soil and its uptake decreases concomitantly. Similarly, in several crops, the higher soil phosphorus (P) contents may induce Zn deficiency. Poor growth and little brown spots on leaves are common symptoms in rice and maize plants grown on Zn deficient soils. Seed priming with Zinc improve crop establishment, stand establishment and gives better growth and yield.

Advantages and Effects



Seed priming is also surely more cost effective in comparison with soil application having significant savings, it is sensitive and can be changed by various environmental conditions and other factors. Oxygen levels, temperature and water potential are amongst the most important factors that impact seed priming. Even after seed priming with Zn, crops have shown to possess no effect on the grain yield and sometimes leading to even complete failure . This is possible due a lack of testing and optimizing the priming levels. Instead, it's wiser to optimize micronutrient seed priming levels within the laboratory then test in soil for germination before priming the whole batch.

Similarly, other factors such as regulating the oxygen supply during seed soaking can improve the effectiveness of the process. There is a substantial difference in the performance of aerated vs. non-aerated solutions during seed priming. Presence of oxygen improves seed performance at the time of sowing. The temperature of the primed media also affects the efficacy of seed priming. For example, low temperature during priming can delay the physiological processes of germination, albeit seeds absorb water in optimal amounts.

Conclusion

Overall, there is massive potential of micronutrient seed treatments for enhancing crop growth and grain nutrient enrichment. Micronutrient applications through seed treatments improves the crop stand establishment, increases phenological events by many folds and increases yield and micronutrient grain contents. Being an easy and cost-effective method of micronutrient application, seed treatments has emerged an attractive option for resource poor farmers.

Seed treatment with micronutrients has the potential to deal with crop micronutrient requirements, enhance seedling emergence, yield, and grain micronutrient enrichment. Seed priming or seed coating, are pragmatic, inexpensive and an easy alternatives of micronutrient delivery especially by small landholders in developing countries. Variation exists within crops and varieties / genotypes / hybrids which researchers are actively working on to:

1. Develop precise techniques using a range of micronutrient sources at varying concentrations and durations.
2. Optimizing the temperature range, oxygenation requirements and water potential for maximum benefit.
3. Enhancing the storage potential of nutriprimed seeds, which may be critical for technology transfer in the future.

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Food Fortification: Today's Need

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Introduction

Food fortification is the process of adding micronutrients (essential trace elements and vitamins) to food. It may be a purely commercial choice to provide extra nutrients in a food, while other times it is a public health policy which aims to reduce the number of people with dietary deficiencies within a population. Staple foods of a region can lack particular nutrients due to the soil of the region or from inherent inadequacy of a normal diet. Addition of micronutrients to staples and condiments can prevent large-scale deficiency diseases. It is a safe, effective way to improve public health and has been used around the world since the 1920s. Commonly fortified foods include staple products such as salt, maize flour, wheat flour, sugar, vegetable oil and rice.

Need of Fortification

More than two billion people worldwide suffer from micronutrient deficiencies because they are not meeting their daily dietary requirements for essential vitamins and minerals. These deficiencies not only affect an individual's long-term health but can also raise social and public health care costs and potentially depress a nation's economic productivity (WHO/FAO).

It may be difficult for those living in developed countries to remember when diseases such as goitre, rickets, beriberi, and pellagra were once common health problems back in the early 20th century. As per World Health Organization (WHO), about two billion people worldwide suffer from micronutrient deficiencies because they are not getting essential daily dietary requirements. Many diets, especially those of the poor, contain insufficient amounts of these essential vitamins and minerals due to lack of variation and/or consumption of predominantly processed foods.

Since most populations in rural areas do not have access to adequate quantities of fruits, vegetables and meats, where micronutrients are abundant, they are vulnerable to long-term health problems and raise social and public health care costs and potentially depress the country's productivity. Today, these diseases are rarely seen due to a series of food fortification programs that helped fend off a multitude of nutrient deficiencies.

According to the World Health Organization and the Food and Agriculture Organization of the United Nations, food fortification is the practice of designedly increasing content of an essential micronutrient in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.

Fortification in India

In India, fortification of salt with iodine (generally called iodization of salt) and fortification of Vanaspati (hydrogenated fats) with vitamin A is compulsory. The National Anaemia Control Program (started in 1970) distributes iron tablets to children, pregnant and lactating women. Anaemia continues to jeopardize the life and wellbeing of a large number of the population, and vitamin A deficiency remains a public health problem. Hence, provisioning of small amounts of micronutrients through fortification of multiple foods that are consumed by various population groups and are either distributed through public funded programmes like public distribution system (PDS), Integrated Child Development Services (ICDS), and Mid-day Meal (MDM) scheme, and/or sold through the open market commercial channels offers an opportunity to provide micronutrients on a sustained basis.

Advantage of Food Fortification

1. Food fortification does not require people to change their food habits thus it is socially acceptable. Effect of fortification is fast and broad. Food fortification is the safest strategy as the nutrient provided in diet is low but in incessant amount can be introduced quickly and can produce nutritional benefits for populations in a short period of time.

2. Fortification supplies micronutrients in amounts that are appropriate. Hence, safer than supplements. When properly regulated, fortification carries a minimal risk of chronic toxicity.

3. Fortification of widely distributed and widely consumed foods has potential to improve the nutritional status of a large population, covering both poor and wealthy.

4. Fortification does not require any changes in existing food patterns, nor individual compliance – which are very difficult to achieve.

Limitation

1. A specific fortified foodstuff might not be consumed by all members of a target population. While, everyone in the population is exposed to the increased levels of micronutrients in food, whether they need it or not.

2. Infants and young children, who consume relatively small amounts of food, are less likely to fulfil their recommended micronutrients from universally fortified staples alone.

3. Fortified foods often unable to reach the poorest segments of the general population due to their low purchasing power and an underdeveloped distribution channel. Availability, access and consumption of adequate quantities and a variety of micro nutrient-rich foods, such as animal foods and fruits and vegetables, is limited.

4. Very low-income population groups are known to have coexisting multiple micronutrient deficiencies. Although multiple micronutrient fortification is technically possible, the poor will be unable to obtain recommended intakes of all micronutrients from fortified foods alone.

5. Nature of the food vehicle or the fortificant, sometimes limit the amount of fortification. For example, some iron fortificants change the colour and flavour of many foods, and can cause the destruction of fortificant vitamin A and iodine.

6. It is more cost-effective than other strategies, there are several costs associated with the food fortification process, which might limit the implementation and effectiveness of food fortification programmes in developing country like India.

Examples of Fortified Foods

1. Grain products (like bread and pasta) with folic acid- Folic acid is a vitamin B found in foods like leafy green vegetables, beans and orange juice. These provide an excellent way to help reduce the incidence of the birth defect spina bifida when consumed by pregnant women.

2. Golden rice is fortified with beta carotene which is precursor of vitamin A through genetic engineering biosynthesize of beta carotene.

3. Milk fortified with vitamin D - Vitamin D is crucial for strong bones, normal muscle function and aids in keeping the immune system healthy. In North America and around the world, a deficiency of vitamin D has been on the rise in recent years. Adding vitamin D to milk is great, especially for the elderly (whose bodies don't make vitamin D as efficiently from sunshine as their younger peers) as well as for children and people who live in harsh climates who aren't able to gain the nutrient from sunlight exposure.

4. Fortified orange juice with calcium - Just as with milk, orange juice can be a healthy dietary inclusion. Having a selection of juices that include antioxidants and bone-building calcium and vitamin D only increases its healthfulness.

5. Eggs fortified with omega-3 fatty acids - Typically, omega-3s come from fatty fish in the diet. They help in reducing the risk of coronary heart disease, help improve brain function, prevent cancer, boost health of unborn babies and ease arthritis pain, getting them from another source is great especially for people who don't get them from other foods.

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Crop Residues Management: A Strategy for Sustainable Agriculture

Article ID: 31212

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Introduction

Crop residue is the largest agricultural harvest. Over half of all dry matter in the global harvest consists of cereal and legume straws; tops, stalks, leaves, and shoots of tuber, oil, sugar, and vegetable crops; and pruning and litter from fruit and nut trees. Out of various crops grown, rice, wheat and sugarcane are prone to crop residue burning.

These crops are preferred by farmers since they provide higher economic return, as compared to other crops. Soil organic carbon (SOC) content, which plays an important role in soil sustainability, is a key indicator of soil fertility. The main source of SOC in cropland is crop residue; therefore, crop residue amendment is considered one of the most important management practices in maintaining soil fertility. Crop residue, the largest product of agricultural harvests, contains large amounts of assimilated carbon (C) and nutrients such as nitrogen (N), phosphorus (P), and potassium (P); these elements must be recycled for the sustainable development of agriculture.

Harvesting of various crops generates large volume of residues both on and off farm. Ministry of New and Renewable Energy estimated that about 500 Mt of crop residues are generated annually. The generation of crop residues is highest in Uttar Pradesh (60 Mt), followed by Punjab (51 Mt) and Maharashtra (46 Mt). Among different crops, cereals generate maximum residues (352 Mt), followed by fibres (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt).

Cereal crops (rice, wheat, maize, millets) contribute 70%, while rice crop alone contributes 34% to the crop residues. A large portion of crop residue is burnt 'on-farm' primarily to clean the field for sowing the next crop. burning of crop residues is predominant in four states, namely, Haryana, Punjab, Uttar Pradesh & West Bengal.

Uses of Crop Residues

Crop residues are primarily used as bedding material for animals, livestock feed, soil mulching, bio-gas generation, bio-manure/compost, thatching for rural homes, mushroom cultivation, biomass energy production, fuel for domestic and industrial use, etc.

Negative Impact of Crop Residue Burning

1. Loss of nutrients: It is estimated that burning of one tonne of rice straw accounts for loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides, organic carbon. Generally, crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) and 20% of Potassium (K). If the crop residue is incorporated or retained in the soil itself, it gets enriched, particularly with organic C and N.

2. Impact on soil properties: Heat from burning residues elevates soil temperature causing death of beneficial soil organisms. Frequent residue burning leads to complete loss of microbial population and reduces level of N and C in the top 0-15 cm soil profile, which is important for crop root development.

3. Emission of greenhouse and other gases: Crop residues burning is a potential source of Green House Gases (GHGs) and other chemically and radiative important trace gases and aerosols such as CH4, CO,

N_2O, NO_X and other hydrocarbons. It is estimated that upon burning, Carbon (C) present in rice straw is emitted as CO_2 (70% of Carbon present), CO (7%) and CH_4(0.66%) while 2.09% of Nitrogen (N) in straw is emitted as N_2O.

Besides, burning of crop residue also emits large number of particulates that are composed of wide variety of organic and inorganic species. Many of the pollutants found in large quantities in biomass smoke are known or suspected carcinogens and could lead to various air borne/lung.

How to Manage Crop Residues and Prevention of Crop Residues Burning

1. Incorporation of crop residue into soils through adoption of conservation agriculture practices to prevent soil erosion from wind & water and to augment the soil moisture;

2. Promotion of use of crop residue for preparation of bio enriched compost/vermin compost and its utilization as farm yard manure.

3. Use of crop residue for cultivation of mushroom particularly *Agaricus bisporus* (white button mushroom) and Volvriella Volvacea (straw mushroom).

4. Subsidy to the farmers for hiring resource conservation machineries from Custom Hiring Centre / Agriculture Service Centre and promotion of establishment of new CHS/ASC to ensure availability of such machines to the farmers at the time of crop harvesting.

Machineries Used for Residues Management

1. Straw Reeper: The left-over wheat stalks after cut by combine harvester, thresh and blow out the straw to netted trolley attached which allows blowing of dust particles. Recover wheat straw after combine operation. Recovered wheat straw is used as cattle feed. The capacity of machine on an average is 0.4 ha/h and straw recovery is about 55-60%.The quality of bhusa is comparable with that made available thresher. There is an additional grain recovery of 50-100 kg/ha.

2. Mulcher Machine: It is used for mulching of straws of crops such as rice, maize, sunflower and tobacco residues easily. The knives which are jointed on the roller, rotates vertically. This machine shreds the weeds and stock of row crops in orchards. Cutting height is adjustable by two wheels at the back of the machine.

3. Beller: It is used to compress raked residues of rice, wheat, fodders, sugarcane, legumes etc into compact bales that are easy to handle, transport, and store. Two different type of bale rectangular or cylindrical, of various sizes, bound with twine, strapping, netting or wire. Crop residues are turned into bales, which is used for animal feeding as well as bio fuels. It creates alternative business for farmers to sell bales to power plants. Save the environment from air pollution.

4. Happy Seeder: Happy Seeder is one of the unique techniques which is used for sowing seed without any burning of Crop residue. In this machine a Rotor unit is attached at front of seeding unit that cuts & spread straw in between the rows, as mulch. Majority of the residue is not disturbed and seed is sown in a single pass. This technology is eco-friendly with environment for the health of soil as well as it also saves water.

Advantages

It removes the need to burn rice stubble before planting wheat, therefore reducing air pollution. Direct sowing also reduces soil disturbance, enabling it to retain more nutrients, moisture and organic content. It also saves money as less time is needed on carrying out field operations, which in turn reduces fuel and labour costs.

Conclusion

The practice of crop residue amendment triggers the benign cycling of C and nutrients such as N, P, and K in agriculture. In the past, crop residue was, and remains, in areas of poverty, used for household fuel (cooking and heating), fodder, and bedding. Intensive burning of crop residue in the field is currently an environmental problem in India, especially in the primary agricultural regions. animals, and SOC levels were low compared to those in natural soils. Control of burning of crop residue to prevent environmental degradation and loss of soil nutrients and minerals by promotion of in-situ management should be done.

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The Use of Anti Hail Nets in the Changing Climate Scenario for Quality Fruit Production

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Introduction

India is the second-largest producer of fruits in the world but productivity was less compared to other countries, the reason for low productivity is lack of availability of quality planting material and climate change resulting in low productivity. The occurrence of a hail storm is very frequent nowadays in temperate areas due to climate change results in damage to the crop and increased incidences of the pests and diseases cause widespread damage and losses to the fruit crops and quality of the fruits are also greatly affected. Though hailstorm can occur in any part of the world, temperate zones are the most vulnerable. Widespread unseasonal rains spells accompanied by hail occurred in several states during February-March, 2014. It caused large scale destruction of crops in Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra, Punjab, Gujarat, Uttarakhand, Haryana, Andhra Pradesh and Karnataka with central India (Maharashtra and Madhya Pradesh) being the worst hit. The country did not witness such a severe weather aberration for a long time (source: The Indian Express, 20 March 2014). Hail is a solid, frozen form of precipitation that causes extensive damage to properties and growing crops.

Hailstorm

1. Formation, Occurrence, and size of Hails: Hailstones are formed when raindrops are carried upward by thunderstorm updrafts into extremely cold areas of the atmosphere and freeze. Hailstones then grow by colliding with liquid water drops that freeze onto the hailstone's surface. If the water freezes instantaneously when colliding with the hailstone, cloudy ice will form as air bubbles will be trapped in the newly formed ice. However, if the water freezes slowly, the air bubbles can escape and the new ice will be clear. The hail falls when the thunderstorm's updraft can no longer support the weight of the hailstone, which can occur if the stone becomes large enough or the updraft weakens. Hail falls when it becomes heavy enough to overcome the strength of the thunderstorm updraft and is pulled toward the earth by gravity. Smaller hailstones can be blown away from the updraft by horizontal winds, so larger hail typically falls closer to the updraft than smaller hail. (Source: https://www.nssl.noaa.gov/education/svrwx101/hail/). Size is a very important factor causing crop damage. Studies have concluded that most property damage begins when hailstone diameters are 20 mm or greater. Hails of different sizes borne out of hailstorms of different intensities are given in table 1.

Table:1 Hailstorm intensity scale:

Size code	Typical hail diameter	Equivalent shape	Intensity category	Typical damage impact
H0	<8.4	Pea	Hard hail	No damage
H1	8.4-15.2	Marble	Potentially damaging	Slight damage to plants, crops
H2	15.2-20.3	Coin or Grape	Potentially damaging	Significant damage to fruit, crops, vegetation
H3	20.3-30.5	Nickel to Quarter	Severe	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	30.5-40.6	Golf ball	Severe	Wide spread glass damage, vehicle bodywork damage

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H5	40.6-50.8	Tennis ball	Destructive	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	50.8-61.0	Base ball	Destructive	Aircraft bodywork dented, brick wall spitted
H7	61.0-76.2	Grape fruit	Very Destructive	Severe roof damage, risk of serious injuries
H8	76.2-88.9	Soft ball	Very Destructive	Severe damage to aircraft bodywork
H9	88.9-101.6	Soft ball	Super hailstorms	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	>101.6	Soft ball and up	Super hailstorms	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

(Source:www.noaa.govandwww.torro.org)

2. Hail forecasting: Forecasters use radar technology for detection of hail and have met with various degrees of success depending on conditions. Radar is an acronym that stands Dual-wavelength radar (DWR) makes simultaneous use of two different wavelengths, hence offer better scope compared to single wavelength radars for detecting hail and distinguish it from rain showers. This technique has been successfully applied in the USSR.

3. Damage symptoms of Hails on fruit crops: Hail damage can occur at any time during the growing season. The damage looks like at harvest will depend on how mature the fruit was and how large and hard the hail was it struck. A hard impact early in the season could cause very deep depression and deformation of the fruit. Later-season damage could appear more bruise-like. It is important to inspect the damage of fruit trees as soon as possible after a hail event as the level of damage can be observed by subsequent growth. Hail can impact on the foliage, flowers, stems, branches, and fruit in various ways and the quality of damaged fruits is severely affected and less market price.

Fig: Formation of Lesions on fruits due to hail damage

4. Management of hail-damaged trees:

a. Hail wounds on the fruit and bark may need fungicides to prevent disease entry.
b. Wounds are a key infection site for disease, and particularly bacterial diseases.

c. Severely damaged stems and branches should be pruned off as soon as possible to prevent infections. Stems of branches should be sealed to protect against infection.
d. To reduce the risk of pests and disease remove or mulch fruit that has fallen to the ground.
e. Replacement of young trees may be necessary if damage to the plants is severe enough.
f. Fertilizers and irrigation applied at optimum levels will help the trees overcome the stress caused by hail damage.
g. Inspect damaged plants more frequently for pests and diseases.
h. Where practical, large wounds on trunks and branches should be covered with water-based paint to avoid desiccation and disease infection.
i. Use fruit thinning to selectively remove hail-damaged fruit and to improve yield and quality of remaining fruit.

Hail Control Mechanisms

1. Cloud seeding: silver iodide and smoke particles are injected into the clouds of a storm in order to create more ice crystals, which then compete for the available liquid water. It competes for the water so that it produces may small hailstones and less damage if they survive to fall the ground.

2. Creating shock waves: According to Eggers Hail Cannons from New Zealand, one of the leaders in manufacturing this device, anti-hail cannons have been used since the 18th century. They have been largely developed over the past thirty years, with the last ten being the most relevant. The cannons generate a shock wave that disrupts the formation of hail in the sky. Acetylene gas and air is fired in the lower chamber of the machine. The gas then passes through the neck and while it travels into and through the cone, it develops into a force that becomes a shock wave. The shock wave is shot directly above the cannon, disrupting the growth phase of hailstones (https://core.ac.uk/reader/19152618).

3. Preventive measures: Anti hail nets are used to control the damage going to cause by a hailstorm. Due to hailstorms, the crop used to damage more often in Himachal Pradesh. The farmers from rural areas of Shimla, Kinnaur and Kullu districts are now trying to protect their crop with these anti-hail nets.

Conclusion

The climate the change resulted in the occurrence of thunderstorms associated with hails which resulted in great damage to the fruit crops. The damage intensity of the hails depends on the size of the hails, if the crop in reproductive stage or fruiting stage the great economic damage will occur and quality of the hail affected fruits also poor quality, later they invade by microorganisms causing a secondary infection. Netting is a good solution to save the crop from hail damage compared to cloud seeding and creating shock waves that are cost-effective.

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Different Crop Modification Breeding Techniques for Desirable Food Production

Article ID: 31214

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Introduction

Agricultural science is rapidly developing in the modern world. As the world's population is dramatically increasing over the decades and it will reach about 10 billion by 2030. Plant breeding is the only way to feed and meet the growing population demand. Using this science (Art) breeder from all over the world can develop the food which is sufficient to meet the growing population demand.

Plant breeding helps not only in the development of high yielding plants also useful for inducing desirable traits in the food which allows the people to get satisfied. Different crop breeding techniques were developed by scientists to create new traits. To help educate people about the different plant breeding methods that are used in agriculture to create new traits in plants, here an overview of different crop breeding techniques has been listed for simple understanding.

Cross Breeding

It is the classical breeding method that has been used since ancient times. Traditional crossbreeding has been the backbone of improving the genetics of our crops. In this method, pollen from one plant is placed on the female part (ovary) of the flower of another, leading to the production of seeds that are hybrids of the two parents. Then, plant breeders select the plants that have the beneficial traits they are looking for to go on to the next generation. Many plant species were developed in this way. Apple varieties such as the Honey crisp apple were developed in this way.

Mutation Breeding

In nature, new traits often arise through spontaneous mutations which led to the greater fitness of species in course of evolution. In the past century, this idea has been mimicked by scientists, who have used mutagens (such as ethyl methane sulfonate or radioactivity to generate random mutations in plants, and subsequently screening for new or desired traits. The Ruby Red and the Star Ruby varieties of citrus fruits were developed using ionizing radiation. The mutations that they carry give these fruits their characteristic deep red colour. (Graca et al. 2004).

Polyploidy

Most of the eukaryotic species in the world are called diploid organisms, having 2 sets of chromosomes in their genome (Diploidy). One set inherited from the male parent and another set from the female parent. Using these concept plant breeders developed a technique called Polyploidy which involves the multiplication of the original chromosome number in a plant to impact its fertility. Polyploidy is the occurrence of more than 2 sets of chromosomes.

It can occur naturally in some species, but polyploidy can also be induced through the use of chemicals (Thomas et al. 2002). This breeding technique is usually used to increase the size of fruits or to modify their fertility. For example, the seedless watermelon (having 3 sets of chromosomes) was created using the hybridization of one watermelon (having 4 sets of chromosomes) with another watermelon (having 2 sets of chromosomes) making a sterile watermelon with 3 sets of chromosomes. (Jerry parson et al. 2000).

Protoplast Fusion

It is the biotech breeding method of using plant living cells that involves the fusion of cells or cell components to transfer traits between plant species. When sperm cells in pollen combine with the ova in the ovaries of a flower, this is a fusion of two cells into one Protoplast fusion is an artificial version of this process. This technique is useful for the transfer of beneficial traits from one species to another species by fusing the protoplasts ('naked' cells without the cell walls that give plants their structure). Using this technique scientists have transfer traits like male sterility between species (Motegi et al. 2003) which are used for the easy hybrid seed production.

Transgenic Breeding

Transgenic breeding is a genetic engineering approach that involves the addition of desirable genes from any foreign genome into the organism's genome of interest. The food developed using these plants is called GM (Genetically Modified) food. This technique usually involves handling and modifying the DNA itself in a test tube, and then packaging it to insert it into the new organism.

There are several ways to transfer genes such as biolistics or "gene gun" (Kikkert et al. 2005) using Agrobacterium, a naturally occurring organism that inserts DNA into plants (Gelvins, 2003) or by using electricity, a process called electroporation (Joersbo M and Brunstedt J. 1996). Using this approach breeder can create many useful traits such as insect resistance, herbicide tolerance, and drought tolerance, etc. in the plants. For instance, papayas were transformed with a gene from the virus that infects the plant to make it resistant to the virus.

Genome Breeding

This is the very recent development in the plant breeding world. Here Use of an enzyme system to modify or change the DNA genome at specific sequence directly within the cell. Different enzyme systems can be used for genome editing, the most promising of which is the CRISPR-Cas9 system (Patrick et al. 2014).

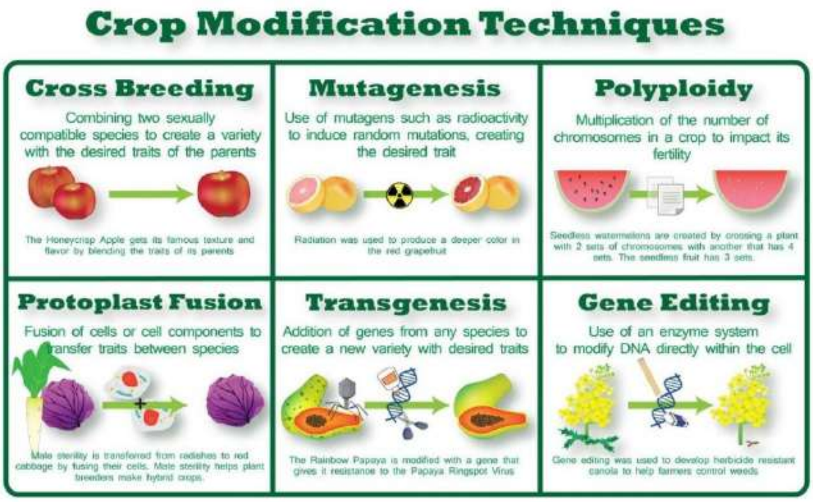
Canola crop with the sulfonylurea (SU) herbicide-tolerant was developed using this technique to enable farmers to better control weeds and to enable crop rotation. The crop was created using a patented genome editing system known as Rapid Trait Development System (RTDS). You could conceivably edit the genome of any crop to alter any gene you wanted, from introducing new genes to restoring 'natural' alleles from the ancestors of our crops (Gina Kolata, 2015).

Conclusion

Each of these crop modification techniques has similarities and differences, and some work better for some traits rather than others. Each of them modifies the genetic makeup of the plant to combine useful traits to improve agriculture.

All of them have examples that are being grown on farms and are producing benefits, all can be patented in one way or another, and all of them can have unintended consequences. However, socially and politically the products of these methods are treated very differently.

The fact that the changes that these techniques introduce do not line up with how they are treated when it comes to debates over the regulations for health and environmental safety, and political debates about labelling has come to be known as the "Frankenfood Paradox." For instance, transgenesis produces far fewer changes and unintended consequences than mutagenesis while mutagenesis is generally accepted and ignored in political discussions (Layla katiraee, 2015).



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Recycling of Crop Residues for Soil Quality Improvement

Article ID: 31215

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Introduction

Crop residue recycling has to play a key role in achieving sustainability in agricultural production. An important resource not only as a source of significant quantities of nutrients for crop production but also improve soil quality by improving physical, chemical and biological functions of soil. The removal of NPK at the present level of crop production has been estimated at 125 kg/ha whereas the annual addition is not more than 75 kg/ha resulting in depletion of soil nutrients. The country has potential to produced 650 million tonne crop residues every year which can provide 11.6 million tonne of plant nutrients annually (Pathak et al., 2012). Therefore, the regular recycling of crop residue in the soil is most efficient on the use of organic input is aimed at the conservation and optimized utilization of available resource for maintain soil quality and crop productivity.

Importance of Recycling of Crop Residues in Soil

1. A good crop residues management in various cropping system is an important way to build up status in soil organic matter and there by augmenting soil fertility and good sources of plant nutrient and important component of ecosystem stability.
2. Recycling of crop residues is an integral part of the strategies of plant nutrients management for sustaining soil quality and crop yield. Approximately 90-140 Mt of the residues are burned on-farm primarily to clear the field from straw and stubble of the preceding crop for sowing of the succeeding crop.
3. Recently, the problem of on-farm burning of residues has intensified due to unavailability of labour, high cost of removing the residues and use of combines without straw spreading mechanism. According to an estimate 75-80% of rice in Punjab is machine harvested which leaves behind enormous amount of crop residue (Badrinath et al., 2006).
4. The generation of crop residues is highest in Uttar Pradesh (60 Mt) followed by Punjab (51 Mt) and Maharashtra (46 Mt). (Pathak et al., 2014)

Crop Residue

Defined as the vegetative crop material left on a field after a crop is harvested, pruned or processed or left after pasture are grazed.

Types of Crop Residues

Crop residues are two types:
1. Field residues: Straw, seed husks, bagasses, coconut shell, cane trashes, stalks, stubble etc.
2. Processed residues: Husks, bagasses, coconut shell, cane trashes etc.

Alternative and Competing Uses of Crop Residues

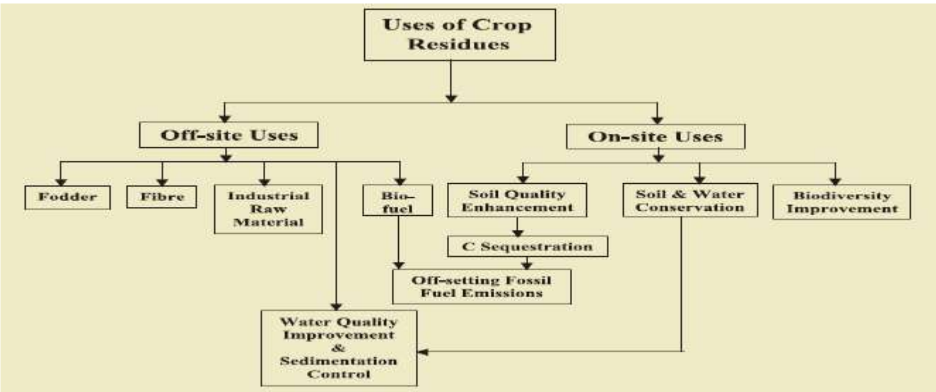

Fig. 1 Uses of crop residues

What are Crop Residues Recycling?

Returning nutrients removed by crops to the soil for further use.

Factors Affecting Decomposition of Residues

1. Size of the residue: Composting process can be accelerated if raw materials are shredded into smaller pieces or ground.

2. Amount of residues: Amount of crop residue added to the soil has a direct influence on the C: N ratio of the soil, which determines the decomposition kinetics of the residues.

3. Time of incorporation: If sufficient time is available between residue incorporation and the sowing of succeeding crops, significant beneficial effects are observed on the yield of succeeding crop .

4. Decomposition of residue by microorganisms: Organic materials are subjected to intense biodegradation by the intervention of soil biota including earthworms, bacteria, fungi, actinomycetes and protozoan species

5. Decomposition of repeatedly added crop residues: Addition of large amount of residue to the soil inevitably, increase biological activity in the soil and this influence the rate of decomposition of organic materials remained from previous additions.

6. Decomposition of residues in tropical / subtropical soils: Under tropical environments, the rate of decomposition of residues is generally very high due to high temperature and microbial activity.

7. Tillage and residue decomposition: Deep tillage helps in the rapid decomposition of crop residues.

Methods of Crop Residues Recycling

1. Composting from crop residues.
2. As a surface mulch.
3. In situ incorporation of crop residues in soil.
4. As a biochar.

Composting

C:N ratio = 30 (26 - 40) of raw material is most favourable for efficient composting. With wide C:N ratio such as in residues of wheat, paddy, sorghum, pearl-millet, maize, sugarcane trash, stalks of the cotton; microbial activities diminish, as they do not get sufficient amount of nitrogen.

Different methods of composting:
1. Indore method.
2. Bangalore method.
3. NADEP method.
4. Vermi-composting.
5. Coimbatore method.

Crop Residues as a Surface Mulch

Mulch influences reflectivity of heat and water transmission characteristics of soil. Mulch also improves the soil water storage capacity and reduces evaporation losses. Beneficial effect of crop residue mulch on soil is moisture conservation and moderate soil temperature. Crop residue is an effective mean of runoff, erosion and transport of sediment to stream. (Bairathi., 1974).

In Situ Incorporation of Crop Residues in Soil

Crop residues are incorporated in soil before sowing of succeeding crop. Period available for decomposition of crop residues is important so as to insure availability of nutrients. Crop residues having wide C:N ratio decomposes slowly in the soil. Decomposition is highly influenced by soil properties, temperature and moisture regime.

Biochar

Biochar is a carbon rich charcoal-like substance created by heating of biomass (organic matter) in low oxygen conditions (pyrolysis). It is produced with the intent to deliberately apply to soils to sequester carbon and improve soil properties.

Effect of Crop Residue on Soil Quality

Soil quality is the capacity of specific kind of soil to function within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and sustain plant, animal, and human health. Soil quality indicators: physical, chemical, biological and organic matter. Such as soil structure, bulk density, aggregation, erosion control, soil tilth, aeration, water holding capacity, soil temperature, nutrient cycling, ion exchange, buffering capacity, insect/microbial activity, filtration, reducing evaporation.

Effect of Crop Residues Recycling on Physical, Chemical and Biological Properties of Soil

1. Physical: Crop residues favours the formation of aggregates, decreases the bulk density of soil & increase the porosity of the soils, increase hydraulic conductivity by modifying soil structure microspores and increases the minimum soil temperature in winter and decrease soil temperature during summer due to shading effect. Soil moisture also reduces evaporation rate due to increase in number of residues on the soil surface.

2. Chemical: Organic carbon increases with continuous O.M. addition and increases soil pH significantly. by decarboxylation of organic anions & addition of basic cations. Soil O.M. as reservoir for plant nutrients, addition of residues increases C.E.C.

3. Biological: A Crop residue provides energy for growth & activities of microbes and substrates for microbial biomass. It provides suitable environment for biological N – fixation and also enzymes (dehydrogenase and alkaline phosphatase) activities increase in soil. Increase in microbial population and humus formation.

Conclusion

Crop residues is dynamic material changing/improving physical (B.D. porosity, available water capacity, hydraulic conductivity), chemical (OC, CEC, available NPK, S, Zn & Fe) and biological (fungi, actinomycetes, bacteria) properties of soil. Judicious use of crop residues considerably improves soil fertility and productivity. Therefore, the crop residues should be utilized through proper recycling in soil rather than burning unnecessarily.

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Application of Sensor-Based Techniques for Nutrient Management Strategies

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Introduction

With a growing global population, the world food demand is expected to increase as well (FAO 2004). To compensate this demand, farmers continuously applying nutrient in excess amount which leads to poor soil health, low crop yield and other environmental impacts. Apart from this, lack of synchronization between plant nutrient demand and soil nutrient supply leads to poor nutrient use efficiency. To face these challenges, efficient nutrient management strategies along with new production technologies are needed to feed the increasing global population (Sakamoto et al. 2009). A new concept, precision farming has been introduced where nutrients are supplied according to spatial and temporal variability of nutrients in the field. Sensors are important tool in precision agriculture to optimize the supply and demand of nutrients according to crop demand. These sensors placed in contact with or close to the crop which can provide a rapid and real time assessment of nutrient status.

Advantages of Sensor Based Nutrient Management

Optimal nutrient management is essential for profitable crop production and to minimize nutrient losses to the environment that are a consequence of an excessive nutrient supply. It provides a real-time quick nutrient status in plants which is not possible by soil and plant test-based methods. It responds quickly to the deficiency of nutrients during crop growth. Application of fertilizer according to the spatial-temporal variability of nutrients in the field resulting higher nutrient use efficiency. Some negative environmental impacts such as leaching of excessive nitrogen also reduce. Sensors also reduce the accumulation of nutrients at toxic level in various plant parts resulting healthy life.

Classification of Sensors

Proximal optical sensors are classified in three categories: transmittance-based sensors, reflectance-based sensors, and machine vision systems (Padilla et al., 2018).

SPAD as Iron (Fe) Indicator

SPAD is not only used for nitrogen estimation in plant leaves but also other nutrient like Fe which significantly affect the chlorophyll content. Nogia et al. (2016) found that SPAD meter values were higher for Fe sufficiency plot rather than Fe- deficiency plot. It was 23 to 25 for Fe-sufficiency plot and 4 to 7 for Fe-deficiency plots. Therefore, SPAD can be used to enhance the nutrient use efficiency for those nutrients which affects the chlorophyll content in plant canopy like nitrogen and iron.

Chlorophyll Meter 1000

It is a chlorophyll reflectance meter and hand-held working on parallel principles to the SPAD meter. The Spectrum meter works on the fine-leafed turf stands canopy. This allows larger area assessment, and integrates many leaf surfaces. Mahajan et al. (2014) developed the critical values for rice (PRH-10) varieties. It was 285 (tillering), 276 (panicle initiation) and 270 (flowering) which play an important role to guide the fertilizer.

GreenSeeker

GreenSeeker is an incorporated system of optical sensor and application system for optimizing N application. This unit emits light in two wavelengths and the light reflectance from target (plants in the soil) is measured. The GreenSeeker active lighting optical sensor uses high intensity light emitting diodes (LEDs) that radiate light at 780 mm (NIR) and 600 nm (red) as light sources. The normalized difference vegetation index (NDVI) is calculated from the NIR and red values by the computer.

$$NDVI = (NIR - R)/ (NIR + R)$$

Ali et al. (2015) developed the algorithm to compute N fertilizer dose using GreenSeeker. It includes following parameters.

Crop-Circle

It measures plant reflectance using light sensor. It used up to 6 spectral bands: Blue (450 ± 20 nm), Green (550 ± 20 nm), Red 1(650 ± 20 nm), Red 2 (670 ± 11 nm),Red edge (730 ± 10 nm), and NIR (760 nm).As a result, a variety of spectral vegetation indices can be derived (Table 6). Some of these indices have been found to be better than the traditional NDVI and RVI indices for estimating crop N status.

Table 1. Vegetation Indices Computed from Crop-Circle

Index	Formula
Normalized green index (NGI)	G/(NIR + RE + G)
Green chlorophyll index (CIG)	NIR/G-1
Normalized NIR index (NNIR)	NIR/(NIR + RE + G)
Red edge ratio vegetation index (RERVI)	NIR/RE
Green ratio vegetation index (GRVI)	NIR/G
Green optimal soil adjusted vegetation index (GOSAVI)	(1 + 0.16)(NIR-G)/(NIR + G + 0.16)
Green difference vegetation index (GDVI)	NIR-G
Red edge difference vegetation index (REDVI)	NIR-RE
Red edge green difference vegetation index (REDVI)	RE-G
Green normalized difference vegetation index (GNDVI)	(NIR - G) /(NIR + G)

Advanced Remote Sensing Sensors

Electromagnetic energy incident on the surface features are partially reflected, absorbed or transmitted through it. The fractions that are reflected, absorbed or transmitted vary with material type and the condition of the feature.

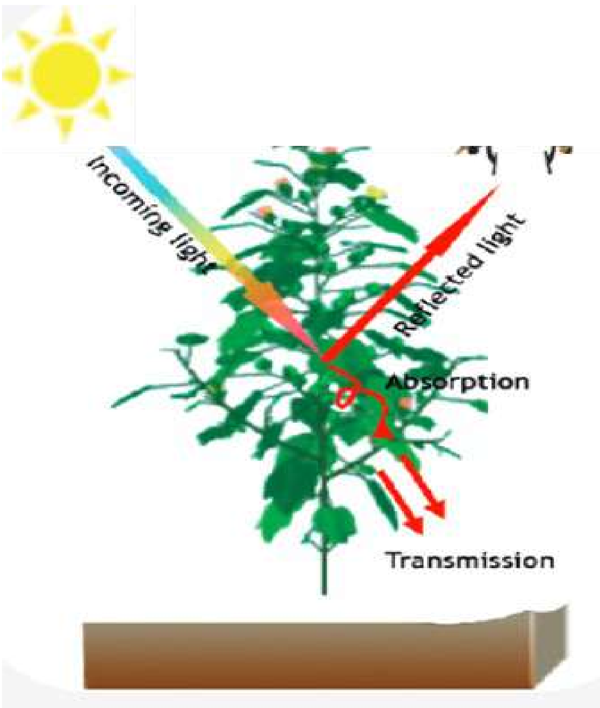

Fig. 1 Radiation distribution over plant canopy

Nutrient Stress Detection Using Remote Sensing Techniques

Nutrient stress can be detected using spectral reflectance pattern of plant canopy. Healthy plant has more chlorophyll resulting more light absorption and less reflectance in red band while stressed leaves have low chlorophyll which leads to higher reflectance in red band. In NIR band stressed plant have low reflectance compare to healthy plant. Therefore, this information is useful to monitor the nutrient stress in plants.

Spectro-Radiometer

Spectro-radiometer is a transportable battery powered spectrometer. It has spectral range 350–2500 nm wavelength with 25-degree field of view (FOV). It has 2151 channels and detectors are specific for each band. It has silicon array for VNIR (350-1000 nm), InGaAs(Indium, Gallium, Arsenid) Photodiode for SWIR 1 (1001-1800 nm) and SWIR 2 (1801-2500 nm) bands. Calibration or optimization of the instrument is done using a standard spectralon white reference panel. Resultant data are processed using ASD ViewSpecPro software to produce values at 1 nm interval.

Conclusion

High NUE can be achieved by replacing blanket fertilizer recommendation by an optical sensor-based strategy. Digital meter devices, such as SPAD and GreenSeeker are widely used but more expensive as well as Crop-Circle based VIs has better performance than GreenSeeker in nitrogen management. Currently, drone is more popular to detect the early sign of nutrient stress in plants. For a regional scale, satellite or aircraft-based techniques are most feasible option to monitor the nutrient status in crops. Apart from traditional indices like NDVI, RVI, other indices like P_1080_1460 and S_660_1260 have better prediction of nutrient status. Site specific nutrient management strategies based on sensors are most powerful tools to enhance the nutrient efficiency. A maximum sensor has been developed for primary nutrients, so there is need to develop sensors for other secondary and micronutrients. In USA, satellite and GIS based projects (like FERTISAT & CROPSAT) are going on which provide the soil fertility and plant nutrient data to farmer to synchronize the demand and supply. Therefore, we have to implement such type of strategies in our country also.

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Phytoremedation of Heavy metals: A Green Technology to Clean Soil

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Introduction

Heavy metals are generally defined as metals with relatively high densities more than 5gm/cm3 and atomic weight more than sodium and conventionally defined as elements with metallic properties and an atominc number > 20 (Emsley, 2011) .The most common heavy metals found at contaminated sites, in order of abundance are Pb, Cr, As, Zn, Cd, Cu, and Hg [40]. Those metals are important since they are capable of decreasing crop production due to the risk of bioaccumulation and biomagnification in the food chain. There's also the risk of superficial and groundwater contamination. Knowledge of the basic chemistry, environmental and associated health effects of these heavy metals is necessary in understanding their speciation, bioavailability, and remedial options. The fate and transport of a heavy metal in soil depends significantly on the chemical form and speciation of the metal. Once in the soil, heavy metals are absorbed by initial fast reactions (minutes, hours), followed by slow adsorption reactions (days, years) and are, therefore, redistributed into different chemical forms with varying bioavailability, mobility, and toxicity (Shiowantana et al. 2001).

This distribution is believed to be controlled by reactions of heavy metals in soils such as:
1. Mineral precipitation and dissolution.
2. Ion exchange, adsorption, and desorption.
3. Aqueous complexation.
4. Biological immobilization and mobilization.
5. Plant uptake (levy et al. 1992).

Phytoremedation

The term phytoremediation comes from the Ancient Greek word *phyto* meaning "plant" and the Latin word *remedium* meaning "restoring balance." It is a technology that uses plants to treat environmental pollution problems. Plants are used either to remove or to stabilize (hold in place) pollution in the soil. Phytoremediation concept of using plant to remove metals from contaminant soil given by Utsunamiya and Chaney (1991) first plant use for phytoremediation is *Thalpsi caerulscens.*

Fundamental Processes Involved Phytoremediation and their Characteristics

Phytoremediation of contaminated soils is generally believed to occur through one or more of the following mechanisms or processes: phytoextraction, phytostabilization, phytodegradation, phytovolatilization, rhizofiltration and rhizodegradation .Phytoremediation is applicable to a broad range of contaminants, including heavy metals and radionuclides, as well as organic compounds like chlorinated solvents, polycyclic aromatic hydrocarbons, pesticides/insecticides, explosives, and surfactant Phytoremediation processes rely on the ability of plants to take up and/or metabolize pollutants to less toxic substances. The uptake, accumulation and degradation of contaminants vary from plant to plant. The plants used in phytoremediation are generally selected on the basis of their growth rate and biomass, their ability to tolerate and accumulate contaminants, the depth of their root zone, and their potential to transpire groundwater. The plants used in phytoremediation should not only accumulate, degrade or volatilize the contaminants, but should also grow quickly in a wild range of different conditions.

Table 1: Phytoremediation Processes for Remediation of Contaminated Soils

Phytoremediation processes	Description
Phytoextraction	Plants absorb contaminants and store in above-ground shoots and the harvestable parts of roots.

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Phytostabilization	Roots and their exudates immobilize contaminants through adsorption, accumulation, precipitation within the root zone, and thus prevent the spreading of contaminants.
Phytodegradation	Plant enzymatic breakdown of organic contaminants, both internally and through Secreted enzymes.
Rhizodegradation (Phytostimulation)	Plant roots stimulate soil microbial communities in plant root zones to break down contaminants.
Phytovolatilization	Contaminants taken up by the roots through the plants to the leaves and are volatized through stomata where gas exchange occurs.

Why to Use Phytoremedation?

1. Solar-driven Sustainable green technology improves air quality and sequesters greenhouse gases
2. Controls erosion, runoff, infiltration, and fugitive dust emissions
3. Passive and in-situ
4. Applicable to remote locations, potentially without utility access
5. Can be used to supplement other remediation approaches or as a polishing step
6. Can be used to identify and map contamination
7. Lower maintenance, resilient, and self-repairing
8. Provides restoration and land reclamation during clean up and upon completion can be cost competitive.

Phytoremedation Mechanisms

1. Phytosequestration.
2. Rhizodegration.
3. Phytohydralics.
4. Phytoextraction.
5. Phytodegradation.
6. Phytovoltalisation.

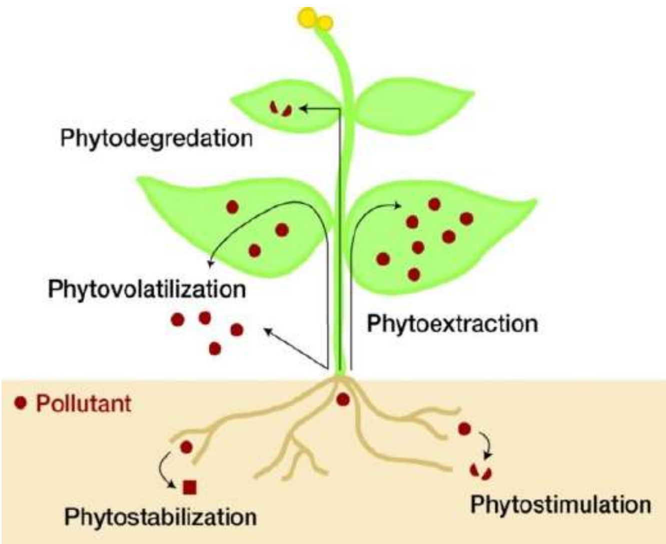

Fig.1 Mechanisms of phytoremediation

The mechanisms and efficiency of phytoremediation depend on the type of contaminant, bioavailability and soil properties (Cunningham and Ow, 1996). The uptake of contaminants in plants occurs primarily through the root system, in which the principal mechanisms for preventing toxicity are found. The root system provides an enormous surface area that absorbs and accumulates water and nutrients essential for growth along with other non-essential contaminants (Raskin and Ensley, 2000).

Rhizodegradation Mechanism

This is also refered to as phytostimulation. Rhizodegradation refers to the breakdown of contaminants within the plant root zone, or rhizosphere. It is believed to be carried out by bacteria or other

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microorganisms whose numbers typically flourish in the rhizosphere. Studies have documented up to 100 times as many microorganisms in rhizosphere soil as in soil outside the rhizosphere (USEPA).

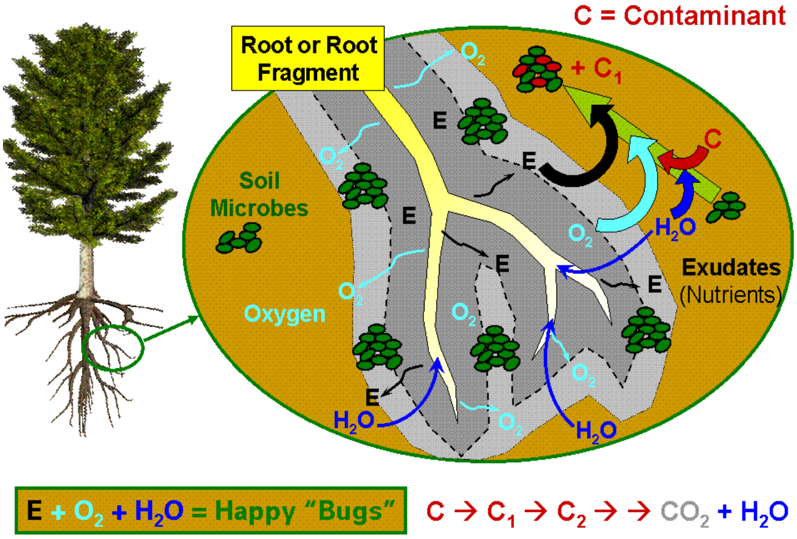

Fig.2 Rhizodegradation mechanism

Phytohydraulic

This is the control of the water table and the soil field capacity by plant canopies. Phytoremediation projects employing hydraulic control generally use phreatophytic trees and plants that have the ability to transpire large volumes of water and thereby affect the existing water balance at the site.

Phytoextraction

This also called phytoaccumulation, it refers to the uptake and translocation of metal contaminants in the soil by plant roots into the above ground portions of the plants. Phytoextraction is primarily used for the treatment of contaminated soils (USEPA, 2000).

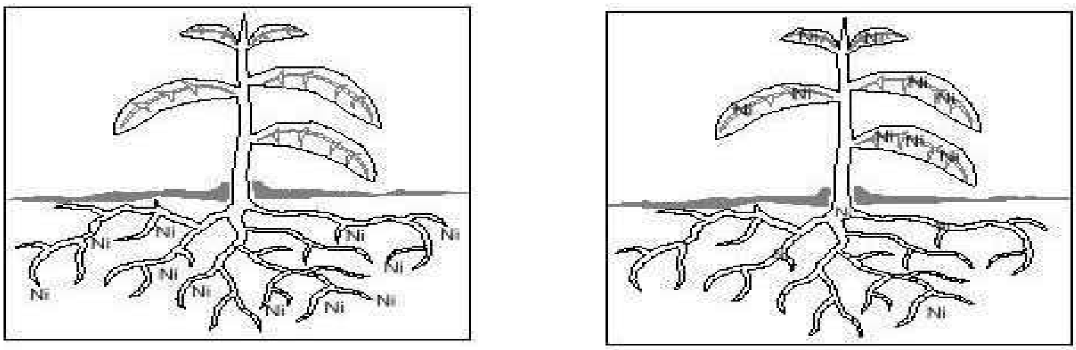

Fig. 3 Phytoextraction of Ni from contaminated soil

The use of hyperaccumulator species is limited by slow growth, shallow root system, and small biomass production. In addition, the plant biomass must also be harvested and disposed of properly, complying with standards (Raskin and Ensley, 2000).

There are several factors limiting the extent of metal phytoextraction including:
1. Metal bioavailability within the rhizosphere.
2. Rate of metal uptake by roots.
3. Proportion of metal "fixed" within the roots.
4. Rate of xylem loading/translocation to shoots.
5. Cellular tolerance to toxic metals.

Phytodegradation

This is also referred to as phytotransformation. It involves the degradation of complex organic molecules to simple molecules or the incorporation of these molecules into plant tissues (Trap et al., 2005).

Phytovolatilization

This involves the use of plants to take up contaminants from the soil, transforming them into volatile forms and transpiring them into the atmosphere (USEPA, 2000). Phytovolatilization also involves contaminants being taken up into the body of the plant, but then the contaminant, a volatile form thereof, or a volatile degradation product is transpired with water vapor from leaves (EPA, 2000).

Phytodesalination Mechanism

This technique is a modality of phytoextraction. Salinization is most serious problem confronting sustainable agriculture in irrigated production system in arid and semi-arid regions. it is a recently reported emerging technique that utilizes halophytes to remove excess salts from saline soils. The potential of *Suaeda maritima* and *Sesuvium portulacastrum* in removal and accumulation of NaCl, from highly saline soils, has been demonstrated. Example of halophytes plants are: *Portulaca oleracea*, *Amaranthus spp.*, *Sesuvium portulacatrum, Suaeda fruticose.*

Optimization of Metal Phytoextraction with Agronomic Practices

1. Plant selection.
    a. Native sps Vs exotic spes, Metal hyper accumulators Vs Common Nonaccumulator sps , Shallow -rooted Vs Deep- rooted
2. Soil fertilization and conditioning.
3. Enhancing metal bioavailability with synthetic chelators.
4. Sowing and Crop rotation Plant density.
    a. Monoculture & multiple cropping, Stage of harvest, Crop maintenance: Pest control and irrigation.

Conclusion

Phytoremediation is a fast-developing field, since last ten years a lot of field applications were initiated all over the world, this sustainable and inexpensive process is fast emerging as a viable alternative to conventional remediation methods, and will be most suitable for a developing country like India. There is a need to optimize the agronomic practices to maximize the clean-up potential of premeditative plants.

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Role of Potassium in Soils and Plants

Article ID: 31218

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Introduction

Potassium (K) is one of sixteen essential nutrients required for plant growth and reproduction. It is classified as a macronutrient, as are nitrogen (N) and phosphorus (P). The chemical symbol for potassium is "K." It is taken up by plants in its ionic form ($K+$).

The word potassium translates from the Latin or German word, Kalium. The term "potash" comes from the colonial practice of burning wood in large pots and using the ashes as fertilizer and making soap, gunpowder and glass. "Potash" is defined as $K2O$ and is used to express the content of various fertilizer materials containing potassium,such as muriate of potash (KCl), sulfate of potash ($K2SO4$), double sulfate of potash and magnesium ($K2SO4 \cdot 2MgSO4$), and nitrate of potash ($KNO3$). Frequently, the expressions "K" and "$K2O$" are used interchangeably, although technically incorrectly.

Potassium is abundant in nature, comprising about 2.4 percent of the earth's crust. The potassium content of soils varies widely, ranging from only a few hundred pounds per acre (furrow-slice 6" depth) to over 50,000 pounds per acre or more in fine-texture soils formed from rocks that are high in potassium-bearing minerals. All naturally occurring potassium contained in the soil originated from the disintegration and decomposition of potash-feldspars (orthoclase and microcline) and micas (muscovite and biotite).

Soil potassium is present in four forms:
1. Soil solution potassium.
2. Exchangeable potassium.
3. Non-exchangeable potassium.
4. Lattice potassium.

Potassium in Plants

Potassium plays a vital role in: Photosynthesis, translocation of photosynthates, protein synthesis, control of ionic balance, regulation of plant stomata and water use, activation of plant enzymes and, many other processes. It is known to activate at least sixty enzymes involved in plant growth. They are also less resistant to pests, diseases and nematode attacks.

Potassium is also known as the quality nutrient because of its important effects on quality factors such as size, shape, colour, taste, shelf life, fibre quality and other quality measurements. Potassium plays many roles in plants such as water relation, energy relations, translocation of assimilates, photosynthesis, protein and starch synthesis, metabolic processes and grain/seed formation, preventing lodging in crops, improving resistance to pest and diseases.

Potassium Increases Crop Yields Because it

Increases root growth and improves drought tolerance, builds cellulose and reduces lodging, enhances many enzyme actions, aids in photosynthesis and food formation, helps in translocation of sugars and starches, produces grains rich in starch, increases protein content of plants, maintains turgor pressure, reduces water loss and wilting, helps retard crop diseases and nematode.

Potassium Uptake by Plants

Time of potassium uptake varies with different plants. However, plants generally absorb the majority of their potassium at an earlier growth stage than they do nitrogen and phosphorus. Experiments on potassium uptake by corn showed that 70-80 percent was absorbed by sulking time, and 100 percent was absorbed three to four weeks after sulking. Translocation of potassium from the leaves and stems to the grain was much less than for phosphorus and nitrogen.

The period during grain formation is apparently not a critical one for supply of potassium. Cotton takes up about 30 percent of its potassium during uptake; 3-4 lb/acre are taken up daily. Sixty-six percent of the total potassium is rapidly translocated from the leaves and stems to the bur of the boll during boll fill. Nitrogen and phosphorus are translocated to the seed.

Potassium Removal by Crops

Nutrient uptake or utilization is an important consideration but crops take up far more potassium than they remove with the harvested portion. Harvest management is the major consideration in developing a potash fertilization program.

Crops harvested where the whole plant is removed from the field, like alfalfa hay, must have more potash applied than crops where only grain, lint or fruit are removed. Often with hay and Silage crops, removal is an excellent guide for planning the potash fertilization program. With other crops, such as grain, soil tests offer the best guide.

Potassium Deficiency Symptoms

Plants absorb potassium as the potassium ion (K^+). Potassium is a highly mobile element in the plant and is translocated from the older to younger tissue. Consequently, potassium deficiency symptoms usually occur first on the lower leaves of the plant and progress toward the top as the severity of the deficiency increases.

One of the most common signs of potassium deficiency is the yellow scorching or firing (chlorosis) along the leaf margin. In severe cases of potassium deficiency, the fired margin of the leaf may fall out. Stalks are weak and lodging of cereal crops such as corn and small grain is common. Legumes are not strong competitors for soil potassium and are often crowded out by grasses in a grass-legume pasture. Seeds from potassium deficient plants are small, shrivelled, and are more susceptible to diseases.

Fig. 1 Potassium deficiency symptoms in wheat and sugar beets

Occurrence of Potassium in Nature

Potassium is abundant in nature, comprising about 2.4 percent of the earth's crust. The potassium content of soils varies widely, ranging from only a few hundred kg per hectare (furrow-slice 15cm depth) to over 56,020 kg/ha or more in fine-textured soils formed from rocks that are high in potassium-bearing minerals.

All naturally occurring potassium contained in the soil originated from the disintegration and decomposition of potash-feldspars (orthoclase and microcline) and micas (muscovite and biotite). Much of the natural potassium occurring in soils is not available to plants and crops; therefore, soils containing relatively large amounts of total potassium usually respond to potassium fertilization.

Relatively Unavailable Potassium

From 90-98 percent of the total potassium present in soils is found in insoluble primary minerals such as feldspars and micas. These minerals consist of potassium aluminium silicates which are resistant to chemical breakdown. They release potassium slowly, but in small quantities compared to total needs of growing crops.

Slowly Available Potassium

This form comprises 1-10 percent of the total potassium supply and may originate from dissolved primary minerals or from potassium fertilizers. This potassium is attracted to the surface of clay minerals where it may be firmly bound or fixed between the clay layers in a form slowly available to plants. The actual amount available depends on the type and amount of clay present.

Readily Available Potassium

Readily available forms of potassium comprise only 0.1 to 2 percent of the total potassium in the soil and consist of potassium dissolved in the soil solution and held on the exchange positions of the clay and organic matter. This potassium is referred to as "exchangeable" because it can be replaced by other positively-charged ions (cations) such as hydrogen, calcium, and magnesium. This exchange happens rapidly and frequently. The potassium in the soil solution may be taken up by the plant or lost from the soil by leaching, especially on sandy coarse-textured soils in regions of high rainfall.

Factors Affecting Amount of Available Potassium to Plant

1. Soil texture: It influences the status of both available and non-exchangeable potassium. Fine texture soil has larger amount of both forms' potassium compared to coarse-textured soils.

2. Clay mineralogy: Potassium availability to plants is a function of quantitative mineralogical make-up, degree of weathering and nature complementary cations on the exchange complex. The available (exchangeable) potassium is generally high in smectite-dominent vertisols, followed by mixed mineralogy, illite and kaolinite dominant soils.

3. Soil depth: As well as increases the depth of soil, decreases the availability of potassium.

4. Soil pH: Potassium availability more in acid and neutral soils.

5. Liming: Liming in acid soil increase the availability of potassium in soil.

6. Wetting & drying and Freezing and thawing: Alternate Wetting & drying and Freezing and thawing also increases the availability of potassium in soil.

Losses of Potassium

Losses of potassium may take place in the form of luxury consumption, leaching, and soil erosion as described below.

1. Luxury Consumption: Some crops tend to absorb and accumulate potassium far in excess of their needs, if it is present in sufficiently large quantities in the soil. This tendency is termed "luxury consumption"

2. Leaching and Erosion Losses of potassium: Leaching losses can vary widely from traces to 4-5 kg/ha/yr, depending on soil, irrigation, fertilizer-usage and cropping. leaching of the applied potassium are highest in light textured soils (7-17 kg/ha/yr), organic soils and soils with kaolinite as the dominant clay mineral soil.

The erosion loss of potassium is considerable and generally exceeds that of any other major nutrients element and it generally varies between 10and 55 kg/ha/yr. Soil erosion also leads to considerable loss of total potassium from the soil.

Conclusion

Phytoremediation is a fast-developing field, since last ten years a lot of field applications were initiated all over the world, this sustainable and inexpensive process is fast emerging as a viable alternative to conventional remediation methods, and will be most suitable for a developing country like India. There is a need to optimize the agronomic practices to maximize the clean-up potential of premeditative plants.

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Role of Conservation Agriculture in Sustaining Soil Quality

Article ID: 31219

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Introduction

Global agriculture is facing numerous challenges and adversely affecting food and nutritional security. Among others, intensive agriculture and excessive use of external inputs are leading to degradation of soil, water and genetic resources and negatively affecting agricultural production. Degradation of natural resources is posing a serious threat to meet the future demand for food, feed, fodder and fibre. Wide spread soil erosion, nutrient mining, depleting water table, and eroding biodiversity are the global concerns which are threatening the food security and livelihood opportunities of farmers, especially the poor and underprivileged. A study by the Food and Agriculture Organization of United Nations (FAO) revealed that an estimated 1.5 billion people depend directly on land that is degrading. Another study by the FAO indicated that land degradation is worsening rather than improving, with declining trends revealed across some 24 per cent of global land area. According to this study, the main driver of degradation is poor land management (Paroda, 2009).

Conservation Agriculture

The concept of conservation agriculture is relatively new in modern cultivation practices. It is differentiated with the conventional agriculture. It argues that the conventional agriculture promotes extensive soil tillage and burn crop residue. Bare soil is also allowed for weeks or months. Broadly, the conventional agriculture is characterised as intensive tillage, straw burning and external inputs. Such practices lead to soil degradation through loss of organic matter, soil erosion and compaction. In Brazil, it was estimated that 1 tonne harvest of soybean means degradation of 10 ha.

On the contrary, conservation agriculture is a range of soil management practices that minimise effects on composition, structure and natural biodiversity and reduce erosion and degradation. Largely, the conservation agriculture practices include:
1. Direct sowing / no- tillage, reduced tillage/minimum tillage.
2. Surface-incorporation of crop residues.
3. Establishment of cover crops in both annual and perennial crops.

These concepts confined to improve soil health and do not refer the farm income. To integrate farm income and soil health through conservation agriculture, the Food and Agriculture Organization of the United Nations (FAO), has focused the concept as resource-saving agricultural crop production. As per FAO definition, the conservation agriculture is to:
1. achieve acceptable profits.
2. high and sustained production levels
3. conserve the environment (FAO, 2009).

Principles of Conservation Agriculture

Conservation agriculture practices perused in many parts of the world are built on ecological principles making land use more sustainable (Wassmann, 2009; Behera et al. 2010; Lal, 2013. Conservation agriculture basically relies on 3 principles, which are linked and must be considered together for appropriate design, planning and implementation processes. These are:

1. Minimal mechanical soil disturbance: The soil biological activity produces very stable soil aggregates as well as various sizes of pores, allowing air and water infiltration. This process can be called “biological tillage” and it is not compatible with mechanical tillage. With mechanical soil disturbance, the biological soil structuring processes will disappear. Minimum soil disturbance provides/maintains optimum proportions of respiration gases in the rooting-zone, moderate organic matter oxidation, porosity for water movement, retention and release and limits the re-exposure of weed seeds and their germination (Kassam and Friedrich, 2009).

2. Permanent organic soil cover: A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots. In turn it improves soil aggregation, soil biological activity and soil biodiversity and carbon sequestration (Ghosh et al.., 2010).

3. Diversified crop rotations: The rotation of crops is not only necessary to offer a diverse "diet" to the soil microorganisms, but also for exploring different soil layers for nutrients that have been leached to deeper layers that can be "recycled" by the crops in rotation. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna. Cropping sequence and rotations involving legumes helps in minimal rates of build-up of population of pest species, through life cycle disruption, biological nitrogen fixation, control of off-site pollution and enhancing biodiversity (Kassam and Friedrich, 2009; Dumanski et. al., 2006).

Fig. 1 Principles of conservation agriculture

Benefits of Conservation Agriculture

The benefits can be classified into three broad categories:
1. agronomic benefits that improve soil productivity.
2. economic benefits that improve the production efficiency and profitability.
3. environmental and social benefits that protect the soil and make agriculture more sustainable.

Some of the benefits of conservation agriculture are listed below:
1. Improve the sustainability of different production systems.
2. Provides soil as sink for carbon dioxide, thereby improves soil organic carbon content and contribute in reducing global warming. Conservation agriculture is now receiving global focus for its carbon sequestration potential. It has been estimated that the total potential for soil carbon sequestration by agriculture could reduce about 40 per cent of the estimated annual increase in CO2 emissions (FAO, 2009).
3. Improves water infiltration and thereby reduces run-off of surface and ground water and enhance ground water recharge.
4. Improves habitation of organisms, from larger insects down to soil borne fungi and bacteria, which improve soil biological, physical and chemical properties, thereby contribute in increasing crop productivity.
5. Reduce cost of production (15-16 per cent) by saving energy, labour and water, thereby increase farm income.
6. Enhance biodiversity and improves the value of environmental services. Reduction in poverty and enhance food and nutritional security due to higher, more stable yields and lower food prices.

Constraints in Adoption

There are a number of problems encountered in adoption of conservation agriculture. The most important is the mindset of farming community who were educated extensively and convinced about the intensive agriculture and use of external inputs. In the past, farmers have realised huge economic benefits by intensive agriculture practices.

Conclusion

CA is spread over 155 M ha across all continents (11% of global cropland), an increase of 24% since 2010, & continues to spread at an annual rate of 10 M ha. Originally a farmer's driven process, but attention increasingly paid by donors, national and international development organizations, and increasingly by governments – becoming a structural response CA is getting recognized more widely as an approach for sustainable production intensification that offers enhancement of productivity with ecosystem services and improved resilience, and climate change adaptability and mitigation. The spread of CA is equally divided between developed regions and developing regions; major share is located in the Americas and Australia. CA is now increasing in Europe, Asia & Africa as relatively more attention is directed to it by development stakeholders and governments. Other regions struggle with keeping good quality CA (Latin America with Soya) Further policy and institutional support is needed for faster adoption AND for safeguarding quality of CA to ensure environmental services.

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The Use of Anti Hail Nets in the Changing Climate Scenario for Quality Fruit Production

Article ID: 31220

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Introduction

India is the second-largest producer of fruits in the world but productivity was less compared to other countries, the reason for low productivity is lack of availability of quality planting material and climate change resulting in low productivity. The occurrence of a hail storm is very frequent nowadays in temperate areas due to climate change results in damage to the crop and increased incidences of the pests and diseases cause widespread damage and losses to the fruit crops and quality of the fruits are also greatly affected. Though hailstorm can occur in any part of the world, temperate zones are the most vulnerable. Widespread unseasonal rains spells accompanied by hail occurred in several states during February-March, 2014. It caused large scale destruction of crops in Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra, Punjab, Gujarat, Uttarakhand, Haryana, Andhra Pradesh and Karnataka with central India (Maharashtra and Madhya Pradesh) being the worst hit. The country did not witness such a severe weather aberration for a long time (source: The Indian Express, 20 March 2014). Hail is a solid, frozen form of precipitation that causes extensive damage to properties and growing crops.

Hailstorm

1. Formation, Occurrence, and size of Hails: Hailstones are formed when raindrops are carried upward by thunderstorm updrafts into extremely cold areas of the atmosphere and freeze. Hailstones then grow by colliding with liquid water drops that freeze onto the hailstone's surface. If the water freezes instantaneously when colliding with the hailstone, cloudy ice will form as air bubbles will be trapped in the newly formed ice. However, if the water freezes slowly, the air bubbles can escape and the new ice will be clear. The hail falls when the thunderstorm's updraft can no longer support the weight of the hailstone, which can occur if the stone becomes large enough or the updraft weakens. Hail falls when it becomes heavy enough to overcome the strength of the thunderstorm updraft and is pulled toward the earth by gravity. Smaller hailstones can be blown away from the updraft by horizontal winds, so larger hail typically falls closer to the updraft than smaller hail. (Source: https://www.nssl.noaa.gov/education/svrwx101/hail/). Size is a very important factor causing crop damage. Studies have concluded that most property damage begins when hailstone diameters are 20 mm or greater. Hails of different sizes borne out of hailstorms of different intensities are given in table 1.

Table:1 Hailstorm intensity scale:

Size code	Typical hail diameter	Equivalent shape	Intensity category	Typical damage impact
H0	<8.4	Pea	Hard hail	No damage
H1	8.4-15.2	Marble	Potentially damaging	Slight damage to plants, crops
H2	15.2-20.3	Coin or Grape	Potentially damaging	Significant damage to fruit, crops, vegetation
H3	20.3-30.5	Nickel to Quarter	Severe	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	30.5-40.6	Golf ball	Severe	Wide spread glass damage, vehicle bodywork damage
H5	40.6-50.8	Tennis ball	Destructive	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries

H6	50.8-61.0	Base ball	Destructive	Aircraft bodywork dented; brick wall spitted
H7	61.0-76.2	Grape fruit	Very Destructive	Severe roof damage, risk of serious injuries
H8	76.2-88.9	Soft ball	Very Destructive	Severe damage to aircraft bodywork
H9	88.9-101.6	Soft ball	Super hailstorms	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	>101.6	Soft ball and up	Super hailstorms	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

2. Hail forecasting: Forecasters use radar technology for detection of hail and have met with various degrees of success depending on conditions. Radar is an acronym that stands Dual-wavelength radar (DWR) makes simultaneous use of two different wavelengths, hence offer better scope compared to single wavelength radars for detecting hail and distinguish it from rain showers. This technique has been successfully applied in the USSR.

3. Damage symptoms of Hails on fruit crops: Hail damage can occur at any time during the growing season. The damage looks like at harvest will depend on how mature the fruit was and how large and hard the hail was it struck. A hard impact early in the season could cause very deep depression and deformation of the fruit. Later-season damage could appear more bruise-like. It is important to inspect the damage of fruit trees as soon as possible after a hail event as the level of damage can be observed by subsequent growth. Hail can impact on the foliage, flowers, stems, branches, and fruit in various ways and the quality of damaged fruits is severely affected and less market price.

Fig: Formation of Lesions on fruits due to hail damage

4. Management of hail-damaged trees:

a. Hail wounds on the fruit and bark may need fungicides to prevent disease entry.
b. Wounds are a key infection site for disease, and particularly bacterial diseases.
c. Severely damaged stems and branches should be pruned off as soon as possible to prevent infections. Stems of branches should be sealed to protect against infection.
d. To reduce the risk of pests and disease remove or mulch fruit that has fallen to the ground.
e. Replacement of young trees may be necessary if damage to the plants is severe enough.
f. Fertilizers and irrigation applied at optimum levels will help the trees overcome the stress caused by hail damage.
g. Inspect damaged plants more frequently for pests and diseases.

h. Where practical, large wounds on trunks and branches should be covered with water-based paint to avoid desiccation and disease infection.
i. Use fruit thinning to selectively remove hail-damaged fruit and to improve yield and quality of remaining fruit.

Hail Control Mechanisms

1. Cloud seeding: silver iodide and smoke particles are injected into the clouds of a storm in order to create more ice crystals, which then compete for the available liquid water. It competes for the water so that it produces may small hailstones and less damage if they survive to fall the ground.

2. Creating shock waves: According to Eggers Hail Cannons from New Zealand, one of the leaders in manufacturing this device, anti-hail cannons have been used since the 18th century. They have been largely developed over the past thirty years, with the last ten being the most relevant. The cannons generate a shock wave that disrupts the formation of hail in the sky. Acetylene gas and air is fired in the lower chamber of the machine. The gas then passes through the neck and while it travels into and through the cone, it develops into a force that becomes a shock wave. The shock wave is shot directly above the cannon, disrupting the growth phase of hailstones (https://core.ac.uk/reader/19152618).

3. Preventive measures: Anti hail nets are used to control the damage going to cause by a hailstorm. Due to hailstorms, the crop used to damage more often in Himachal Pradesh. The farmers from rural areas of Shimla, Kinnaur and Kullu districts are now trying to protect their crop with these anti-hail nets.

Conclusion

The climate the change resulted in the occurrence of thunderstorms associated with hails which resulted in great damage to the fruit crops. The damage intensity of the hails depends on the size of the hails, if the crop in reproductive stage or fruiting stage the great economic damage will occur and quality of the hail affected fruits also poor quality, later they invade by microorganisms causing a secondary infection. Netting is a good solution to save the crop from hail damage compared to cloud seeding and creating shock waves that are cost-effective.

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"Participatory Irrigation Management" A New Trend in the Present Era of Irrigation Management

Article ID: 31221

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Introduction

Irrigation is life line for agriculture. It is said that .India's irrigation potential has increased from 22.6 million hectares in 1950–1951 to about 123 million hectares by including 42 million hectares under major and medium irrigation projects, 14 and 67 million hectares under minor surface and minor groundwater lift projects, respectively, making it a world leader in irrigation. Irrigated area accounts for nearly 48.8 per cent of the 140 million hectare (mha) of agricultural land in India and the remaining 51.2 per cent of land is under rainfed.

Low irrigation efficiency, poor physical structures, seepage loss, siltation, soil salinity, lack of judicial use of water for irrigation among the farmers, improper coordination among irrigation department officials of command area with the local farmers, and politicizing water disputes are the major drawbacks that an irrigation sector is facing right now in our country.

Aforementioned problems are to be met with local solution. Farmers' participation in irrigation policy framework and management is the key. Water Policy of India has underlined upbringing farmers' participation in irrigation management. At the present scenario Participatory Irrigation Management (PIM) is the saviour trend which mainly stress upon bringing local solution to local problems affecting our farmers.

PIM Definition, Meaning and Objectives

PIM refers to "participation of irrigation users in irrigation water management at all levels"

There are three basic types of irrigation management. The one which is under public sector, for example an irrigation department. Private entity is the other type, in which a firm distributes water through their own water management facilities. The third one is thorough water user's organization, for example WUA (Water Users Association). The PIM is related to the third aspect of above-mentioned types of irrigation management.

Objectives of the PIM:
1. To ensure water judiciously to the required users.
2. To create the sense of ownership of water resources among the users.
3. To promote sense of optimum utilization of water for irrigation as per crop need.
4. To increase the production per unit of water and the production per unit of land in command area.
5. To promote cordial and healthy atmosphere between irrigation officials (personnel) and the users.

PIM in India

Realizing the need of PIM, the Government of India brought out a model act which has to be adopted by the state legislatures. This model act provides a blueprint of legal framework for creation of farmers organizations at different levels of irrigation system as under:
1. Water Users' Association (WUA): will have a delineated command area on a hydraulic basis, which shall be administratively viable. Generally, a WUA would cover a group of outlets or a minor.
2. Distributary Committee: will comprise of 5 or more WUAs. All the presidents of WUAs will comprise general body of the distributary committee.
3. Project Committee: will be an apex committee of an irrigation system and presidents of the Distributary committees in the project area shall constitute general body of this committee.

Constraints of PIM

1. Lack of proper coordination among WUAs , Distributary Committee, Project Committee.
2. Uncertainty of water availability.

3. Lack of proper leadership.
4. Financial viability fear.
5. Lack of technical knowledge among the users and the implementing authority.

Conclusion

PIM ensures the better irrigation aspect than the past methodologies used . proper legal framework helps in boosting up the skill, technology and funding for the irrigation management in our country. Regular monitoring and evaluating the performance of WUAs is the only key in enhancing the PIM programme. States should also constitute a State level monitoring committee. The success and failure of the WUAs at one place could provide useful lessons and enable taking up of corrective steps in formation and sustainability of WUAs at other places.

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Farmer Double Income by Use of Post-Harvest Techniques

Article ID: 31222

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Abstract

In India, having wide range of climatic conditions, varied topography which helps to growing different type of horticultural crops. India is following largest producer of fruits and vegetables in the world after china. Unfortunately, due to ineffective postharvest management practices a significantly postharvest loss of 5% - 15% of fruits and vegetables occur yearly. Only 2% of fruit and vegetable crops are processed of total production.

Due to improper post-harvest management, storage, processing and value addition consequences in horticultural produce the farmers' incomes decreases every year because of this economy has losses huge amount of money. These losses controlled by different methods like proper harvesting and handling of produce, provide better postharvest management practices, storage facilities and good transportation services which reduced the postharvest losses of fruits and vegetables as well as doubling the farmer's income.

Introduction

India is a rich horticultural country producing wide variety of fruits, vegetables, ornamental and flower crops, medicinal and spices plants. The Indian Economy is deeply dependent on agriculture and allied sector which contributed approximately 13.9% of India's GDP in 2013-14 (Ministry of Agriculture, 2015). India is following largest producer of fruits and vegetables in the world after china.

In India, food production has been progressively increased due to improvement in production technology, on the other hand improper post-harvest management, storage, processing and value addition consequences in higher losses in agricultural produces. Unfortunately, due to ineffective postharvest management practices a significantly postharvest loss of 5% - 15% of fruits and vegetables occur yearly.

The optimum postharvest management of fruits and vegetables are not the same for all products, they based on the requirements of growers, traders, exporters, retailers, consumers, processing and transportation distance. Approximately, according to CIPHET, Ludhiana only 2% of fruit and vegetable crops are processed of total production.

Due to harvesting and postharvest losses of agricultural produce the farmers suffer Rs. 92,651 crore per annum. The word postharvest losses are well-defined as "losses that happen after harvest till the produce reaches to the consumers from field" which can quantity as well as qualitatively losses. Major causes for postharvest losses are done during harvest and postharvest management due to poor handling of products.

These losses controlled by different methods like proper harvesting and handling of produce, provide better postharvest management practices, storage facilities and good transportation services which reduced the postharvest losses of fruits and vegetables.

Factors for Postharvest Losses in Fruits & Vegetables

There are several factors such as moisture loss, loss of photosynthates, damage by biotic and abiotic stresses, mishandling of produce, decline in quality, activity of enzymes and physical damages by freezing, brushing, mechanical injury, etc. These factors which are fluctuate widely from place to place which responsible for post-harvest losses of horticulture produce and sometimes they become complex.

Factors for Reduces Postharvest Losses in Horticultural Products

Post-harvest losses can be decreased by implementing advance postharvest management technologies for longer shelf life, improvement harvesting techniques, proper handling of produce, better storage facilities, packaging, marketing and transportation, development of suitable processing technology for horticultural produces.

1. Harvesting: In horticultural crops, harvesting should be done at appropriate stage where there is least damage and loss, as quickly as possible and at minimum cost. Harvesting should be generally done at early morning or late evening hours in the cool hours of day. During higher temperature above 27℃ or immediately after rain or irrigation harvesting should be avoided and prevents from injuries during harvesting.

2. Sorting/Grading: Horticultural produce must be sorted and graded on the basis of different parameters such as maturity stage, colour, shape, size, weight, pesticide residues, freedom from insects and pests and availability of market. In sorting and grading all defective produce are removed from the harvest lot.

3. Washing: The Produce after harvesting is washed or cleaned to remove impurities from surface such as adhering dirt, insects, mould and pesticide residues and also improve the appearance. Chlorinated water of 100 ppm concentration usually effective in surface sanitization of produce. After treatment with chlorine water rinsed again and excess water allowed to dry before packing of produce.

4. Trimming: Trimming is done in to remove discoloured, unwanted, decayed and damaged parts in cabbage and lettuce crops etc. Trimming improves visual quality, decreases deterioration of produce and simplifies the handling, packaging and transport of produce.

5. Curing: Curing is a practise of healing of wound periderm and solidification of skin of tuber and root crops for a specified period under precise conditions of temperature and relative humidity (RH) which improves the shelf life of produce by forming corky layer which defends against water loss and infections by microorganisms.

6. Waxing: Waxing of fruits and vegetables primarily done to minimalize water loss and decrease shrivelling and wilting to increase shelf life. Waxing reduces the transpiration from surface of produce which affects the quality and quantity. It's also improves the appearance of produce. There is some common example of waxing material like semperfresh, prolong and waxol which is widely used to increase shelf life.

7. Precooling: Pre-cooling is the method of take away the field heat from the harvested commodity, mainly done when produce harvested during hot weather conditions. Pre-cooling aids in reducing the transpiration and respiration rate which significantly delayed ripening and enhanced the shelf life of fruits and vegetables. There are a number of methods of pre-cooling methods such as room cooling, forced air cooling, hydro-cooling, contact or package icing, vaccum cooling, etc.

8. Post- Harvest Disease Control: Fruits and vegetables suffer significantly due to attack of spoilage microorganisms which causing disease and subsequently in huge postharvest losses. Post-harvest decaying can be managed by application of fungicides as sprays or dips, combined in wax or coating or else impregnated in packaging materials.

9. Sprout inhibition: After harvesting of root and tuber type vegetables crops have dormant period but during favourable condition re-grow again. Sprouting its growth during storage which causes huge loss due to utilisation of respiratory substrates. There is some chemical such as MH-40, CIPC, MENA and TCNB are generally used as sprout inhibitors.

10. Packaging: Packaging is an important and essential for management of highly perishable products. The key role of packaging is to assemble the produce into appropriate units for handling and protection of the produce during supply, storage and marketing. Packaging materials are carefully chosen on the basis of plant characteristics. It increases storage life of produce, offers more attraction to the produce and protects from any physical injury, physiological and pathological deterioration during storage period, transportation and marketing.

11. Transport: Transport is an important connection in postharvest management, storage and distribution in markets. Transport of harvested produce from field to the distribution in different markets is done by road (train, trucks), air (airplanes) and sea route (ships). Serious losses are due to improper handling, use of unsuitable containers, careless loading and unloading of produce.

12. Storage: Storage of horticultural produce are vital for improving shelf life, avoiding market overabundance and to confirm supply throughout the year and increase return to the producers. The principle of storage is to decrease or control transpiration and respiration rate and disease infection at the same time upholding life processes at the necessary level. There are different methods of storage of produce are such as refrigerated storage, controlled/modified atmosphere, hyobaric storage, zero-energy cool chamber.

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Communication System in Nematodes

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Abstract
Communication in nematodes are associated with:
1. Nervous system.
2. Sensory organs.
3. Chemical communication.

Nervous System
The nervous system of nematodes consists of a set of parallel interconnected neuronal processes that run lengthwise on the nematode body, or circle the nematode body adjacent to the hypodermis. Various functions of stimulation, coordination and responsive actions are the responsibility of nervous system. It receives stimuli from the environment and transmits them to the internal tissues in which latent energy for the activity is stored. It is the nervous tissue that controls and directs the results of the liberated energy. The functional unit of the nervous system is neuron

Neurons are Classified into Three Types
1. Sensory or afferent neurons – conduct impulses from receptor to or towards the central nervous system
2. Motor or efferent neurons – conduct impulses to the effectors
3. Adjustor or associative neurons – join the sensory and motor neurons.

Nematodes consists of the central nervous system - the ganglia and ventral nerve, the pheripheral nervous system - cephalic papillary nerve, amphidial nerve, genital papillary nerves, deirids, somatic nerves and hemizonids, The recto-sympathetic system in the region of posterior gut comprises of a concentration of commissures, ganglia and nerves and the esophagus-sympathetic system present in esophagus that consists of three nerves, which run along the length of the esophagus and are connected with each other by commissures and also with the nerve ring. Nerves conduct signals from the sensory structures.

Sensory Organs
Nematodes interact with their external environment by wide range of sensory organs /sensilla.

There are two types of sensory organs:
1. Exteroreceptors.
2. Interoreceptors.

The sense organs receive the stimulus and transmit the same to the nerve centre. A nematodes receptor system is highly sensitive and the nervous system is highly coordinated. A number of chemo- , mechano- , thermo-,and electro – reception systems , the four functional systems attributed in nematodes.

1. Chemoreceptors: Amphids, Phasmids.
2. Mechanoreceptors: Cephallic papillae, Labial papillae, Genital papillae, Deirids.
3. Photoreceptors: Oceli.

Chemical Communication
Root exudates and host recognition:
1. Plant roots exude a range of compounds into the rhizosphere which mediate belowground interactions with pathogenic and beneficial soil organisms.
2. Root exudates include secretion of ions, free oxygen and water, enzymes, mucilage and a diverse array of primary and secondary metabolites.
3. These compounds alter nematode behaviour and can either attract nematode to the roots or result in repellence, motility inhibition or even death.

4. The main nematode chemosensory organs involved in host-recognition processes are two bilaterally symmetrical amphids in the nematode head and two paired pore-like phasmids located in the lateral field of the nematode tail.

Pheromones

Pheromones are the chemicals released by male and female nematodes for attracting the nematodes of their own species. These are mostly water soluble or they require a definite medium for their spread. In some nematodes volatile type of attractants are produced. They are secreted in gonads (Hsueh et al. 2013). The organs of chemoreception are amphids, phasmids and labial sensilla. These chemoreceptors are very sensitive and respond to attractants diffusing from a distant source or they may be less sensitive and respond to contact with the source.

Nematodes Speak Universal Language

Nematodes are communicating by secreting small molecules to build chemical structures called ascarosides that nematodes use chemical signals as sexual attractants, which provided the first hint that nematodes use chemistry to communicate (Choe et al., 2012).

Nematodes use complex messages that consist of molecules put together in a modular fashion," said Schroeder. "They put together different chemical fragments depending on what they want to say."

For example, the researchers found several molecules that tell nematodes to scatter and disperse. These molecules consist of only two building blocks. But adding a third building block called an indole changes the meaning completely: instead of "go away" the message becomes "everybody come here" Nematode messages get even more complex by combining two or more different molecules, just like combining different words in a sentence makes for more complex. By combining molecules that include different types of chemical building blocks, worms have developed a sophisticated chemical language that they use to organize their communities.

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Nanopesticides: Next Generation Precision Pesticides for Sustainable Crop Protection

Article ID: 31224

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Introduction

Indian agriculture has come a long way since independence. The country has achieved self-sufficiency in food grain production and is in a position to export various food commodities to other countries. The tremendous growth in agriculture is mainly due to the new production technologies introduced during green revolution in early 1970s.

High yielding crop varieties of wheat and rice were introduced for commercial cultivation with intensive application of chemical pesticides and nutrients. As a result, the production and productivity increased by many folds. Intensive agriculture brought some negative effects also as a number of pest and diseases emerged as major problem and caused epidemics in several parts of India.

Worldwide insect pests cause an estimated loss of 14% (Pimentel, 2009). The major epidemics of insects such as brown plant hopper, armyworm and stem borer in rice, boll worm in cotton, fall armyworm in maize, fruit and shoot borers in various vegetables are being noticed frequently from several parts of India. Management of insect pests are most important in sustainable crop protection and production.

One of the effective strategies of management of pests is the use of chemical pesticides. These are the chemical substances designed to control pests in various crops. Pesticide industry is growing every year and globally six billion pounds of pesticides are applied worldwide.

In India alone, pesticides of worth INR 197 Billion was sold in market during 2018.They are being used in agriculture fields by different method of applications.

They include, seed treatment, seedling dip, foliar spray, soil or stem injection methods. Based on the type of pests they control, pesticides are grouped as insecticides, herbicides, fungicides, nematicides, rodenticides, antibiotics etc. Large scale and injudicious application of pesticides created several negative problems like they could harm beneficial insects, birds, mammals along with causing environmental pollution.

The serious problem created by pesticides raised concern among researchers and people to look for alternate form of pesticides. The pesticides which are precision in their action and non-harmful to environment must be explored. Nano pesticides are the best alternatives to chemical formulations which are gaining attention of researchers to solve the problems associated with chemical pesticides.

Nano Pesticides

Nano pesticides are the pesticides incorporated within nanoparticles. Nanoparticles are very small molecules (Billionth of a matter) that are usually made of metals. Being smaller in size, they can cover larger surface areas and very low rate of nano pesticides would require covering a larger area with high precision.

They do not break down easily and need not be applied frequently for pest control. Since they are encased in a capsule form, penetration and killing of targeted pests is possible more effectively. They also have lower efficacy on non-targeted pests and could reduce overall pesticide requirement.

Nanoparticles with pesticidal action are silver nitrate, gold chromite, zinc oxide and zinc acetate, cadmium sulphide and zinc sulphide and carbon. They can be synthesized from different sources like plant and natural sources (Rai and Ingle, 2012).

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Fig. 1. Advantages of Nanopesticides

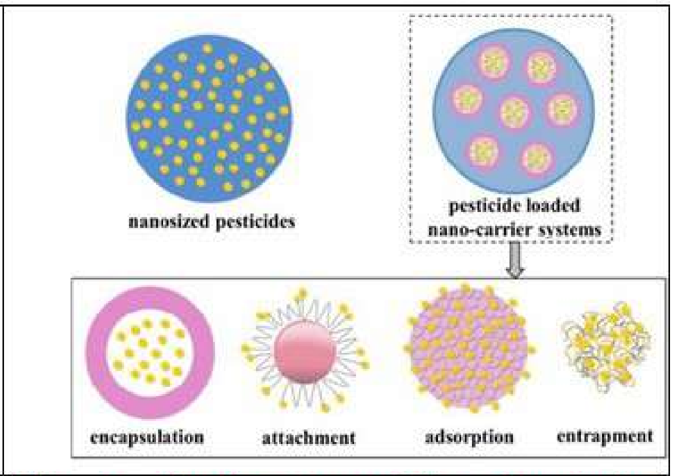

Fig 2. Nanobased pesticide formulation (Urkude, 2019)

Classification of Nano Pesticides

Nano pesticides are classified and described taking the chemical composition of the nanocarrier into account. These nanocarriers may be organic polymer-based formulations, lipid-based formulations, nanosized metals and metal oxides, clay based nano-materials, layered double hydroxides, silica nanoparticles.

Various Types of Nano Pesticides and their Advantages

Agrochemicals can be encapsulated with polymer-based nanomaterials like nano capsules, nanospheres, micelles and nanogels etc. Lipid based nanomaterials like liposomes and lipid nanoparticles, clay-based nanomaterials are available in market (Ohja et al, 2018). Essential oil based (EOs) nano formulations are useful in eco-friendly management of post-harvest pests during storage. Numbers of techniques are developed to encapsulate essential oils with different carrier materials for potential control of insect pests in storage. These EO based microcapsules offer advantages like minimum reactivity with environmental conditions, decreases evaporation rate, enhances handling ability, uniform distribution on targeted pest and safe delivery and action. They do not cause any problem to human health. Usability of nano-based materials also lies in gene delivery, infection detection, pesticide/nutrient level measurement, etc., which will be helpful in effective farming and crop protection (Urkude, 2019).

Conclusion

Nanotechnology and its application in plant protection is still in the early stages of development. Isolation and characterization of potential nanomaterials for their pesticide properties are being explored. Use of nano pesticides / nano pesticide formulations in agriculture could provide better plant protection when compared to chemical pesticides. Various types of pesticide formulations like microemulsion, nano emulsion, nano dispersion and nanoencapsulation of pesticides enhances the efficacy of pesticides by site specific delivery and action. In conclusion, nano pesticides hold tremendous promise for reducing environmental pollution due to conventional pesticides.

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Sharing Cultural Opulence of Nadia District: A Time-Honoured Heritage in West Bengal

Article ID: 31225

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Abstract
The state of West Bengal has a distinct culture which has its roots in the Bengal's history, literature, music, arts, drama, food, festival and cinema. Each of these components of culture is preserved as cultural beliefs in heritage sites across different districts over the state. Nadia district, a traditional heritage in West Bengal is also well-known for its cultural richness. It borders Bangladesh to the east, North 24 Parganas and Hoogly District to the south, Purba Bardhaman to the west and Murshidabad to the north. The cultural heritage of this district is very rich. It has been serving as a Centre for Promotion of Indian Culture, Music, Drama, Dance, Cultural discussions, Recreative Entertainment and Film Festivals for a long time. Krishnagar Rabindra Bhaban was situated at the district headquarter Krishnagar in the year 1961 to commemorate the birth centenary of Rabindranath Tagore. Besides Nadia district is a district famous for its reach traditional folk culture. Important folk forms of the district are Baul & Fakir Songs, String Puppet Dance, Bolan, Jhapan, Astak, Horse-dance, Pot-chitra (Painting on clay plates or paper) etc.

Description of the District
Nadia, a district of West Bengal is situated in its eastern side with its headquarters in Krishnanagar. During the period of the kings of the Sena Empire, who ruled from 1159 to 1206, Nabadwip, a well-known town in the district was the capital of Bengal under Ballal Sen and later Lakshman Sen. But when Bakhtiyar Khilji captured the town then it paved the way for Mugal ruler to West Bengal. At that time Nabadwip and some other places in the district were distinguished seats of learning and intellectual expertise. In the year 1787 Nadia was emerged as a separate district in the map of West Bengal. Raghunatha Shiromani, an eminent Indian philosopher and logician was born in 1477 at Nabadwip in the district. He was a pupil of Vasudeva Sarvabhauma. He set up a new school system of Nyaya, Navya Nyaya, representing the final development of Indian formal logic, to its peak of analytic power. Geographically, the district lies at 23°47'N latitude, 88°56'E longitude and 14 m Altitude. The district occupies an area of 3,927 sq km and it is bounded by Bangladesh on the east, Bardhaman and Hoogly district on the west, Murshidabad on the north and north-west and North 24 Parganas on the south and south-east. The main rivers in the district are Bhagirathi, Jalangi, Bhairav, Churni, Mathabhanga and Ichamati. Administrative wise, the district is divided into 4 subdivisions namely Krishnanagar Sadar, Kalyani, Ranaghat and Tehatta. There are 15 assembly constituencies in the district. But according to the order of the Delimitation Commission regarding the delimitation of constituencies in the state, the district will be divided into 17 assembly constituencies. According to the 2011 census the district has a population of 51,67, 600 (persons) including 26,53,768 (males) and 25,13,832 (females). The district has sex ratio of 947 females for every 1000 males. In the year 2001-2011 the population growth rate of the district was 12.22 % (persons) out of which 12.12 % are males and 12.33% are females. The major religions in the district are Hindu and Muslim with 72.15% and 26.76% of the total population respectively. Agriculture is the main occupation of the district. Handloom industries hold a significant position in the district. In the year 2013-2014 the Gross Domestic Product of the district was Rs 36,52,145 lakhs at current price. Earlier as compare to the other districts of the state, Nadia was not educationally well developed. The rural people were not enlightened enough to come to the schools. But with the establishment of Kalyani University has made a rapid change in its educational scenario. The University conducted the undergraduate and the postgraduate programs and various vocational trainings at a time. A group of colleges not only in Nadia but its neighbouring districts are affiliated with the Kalyani University. As per 2011 census the literacy rate of the district is 74.97% (persons), 78.75% (males) and 70.98% (females). Nadia is a notable district in the sphere of tourism in India. There are numerous tourist destinations in the district which allures many travelers from different

parts of the world. Mayapur, a place is situated at a distance of 40 km from Nadia. The Iskon temple of this place is famous in West Bengal. Rajbari is the identity of Krishnanagar of the district. The Rajbari of Krishnanagar, with its collections of antique fabrications around its walls draws the attention of the tourists. Shantipur, a marvellous temple in the state is located at a distance about 30 km of Nadia. Since the 9th century, the place is the main seat of Sanskrit learning and literature along with the Vedic texts and scriptures. Bethuadahari Wildlife Sanctuary situated in the Nakashipara area of the district covers 67 hectares was established in 1980. It is a remarkable wildlife sanctuary of the district.

Cultural Practices Related to Food

1. Folklore – folk story/folk song/proverbs/riddles: Bauls and Fakirs, frequently referred to as the wandering minstrels a mystic of Nadia Districts. Apart from bauls, Sree chaitanya kirton, Manasar Gan, Gajon, Conventions on Religious belief such as Bhavagat Geeta adhyayan, Songs on Mahaprabhur Doljatra, Songs on Raspurnima etc are the intrinsic culture followed in Nadia District.

2. Rituals: Nadia district is a cultural as well as religious Heritage of West Bengal for the people belief in Hinduism. Therefore, a list of rituals starting from Mahaprabhur (Sree Chaitanyadev) Dolyatra, Ras Purnima, Durga puja, Kali Puja, Laxmi Puja, Saraswati Puja, Manasha Puja, worship of Devadidev Mahadev etc. celebrated as the religious belief of the local Hindu people in the district. Apart from these programme, Worship of god for maintaining happiness and integrity among the local community people were celebrated by different community (Muslims, Christians etc.) people across the districts.

3. Festivals: Mahaprabhur Dolyatra, Mahaprabhur Rasjatra, Durga puja, Manosamangol, Ma shitolargan, Swaraswati puja, Powsh Sankranti, Arandhan, Kona puja, Itu puja, Kartick puja, PoilaBaishak, Nabanno, Shib Chaturdashi, Talnabami, Gajan, Charak, Nil puja.

4. Paintings:

Pic: Sri Chaitanya Mahaprabhur DolJatra

Pic: Radha-Krishna at ISKON, Mayapur

5. Community food: Khichuri, plain rice, dal, vegetables, fish curry, Chatni (Mango, tomato etc.)

6. Temple food: Prasad in temples (Bhog veg dish consisting of rice, pulao, ghee, fries, vegetable, curries and sweets), Fruit prasad, Milk prepared prasad etc.

7. Stages of life food:

Sl. No.	Stages of life	Food
1	Childhood - 6 months to 2yrs	Khichuri, Milk prepared with rice
2	Toddler	Soft rice, smashed vegetable, fish, pulse
3	Children	Family diet

4	Adolescent	Family diet
5	Adult	Family diet
6	Elderly	Family diet (Rice, dal, veg curry, fish)

Food Group

It is often said, half-jokingly, while others eat to live, the Bengalis live to eat. All Bengali rituals and festivities end up with one thing, hearty feasts involving an astonishing number of intricately prepared dishes.

In this context, we are trying try to make a list of Bengali cuisine generally followed in different temples (form of Prasad) and in household consumption.

1. Staple Food: Rice.
2. Number of Meals per day: 3 to 4 meals.
3. Cereals – 2 to 3 times.
4. Pulses – 2 times.
5. Spices and condiments – 2 times.
6. Oils – 2 times.
7. Vegetables – 2 to 3 times.
8. Fruits – 1 time.
9. Fish – 1 to 2 time.
10. Cereals, pulses, spices and condiments, oils, drinks, vegetables, fruits, milk products, egg-meat, fish, etc.
11. Dried fruits/vegetables.
12. Processed food.

Food Type

Seasonal – Spring, Summer, Monsoon, Autumn, Pre-winter, Winter:

Spring	Rice, Dal, Palak curry, fish, Tomato chatni
Summer	Rice, Dal, Bassella curry, Rui/katla fish, Mango chatni
Monsoon	Rice, Dal, Mixed vegetable curry, small fish curry
Autumn	Rice, Dal, Vegetable curry, fish curry
Pre-winter	Rice, Dal, Vegetable curry, fish curry
Winter	Rice, Dal, Amaranth sag, Mixed vegetable curry, fish

1. Daily thali (number of meals/day): 2 to 3.

2. Special festival food: Prasad in temples (Bhog veg dish consisting of rice, pulao, ghee, fries, vegetable, curries and sweets), Hilsa fish curry, Vegetables with small fishes, Arandhan- fermented rice especially in summer months, colocasia sag etc.

3. Ritualistic fasting food: Fruits, Sarbat, items prepared from Wheat flour (Roti, Paratha, Puri), Sabji etc.

4. Community food (food prepared by a section of the community during various times either during life events/festivals/harvest/social work): Khichuri, plain rice, dal, vegetables, fish curry, Chatni (Mango, tomato etc.).

5. Prasad in temples, Fruits, Different items prepared from Wheat flour (Roti, Paratha, Puri), Sabji etc.

Special Festival Food (Two Minimum Festival Per Season)

1. Season: Autumn

a. Name: Arandhan

b. Description (of the food and the festival): Cleaning of kitchen worship of Manasa Goddess – The food cooked on the last night and served on the next day.

c. For the food (objects used, ingredients, process of preparation, recipe): Plain rice, pulao, ghee, potato fry, Vegetables, Colocasia sag, Chatni, Paneer curry, Chatni, Payesh/ Dahi, Sweets etc.




Different food items at the time of special festive season

2. Season: Winter

- **a. Name:** Arandhan
- **b. Description (food and the festival):** Worship of Swaraswati Goddess– The food cooked on the last night and served on the next day.
- **c. For the food (objects used, ingredients, process of preparation, recipe):** All vegetables, 4-5 types pulses, (All are boiled with salt, chilli, cumine powder).

3. Special fasting foods:

- **a. Name:** Fruits & sagoo and milk.
- **b. Description (food and the ritualistic fast):** ShivRatri.
- **c. For the food (objects used, ingredients, process of preparation, recipe):** Sagoo is soaked in water and water is drained and mixed with milk and fruits and sugar.

Temple / Religious Food

1. Name: Mahaprabhur Dolyatra
2. Description (food and the ritualistic fast): Holi and Worship of Radha-krishna
3. For the food (objects used, ingredients, process of preparation, recipe): Khichuri.


Foods used for Prasad purpose and Worship

Stages of Life (Food Related to Life Events Like Birth, Marriage, Death)

1. Birth:

a. Name: Sweet, payes – Annaprashan

b. Description (food and the life event): Date of birth and starting of weaning

c. For the food (objects used, ingredients, process of preparation, recipe): Food served to the community people, friends, well-wishers to bless the child for good health. Govindabhog rice cooked in milk with sugar.

2. Marriage:

a. Name: Puffed rice and dahi (Morning) – Dadhi Mongal.

b. Description (food and the life event): Dinner – Rice, Dal, Veg curry, Fish, Meat, Chatni, Papad, Rasagolla, Dahi, Pan.

c. For the food (objects used, ingredients, process of preparation, recipe): Food served to the community people and relatives, friends and all bless the new couple.

Rice for bachelors' ceremony at the time of marriage

3. Funeral ceremony:

a. Name: Shradha- Lunch

b. Description (food and the life event): Dinner – Rice, Dal, Veg curry, Shukta, Chatni, Papad, Rasagolla, Dahi, Pan

c. For the food (objects used, ingredients, process of preparation, recipe): The food is served to the community and all of the people pray for the peace of their soul and peace for their community also.

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Biodegradable Plastics: A Need of the Current Era

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Introduction

Synthetic polymers are having paramount importance in many industries in particular the packaging industry. Nonetheless, it has an inadmissible influence on the environment and causes problems with deposition of waste and consumption. So, there is a propensity to replace the synthetic polymer with a biodegradable one. Starch based plastics, bacteria-based plastics, soy-based plastics, cellulose based plastics, lignin-based plastics and natural fibre reinforced plastics are some of the notable biodegradable plastics that have been commercialized. Production of this kind of material and its introduction to the market is important for the natural environmental.

Biodegradable Plastic

Biodegradable plastics have been studied extensively in past few years and have been commercialized in the manufacturing of several products such as garbage bags, compost bags, poly bags and agricultural mulch films. Such materials can be decomposed by the activity of microorganisms to produce the final products carbon dioxide and water.
Exploratory studies have shown that the usage of biodegradable plastics can curtail the cost of disposal. Photodegradable plastics, mulch film and biodegradable plastics have been considered by researchers to replace petroleum-based plastics (Halley et al., 2001).

Broadly there are two main types of degradable plastics such as photodegradable and biodegradable. Photodegradable plastic is generally made of plastic polymers and is oil-based as in the case of conventional plastic. The structure of photodegradable plastic is such that the bonds may get damaged by sunlight or they contain chemical additives which absorb light and then attack the polymer to break some of the bonds. Photodegradable plastic tends to break down into small plastic rather than fully decompose.

Unfortunately, this is often not the case with non-biodegradable plastics which remain in the environment. Presently, most of the plastic waste ends up in landfills where it is buried in the ground. Under these conditions, photodegradable plastic will not decompose.

Two major types of biodegradable polymers used in manufacture of eco-friendly agricultural mulch film are polylactic acid (PLA) and polyhydroxyalkanoate (PHA). PLA is a versatile biodegradable polyester derived from renewable resources such as corn and starch and offer great promise in many commodity applications (Drumright et al., 2000).

The promising PHA biodegradable plastics have been highlighted as green because they are made of polymer from renewable resources in a one-step fermentation of sugar or lipid bacteria (Posada et al., 2011). High production costs of PHA have been a major drawback for its substitution with petrochemical plastics.

Biodegradable plastics can be produced from oils or plant-based products. During the process of decomposition biodegradable plastics will be susceptible to bacteria, fungi or other micro-organisms that use them as food.

At the present time, there are an increasing number of commercial biodegradable plastics manufacturers. Some biodegradable plastics available in the market are:

1. Starch-based plastics.
2. Bacteria-based plastics
3. Soy-based plastics.
4. Cellulose based plastics.
5. Lignin-based plastics.

6. Natural fibres reinforcement plastic.

Starch Based Plastics

Starch based plastics are usually manufactured from wheat, potatoes, rice, and corn. Corn starch is the cheapest and most commonly used among all these four types of starch. Starch based plastics have been processed into eating utensils, plates, cups and other products. Starch biodegradable plastics can be processed using conventional technologies such as injection molding, blow molding, blown film, extrusion and thermo forming (Mohanty et al., 2000).

Bacteria Based Plastics

Bacteria are an additional treatment that is used to create a variety of biodegradable plastics. Using polymer chain polyhydroxyalkanoate (PHA), PHA is produced in bacterial cells. Bacteria are harvested after they are grown in culture and then created into biodegradable plastics. The mechanical properties of the resin can be changed depending on the product needs.

Soy Based Plastics

Soy based plastics use another material which is a suitable substitute for material used in case of biodegradable plastics. The protein content in soybeans lies in the range of 40-55% with limited fats and oils. This high percent of protein allows the soy to be moulded into plastic materials and films that are commonly used for food coating.

Cellulose Based Plastics

Cellulose is the most abundant biopolymer on earth and exists in a variety of species such as animals, plants and bacteria. Usually modified cellulose based plastic comes from plant cellulose material. Examples of commonly used cellulose sources are wood pulp, hemp and cotton. Various types of cellulose fillers such as flax fibre, eucalyptus pulp fibre, flax fibre, hemp fibre and tunicin, have been used as an agent in the bio composite stiffeners (Chakraborty et al., 2007).

Lignin Based Plastics

Lignin based plastic is a by-product of paper manufacturing industry. Lignin is a potential substitute for oil phenolic, epoxy resins and adhesives (Stewart et al., 2008). The addition of lignin into the matrix polymer (polyolefin) offers certain benefits including better chemistry, UV stabilizing and capabilities that can enhance biodegradation.

Natural Fibre Reinforced Plastics

Natural fibres such as bamboo, jute, sisal, kenaf and bagasse were used as reinforcement in composites due to its low cost, acceptable specific strength, modulus and biodegradability. Natural fibres provide features that are very attractive such as a low cost, biodegradable, high strength and modulus, low density, easy process and reactive surfaces for particular listings.

Conclusion

Technical and economic problems related with reusing materials have provoked scientists to search for new materials that can be recycled organically. The negative effect of synthetic polymers on the natural environment creates a lot of problems with deposition of waste and consumption.

Biodegradable polymers have been contemplated, however polymer-based sources that are sustainable are the most attractive. The main advantage of biodegradable polymers is that they can be composted with organic waste and release back to enrich the soil.

Their utilization won't just lessen dangers to untamed life brought about by dumping traditional plastic yet will likewise decrease the expense of work for expulsion of plastic waste in the earth since they are parsed essentially.

Decay will help increment the life span and stability of the landfills by reducing the amount of waste, which can be recycled to useful monomers and oligomers by microbial and enzyme treatments. Using biodegradable polymers in a variety of industries instead of synthetic materials can significantly help to protect the natural environment.

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Entomology: Seasonal Management of Honey Bee Colony

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Introduction

In beekeeping management, seasonal colony management means adoption of system of control. This leads to the maximum possible production whether it's for honey production or for pollination service. Seasonal colony management is the combination of activities which are undertaken by beekeepers at different seasons. Bees need to be checked periodically and the amount of time you spend on the bee depends on the needs of the bees at the given time.

Different Periods During Different Seasons

1. Honey flow period: Bee plants are in full bloom during this period. Bees bring in nectar and pollen in greater quantities for their daily requirement and therefore utilize the period for storing.

2. Dearth period: This is the time of year when nectar and pollen are not available to the bees. Egg laying activities decreases or stops as there is no food to feed the brood. This period may be caused by prolonged dry season followed by very heavy rains.

3. Build-up period: This is a time when bee plants start flowering and bees start to bring pollen and nectar. During this period all the stores are used for comb building, egg laying and brood rearing.

The following are the specific management practices for the specific season.

Summer Management

Summer is generally marked by hot winds and an ambient temperature often exceeds 40 degrees Celsius. During this period bees throw out drones and colony population also dwindles due to the death of old bees who have worked hard during honey flow season. Attack of bee enemies and robbing activity of bee also increases if not managed properly.

To maintain the colony properly we should the following practices during summer,
1. Provide the bee colonies with shade by shifting to shady areas or placing them under open straw huts.
2. Provide proper ventilation by slightly raising the brood chamber or the super such that bees don't pass through this ventilation.
3. Close all the cracks and crevices to prevent the entry of enemies.
4. In areas where summer temperature rises above 40 degree Celsius, gunny bags or straw packs moistened twice a day with water should be spread over the top of the colonies.
5. Provide a source of fresh water as honey bees maintain their hive temperature during summer by collecting water from outside source, spilling it inside hive evaporating it by fanning.

Monsoon Management

In the tropical and subtropical regions of the country, June to September represents the monsoon season. Bees face several problems of pests, predators, excessive humidity and starvation. Sometimes due to continuous rains, bees are confined to their hives for a long period. Honey bees become lethargic and may develop dysentery.

Colony needs the following management practices,
1. Week colonies which have become queen less should be united with queen right colonies, since during this period due to absence of drone's new virgin queen cannot mate.
2. If colonies have poor food stores, then provide sugar in the form of candy or dry sugar instead of sugar syrup.
3. Keep in check the attack of enemies like wax moth, ants, mites and wasps.

4. The hives are kept on stands sloping towards entrance in order to drain out water and prevent its accumulation inside the hive.

Autumn Management

The management practice during this period depends on the climatic and floral conditions where bees are kept. During this period many colonies make preparation for superseding old queens and raise few queens' cells and this is natural replacement of failing queen any colony. The new queen on emergence kills the old queen.

For successful over wintering, following management should be done.
1. Colonies below average population or having scattered or less brood than the average colonies indicate failure of queens. Replace queens of such colonies by early fall so that these colonies produce desirable number of young bees.
2. Colonies for winter should be free from disease.
3. Reduce the comb space by removing extra frames to such a level which can be covered by the bees well.
4. Under moderate climatic conditions, colonies of bees on 3-5 frames can winter successfully, if the colonies have proper food stores. Unite the weak colonies with colonies of average bee strength.
5. If colonies have less honey stores, feed them with heavy sugar which is prepared by dissolving 2 parts of sugar in one part of boiling water and to avoid crystallization add 1 table spoon full of tartaric acid to each of 50kg of sugar. Fill the syrup in combs and exchange for empty combs in the hive.

Conclusion

The general purpose of seasonal colony management is to ensure that the maximum strength of the colonies can be coincide with the maximum nectar flow in order to obtain a surplus honey production, strong or large colonies produce more honey than small or weak colonies. The primary aim is therefore to have large or maximum population of adult bees in the colonies during the period of main honey flow. Population must be built up at the appropriate time. By practicing the above management practices beekeepers can get the maximum output from bee colony.

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Locusts: Behaviour and Management

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Keywords: Swarms, Locusts, Behaviour, Management

Introduction

Locusts are short horned grasshoppers and have an exceptional ability to fly over miles *i.e.,* 10-100 km/day. These Orthopteran ruiners belong to the family Acrididae. Locusts differ from grasshoppers in their ability to change behavior and habit from time to time. They migrate by forming swarms and settle at a stretch on foliage and start feeding voraciously. There are about ten different species of locusts, *viz.,* Desert locust, *Schistocerca gregaria*; Bombay locust, *Nomadacris succincta*; Migratory locust, *Locusta migratoria*; Tree locust, *Anacridium* Spp., Italian locust, *Calliptamus italicus*; Moroccan locust, *Dociostaurus morocannus*; Red locust, *Nomadacris septemfaciata*; Brown locust, *Locustana pardalina*; South American locust, *Schistocerca paranensis* and Australian locust, *Chortoicetes termenifera*. The first four in the above list are major species found in India.

Behaviour

Active flight of swarms is seen during day and roosting begins at the sunset. Early in the morning after sunrise the individuals start flying in small scattered groups and these joins eventually forming large swarms. The swarms generally fly at an elevation of one to two thousand feet during their mass movement. Whereas, during rainy days they settle down on foliage or barren land even during day. At sun set the swarms start settling on the trees and standing crops and feed. Unlike the gregarious forms, adults of solitary locust fly generally during nights. Locust swarm size may range from one to several hundred square kilometres and there may me be up to 40 million locust adults in each swarm of one kilometre.


Locusts Swarms Settled on Tree and Barren Land

Management: Management of locusts has become a challenge to agrarian community in recent times. Insecticide resistance and resurgence towards chemicals which were effective earlier has made it even difficult to manage this polyphagous pest. Some of the common management practices recommended are:

a. Poisoning the breeding grounds of locusts which is known to have ovicidal action.

b. Digging trenches and dusting them with chemicals will kill the marching hoppers but is very laborious and less effective.

c. Mass collection, burning and burying the nymphs and adults will reduce the damage to some extent.

d. Beating drums, Digital sound systems, crackers and smashing different utensils, metal plates etc. to scare off the swarms is usually followed and found to be effective.

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Chemicals in Management of Locusts

Chemicals used in locust control should be used in little doses to avoid phytotoxicity and hazardous effect on plants, animals and humans. Vehicle mounted or aerial sprayers fitted with Ultra-low volume (ULV) spraying mechanism are preferred. Central Insecticide Board and Registration Committee (CIB & RC) has approved and recommended a list of chemicals that can be used for locust control. The organophosphate and carbamate insecticides are moderately effective and synthetic pyrethroids are most effective in locust control. Chlorpyriphos 20%EC or 50% EC, Deltamethrin 2.8% EC or 1.25% ulv, Fipronil 5% SC or 2.92% EC, Lambda cyhalothrin 5% EC or 10% WP and Malathion 50% EC or 25% WP are the approved chemicals for locust control. Diflubenzuran 25% WP is used only for hopper control.

Spraying of insecticide on trees during early hours

Conclusion

Locusts are the minimal creatures which cause maximum crop damage. Proper management practices along with the timely precautions can reduce the crop loss. Study of the locust behaviour is pivotal step in order to lessen the burden caused by them. Proper chemical management along with the smart enhanced measures will enable farmers to face the hurdles caused by the mighty locusts.

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Economic Aspects of Zero Budget Natural Farming in India

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Zero Budget Natural Farming (ZBNF)

1. Zero budget natural farming is a method of chemical-free agriculture drawing from traditional Indian practices.
2. It was originally promoted by agriculturist Subhash Palekar, who developed it in the mid-1990s as an alternative to the Green Revolution's methods that are driven by chemical fertilizers and pesticides and intensive irrigation.
3. It is a unique model that relies on agro-ecology.
4. It aims to bring down the cost of production to nearly zero and return to a pre-green revolution style of farming.
5. It claims that there is no need for expensive inputs such as fertilizers, pesticides and intensive irrigation.

Specific Features of ZBNF

1. Zero budget natural farming requires only 10 percent water and 10 percent electricity than what is required under chemical and organic farming. ZBNF may improve the potential of crops to adapt to and be produced for evolving climatic conditions.

2. It is, basically, a natural farming technique that uses biological pesticides instead of chemical-based fertilizers. Farmer use earthworms, cow dung, urine, plants, human excreta and such biological fertilizers for crop protection. It reduces farmer's investment. It also protects the soil from degradation.

3. The ZBNF method also promotes soil aeration, minimal watering, inter-cropping, bunds and top soil mulching and discourages intensive irrigation and deep ploughing. Since farmers are not required to buy any inputs, the cost of production in ZBNF is reportedly zero.

Benefits of ZBNF

1. With the rising cost of external inputs (fertilizers and pesticides), which is the leading cause of indebtedness and suicide among farmers. According to the National Sample Survey Office (NSSO) data, almost 70% of agricultural households spend more than they earn and more than half of all farmers are in debt.

   a. Since in ZBNF there is the need to spend money or take loans for external inputs, the cost of production could be reduced and farming made into a "zero budget" exercise.

   b. This would break the debt cycle for many small farmers and help to envisage the doubling of farmer's income by 2022.

2. At a time when chemical-intensive farming is resulting in soil and environmental degradation, a zero-cost environmentally-friendly farming method is definitely a timely initiative.

3. The ZBNF method promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching and discourages intensive irrigation and deep ploughing.

4. It suits all crops in all agro-climatic zones.

The Four Pillars of ZBNF

1. Jivamrita / jeevamrutha: It is a mixture of fresh cow dung and aged cow urine (both from India's indigenous cow breed), jaggery, pulse flour, water and soil; to be applied on farmland.

Benefit: Stimulate microbial activity to make nutrients bioavailable; protect against pathogens.

2. Bijamrita / beejamrutha: It is a concoction of neem leaves & pulp, tobacco and green chilies prepared for insect and pest management, that can be used to treat seeds.

Benefit: Protects young roots from fungus and seed borne or soil borne diseases.

3. Acchadana (mulching): Covering the top soil with cover crops and crop residues.

Benefit: Produces humus, conserves top soil, increases water retention, encourages soil fauna, prevents weeds.

4. Whapasa (moisture): It is the condition where there are both air molecules and water molecules present in the soil. Thereby helping in reducing irrigation requirement.

Benefit: Increase water availability, water use efficiency, increase resilience to drought.

Other Important Principles of ZBNF

1. Intercropping: This is primarily how ZBNF gets its "Zero Budget" name. It doesn't mean that the farmer is going to have no costs at all, but rather that any costs will be compensated for by income from intercrops, making farming a close to zero budget activity.

2. Contours and bunds: To preserve rain water, Palekar explains in detail how to make the contours and bunds, which promote maximum efficacy for different crops.

3. Local species of earthworms: Palekar opposes the use of vermicompost. He claims that the revival of local deep soil earthworms through increased organic matter is most recommended.

4. Cow dung: According to Palekar, dung from the Bos indicus (humped cow) is most beneficial and has the highest concentrations of micro-organisms as compared to European cow breeds such as Holstein. The entire ZBNF method is centred on the Indian cow, which historically has been part of Indian rural life.

Government Initiatives to Support ZBNF

1. Government of India has been promoting organic farming in the country through the dedicated schemes of Paramparagat Krishi Vikas Yojana (PKVY) since 2015-16 and also through Rashtriya Krishi Vikas Yojana (RKVY). In the revised guidelines of PKVY scheme during the year 2018, various organic farming models like Natural Farming, Rishi Farming, Vedic Farming, Cow Farming, Homa Farming, Zero Budget Natural Farming etc. have been included where in flexibility is given to states to adopt any model of Organic Farming including ZBNF depending on farmer's choice.

2. Under the RKVY scheme, organic farming/natural farming project components are considered by the respective State Level Sanctioning Committee (SLSC) according to their priority/choice.

Future Prospective

1. In her maiden Union Budget speech in july last year, Finance Minister Nirmala Sitharaman hailed ZBNF as an innovative model and said adopting this could help Indian farmers to double their income by 2022, which happens to be the 75th of independence.

2. A new farmer pension scheme called Pradhan Mantri Kisan Pension Yojana worth Rs. 900 crores were announced. To promote and deepen markets, creation of 10,000 new farmer producer organizations (FPOs) was envisaged and passing reference was made to the role of e-NAM and APMC in that regard. Fishery sector was given a thrust as the speech proposed to create value-chains and infrastructure. Return to zero-budget traditional farming was emphasized.

3. The population of India, which is currently 17.71 percent of the total world population, is predicted to increase by 33 percent from 1.2 billion in 2010 to 1.6 billion in 2050. Under 'business-as-usual' scenario, by 2050, 60 percent of the people on Earth, will experience severe deficiencies in calories, digestible protein and fat.

4. One of the more progressive announcements were the cluster-based scheme SFURTI (Scheme of Fund for Up gradation and Regeneration of Traditional Industries). It is designed to promote bamboo, honey and khadi clusters. Hundred such clusters are envisaged under SFURTI for 2019-20.

5. To meet increased demands for food on a shrinking area of agricultural land, efficiency of crop production must increase, but climate change, soil degradation and depopulation present further challenges to increasing the efficiency of Indian agriculture.

Conclusion

Zero budget natural farming started as a grassroots movement, aiming to provide multiple benefits, both to the environment and to farmers. However, there are conflicting opinions about how it should be developed for widespread use.

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Development and Environment

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SINCE as far back as we know, all religions of the world propagated that a clean environment was fundamental for the growth of community, both for its individuals or collectively in their endeavours. This explains why primacy was given to invoking magnanimity of elements before any enterprise was undertaken. The objectives were not purely religious, but to underline and ensure proper regards for environmental bounties like earth, air, water, etc. whose utilization was ordained to be done judiciously and with universal approval. Over the centuries, unfortunately, man in his capriciousness has reached a stage where the all-round development, that was said to be the reason behind the exploitation of natural resources, now looks ephemeral and not worth it. We seem to be almost veering round to the view that perhaps our approach had been short-sighted, if not completely irresponsible. Planet earth is heading towards becoming unliveable and its resources are nearing extinction due to over exploitation.

Development and environment have been the issues at debate ever since industrialization brought in quick prosperity to the Western World. In its haste to amass wealth, the natural resources were exploited blindly. The result was what we see today. The cities and towns are too crowded, too noisy and too unhygienic for healthy human living.

The forests are denuded leading to increased disturbances in the weather and water table. Oceans are not only polluted but are getting shore of their natural wealth through human voraciousness. The atmosphere is beset with the looming danger of depleting ozone layer. The earth through over exploitation is losing its fertility. What a scenario which we are going to bequeath to posterity.

The question of environment protection is not only linked to the quality of life but to the very survival of millions of people. Large scale destruction of forest and vegetable cover, contamination of rivers and other water bodies, rise of air pollution in urban areas, is the beginning of the end.

According to FAO estimates, 10 million hectares of the world's tropical forests disappear each year. Fertile lands are lost at a rate of 24 billion tonnes every year, and it is the most productive tracts of lands which are lost lying in the fertile earth belts, in the deltas and flood lands of our major rivers. That's 3.4tonnes lost every year for every person on the planet.

When man begins to interfere with the order and system that nature has so interestedly arranged in an act of seeming revenge, he further upsets the delicate balance in the planet's eco-system by causing death and destruction through floods, droughts and epidemics.

The environmental scenario in India is alarming in all its aspects. Almost all surface water is unfit for human consumption. It is estimated that 4, 00,000 lives are lost every year due to poor water quality, sanitation and hygiene. WHO data shows that 21 per cent of all communicable diseases in India are water related. All the 16 major rivers, lakes and other water bodies have become contamination of ground water resources has reached a critical stage.

Over exploitation, enhanced pumping intrusion of saline water in coastal areas, discharge of toxic effluents on land and in water bodies have all led to a decline in water table and serious contamination of ground water resources. The Ground Water Board has identified 231 blocks in the Country where ground water depletion has reached critical levels.

Since a majority of population in the Country relies on ground water even for drinking water, the situations called for immediate steps in regulating the use of ground water and prevent contamination. Though various government bodies exist under the Ministry of Water Resources, none was empowered to take action against polluting industries or against misuse of ground water.

In all the big cities, the number of vehicles playing on the roads has increased phenomenally. As a result of the noxious emissions into the atmosphere, heart problems, respiratory diseases, asthma etc. are on the rise. Lead is a poison which attacks the blood system, kidneys, and central nervous system, reproductive and other systems.

Vehicles are not the only source of pollution, other sources of urban air pollution are, power plants, industries and refuse burning. According to a report by The Lancet Commission on pollution and health (2019) on Environmental Cost, more than 4.6 million premature deaths take place in India.

The Tata Energy Research Institute's study entitled "Green India 2047" on air pollution, places the mortality and morbidity due to air pollution to be 2.5 times higher in the capital than predicted earlier. Taking into account the indoor air pollution as well, it has estimated that an astounding 2.2 million Indian die annually due to air pollution. Without food an adult can survive for three weeks, without water for three days but without air not more than three minutes. So much is the importance of fresh air to life in over sacred texts that water is compared to father and earth to mother, air has been equated with God.

India's population has expanded from 361 million in 1951 to around 1027 million in 2001. The population of India increased by more than 2.8 times during the period of 1951-2001. Census 2011 has shown that more than 377 million constituting 31.16 % of the total population of Indian resides in about 6166 urban agglomeration. Forty-four per cent of urban population are poor and live in slums or foot paths without any access to safe drinking water and sanitation facilities.

Today India's population crosses 1.38 billion marks. The urban population is expected to grow to 600 million by 2031 AD. Over the year there has been a progressive decline in the availability of essential services as well as in the quality of life in urban as well as rural areas, urban poor have been the worst affected segments in this change.

The health and environmental consequences of increasing population density, lack of safe drinking water and inadequate urban sanitation are likely to be further aggravated unless steps are initiated to improve the situation through sectoral coordination and appropriated and innovative technologies for safe management of both urban solid and liquid wastes.

Forests are among the most basic life support system of our planet. They support an extremely rich biodiversity which provides a wide variety of products and services. They are extremely important for regulating water flow in rivers.

Forests, apart from producing food, fodder, fibre, timber and non-timber products, regenerate and improve air quality through the process of photosynthesis through which they harvest solar energy by utilizing carbon dioxide and water. In this process, trees and the green plants give out oxygen which is an essential requirement for all living organisms on this planet. The importance of forests in soil formation and conservation is extremely crucial.

The recorded forest area in India is 71.22 m ha. But all the recorded forest does not have adequate tree cover. According to Landsat imagery of 2017, the area covered by forests is only 70.82 m ha. Today, India has less than two per cent of the total forest area in the world, but supports over 17.7 per cent of the world population. The per capita forest area has decreased from 0.20 hectare in 1981 to 0.07 hectare in 1994-95. By Comparison, the average per capita forest area for the world is 0.064 hectare.

With the pressure of growing population, agriculture, urbanization and rapid industrial development, forests have suffered progressively. There has been a continuous demand of forests lands for non-forest uses which has affected the forest cover in this country in a serious manner. In addition, deforestation caused by excessive and illegal free felling has vastly increased to gain short-term profits by mortgaging future well-being.

Deforestation has created complex and wide-ranging problems in the form of soil erosion, flooding, landslides, excessive siltation of rivers and reservoirs, affecting the local population and economy adversely. With the destruction of forests, thousands of plants and animal species are threatened with extinction.

The rain forests in the North-East and in the Western Ghats support an incredible diversity of species. The forests loss is causing severe damage well beyond the forests themselves. Large-scale clear cutting often leads to severe soil erosions which can choke rivers and streams. Forests loss can also reduce and areas water retention capacity, thereby causing extensive floods.

The subject of environment and development has become a critical topic especially in the context of the modern race towards industrialization. As more and more industrialization are taking place leading to sizable increase in national income, the costs in terms of permanent loss of limited environmental resources is also being realized in most quarters. Experts across the world are searching for models which would yield 'industrialized development' which at the same time is 'environment-friendly'. The search is still on but the 'trade offs' in terms of destruction of environment has become continuous phenomena.

Development and environment need not be looked upon as contradictions but as complementary. Both propose reasonable parameters to each other. Both are necessary for growth of human society, and of nations. A balanced and buoyant environment is fundamental not only for continued development efforts, but also for ensuring quality of life. A cleaner environment means less pollution, less misery and would result in greater productivity that would lead to development. This interdependence has to be properly understood and practiced. And that is possible through a pragmatic blend of urgency for development and the need to preserve the environment. The answer lies in evolving an enlightened view through enhanced awareness.

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Plant Protection of Apple

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Insect-Pests Management of Apple

1. Crop: Apple
2. Scientific Name: *Malus domestica*
3. Family: Rosaceae

Green Apple Aphid: *Aphis pomi*

1. Symptoms of damage:

a. Both nymph and adult suck the cell sap from leaf, terminal twigs and fruits.
b. Young trees may seriously retard normal growth
c. In heavy infestations black, sooty mould develop due to the secretion of honeydew on the fruit and foliage.

2. Identification:

a. Nymph - Pear shaped body, wingless, dark green or yellowish green in colour with black cornicles.
b. Adult - Pear-shaped body, bright green or yellowish-green in colour with black cauda (tail-like prolongation of the body) of wingless females. Winged females have a black thorax and green abdomen with black carnicles.

3. Management:

a. Adopt clean cultivation using healthy and pest free plants.
b. Spray of acephate 75SP @ 1.3g/lit or dimethoate 30 EC @ 0.75ml/lit of water.
c. Release predators like lady beetle, green lacewing and syrphid fly.

Woolly Aphid: *Eriosoma lanigerum*

1. Symptoms of damage:

a. Nymphs and adults suck the juice from all parts of the plants.
b. Weakening and death of the smaller plants.
c. Infested twigs shrivel and die.

d. Galls on the roots
e. White, woolly patches on the trunk.

2. Identification of the pest: Wooly aphid purplish in colour and covered with white cottony thread-like secretions.

3. Management:

a. Use resistant root stocks Golden Delicious, Northern Spy and Morton Stock 778, M 779, MM 14, MM 110, MM 112.
b. Spray of chloripyriphos 20EC @ 2.5ml/lit or dimethoate 30 EC@ 0.75ml/lit or methyl demeton 25 EC @ 1ml/lit of water.
c. Release the parasitoid: *Aphelinus mali*.
d. Predators: *Chilomenus bijugus* and *Coccinella septumpunctata*.

San Jose Scale: *Quadraspidiotus perniciosus*

1. Symptoms of damage:

a. The infested region in bark becomes reddish pink.
b. Purple discolouration on fruits.
c. Infested shoots - loss of vigour and death of young tree or branches.

2. Identification of the pest:

a. Nymph - Crawlers tiny yellow
b. Adult - Female round, slightly convex with a black pustule
c. Male- Linear

3. Management:

a. Select nursery stock free scale infestation
b. Spray diesel oil emulsion + Bordeaux mixture (Diesel oil 68 liters +Copper sulphate 15 kg +unslacked lime 3.75 kg) to be emulsified and diluted 5-6 times before spraying.
c. Winter spray with diesel oil emulsion at 8-12 l/ tree (diesel oil 4.5 l, soap 1 kg, water 54 -72 l)
d. Spray 1.25 liters of Chlorpyriphos 20 EC or 625 ml Malathion 50 EC in 500 liters of water per ha during summer.
e. Encourage the activity of parasitoids of *Prospaltella perniciosi, Encarsia perniciosi* and *Aspidiotophagus* sp.
f. Field release of coccinellid, *Chilocorus circumdatus* predator.


Codling Moth: *Cydia pomonella*

1. Symptoms of damage:

a. Caterpillar bore into the fruits and feed on the pulp.

b. Infested leaves and fruits show tunnels with frass.
c. Infested fruits unsuitable for human consumption.

2. Identification of the pest:

a. Egg- Flat, white transparent
b. Larva- Early stage creamy white, later becomes light pink with black or mottled black head.
c. Adult- Small greyish moth, chocolate brown patches near the tip of fore wings

3. Management:

a. Removed debris and grasses from orchard.
b. Collect and destroy the infested fruits and cocoons.
c. Band the trees with grass ropes or Jute cloth in 3-4 folds for larva collection before the larval descend to the ground for hibernation.
d. Use sex pheromone trap.
e. Mass trap males with codling moth lure traps.
f. Release egg parasitoids, *Trichogramma embryophagum* at 2000/tree.
g. Apply Virosoft CP4 Granulovirus for larvae before entry of fruit.
h. Sprayed Chlorpyrifos 20EC @ 0.02 per cent during early fruiting stage.
i. Apply acetempride (4 application per season) during egg laying stag.


Cottony Cushion Scale: *Icerya purchasi*

1. Symptoms of damage:

a. Nymph and adults suck the sap from leaves and twigs
b. Yellowing of leaves.

2. Identification of the pest:

a. Nymph - Pale red-brown body covered with little white wax and long hairs.
b. Adult - Female with a cottony ovisac.
c. Male one pair dusky winged.

3. Management:

a. Select healthy and pest free rootstock
b. Collect and destroy the infested plant parts
c. Spray application of neem oil 2%, NSKE 5%
d. Spray application of chlorpyriphos 20 EC 0.04% with sticking agent
e. Field release of some coccinelid predators and *Chilocorus nigritus*.


Tussock Caterpillar: *Orygia leucostigma*

1. Symptoms of the pests:

a. Leaves become skeletonized.
b. Larvae consume the entire leaf except main vein and petiole.
c. They feed on the upper third of the tree first.
d. They can cause severe defoliation.

2. Identification:

a. Larva- Reddish orange head, hairy body, four brushes like tuft on the back and a pair of longer tufts of black hairs rises from the prothorax.
b. Pupa – Dark grey cocoons spun of silk and body hairs found on twigs, branches and crevices in bark.
c. Adult – Male ash gray, forewings marked with dark wavy bands. Female – creamy white to gray, hairy and flightless.

3. Management: Spray of *Baccillus thuringiensis* var kurstaki or spinosad.


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Ecosystem Services for Human Well-Being

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Introduction

An ecosystem is defined as a structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them. It consists of both the biotic and abiotic components which are linked together through nutrient cycles and energy flows. Examples of ecosystems are agroecosystems, forest ecosystems, grassland ecosystems aquatic ecosystems etc. Ecosystem services refer to the various benefits which human beings obtain from the natural environment and from healthy ecosystems (Fig.1).

Such benefits include natural pollination of crops, timber, fiber, clean air, clean water, extreme weather mitigation, recreational value from natural environment, human mental and physical well-being. The concept of ecosystem services was popularized in early 2000s by Millennium ecosystem assessment (MA) which is a UN funded assessment body. According to MA, 2006 the ecosystem services are defined as "the benefits people obtain from ecosystems". The MA also delineated the four categories of ecosystem services—supporting, provisioning, regulating and cultural.

Supporting Services

Supporting services are the services that are necessary for the production of all the other ecosystem services. Unlike other ecosystem services, supporting service impacts on people are either indirect or occur over a very long time. These include services such as nutrient cycling, primary production, soil formation, habitat provision and pollination. These services make it possible for the ecosystems to continue providing services such as food supply, flood regulation, and water purification. Several services can be considered as being both supporting services and regulating/cultural/provisioning services.

Provisioning Services

Provisioning services consist of all "the products obtained from ecosystems". These services are also known as ecosystem goods which include Food and fiber (plants, animals, and microbes, wood, jute, hemp, silk), fuel (wood, dung, and other biological materials serve as sources of energy), genetic resources (including crop improvement genes, and health care), water purity, medicinal resources (pharmaceuticals, chemical models, and test and assay organisms), energy (hydropower, biomass fuels), ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.).

Regulating Services

Regulating services are the "benefits obtained from the regulation of ecosystem processes". This service includes air quality maintenance, climate regulation, water regulation, erosion control, water purification and waste treatment, regulation of human diseases, biological control, pollination, storm protection etc.

Cultural Services

These are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. These are not easily quantifiable in monetary terms. The cultural service include cultural (including use of nature as motif in books, film, painting, folklore, national symbols, advertising, etc.), spiritual and historical (including use of nature for religious or heritage value or natural), recreational experiences (including ecotourism, outdoor sports, and recreation), science and education (including use of natural systems for school excursions, and scientific discovery), therapeutic (including Ecotherapy, social forestry and animal assisted therapy).

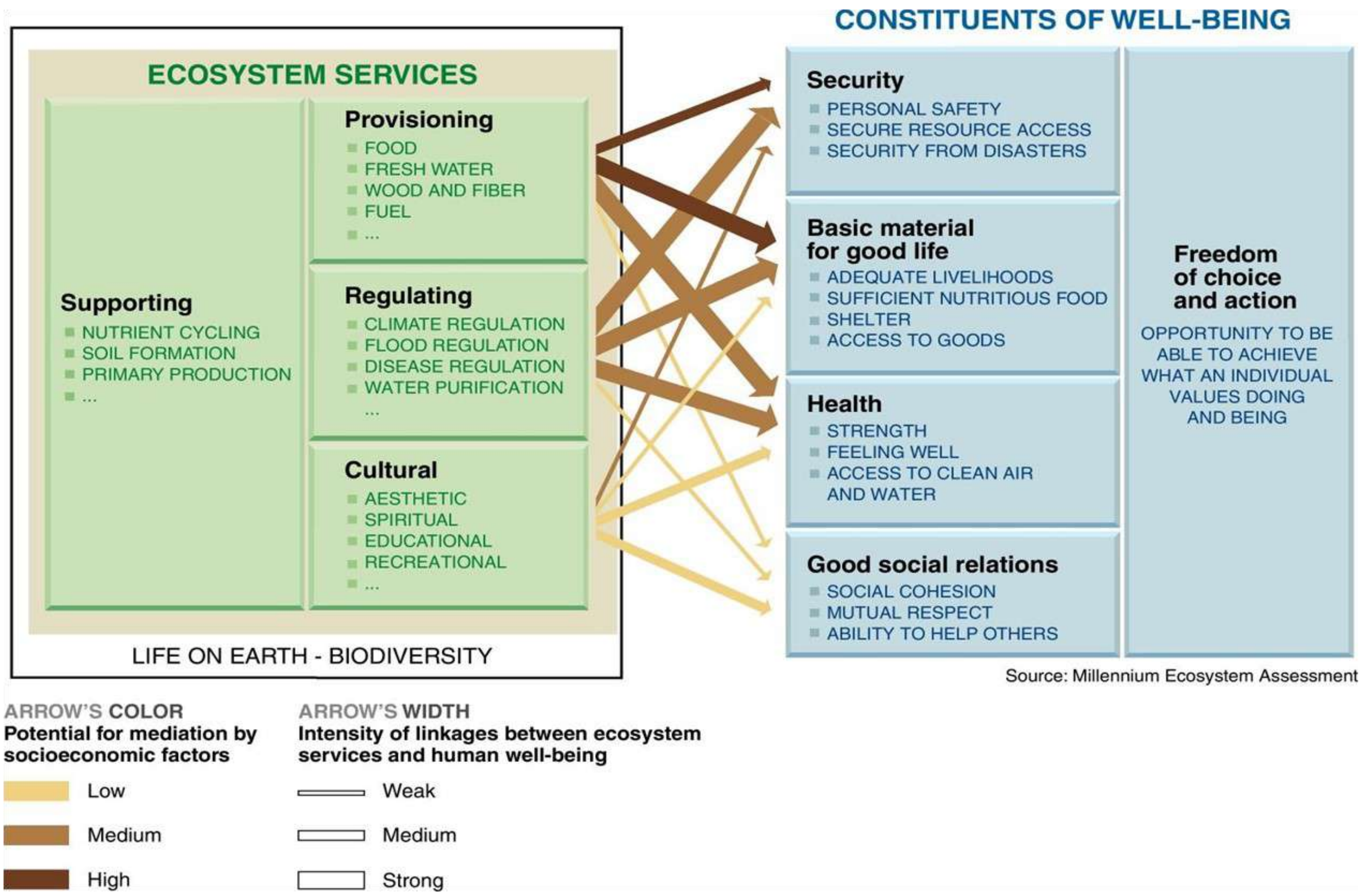

Fig. 1. The link between ecosystem services and human well-being as described by MA classification system (Sources- MA, 2005)

Economic Valuation of Ecosystem Services

Economic valuation of ecosystem services is vital to spread awareness about significance of surrounding environment. This will sensitize the general public, policy makers and other stake holders about the importance of ES and the value added to the society and need for maintaining and enhancing it.

The six major methods for valuing ecosystem services in monetary terms are as follow (Farber et al. 2002):

1. Avoided cost: Services allow society to avoid costs that would have been incurred in the absence of those services (e.g. waste treatment by wetland habitats avoids health costs).

2. Replacement cost: Services could be replaced with man-made systems (e.g. restoration of the Catskill Watershed cost less than the construction of a water purification plant).

3. Factor income: Services provide for the enhancement of incomes (e.g. improved water quality increases the commercial take of a fishery and improves the income of fishers).

4. Travel cost: Service demand may require travel, whose costs can reflect the implied value of the service (e.g. value of ecotourism experience is at least what a visitor is willing to pay to get there).

5. Hedonic pricing: Service demand may be reflected in the prices people will pay for associated goods (e.g. coastal housing prices exceed that of inland homes).

6. Contingent valuation: Service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives (e.g. visitors willing to pay for increased access to national parks).

Conclusion

Agroecosystems also produce a variety of ES such as regulation of soil and water quality, carbon sequestration, support for biodiversity and cultural services. Agroecosystems are thus both providers and consumers of ecosystem services.

Hence, the agricultural production process should be managed holistically considering the ES embedded with it. This will promote both the sustainability of ecosystems and agricultural development.

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Weed- Farmers Enemy

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Introduction

Weed is unwanted plant, grown everywhere in the field. Weeds are major threats to the farmers community and growers. They are destroying habitats of our crops, threatening native plants and animals including rivers and forests, mainly disturbing biodiversity. Weeds reduce farm and forest productivity in respect of production, invade crops, smother pastures and some can harm livestock. Weed from integral part of each and every argophytocoensis thus their interference with crop plant but nature. Because of their highly competitive ability and allelopathic influence weed causes irreversible damage to crops. Weeds constitute a major limiting factor in successful crop production and cause huge yield losses which depends on nature and intensity of the weed flora, duration of crop-weed competition, various soil factor and agro climatic conditions prevailing under a particular region.

The loose caused by weed are well known which depend upon the species density, dominance and ecological success. India loses agricultural produce worth over $11 billion more than the Centre's budgetary allocation for agriculture for 2017-18. Annually to weeds, according to a study by researchers associated with the Indian Council for Agricultural Research (ICAR). At $4.42 billion, the actual economic losses due to weeds were found to be highest in rice, followed by wheat ($3.376 billion) and soybean ($1.56 billion). The real cost of weeds to the environment is difficult to calculate, however it is expected that the cost would be similar to, if not greater than, that estimated for agricultural industries.

After estimation of critical period of weed crop competition, weed control is very essential to harvest maximum yield all the crops which are grown in field. Weeds can be controlled manually, mechanically, biologically and chemically. Manual weed control is laborious, time consuming and expensive than chemicals weed control. Chemical weed control by herbicide is relatively efficient and economical. The effectiveness and relatively low cost of herbicide has resulted in management system which are reliant upon their continued availability and has led to almost a total exclusion of non-herbicidal methods of weed control.

Impact of Weeds on the Environment

Weeds are one of the major threats to natural environment. Major weed invasions change the natural diversity and balance of ecological communities between crop, plant and environment. These changes threaten the survival of many crop plants and animals because the weeds compete for space, nutrients and sunlight. Weeds reduce farm and forest productivity, they invade crops, smother pastures and in some cases can harm livestock. They aggressively compete for water, nutrients, sunlight and minerals resulting in reduced crop yield and poor crop quality. For example, prickle bushes such as Gorse, Blackberries, Prickly Acacia, Parkinsonia and Mesquite can invade vast areas of grazing land preventing productive use of that land.

The Impact of Weeds on Agriculture

Weeds are plants in the wrong place in the field. They competitive for mineral nutrient, make hardy and vigorous growth habit. Second water and solar energy, weed make faster dry matter producing and high-water transpiration so, water losses increased in weed field. Some weeds have higher growth habit in term of space covering. Weed covers the space and trap solar radiation.

Weeds may reduce the quality of the crop produce in many ways like weed cover the space to increase foliage. More water transpiration in field to reduce availability of water to crop. Weed like Mexican poppy and bulblets of wild garlic and wild onion when threshed and ground with winter grains can results in serious consequences besides imparting objectionable odor to the flour. Further studies showed that striga weed reduced the quality of sugarcane juice by 3.9 to 8.9 percent.

Studies some years ago showed that globally, weeds are responsible for decreasing production of the eight most important food and cash crops by 13.6 per cent, leading to an economic loss of $100 billion. According to research on weed, judicious use of herbicides can cost farmers just one-third of what they spend on manual weeding.

Sr. No.	Crop	Losses in million	Sr. No.	Crop	Losses in million
1	Rice	4420	5	Sorghum	276
2	Wheat	3376	6	Green gram	75
3	Soybean	1559	7	Mustard	50
4	Ground nut	739	8	Pearl millet	14

According to research on weed, judicious use of herbicides can cost farmers just one-third of what they spend on manual weeding. Farmers spend a large amount of time and money managing weeds in every year but he fails to control. Weed-related issues affected Indian agricultural establishments during the current year. Farmers reporting soil and land issues and others reporting to water issues.

Impact of Weeds on Animal Health

Several weeds of grasslands and forage crops contain high toxic number of alkaloids, tannis, oxalates, gulcosides, and other substances that prove poisonous to animals when ingested. For e.g. Silky lupine (*Lupinus sericeus* L.) is responsible for crooked calf disease. Weeds either give shelter to various insect pests and diseases or serve as alternate host, so weed is part of spreading of disease or host of dangerous diseases. Aquatic weeds change the flavor appearance and taste of drinking water. Aquatic weeds are a menace to fisheries too, they reduce the level of oxygen into water. Aquatic weeds on decomposition give offensive odors that whys animal not drink water. Those are the main impacts of weed on animal health.

Impact of Weeds on Human Health

Weeds can also cause human health problems. Many common weeds such as Parthenium Weed, Ragweed, Rye Grass and Privet cause asthma and other respiratory problems, especially in children and elders. Some weeds can also cause skin irritation, asthma, allergies and some are poisonous. Some water weeds such as Water Hyacinth (*Eichhornia crassipes*) and Cabomba (*Cabomba caroliniana*) can affect the quality of our drinking water if infestations are not managed within water supply dams, they block to entire water supply chain. But as a general rule, plants with a bitter taste, unusual smell, milky sap or red berries may be poisonous with some plants having poisonous roots and bulbs. For e.g. people in U.P. are plagued year after year with hay fever and asthma aggravated by pollens of weeds bursage. Tsetse fly which cause African sleeping sickness disease.

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Polylactic Acid (PLA) - Synthesis and Applications

Article ID: 31234

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Abstract
Over the past decades, the serious environmental problem is the accumulation of petroleum derived plastic waste which are non-biodegradable in nature. There is a need for alternative plastic "bio-plastics" which are degraded into environment and will not cause any harm to the environment.

Poly lactic acid (PLA) is a well-known sustainable bio-plastic material, and an emerging product from lactic acid is used in the manufacture of biodegradable plastics.

Introduction
The production of lactic acid from fossil fuel is now widely accepted as unsustainable due to depleting resources and the accumulation of environmentally hazardous chemicals. Cost effective production of Lactic Acid using cheap raw material is appreciable.

Bio-renewable biomass has been widely studied and employed due to their availability and cost. PLA is synthesised biologically by lactic acid fermentation. In the first step, lactide was synthesized and further PLA polymerized.

PLA based plastics are produced from fermentation of starch rich substances like maize, wheat, corn which converts into lactic acid. The strength and properties of packaging material made of PLA based bio-plastic depends on the ratio of two optical isomers (D or L) of lactic acid monomers. 100% L-PLA results in high crystallinity and 90%D/10%LPLA result in polymerizable melt.

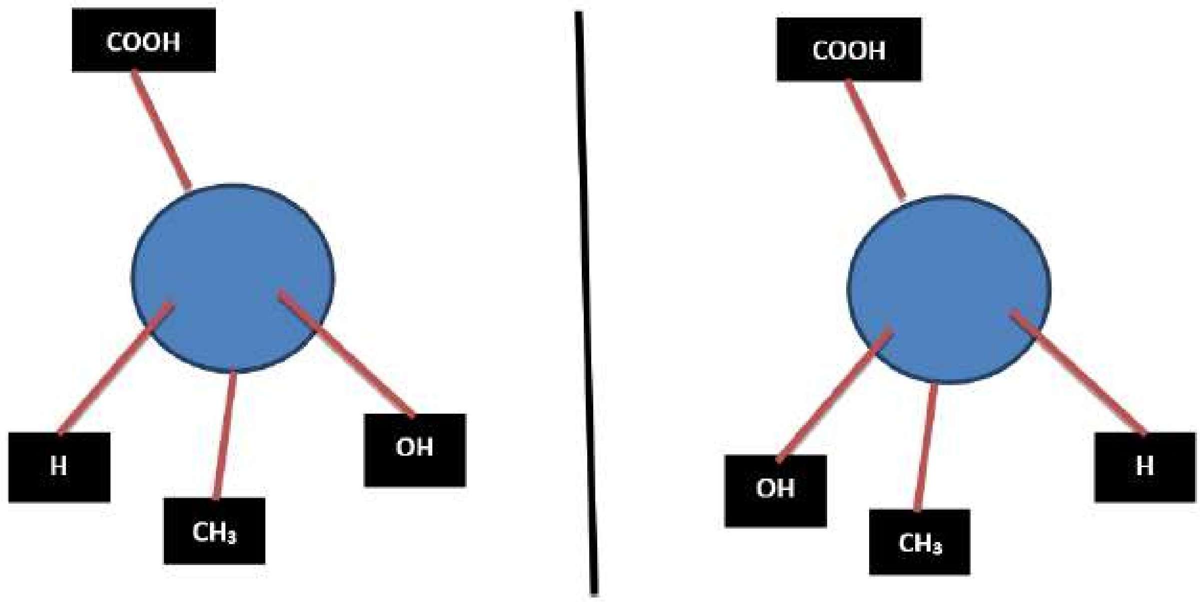
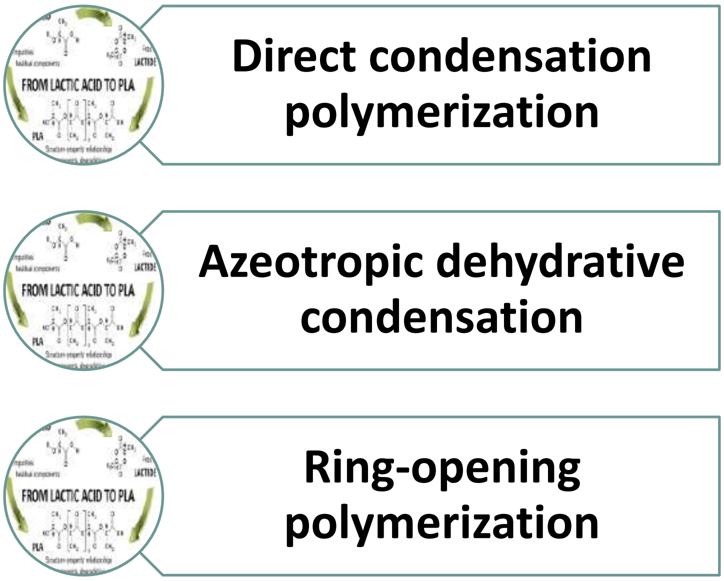


Fig 1: Stereoisomers of Lactic Acid

Synthesis of PLA
PLA can be obtained using different routes (Figure 1). In general, there are three methods which can be used to produce high molecular mass PLA of about 100,000 Daltons. Currently, direct condensation and ring-opening polymerization are the most used production techniques.



Inkinen et al ., 2011

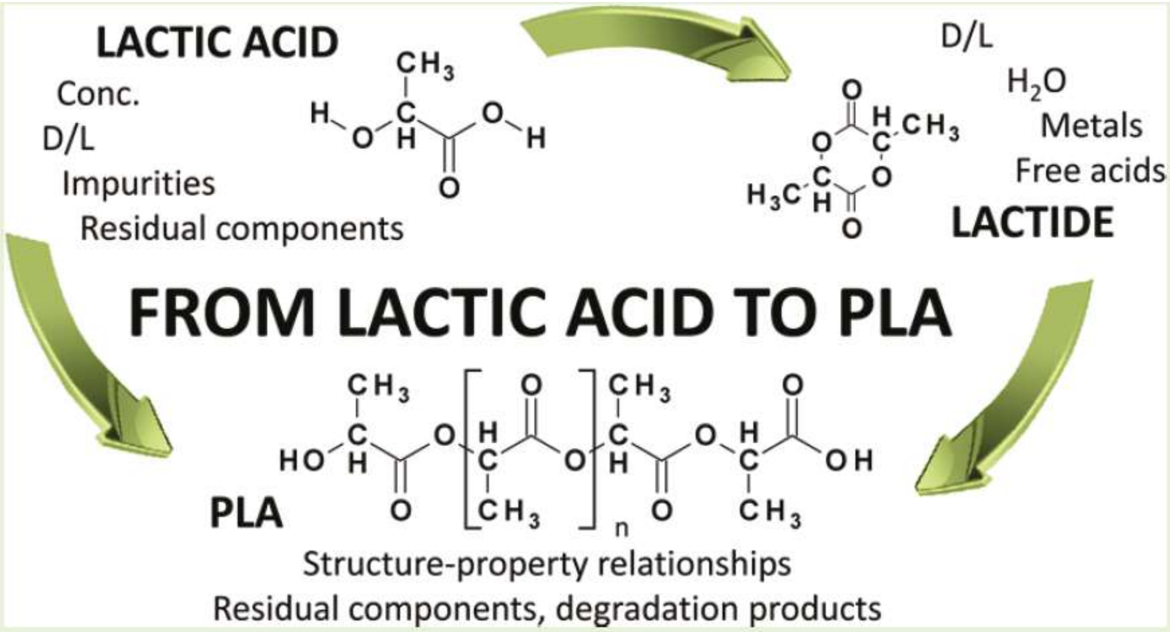
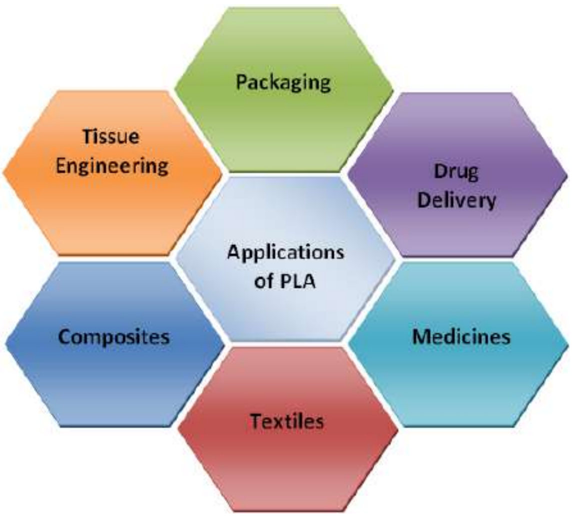


Figure 2

Applications of PLA



"Mulch film" is one such example of PLA based bio-plastic. These are thermoplastic, biodegradable polyester having enough capacity for packaging purposes.

Conclusion

There has been rising awareness for the use of bio-degradable polymers which is derived from variable renewable resources. Polymers found in nature, or biopolymers, can be derived from a plethora of plants, vegetables, and even industrial waste products. The need of synthetic plastic can be fulfilled by bioplastics like PLA-based which is bio-degradable in nature and safe to the environment.

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Production Technology of Onion

Article ID: 31235

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Botanical Name - *Allium cepa* L.
Family - Alliaceae
Chromosome no - 16
Origin – Asia

Onion is most important commercial vegetable crop grown in India. India is the second largest onion growing country in the world. It is a cool season vegetable crop. It is a known as "Queen of Kitchen". Pungency in onion is due to volatile oil - allyl propyl disulfide. Yellow color of the outer skin of onion bulb is due to "Quercetin". Onion is richest source of vanadium. Anti- fungal factor in onion is phenolic compound known as "Catechol".

Botany

Onion is a highly cross-pollinated crop. It is a pollinated by bees and another insect. Onion is an herbaceous annual for the edible bulb production and biennial for seed production having bisexual flower. The edible portion is a modified stem called bulb and develops underground. The leaves are yellowish to bluish green and grow alternately in a flattened, fan shaped swathe. From the underside of disc, a bundle of fibrous roots extends for a short way into the soil. Onion flower are protandrous. The common onion contains 88 - 90 % moisture, 0.8-1.4% protein, 0.2% fat, 5.2-9.0% carbohydrates, 50-52 mg sulphur and 23-26 calories energy per 100 gm of edible portion.

Climate

Onion is a cool season, long days favor bulb formation. Optimum temperature is required vegetative growth 12.8-23 °C and bulb formation 20-25 °C. Low temperature in early stage cause bolting whereas high temperature result in small sized bulb. Kharif Onion varieties require day length of 10-11hrs where Rabi varieties relatively higher temperature and 12-13 hrs. of the day length. Temperature is the most important than day length in seed production while photoperiod is more important than temperature for bulb formation.

Soil

Onion prefers to grow well and form good size of bulb in light soil rich humus, well drained, friable with ability to retain soil moisture. The optimum pH is 5.8 - 6.5.

Time of Planting

Shallow rooted crop, Oct - Nov is the best planting season. If planting earlier produce premature bolting in the bulb. Kharif season planting June -July is the best.

Method of Planting

1. Kharif season:

a. Seed broadcasting method- 15th June - 15th July.

b. Transplanting method – Raising seedling in nursery bed 15 th June -15 th July. 45-50 days seedling transplanted July to August.

2. Winter season:

a. Only transplanting - Raising seedling 20 Sep to 10 Oct and transplanting Oct - Nov.

b. Seed Rate - Raising seedlings- 8 to 10 kg /hac.

c. Broadcasting - 20 to 25 kg /hac.

Seed Treatment

Application of Trichoderma viride @1.25 g/ha is and recommended to manage damping off and raise healthy seedling.

Spacing

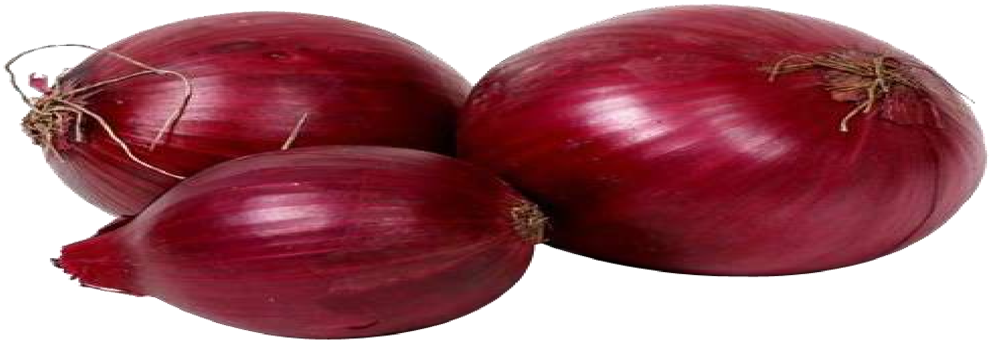
1. Big onion - 15cm×10cm.
2. Small pickling onion - 8cm×5cm.

Improved Variety with Specific Purpose

1. Yellow onion: The most popular cooking onion because they add excellent flavour to most stews, soups and meat dishes. They have a sulphur content and are the most pungent. Variety-Arka Pitamber, Phule Swarna, Brown Spanish, Early Grano.

2. White onion: White onion have a white or off-white skin and are a little less pungent compared to yellow onions. They are majorly used for processing and in Mexican cuisines. Variety-Pusa White Round, Pusa White Flat, Bhima Shweta, Bhima Subra, Agri found White.

3. Red onion: Red onion have a mild sweet flavour and suitable for raw consumption in salads and sandwiches. Variety- Pusa Ratnar, Pusa Madhavi, Pusa Riddhi, Pusa Red.



a. Suitable for Kharif season - Arka Kalyan, Agrifound dark red, N-53, N-2-4-1.
b. Suitable for Rabi season - Pusa Red, Nasik Red, Patna Red, Udaipur-101,102,103, Pusa Ratnar, N-53, Kalyanpur Red Round, Pusa Madhavi , Arka Bindu.
b. Resistant to Purple blotch - Italica red, Local Brazilian.
c. Resistant to Thrips - Pusa Ratnar, N-53.
d. Suitable for Salad Purpose- Udaipur 101, Early Grano.
e. Suitable for Kharif and Rabi seasons - Arka Niketan.
f. Suitable for hilly areas - Brown Spanish, White Spanish, Cream Gold.
g. Manures and Fertilizer - N- 80kg/ha, P-50kg/ha, K-60kg/ha, FYM-20-25t/ha.

Irrigation

1. Kharif season 15-20-day interval irrigation.
2. Rabi season 8-10-day interval irrigation.

Interculturing

Weeds are to be kept down to get a good yield of onion. Onion is a poor competitor of weeds. Stomp @ 3.35 l /ha applied immediately after transplanting and before first irrigation with one hand weeding gives the best results. Application of Basalin @1l/ha immediately transplantings.

Harvesting

Harvesting of onion depends on its type and purpose:
1. Onion for green: The purpose of this type of onion is to get high quality green leaves. Plants are pulled when bulb formation starts.

2. Immature bulb: As per need for the home consumption and supply to the market, immature onion plants are pulled along with bulbs.

3. Mature bulb: When bulbs become fully mature, the maturity is indicated by dropping of the tops just above the bulb knows as neck fall.

Yield

1. Big sized onion - 25 - 30 t/ha.
2. Small sized onion - 16 - 20 t/ha.
3. Multiplier onion - 15 - 18 t/ha.

Curing

Curing is an essential operation after harvesting. It will remove excess moisture from the outer skin and neck of onion bulbs. Curing increases storage life of the onion bulbs. Not only this, curing helps in improving the colour of the skin. Properly cured onion will have tight skin and well dried outer skin. Usually 10 to 15 days or so will be sufficient for curing the onion bulbs.

Grading

Cureds bulbs are graded on size and depending on market.

Different grades of onion are as follows on the basis of their diameter:
1. < 35 mm.
2. 35-50mm.

3. 50-60mm.
4. 60-80mm.
5. >80mm.

Storage

1. Cured bulbs are stored in well ventilated rooms.
2. Pre harvest spray malic hydrazide (2000-2500ppm) prevents rooting and sprouting of bulb stored @room temperature.
3. Bulbs harvested in kharif can be stored @0.2- 2.26 under cold storage.

Plant Protection

1. Diseases:

a. Damping off: *Fusarium* spp, Pre emergence and poste emergence damping off seedlings whenever onion grown from seeds.

Control: seed Treatment with thiram @2.5 /kg. Drenching of nursery bed with captaf @2.5l/of $H2O$

b. Purple Blotch: *Alternaria porri*. Large bleached lesions with purple center, rapidly enlarged leading to rot of infected bulbs.

Control: Spray dithane M-45 @O.25%.

c. Black Mould: Aspergillus Niger. Common storage disease. Black powdery mass of spores of black mould on exterior of scales.

Control: Protects bulbs from moisture after harvest. Store the bulbs @0 °C.

d. Bottom rot / basal rot: *Fusarium oxysporum*. Soil born disease yellowing and dying back from the tips of leaves.

Control: follow crop rotations upto 4 years soil drenching with captaf or thiram @ 0.2%.

2. Insects:

a. Thrips: *Trips tabaci*. Both larvae and adult causes injury. Feed by rasping surface of leaves and sucking liberated juice.

Control: Spray 0.1% malathion to 1% sandovit 4 spray @15 days interval.

b. Maggot: Hylenia antiquay. It attacks the tender portion of the remain hiding in the base of the plant and or in the cracks of the soil where they also lay the eggs.

Control: Soil application thimet 10G is beneficial. Follow crop rotation.

c. Mites: *Rhizoglyphus* sp. These are very small insects. They remain mostly on the under surface of the leaves. They suck the sap of leaves, affected plants become pale yellow.

Control: Dust the crop with sulphur at the rate of 20 to 25 kg / ha. Exposes infected bulbs to sun for about two days.

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Green Manures as an Important Tool for Maintaining Soil Properties

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Abstract
As the nutrient status of the soil is depleting day by day due to overuse of chemical fertilizers for increasing the production to meet the demands of the increasing population. One of the reasons for depletion in nutrient status of the soil can be continuous cropping without using optimum or required quantity of manure. Green manuring can be a method or strategy to improve the properties of soil that will ultimately lead to the good production. Main nutrient that is added by the method of green manure is nitrogen as in its leguminous crops are used that fix atmospheric nitrogen in the root nodules by forming symbiotic association with rhizobium bacteria. Green manuring also adds organic matter in the soil.

Introduction
Green manuring is a method in which undecomposed green plants are incorporated into the soil. Both legume and non-legume crops can be used for green manure but basically legume crops are used. Crops grown for this purpose are called as green manure crops. As we know that nitrogen is a major macronutrient needed by the plant for its proper growth and development, this nutrient can be added to the soil at low cost by adopting the method of green manuring. It also helps in maintaining the fertility status of soil and soil productivity. Mulching is an effective measure to suppress weed growth and in maintenance of soil moisture green manure crops can be used as a mulch by cutting and leaving them on the soil surface. The documents of low crop yields are acceptance of inappropriate methods of soil management, across-the-board of the afire of crop residues, non-judicious adoption of agronomic practices (Florentinet al., 2011) and asymmetric nutrients management. Further, depletion of soil organic matter, scant use of bio and organic-fertilizer and poor management is as well amenable for lowering down crop yield per unit area of land (Martiuset al., 2002; Salahinet al. 2013).

Types of Green Manuring
1. In- situ green manuring: In this the crop is ploughed in the same field in which it is grown.
2. Ex- situ green manuring: It is also called as green leaf manuring. It is a process in which plant parts of trees or shrubs going on bunds, wasteland is cut and brought to the main field for the purpose of green manuring.

Characteristics of Green Manure Crops
1. They should have fast growth.
2. They should be succulent so that less moisture is needed for decomposition.
3. They should be incorporated easily.
4. They should have low C/N ratio.
5. They should be deep rooted to absorb nutrients from deeper layer of soil.

Crops Used for Green Manuring
1. Legume crops: They fixes atmospheric nitrogen and make them available to the plant.
2. Green manuring legume crops: Dhaincha (*Sesbania aculeata)*, Sunhemp (*Crotalaria juncea),* Berseem (*Trifolium alexandrinum),* Cowpea (*Vigna unguiculata) etc.*
3. Green leaf manuring legume crops: Glyricidia, Subabul (*Leucaena leucocephala),* Karanj (*Pongamia glabra),* Sesbania (*Sesbania grandiflora, Sesbania rostrata) etc.*
4. Non-legume crops: They do not fix atmospheric nitrogen except in plants like Casuarina having root nodules.
5. Green manuring non-legumecrops: Sunflower (*Helianthus annus),* Maize (*Zea mays),* Buckwheat (*Fagopyrum sp.) etc.*
6. Green leaf manuring non-legume crops: Calotropis (*Calotropis gigantea) etc.*

Benefits of Green Manuring

1. It supplies organic matter to the soil which helps in optimum growth of the plant.It was acclaimed that the appliance of green manures to soil stimulated soil microbial advance activities as evident from earlier researchers, with consecutive mineralization of plant nutrients (Eriksen, 2005), and accordingly added soil abundance and superior (Doran et al., 1988).

2. It also act as cover crop and reduces the soil and nutrient loss due to erosion. Baig and Zia (2006) appear that Sesbania green manuring decidedly bigger acrid and saline-sodic soils by ameliorating the concrete and actinic backdrop of the soil.

3. It adds nitrogen to the soil as legume crops are used in green manuring.

4. Assimilation of green manures may accommodate added allowances such as abridgement of soil erosion, absorption of soil water, bigger assimilation of added crop nutrients, and with beneath assurance on off-farm actinic inputs (Bugget al. 1991).

5. It also helps in weed management as green manure reduces the chance of weed growth in the field by shading effect. They take up space and light and do not allow the weeds to establish. Some green manures like clovers and rye as well bury specific allelochemicals into the soil that arrest edger berry formation (Boydston and Hang, 1995).

Disadvantages of Green Manuring

1. Proper decomposition of green manure crops can occur uningrained condition, without sufficient rainfall there will be reduction in the rate of decomposition.
2. Rainfall is also required for the growth of green manure crops.
3. Good quality seeds should be sown for proper growth of green manures.
4. A balance between cost and using green manure crops should be maintained. Cost of raising a green manure crop should not be more than combining all other practices used for production in the field.

Conclusion

Greenmanuring can be utilised as a powerful tool for optimum growth of the crop. It also helps in maintaining soil fertility by adding nutrients like nitrogen to the soil thus maintaining the quality of this soil. Soil diversity is also increased as green manuring helps in the growth of beneficial microbes. Pandeyet al., (2008) declared that green manuring helped to advance the physical and biochemical anatomy of the soil, prevented leaching losses of nutrients, enhanced water holding capacity. Some challenges in this technique should be overcome for proper functioning like good quality when manure seeds should be available to the farmers, more research should be conducted on green manure crops to know more about their potential.

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Beauty of Rice as a Medicinal Plant

Article ID: 31237

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Summary of Article

Rice is the major staple food of more than 2 billion peoples of Asian subcontinent. It is the major source of energy and rich in much nutrition. Apart from energy and essential nutrition it has many medicinal properties. Recent studies from Indian ancient ayurvedic literature reveal the valuable medicinal properties of rice. Since from ancient time till today rice is used to clear stomach problem, Skin diseases, reduces High Blood Pressure and Dysentery. Recent studies claim that some traditional varieties of rice have anti-cancerous properties.

Introduction

Food is the basic need of any living creature for its day to today activities as it provides energy for body and it also provide immunity against disease so act as a natural medicine for everyone. So, it is the right of everyone to provide proper nutrition to their own body for its proper function. Among all three fundamental need food is most vital for human and the food should be highly nutritious and rich in different essential amino acids and vital minerals. The immunity of human mainly depends on the consumption of quality food. Now the major research is going on to increase the yield rather than the quality of food to feed the rapid growing population of the world. So, to solve the food scarcity we forgot the quality of food. Major population solely depends on rice as major food, so our major aim should concentrate towards the development of highly nutritious and quality rice which can fight against disease and provide immunity for future. From Indian ayurvedic literature it is mentioned that rice is treated as tonic, to reduce stomach gas, anti-diuretic and effective in biliousness (Caius, 1986).

Research is also going to develop rice with rich in Zn and Fe. Now researcher successfully developed low GI rice which is helpful the diabetic patients. Many traditional varieties have great importance as medicinal properties. Early peoples were used these traditional land races for their medicinal requirement because that time there was no modern improved medical facilities available like now. These are natural and eco-friendly, no negative impact after use like toady's chemical treatments. Now our effort should concentrate on these natural rice varieties, how can we use these varieties for the human civilization? So, in this article we will more focus on the rice which is of medicinal properties.

Rice can be used as Husks for animal feed, Rice Bran to extract oil, Broken Rice for animal feed, (Rice Flour, Rice Milk, Rice Pudding) for human consumption, (Rice Starch, Rice Straw) for animal feed and Rice can be used in Beverage Making, Rice Paper, Rice Glue, Rice Cakes (mochi), Rice Vinegar, Rice Soy Milk, Red Yeast Rice, Rice based food products. So, it is called as rice is life.

Medicinal Use of Rice

It is believed that around 10,000 year back agriculture was started which leads to the development of the human civilization, nearly 5000 years backs rice cultivation started in china and it was originated from S-E Asia in 2000 year back. Indian ancient literature provides many evidences of unknown medicinal properties of rice. Not only the Indian literature, but also the many Asian countries such as Thailand, Myanmar, China, Malaysia, Indonesia, have Contributed many crucial medicinal qualities of rice.

Medicinal Use of Rice in Different Countries

Sl. No.	Country	Uses
1	China	Restore tranquility, peace and healing process, digestion, toning for muscle, gas problem of stomach, rice yeast for ailments.
2	Malaysian	Eye lotion and skin ailments
3	Cambodia	Treating dysentery
4	Philippines	Source of vitamin B to prevent and cure beri-beri (Vir et al., 2005).

5	India	Rice water as ointment to counteract inflamed surface.

Use of Rice for Different Treatment

Sl. no.	Use as	Treatment for
1	Great Energy Source	Rich source of carbohydrate for energy.
2	Cholesterol Free	Major part of balance diet to prevent coronary disease.
3	Rich in Vitamins	Rich source of niacin, vitamin D, calcium, fibre, iron, thiamine and riboflavin.
4	Resistant Starch	Prevent normal growth of bacteria.
5	High Blood Pressure	Low sodium reduces blood pressure.
6	Cancer Prevention	Insoluble fibre prevents cancer.
7	Dysentery	Husk of rice ant-diuretic and prevents dysentery.
8	Skin Care	Rice powder as skin ailments.
9	Alzheimer’s disease	Brown rice with high amount of neurotransmitter prevents Alzheimer’s disease.
10	Heart Disease	Rice bran oil used for heart patients.

Medicinal Use of Colour Rice

Sl. No.	Type of rice	Medicinal use
1	Brown rice	Diabetes mellitus, anti-carcinogenic properties, Cardiovascular disease, Cholesterol, Hypertension, Obesity
2	Black rice	Diabetes mellitus, anti-carcinogenic properties, Cardiovascular disease, Obesity
3	Red rice	Cardiovascular disease, Cholesterol, Hypertension, Obesity, Anti-allergens

Rice Variety Used for Medicinal Use

Sl. No.	Rice variety	State	Medicinal use
1	Rakthasali	Ancient	Fevers and ulcers; improves eyesight, health, voice and skin health; and increases fertility
2	Sali	Ancient	Hemorrhoids (piles); treat burns and fractures
3	Sashtika	Ancient	Hemorrhoids (piles); treat cervical spondylitis, paralysis, rheumatoid arthritis, neuromuscular disorders, psoriasis, skin lesions, reduce backache, stomach ulcer.
4	Nivara rice	Kerala	Hemorrhoids (piles); used in the preparation of weaning food for underweight babies
5	*Erumakkari*	Kerala	Cough
5	Mahagandhak ras	Ancient rice	Used to control ailments such as vaginal and seminal discharges, diarrhea, constipation and dysentery
6	Matali and Lal Dhan	HP and UP	Curing blood pressure and fever
7	Kafalya	HP and UP	Treating leucorrhoea and complications from abortion
8	Kari Kagga and Atikaya	Karnataka	coolness and also as a tonic,
9	Neelam Samba	TN	used for lactating mothers
10	Alcha	MP	Pimples, small boils in infant
11	Baissor	MP	Chronic headache, epilepsy
12	gathuwanor,	MP	Rheumatism
13	karhani,	MP	Paralysis
14	kalimooch,	MP	Skin diseases
15	maharaji,	MP	Post-natal tonic for women
16	bhajari,	MP	Renewal in placenta in cows

17	dhanwar	MP	Renewal in placenta in cows
18	*Mehar*	Odisha	Post-natal tonic for women
19	*Saraiphol*	Odisha	Post-natal tonic for women
20	*Karikagga*	Karnataka	Cooling effect
21	*Atikaya*	Karnataka	Health tonic
22	*Mullarya*	Karnataka	Cooling effect
23	*Kari Bhatta*	Karnataka	Skin infections, increase milk in women
24	Resari	CG	To cure prolonged cough.
25	Laicha	CG	Pregnant mother as a preventive measure for getting healthy child. Skin disorder (Oudhia, 2008)
26	Soth	CG	Patients suffering from coldness.
27	Sul Dhan	CG	Recover stomach problem in human beings.
28	Gathuwan	CG	Joint's pain in human beings.

Conclusion

Rice not only energy providing food plant, but also highly rich in nutrition. Apart from energy and nutritional value it rich in many medicinal properties. It is very effective in reducing stomach pain; relief from muscle pain, used as ointment, tonic, and recent studies also claims that it has anti-cancerous property. Ancient and traditional knowledge are very useful for tracing the medicinal value of rice. Traditional varieties are the source of medicinal value, so conservation of these varieties is very essential for further research and study.

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Commercialization of Plant Micro-Propagation in India: An Overview

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Introduction

Frederick Campion Steward discovered and pioneered micro-propagation and plant tissue culture in the late 1950s and early 1960s. The term "Plant tissue culture" broadly refers to the in-vitro cultivation of plants seeds, plant parts (tissues, organs, embryos, single cells, protoplasts etc.) on nutrient media under aseptic conditions. This article reviews the salient characteristics of micro-propagation and its commercialization in India.

Micro-Propagation

In simple terms the micro-propagation is the clonal propagation in vitro (Chawla, 2011). The word "clone" means those cultivated plants that were propagated vegetative. Thus, clonal propagation is the multiplication of genetically identical individuals by asexual reproduction. This technique is used to multiply those plants that have mainly been bred through genetic transformation methods. Although this technique has also been promising for the multiplication of plants those are generated through conventional breeding methods. This technique provides sufficient number of plantlets for planting from a mother plant which does not respond well to vegetative reproduction or does not produce seeds. Micro-propagation is so useful because of the advantages it offers like rapid multiplication, required limited mother stock, uniformity in products, seasonal independency, agronomic superiority, high returns etc. Plant regeneration through micro-propagation can be categorized in three categories:

1. Axillary bud proliferation: Enhanced release of axillary bud proliferation i.e. by multiplication through growth & proliferation of existing meristems. It can be through apical shoots excised from the parent plant and by multiplication of existing meristems within axillary shots, which proliferate on explants after removal from the parent plant.

2. Organogenesis: Formation of individual organs such as shoots & roots either directly on the explant where a performed meristem is lacking or de novo origin from callus and cell culture induced from the explant.

3. Somatic embryogenesis: Formation of a bipolar structure containing both shoot & root meristems either directly, from the explant (adventive origin) or de novo origin from callus and cell culture induced from the explant. In other words, somatic embryogenesis refers to an artificial process where a plant or embryo is derived from a single somatic cell. Somatic embryos are produced from plant cells that are not generally involved in the development of embryos. Somatic embryos do not contain any endosperm or seed coat.

Table 1: Various micro-propagation techniques used for propagation of different plant/tree species:

S. No.	Name of the species	Used Micro-propagation Techniques
1	Orchids	Seed culture
2	Cereals, legumes	Embryo culture
3	Solanaceous crops	Root culture
4	Tobacco	Callus culture
5	Bamboo	Organ culture
6	Apple	Nucellus culture
7	Banana	Endosperm culture

Simplified Procedure of Micro-Propagation

Micropropagation can be applied in wide range of plants and trees depend on their suitability, here in this article, banana (Musa paradisiaca) is being used as an example (Suman and Kumar, 2015) to illustrate the steps involved in micropropagation. Banana is one of the world's most important fruit crop which can grow in all type of tropical agricultural system. Various micro-propagation techniques used for propagation of different plant/tree species are given in Table 1.

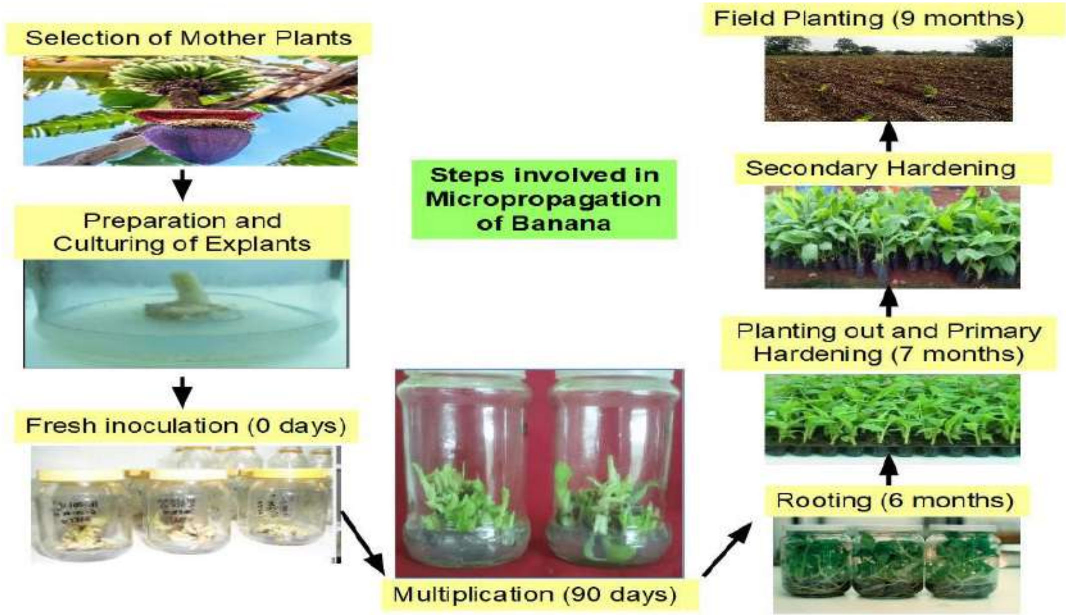

Figure 1: Diagrammatic representation of steps involved in micro-propagation of Banana

Applications of Micropropagation

Micropropagation has several applications in breeding of plants. The major applications of micropropagation are as follows:

1. This micropropagation technique provides a better alternative for those plant species that exhibits resistance to practices of conventional propagations.

2. Using this technique, millions of clones can be produced from small amount of plant tissues in just a single year. Although, production of equal number of plants using conventional methods will require many years.

3. Generated large number of plants can be maintained in small spaces which allows storage of germplasm and conservation of endangered species at minimum expenses.

4. This technique is considered as most powerful alternative of vegetative propagation as it allows production of large number of plants in short period. This technique can reduce time required for varietal development by 50%.

5. Propagation of plants through this technique do not require any specific natural season or climatic condition, as this technique exploits artificial environment.

6. This technique is also useful for seed production in certain crop species as required for genetic conservation.

7. This technique through somatic embryogenesis procedure also allows production of synthetic/artificial seeds. These synthetic artificial seeds are becoming popular nowadays.

8. The micropropagation method also allows production of disease-free plants. Hence, disease-free varieties are produced through this technique by using meristem culture.

9. In floriculture sector, this technique has huge demand as it provides increased yield and vigour in floricultural species.

10. This technique provides fast international exchange of plant material without the risk of disease introduction. Use of this method reduces the time required for quarantine.

Status of Commercialization of Micro-propagation in India

Demands of certain things increases day by day and the tissue culture plantlets are one of them. In initial days, tissue culture was not highlighted but the quality production of fruits, vegetables, trees changed the mindset. India is the hub of the variety of climates which provides every favourable factor to tissue culture.

Commercialization of tissue culture started in 1987 in India when A.V. Thomas and Company Kerala (AVT) established their first production unit in Cochin for clonal propagation of superior genotypes of selected cardamom plants (Mascarenhas, 1999). Since then we started to focus on small scale production with this technique. According to the estimates, investment of Rs. 200 crores can give the annual growth rate of 20% which is a good start.

India have more than 70 established commercial tissue culture units having production capacities 0.5 million to 10 million plants per annum. And also, the Government of India started the various schemes for the commercialization of Tissue culture like provision for assistance of upto Rs. 21 lakhs and Rs. 10 lakhs for setting up tissue cultural units in public and private sector, APEDA (Agricultural and processed food products Export Development authority) also takes initiatives to promote this technique (Shukla, 2017).

Conclusion

Based on certain reports it can be said that India is progressing in tissue culture by focusing on mainly horticulture, floriculture. Because these fields require less space and gives high quality productions within limited period of time which can be prove a good move towards utilizing the science of tissue culture.

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Micro Propagation of Sugarcane Quality Seed

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Micro propagation is the true to type propagation of selected varieties through meristem culture under controlled nutritional and environmental conditions. This provides a rapid and reliable system for production of a large number of genetically uniform disease-free plantlets which ensures maximum production potential of varieties. It is an important Technique for commercial plant propagation in sugarcane seed production and has vast significance. This technique in sugarcane can be used for rapid multiplication of newly developed high yielding, high sugar, disease resistant varieties and rejuvenation of outstanding varieties under cultivation. The vegetative propagation of sugarcane through seed cane cuttings is cumbersome requiring larger quantities of vegetative seed material and the normal rate of multiplication is 1:10. This low rate of multiplication is one of the constraints in the rapid spread of newly released variety for immediate large-scale adoption by the farmers. Classes of quality seed viz., Nucleus and Breeder seed of newly released and notified varieties are generally raised through micro propagation tissue culture technique.

Importance of Micro Propagation

Micropropagation of sugarcane is important to obtain pathogen-free plants, genetically homogeneous and invigorate. The micro propagation procedure is divided into stages for the sake of better understanding. Micro propagation for large-scale sugarcane production using a temporary immersion system (TIS) is described. In addition, the aim of this chapter is to report, from the laboratory to the field, the best way to establish and use basic seed (primary seed), semi-commercial seed (foundation or secondary seed) and commercial seed production Procedures follow proper explant, nutrient media and aseptic condition.

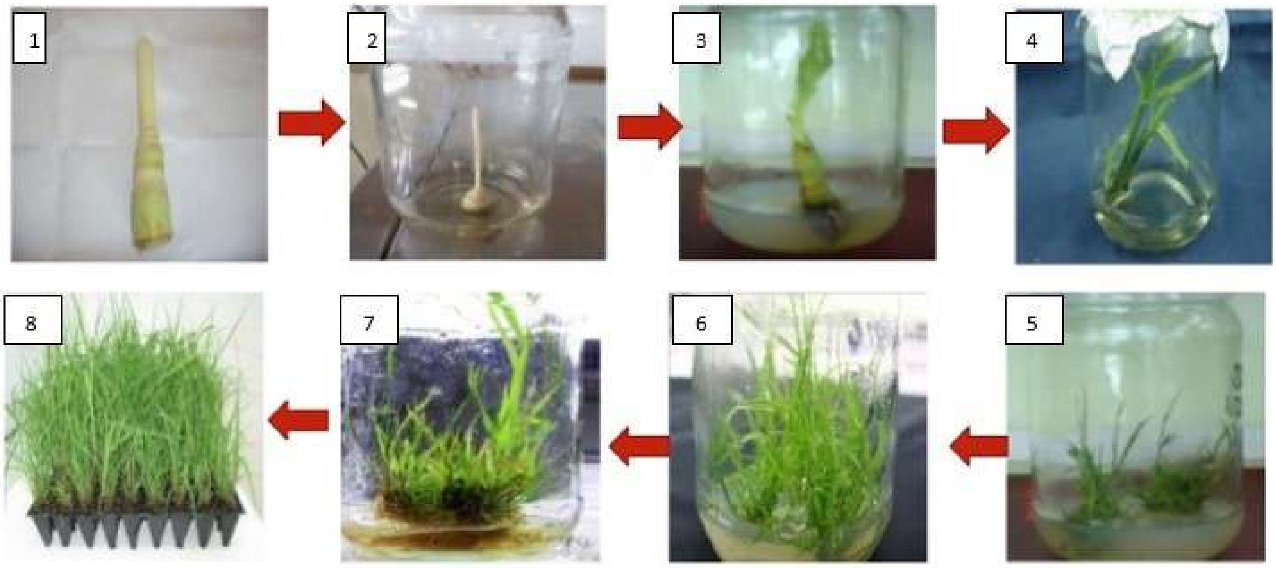

Figure- 1. Sugarcane apical bud or explant (plate1): Establishment of apical shoot bud (plates 2): Shoot initiation in MS (Plates 3): Shoot elongation (plates 4): Shoot initiation in MS (plates 3): Shoot Elongation (plates 4): Initiation of multiple shooting (plates 5): Shoot multiplication (plates 6): Rooting (plates 7): Hardening (plates 8).

Sugarcane Tissue Culture and Covid-19

Plant Tissue Culture is a technique of growing cells, tissues or organs in sterilized nutrient media under controlled aseptic conditions. The plant material to be cultured may be cells, tissues or plant organs such as excised root tip, shoot tip, shoot bud, leaf petiole, florescence, anther, embryo, ovule or ovary while in sugarcane uppermost shoot tip are using. Since the COVID-19 virus outbreak in December 2019, the disease has spread to almost all countries around the globe with the World Health Organization declaring it a public health emergency. The global impacts of the corona virus disease 2019 (COVID-19) has been already starting to be felt, and will significantly affect the Plant Tissue Culture market during 2020. COVID-19 has affected the global economy in three main ways: by directly affecting production and demand, by creating supply chain and market disruption, and by its financial impact on firms and financial markets. The outbreak of COVID-19 has brought effects on many aspects, like flight cancellations; travel bans and quarantines; restaurants closed; all indoor events restricted; over forty countries state of emergency declared; massive slowing of the supply chain; stock market volatility; falling business confidence, growing panic among the population, and uncertainty about future.

Advantages

The rate of multiplication is enormous which ensures rapid spread of newly released varieties. True- to-type, healthy, uniforms, disease and pest free plantlet are produced within shorter time. So, spread of disease and pests through indiscriminate movement of seed can be totally eliminated easily and availability throughout the year. The vigour of the varieties is regained to its original level, thus improving cane yield and quality .Old degenerated varieties can be renovated to ensure higher production. High yielding better quality soma clones can be developed.

Stages of Micro Propagation

Stage I - Establishment of shoot cultures: Sterilization of the materials and inoculation. Actively growing shoots are collected from 4-5 months old field grown healthy plants, treated with detergent, 70 per cent ethyl alcohol for one minute and rinsed with sterile water. The material is treated in solution containing 10% sodium hypochlorite and covered immediately with aluminium foil and shaken vigorously for 20 minutes. The apical meristem is excised with the help of a sterile sharp blade and immediately placed on a filter paper support immersed in the shoot apex medium. The cultures are incubated at 250 C and under 16 hours of light.

Stage II - Multiplication of shoots: After 45-60 days depending on the growth of the meristem, the material is transferred to multiplication medium. After 45 days new shoots will arise from the axils of the developing shoots. These are separated in small groups and transferred to fresh medium.

Stage III - Rooting of shoots: This stage involves the induction of roots in vitro by transferring the well grown plants into rooting medium. A group of 4 - 5 plants can be kept in culture tubes containing the medium. The roots are formed within 15-20 days.

Stage IV - Hardening: Plantlets with well-developed roots are planted in polybag containing mixture of sieved sand, silt and farmyard manure in a 1:1:1 ratio. The plats are kept in shade by covering with polythene sheet for two weeks until the first new leaf emerge and given to improve initial growth. The plants will be ready for field planting after 45-55 days. Canes are ready for harvest at 6 to 8 months for seed purpose.

Stages for Soma Clonal Variation

Stage I - Initiation of callus: Actively growing shoot tips are collected from field grown healthy plants, treated with detergent 70% Ethyl alchohal for one minute and rinsed with sterile water. The material is treated in solution containing 10% calcium hypoclorite for 20 minutes. the meristmetic portion of leaves are excised 2 to 3 mm size for inoculation on MS medium supplemented with 5.0 mg/ litre 2-4,D for callus initiation.

Stage II - Regeneration of shoots: A Regeneration medium with very low auxin and high ratio of cytokinin is added to MS medium for regeneration from callus.

Stage III - Rooting of shoots: Same as above.

Stage IV – Hardening: Same as above.

Stage V - Evaluation of plants.

Hardened plants are evaluated for yield and quality improvement, insect-pests and disease resistance. Soma clones with novel chrematistics are selected and subjected to multi-locational trials for further evaluation. Superior varieties are selected and released as a variety for commercial cultivation.

Field management of tissue culture plants:
1. For transplanting tissue culture seeding an intra-row spacing of 45 am and inter-row spacing of 90 cm is optimum.
2. A pit of 10 cm depth and 10 cm diameters is generally advised for the tissue culture plants and one/pit.
3. Weedicide Atrazine 1.7 kh/ha should be sprayed in the furrows before planting to control weeds.
4. Super phosphate should be applied before planting (75kg/ha).
5. The polythene bag surrounding the soil has to be removed without disturbing the mass of the soil mixture and placed in the pit and covered with the soil.
6. Irrigation to tissue culture plants in the field should be done once in three days still it is established.
7. The crop should be top dressed with N (280kg/ha) and K (120kg/ha) in split doses at 30 days, 60 days, and 90 days after transplanting.
8. Care should be taken not to injure or damage the plants while fertilizer application, weeding or earthing up.
9. Final earthling up should be done at 90-100 days after planting. Delay in this operation results in profuse tillering with thinner canes resulting in poor growth.
10. For early shoot borer chloropyriphos 4 ml/I or Lindane granules can be applied.

Conclusion

This system can be initially utilized to produce breeder seed in sugar factories. Foundation and certified seed can be produced from the meristem multiplied plants through vegetative cutting. If properly implemented it will be possible to obtain improved cane yield and increased sugar production by introducing the newly identified varieties at shorter interval as and when they are released. Though the cost of soma clones becomes a concern for commercial planting, for efficient and economic use of micro propagation, for expansion of sugarcane varieties it is suggested to use micro propagation initially to produce a sizable quantity of breeder seed cane and subsequent multiplication can be done by conventional planting(Sett planting) to raise foundation and certified seeds.

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A Note on Hypermetamorphosis

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Introduction

Hypermetamorphosis is a form of complete insect metamorphosis or holometaboly in which at least one of the instars in the life cycle differs considerably from the others. Two broad categories of hypermetamorphosis can be recognized in insects viz., type-I hypermetamorphosis and type-II hypermetamorphosis.

Type I Hypermetamorphosis

In this case, adult females do not oviposit directly at the larval feeding site; instead, the first instars must find the food source. Such larvae are active, slender, and well-sclerotized. Eg: Strepsiptera (all groups), Neuroptera (Mantispidae), Coleoptera (several families), Diptera (Bombyliidae).

Type II hypermetamorphosis

In this case of hypermetamorphosis the oviposition and larval feeding sites do not differ. But, the first instar (sometimes the second as well) individual has a distinctive morphology. Eg: Several families of parasitic Hymenoptera and in the Lepidopteran family (Gracillariidae, Phyllocnistidae).

I Type I Hypermetamorphosis

1. S.N: *Fulgoraecia cerolestes* (Kirkpatrick, 1957).
Fa: Epipyropidae.
Or: Lepidoptera.

Habitat	Egg	Larva I	Larva II, Larva III	Pupa	Adult
Ectoparasitic way of life	The eggs are laid, in batches of 200 to 400, on the trunks of trees frequented by the host insects	The first-instar larva of the parasitoid is a very active planidium type, which rely largely on chance to find a host (*Metaphaena*)	The legs becoming much reduced and the body covered with white wax. It does not leave the host (*Metaphaena*) fully grown when it looks much like a large mealybug.	*Fulgoraecia* makes a waxy cocoon and pupates on the tree-trunk	Adults of these bugs are found on the tree-trunks, where they occur in small colonies

2. S.N: *Mantispa* Sp. (Comstock, 2009).
Fa: Mantispidae.
Or: Neuropter.

	Egg	Larva I	Larva II	Pupa	Adult
Habitat The larvae of *Aleochara* species are solitary ectoparasitoids of Cyclorrhaphous Diptera	Female *Mantispa* kept eggs in confinement. These eggs were rose-red in color, and fastened	The young larva (planidia) are campodeiform and they find their way into the egg-sacs of the above-named	Here they feed upon the young spiders; and the body becomes proportionately thicker and changed into is scarabaeiform	It then spins a cocoon, and changes to a pupa within the skin of the larva	Adults eat small insects

	upon stalks, like the eggs of *Chrysopa*	spiders (Lycosidae)			

II Type II Hypermetamorphosis

1. S.N: *Phyllocnistis citrella* (Kernasa et al., 2008).
Fa: Lepidoptera.
Or: Phyllocnistidae.

	Egg	Larva-(1-3)	Larva-4 (Pre-pupa)	Pupa	Adult
Habitat	*P. citrella* usually lay a single egg on the young citrus leaves, mainly near the midrib and also, on the leaf blade.	Sap-sucking stage possessing a flattened, apodal body. Legs were reduced and prolegs were absent and had scissor-like mouthpart.	The fourth instar became a prepupa that was a spinning stage by changing to a cylindrical body with spinneret mouthpart.	pupal chamber made of a cocoon of silk and folding over the leaf edge (obtect form).	Adults of the microlepidopteran *P. citrella* usually emerged from evening to dawn but sometimes occurred at noon.

2. S.N: *Phyllonorycter blancardella* (Body et al., 2014).
Fa: Gracillariidae
Or: Lepidoptera.

	Egg	Larva-1, Larva-2, Larva-3	Larva-4, Larva-5	Pupa	Adult
Habitat	lay eggs on the lower surface of green apple tree leaves in random locations	Fluid feeders (have a triangle prognathous, elongated and dorsoventrally flattened head)	Tissue feeders (have a more rounded (cylindrical) and shorter (relative to its body length) head and which is not as dorsoventrally compressed)	Resting phase	Active phase

Conclusion

The hypermetamorphosis is the important character in most of the insect's group to show their different habit and habitat. This phenomenon would help the insect to thrive well in the dearth conditions. There is a lot of scopes to work related to the evolution of the hypermetamorphosis in the understudied insects.

Acknowledgment

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Impact of Crop Domestication on Tritrophic Interactions

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Introduction

Crop domestication is the process of innately selecting plants to largen their suitability to human requirements. There is number of evidence that crop domestication can extremely alter interactions among plants, herbivores and their natural enemies. In general, domesticated crop plants represents better physical traits, simpler morphologies, altered nutritional content and reduced plant defenses compared with their wild ancestors. Given that the traits of domesticated crops have standup from artificial selection rather than natural selection, these domesticated crop phenotypes are likely to be ecologically representing good characters with respect to species at higher tropic levels. A key question, then, is to understand how domestication has shaped plant traits and how, in turn, these plant traits may influence species interactions in agriculture.

Crop domestication Effects on Tritrophic Interactions

Crop domestication is believed to alter the outcome of plant–herbivore interactions through a number of evolutionary mechanisms.

The genetic makeup of plants mainly changes during domestication by hybridization, change in reproductive strategies and increases in ploidy level as these changes have complex consequences for the expression of plant traits. Humans usually select traits that has major impact on defense and anti-nutritive secondary metabolites or physical structures that make handling difficult (Rosenthal, 1997). Major impact will be on the morphological characters.

Morphological Traits

Domesticated crops tend to differ from their wild progenitors in morphological traits. For example:

Enlargement of plant structures: Domesticated sunflower increases its flower size from domestication is positively correlated with landing and egg laying effort of female sunflower moths, *Homoeosoma electellum*, but increased seed size will have less accessibility to parasitoid *H. electellum* larvae. Hence, selection for gigantism may interfere with natural control and domesticated sunflower moths, *Homoeosoma electellum* will have enemy free environment. (Chen, 2003).

Decreased Branching and Tillering

Crop domestication mainly focus on simplification of plant architecture, with reduced branching and tillering in order to get higher yields. As domesticated plants possess reduced branching and tillering more chance will be there for herbivory attack. More tillering and branching nature of wild rice used to have high densities of lycosid spiders when compared to domesticated rice.

Other Morphological Traits

Domestication has reduced tissue toughness, trichome density, and enhances tissue palatability to most of crop plants; all of these changes usually easier herbivore access to plant structures which interims give a chance to develop the insect herbivore faster. For example, a decline in leaf toughness in maize associated with domestication usually have high ovipositional preference by the specialist corn leafhopper, *Dalbulus maidis*. Also, the long-horned borer *Dectes texanus* can chew more easily on the leaf petiole of domesticated sunflowers than on the leaf petiole of wild sunflowers, enabling it to oviposit more frequently and more easily into leaf holes on the former. In addition, wild sunflowers exude more resinous substance than do domesticated sunflowers, which helps to protect wild plants from *D. texanus* (Michaud and Grant, 2009).

Insect herbivores with different feeding techniques might differ because of change in phenology and morphology of domesticated crop plants. For example, stem-boring species usually more affected due to change in plant architecture and organ enlargement in contrast leaf-feeding and sap feeding herbivores may be more affected by changes in nutrient quality. Plant resistance levels can increase its intensity in response to herbivory; so-called herbivore-induced defences are well documented. Domestication may reduce the degree of production of induced defences or have no effect.

Even though crop domestication has clearly conferred herbivore growth and abundance, the effects on the performance and abundance of natural enemies are less clear. Some studies states that parasitoids are more likely to survive and have better performance on herbivores feeding on domesticated crops. However, many studies have been carried out exclusively under laboratory conditions, so it is unclear how increased parasitoid performance on domesticated crops may impact on pest control, especially because other factors may influence natural enemy impact in the field. For example, parasitoid performance in the laboratory is not necessarily correlated with parasitoid performance in the field. Domestication can also negatively affect host foraging behaviour, location and easy access.

Conclusion

Crop domestication has long been validated as a valuable model for understanding evolution. Humans have imposed strong directional selective pressures on crops, providing a unique opportunity to understand how those selective pressures can influence other aspects of plant ecology, such as interactions with herbivores. Recent years have seen considerable advances in technologies such as high-throughput plant phenotyping and comprehensive metabolomics that hold considerable promise for addressing which plant traits are most affected by domestication and how they are related to herbivore resistance. Continued work in this area can provide theoretical insight into the complex dynamics of evolutionary processes involving humans and other organisms as well as a practical understanding of how evolutionary ecology shapes the food systems that sustain our lives.

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Bio-Control Potential Under Protected Cultivation

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Introduction

Among several components of IPM, bio-control is one of the most important components, especially under protected cultivation. The main problems of pesticide use under protected cultivation are 3 R's, i.e. resistance, resurgence and residue. The reason that necessitates the use of bio-control in greenhouse crops is that the pests in the greenhouse are more likely to develop resistance to chemicals when applied over long periods. In addition, crops are harvested frequently in close intervals, and thus intensive use of chemicals becomes questioned due to possible contamination of chemicals with residues. Furthermore, most of the greenhouse vegetables are consumed fresh, which becomes another main motivation to use fewer chemicals or otherwise bio-control agents for pest management. Thus, the bio-control has the solution for it. Bio-control involves the utilization of predators, parasitoids and pathogens as the antagonists of insect pests and mites. The bio-control is more promising because of low cost, effectiveness, eco-friendly and offers permanent results.

The protected cultivation environments are most suitable for the build-up of insect pests especially sucking pests as well it is most suitable for the use of bio-control agents because it is a closed system that acts as a barrier. In addition, inside protected cultivation structures, we can control the environment which is suitable for the establishment of natural enemies. In Agro-ecosystems, several natural enemies of pests are found but only a few among them are most promising.

The use of biological control in protected cultivation dates back earlier to the second World war with the use of whitefly parasitoid *Encarsia formosa* Gahan (Hymenoptera: Aphelinidae). The development of resistance to organic insecticides by the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), was observed in the early 1950s. this opened up the window for the research on utilization of bio-control under protected cultivation, such as the application of Phytoseiid mite, Phytoseiulus persimilis Athis-Henriot (Acari: Phytiseiidae) which is an effective predator of *T. urticae.*

Potential of Biocontrol Agents in Greenhouse Condition

Hussey and Parr (1965) studied the control of *Tetranychus urticae* Koch. on cucumber by the release of predatory mite *Phytoseiulus riegeli* Dosse. After 32 days of the introduction of *P. riegeli* Dosse., it checked the active *T. urticae* Koch. completely and within 17 days it was spread to all the leaves of greenhouse cucumber. Despite of variation in the prey population complete control of *Tetranychus urticae* Koch. achieved in 30 days.

Efficacy Assessment of *Aphidius colemani* Viereck for suppression of *Aphis gossypii* Glover in greenhouse-grown chrysanthemum was compared with a pesticide standard, imidacloprid and an untreated check. No significant differences were found between aphid populations in the two treatments, *A. colemani* Viereck and imidacloprid, kept aphid numbers very low in contrast to the exponential growth of aphid populations observed on the untreated plants (Vasquez *et al*, 2006).

Sanchit and Shukla (2016) studied the feeding potential of phytoseiid predatory mite, *Amblyseius longispinosus* (Evens) spider mite, *Tetranychus urticae* Kochat. The results showed that During the entire life period the male predatory mite consumed 48.07±3.48, 23.43±1.34 and 16.03±1.09 eggs, mixed stages and adults, respectively. The findings indicated the potential of phytoseiid *A. longispinosus* (Evens) for its release to give the best control of two-spotted red spider mite, *T. urticae* Kochat. under greenhouse conditions.

Conclusion

The use of biological control against insects and mite pests in protected cultivation has proven to be both effective and reliable. Studies show the advantages of biocontrol over chemical control. For this reason, it is expected that pest control in the greenhouse will increasingly rely on biological control. Emerging challenges like the introduction of pests in new areas through invasion, conservation of natural enemies, exploration of new potential natural enemies, standardization of release methods, cost-effective mass rearing methods and relationship among the natural enemies need to addressed to provide solutions to pest problems in greenhouse crops to serve public awareness on enhanced sustainability in food production.

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Role of Crop Residue Management and Conservation Agriculture in Sustainable Agriculture

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Abstract
India is an agriculture-based country producing more than 500 million tons of crop residues per year. The residues are generally burnt in the field after harvesting of crops and that affects the air quality, leads to nutrient loss, degrades soil properties. In this present situation, agriculture have to sustainably produce more food from less land through more efficient and optimum use of natural resources with minimal impact on environment. Conservation agriculture with proper residue management have to be widely promoted as a practice to maintain or improve soil quality and enhance crop productivity to meet growing population demand.

Introduction
Conservation agriculture (CA) is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with sustained production and soil quality (Scopel et al. ,2013). Conservation agriculture is characterized by three interlinked principles, namely continuous minimum mechanical soil disturbance, permanent organic soil cover and diversification of crop species grown in sequence or associations (FAO, 2015). Farm Mechanization particularly use of combine harvesters, decrease in no of livestock and non-availability of alternate viable way- out, farmers are generally burning the residues leads to release of soot particles and smoke which causes health hazards and air pollution (H.S. Gupta et al. , 2012).

Karlen et al. (1994) showed that normal rates of residue when combined with zero-tillage gave better soil surface aggregation. Soil microbial biomass (SMB) has generally been used to assess below-ground microbial activity and is a sink and source for plant nutrients. Different amendments such as residues and manures increase while burning and removal of residues reduce SMB (Doran 1980; Collins et al. 1992; Angers et al. 1993; Heenan et al. 2004; Alvear et al. 2005).

Sustainability of Conservation Agriculture
The resource conservation technologies including no or minimum tillage, direct seeding, bed planting and crop rotation and diversification with leguminous crop with proper residue management are the possible alternatives to conventional agriculture which is highly energy and input intensive. Under this present scenario, efficient and proper use of crop residue with conservation agriculture should be implemented to enhance the environmental and economical sustainability.

Constraints of Using Crop Residue with Conservation Agriculture
1. Difficulties in sowing and application of fertilizer and more precisely placement of nutrients, herbicides, irrigation.

2. Large number of chemical herbicides are used for weed control which affects the environmental sustainability.

3. Specialized equipment and management skills are required. Farmers prefers good looking tilled- fields instead of shabby looking fields. Inspire of these constraints, Gupta et al.(2007) found that the application of crop residue for three years not only increased availability of P and K in soil over straw burned but also crop residues can lower the P sorption capacity and enhance nutrient availability. Again et al. (2013) assess the effect of residue management practices on productivity and profitability of rainy-season pearl millet followed by winter-season crops viz. wheat, chickpea and mustard and concluded that pearl millet should be followed by chickpea/mustard along with residue retention of crops/Leucaena twigs for higher productivity and profitability under zero-till dryland conditions of North-Western India.

Managing Crop Residues Under Conservation Agriculture

Conservation agriculture with three main interrelated principles is a viable option for sustainable agriculture and also helps to check land degradation (Kassam,2011).
1. Minimum mechanical soil disturbance.
2. Use of cover crops to protect the soil surface, enhance organic matter and promotes soil biological activity.
3. Diversification of crops and crop rotations.

Crop residues can be used for compost making. It can be used as bio fuel and bio oil production, biochar production. In the process of bio- methanation and gasification crop residues can be utilised. The RCTs with new technologies in residue management avoid burning of straw, increase soil organic carbon and input efficiency and also have the potential for reducing GHGs emissions (Pathak et al. 2011).Fixed or permanent crop cover with recycling of crop residues is a pre-requisite and integral part of conservation agriculture. However, sowing of a crop in the presence of residues of preceding crop is a problem. But new variants of zero-till seed-cum-fertilizer drill/planters such as Happy Seeder, Turbo Seeder and rotary-disc drill have been developed for direct drilling of seeds even in the presence of surface residues (loose and anchored up to 10 t/ha). These machines help managing crop residues for conserving moisture and nutrients as well as controlling weeds in addition to moderating soil temperature.

Burning of residue not only increases mineralisation but also depletes organic matter from the soil, that's why plants in CA either left over or killed for decomposition in situ. This practice protects soil from erosion, weathering and helps in moisture conservation (Theirfelder and wall 2009). Minimum soil disturbance and soil cover increase soil carbon storage (corbeels et al. 2006). Residue cover can influence weed emergence and weed biomass production by altering soil moisture, competition for light and food material and allelopathic effect (Chauhan et al.).

Keeping crop residue in field has positive as well as negative effects, researchers should develop innovative strategies for enhancement of positive effects (Kumar and Goh 2000).In eastern India, where crop residue is used as livestock feed, roof thatching and domestic fuel, instead of that some parts of stubble should be left in the fields which enhanced the crop Development of complete package and practice for conservation agriculture in agro-ecological region and IPM is helpful for sustainable agriculture.

Conclusion

For ensuring our country's food security both in short and long run and making agriculture sustainable, the soil resource base should be strong enough and healthy also. Conservation agriculture with crop residues as an integral component, is an effective solution. The optimal amount of surface residue in the practice of conservation agriculture will depend on the type of constraints to crop production. All stakeholders including farmers should understand the full potential of crop residues and other valuable resources for sustainability and resilience of Indian agriculture. Proper and efficient management of crop residues in conservation agriculture leads towards sustainable agriculture by soil health improvement, biodiversity enhancement, reduced GHGs emission and improved use efficiency of inputs.

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Role of Enzymes in Maintaining Soil Health

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Introduction

Enzymes are the vital activators in life processes, likewise in the soil they are known to play a substantial role in maintaining soil health and its environment. The enzymatic activity in the soil is mainly of microbial origin, being derived from intracellular, cell-associated or free enzymes. A unique balance of chemical, physical, and biological (including microbial especially enzyme activities) components contribute to maintaining soil health. Evaluation of soil health therefore requires indicators of all these components. Healthy soils are essential for the integrity of terrestrial ecosystems to remain intact or to recover from disturbances, such as drought, climate change, pest infestation, pollution, and human exploitation including agriculture. Deterioration of soil, and thereby soil health, is of concern for human, animal, and plant health because air, groundwater, and surface water consumed by humans, can be adversely affected by mismanaged and contaminated soil. As soil is the part of the terrestrial environment and supports all terrestrial life forms, protection of soil is therefore of high priority and a thorough understanding of soil enzymes activities is a critical factor in assuring that soil remains healthy. A better understanding of the role of this soil enzymes activity in maintaining the soil health will potentially provide a unique opportunity for an integrated biological assessment of soils due to their crucial role in several soil biological activities, their ease of measurement, and their rapid response to changes in soil management. Although there have been extensive studies on soil enzymes, little has been reported on their roles in maintaining soil health.

Soil Enzymes

Soil enzymes are a group of enzymes whose usual inhabitants are the soil and are continuously playing an important role in maintaining soil ecology, physical and chemical properties, fertility, and soil health. These enzymes play key biochemical functions in the overall process of organic matter decomposition in the soil system. They are important in catalysing several vital reactions necessary for the life processes of micro-organisms in soils and the stabilization of soil structure, the decomposition of organic wastes, organic matter formation, and nutrient cycling, hence playing an important role in agriculture. All soils contain a group of enzymes that determine soil metabolic processes which, in turn, depend on its physical, chemical, microbiological, and biochemical properties. The enzyme levels in soil systems vary in amounts primarily due to the fact that each soil type has different amounts of organic matter content, composition, and activity of its living organisms and intensity of biological processes.

Kind of Soil Enzymes

1. Constitutive: Always present in nearly constant amounts in a cell (not affected by addition of any particular substrate – genes always expressed).
2. Inducible: Present only in trace amounts or not at all, but quickly increases in concentration when its substrate is present. (Amidase) Both types of enzymes are present in the soil.

Importance of Soil Enzymes

Release of nutrients into the soil by means of organic matter degradation Identification of soils Identification of microbial activity Importance of soil enzymes as sensitive indicators of ecological change.

Application of Soil Enzymes

Correlation with soil fertility Correlation with microbial activity Correlation with biochemical cycling of various elements in soil (C, N, S) Degree of pollution (heavy metals, SO4) To assess the successional stages of an ecosystem Forensic purposes Rapid degradation of pesticides Disease studies Enzyme activity in soil fluctuates with environment.

Soil Health: The definition of soil health must be broad enough to encompass the many functions of soil, e.g., environmental filter, plant growth, and water regulation. Definitions of air and water quality standards have existed for a long time, while a similar definition does not exist for soil. A definition of soil health based on this concept would encompass only a small fraction of the many roles soil play. Soil health is the net result of on-going conservation and degradation processes, depending highly on the biological component of the soil ecosystem, and influences plant health, environmental health, food safety, and quality. Several definitions of soil health have been proposed during the last decades. Historically, the term soil quality described the status of soil as related to agricultural productivity or fertility. In the 1990s, it was proposed that soil quality was not limited to soil productivity but instead expanded to encompass interactions with the surrounding environment, including the implications for human and animal health.

1. The continued capacity of soil to function as a vital living system, within the ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal, and human health.

2. Soil health is an assessment of ability of a soil to meet its range of ecosystem functions as appropriate to its environment.

3. Soil health can also be defined as the continued capacity of a specific kind of soil to function as a vital living system, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, to maintain or enhance the quality of air and water environments, and to support human health and habitation.

Interpretation of Soil Health

Different soils will have different benchmarks of health depending on the "inherited" qualities, and on the geographic circumstance of the soil. The generic aspects defining a healthy soil can be considered as follows "Productive" options are broad Life diversity is broad Absorbency, storing, recycling, and processing is high in relation to limits set by climate Water runoff quality is of high standard Low entropy No damage to or loss of the fundamental components This translates to A comprehensive cover of vegetation Carbon levels relatively close to the limits set by soil type and climate Little leakage of nutrients from the ecosystem biological productivity relatively close to the limits set by the soil environment and climate Only geological rates of erosion No accumulation of contaminants The ecosystem does not rely excessively on inputs of fossil energy An unhealthy soil thus is the simple converse of the above.

Indicators of Soil Health

Microorganism as Indicators of Soil Health: The biological activity in soil is largely concentrated in the topsoil, the depth of which may vary from a few to 30 cm. In the topsoil, the biological components occupy a tiny fraction (<0.5%) of the total soil volume and make up less than 10% of the total organic matter in the soil. These biological components consist mainly of soil organisms, especially microorganisms. Despite of their small volume in soil, microorganisms are key players in the cycling of nitrogen, sulphur, and phosphorus, and the decomposition of organic residues. Thereby they affect nutrient and carbon cycling on a global scale. That is, the energy input into the soil ecosystems is derived from the microbial decomposition of dead plant and animal organic matter. The organic residues are, in this way, converted to biomass or mineralized to CO_2, H_2O, mineral nitrogen, phosphorus, and other nutrients. Microorganisms are further associated with the transformation and degradation of waste materials and synthetic organic compounds. In addition to the effect on nutrient cycling, microorganisms also affect the physical properties of the soil. Production of extra-cellular polysaccharides and other cellular debris by microorganisms help in maintaining soil structure as well as soil health. Thereby, they also affect water holding capacity, infiltration rate, crusting, erodibility, and susceptibility to compaction (Elliott et al. 1996).

Soil Enzymes as Indicators of Soil Health

Enzymes are the direct mediators for biological catabolism of soil organic and mineral components. Thus, these catalysts provide a meaningful assessment of reaction rates for important soil processes. Soil enzyme activities are often closely related to soil organic matter, soil physical properties and microbial activity or biomass, changes much sooner than other parameters, thus providing early indications of changes in soil health, and involve simple procedures. In addition, soil enzyme activities can be used as measures of microbial activity, soil productivity, and inhibiting effects of pollutants.

Potential Roles of Soil Enzymes in Maintaining Soil Health

A number of soil enzymes and their respective roles in maintaining soil health are stated below:

1. Amylase: The starch hydrolysing enzyme amylase is known to be constituted by a-amylase and b-amylase. The a-amylases are synthesized by plants, animals, and microorganisms, whereas, b-amylase is synthesized mainly by plants. This enzyme is widely distributed in plants and soils so it plays a significant role in the breakdown of starch, which converts starch like substrates to glucose and/or oligosaccharides and b-amylase, which converts starch to maltose. Studies have, however, indicated that the roles and activities of a-amylase and b-amylase enzymes may be influenced by different factors ranging from cultural practices, type of vegetation, environment and soil types (Pancholy and Rice 1973; Ross 1975).

2. Arylsulphatases: This is due to the fact that certain proportions of sulphur in different soil profiles are bound into organic compounds and are indirectly available to plants. Arylsulphatases are typically widespread in nature as well as in soils. They are responsible for the hydrolysis of sulphate esters in the soil and are secreted by bacteria into the external environment as a response to sulphur limitation. Its occurrence in different soil systems is often correlated with microbial biomass and rate of S immobilization. This enzyme has a role in the hydrolysis of aromatic sulphate esters (R–O–SO3_) to phenols (R–OH) and sulphate, or sulphate sulphur. Soil is affected by various environmental factors (Burns 1982) such as heavy metal pollution ; pH changes in the soil solution ; organic matter content and its type ; such as absorption to particles surfaces in soils, and the activity persistence of extra cellular arylsulfatases in the soil. Considering the importance of S in plant nutrition, a better understanding of the role(s) of arylsulfatases in S mobilization in agricultural soils is critical. So far, very little is known about specific microbial genera or species that play an important role in the soil organo sulphur circl in which arylsulphatases is the key enzyme.

3. b-Glucosidase: Glucosidase is a common and predominant enzyme in soils. It is named according to the type of bond that it hydrolyses. This enzyme plays an important role in soils because it is involved in catalyzing the hydrolysis and biodegradation of various b-glucosidase present in plant debris decomposing in the ecosystem. Its final product is glucose, an important C energy source of life to microbes in the soil. b-glucosidase is characteristically useful as a soil quality indicator, and may give a reflection of past biological activity, the capacity of soil to stabilize the soil organic matter, and can be used to detect management effect on soils. This has greatly facilitated its adoption for soil quality testing. Some of the a glycons are known to be the precursors of the toxic substances, which cause soil sickness where plants are grown as monocrops. b-Glucosidase enzyme is very sensitive to changes in pH, and soil management practices.

4. Cellulases: Cellulose is the most abundant organic compound in the biosphere, comprising almost 50% of the biomass synthesized by photosynthetic fixation of CO_2. Growth and survival of microorganisms important in most agricultural soils depends on the carbon source contained in the cellulose occurring in the soils. However, for carbon to be released as an energy source for use by the microorganisms, cellulose in plant debris has to be degraded into glucose, cellobiose and high molecular weight oligosaccharides by cellulases enzymes, Cellulases are a group of enzymes that catalyse the degradation of cellulose, polysaccharides built up of b-1,4 linked glucose units. It has been reported that cellulases in soils are derived mainly from plant debris incorporated into the soil, and that a limited amount may also originate from fungi and bacteria in soils. Demonstrating the effects of increasing concentrations of fungicides on cellulases activities, Petker and Rai (1992) showed that there was a decreasing effect with fungicides captan, cosan, thiram, zinels, and sandolex.

5. Chitinase: Chitinase or chitinolytic enzymes are key enzymes responsible for the degradation and hydrolysis of chitin (polyb-1-4-(2-ncetamido-2-deoxy)-D-glucoside). They are also considered as the major structural component of many fungal cell walls that use the hyperparasitism mechanisms against pests/pathogen attack. These biological agents also reduce disease-producing agents by using other mechanisms such as antibiosis or competition mechanisms. This agriculturally important enzyme is produced or released by various organisms including plants and microorganisms. Its presence in different forms in the ecosystem has demonstrated its effectiveness in the control of soil-borne diseases such as *Sclerotium rolfsii* and *Rhizoctonia solani* in beans and cotton, respectively.

6. Dehydrogenase: The dehydrogenase enzyme activity is commonly used as an indicator of biological activity in soils. This enzyme is considered to exist as an integral part of intact cells but does not accumulate extra cellularly in the soil. Dehydrogenase enzyme is known to oxidize soil organic matter by transferring protons and electrons from substrates to acceptors. These processes are the part of respiration pathways of soil microorganisms and are closely related to the type of soil and soil air-water conditions. Since these processes are the part of respiration pathways of soil microorganisms, studies on the activities of dehydrogenase enzyme in the soil is very important as it may give indications of the potential of the soil to support biochemical processes which are essential for maintaining soil fertility as well as soil health. A study suggested that soil water content and temperature influence dehydrogenase activity indirectly by affecting the soil redox status. After flooding the soil, the oxygen present is rapidly exhausted so that a shift of the activity from aerobic to anaerobic microorganisms takes place.

7. Phosphatases: In soil ecosystems, these enzymes are believed to play critical roles in P cycles as evidence shows that they are correlated to P stress and plant growth. Apart from being good indicators of soil fertility, phosphatase enzyme plays a key role in the soil system. For example, when there is a signal indicating P deficiency in the soil, acid phosphatase secretion from plant roots is increased to enhance the solubilization and remobilization of phosphate, thus influencing the ability of the plant to cope with P-stressed conditions. Understanding the dynamics of enzyme activities in these systems is crucial for predicting their interactions as their activities may, in turn, regulate nutrient uptake and plant growth, later on, where soil health is concerned.

8. Proteases: Proteases in the soil play a significant role in N mineralization, an important process regulating the amount of plant available N and plant growth. This enzyme in the soil is generally associated with inorganic and organic colloids. The amount of this extra cellular enzyme activity may be indicative not only of the biological capacity of soil for the enzymatic conversion of the substrate, which is independent of the extent of microbial activity, but might also have an important role in the ecology of microorganisms in the ecosystem. There is a need to study the properties and factors affecting naturally occurring enzyme complexes such as those involving protease enzymes in the soil ecosystem as they may reveal some unknown role(s) in maintaining soil health and fertility.

9. Urease: Urease enzyme is responsible for the hydrolysis of urea fertilizers applied to the soil into NH_3 and CO_2 with the concomitant rise in soil pH. This, in turn, results in a rapid N loss to the atmosphere through NH_3 volatilization. Due to this role, urease activities in soils have received a lot of attention since it was first reported by Rotini (1935), a process considered vital in the regulation of N supply to plants after urea fertilization. Soil urease originates mainly from plants and microorganisms found as both intra- and extra-cellular enzymes. On the other hand, urease extracted from plants or microorganisms is rapidly degraded in soil by proteolytic enzymes. This suggests that a significant fraction of ureolytic activity in the soil is carried out by extracellular urease, which is stabilized by immobilization on organic and mineral soil colloids. Urease activity in soils is influenced by many factors.

Conclusion

It is very essential to understand the possible roles of soil enzymes in order to maintain soil health and its fertility management in ecosystems. These enzymes, usually found in the soil, may have significant effects on soil biology, environmental management, growth and nutrient uptake in plants growing in ecosystems. Their activities may, however, be influenced by unknown cultural management practices either in a major or minor amount. Studies focusing the discovery of new enzymes from microbial diversity in the soil might be the most suitable practices that may positively influence their activities for improved plant growth as well as rendering the friendly biological environments in order to sustain other living beings.

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Hydrolytic Soil Enzymes and their Response to Fertilization

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Abstract
Enzymes are proteins that catalyse chemical reactions in living systems, transforming specific substrates into the products needed in biological cycles and for many edaphic processes. Soil enzymatic activities have been proposed as soil quality indicators, due to their relation with soil biology. Although the long-term effects of organic and mineral fertilization on physical and chemical soil properties have been previously studied, little is known about their effects on microbial community structure, microbial biomass carbon, microbial activity and enzymatic activity. Some studies report that organic and mineral fertilizers can affect, be it positively or negatively, microbial biomass size as well as soil microbial activity. This work examines the effect of fertilization on the enzymatic activity of soil hydrolases.

Keywords: hydrolases, mineral fertilizers, organic fertilizers, soil.

Introduction
Enzymes are proteins whose function is to catalyze chemical reactions in living systems. They act on specific substrates, transforming them into products necessary for biological cycles, and participate in many edaphic processes such as organic residue decomposition, humic substance synthesis, nitrification, oxidation, xenobiotic degradation and nitrogen fixation, among others. Enzymes are also related to ecological functions such as biomass production, contaminated soil recovery and ecosystem conservation. Hydrolase, transferase, oxidoreductase and lyase enzyme activity, all of which participate directly in the C, N, P and S cycles, has been detected in soil. Due to their function, oxidoreductases (in particular dehydrogenases, catalases and peroxidase) and hydrolases (phosphatases, proteases and ureases) are the soil enzymes most studied. Organisms and plants release enzymes into the soil by secretion and cellular lysis upon death; a low percentage of these proteins remain immobilized and stabilized in interaction with different components of the soil solid phase, such as clay, organic molecules and organo-mineral complexes. Depending on the components of the soil solid phase, this interaction is caused by mechanisms that include microencapsulation, transversal bonds, copolymer formation, adsorption, capture, ion exchange and covalent bonds. Only a low percentage of the enzymes leaving the cells are stabilized, as they are released into an inhospitable environment where they can be subjected to non-biological denaturalization, adsorption or protease degradation. The highest production of extracellular enzymes is attributed to microorganisms, due to their high metabolic activity and short life cycle, in contrast with other organisms that also release enzymes, such as plants and animals. High correlations have been found between soil microbial activity and enzymatic activity . Enzymes can also originate from organic matter applied to soil. Nutrients from organic fertilizers are released by microbial metabolism, thus making them available to the plants. In contrast, nutrients in mineral fertilizers can be directly acquired by the plant. The application of organic and mineral fertilizers to soil increases the nutrient content, microbial activity, enzymatic activity, humic fraction, soil structure and the ion exchange system. Although the long-term effects of organic and mineral fertilization on physical and chemical soil properties has been previously studied, little is known about the effects on the microbial community structure, microbial biomass carbon, microbial activity and enzymatic activity . Some studies have reported that organic and mineral fertilizers can have an effect, be it positive or negative, on the size of microbial biomass and soil microbial activity. This work examines the effect of fertilization on the enzymatic activity of soil hydrolases.

Factors that Affect Soil Enzymatic Activity
Changes in the physical, chemical and biological composition of soil can affect enzymatic activity. Other factors that can influence soil enzymatic activity are the type of crop and anthropogenic activities such as management practices, contaminating events and the application of agro-chemicals such as fertilizers, pesticides, herbicides, etc. The expression and conservation of soil enzymatic activity can also be modified

naturally by environmental factors such as seasonal changes, geographical location and thermal and hydric soil regimes. Another important aspect of the complexity of soil enzymatic activity is it's in situ distribution; for example, its spatial variability in a soil profile and its location in soil structural fractions. In general, enzymatic activity decreases with soil depth, due to the decline of microbial activity and certain macronutrients such as organic C and organic N.

Complexity in the Quantification of Soil Enzymatic Activity

The methodologies adopted for soil enzyme measurement are not universal and this often creates difficulties when making comparisons. Most investigations regarding quantification of soil enzyme activity are conducted directly by measuring its activity. An enzymatic assay consists of adding a known quantity of soil to a solution containing a standard concentration of a substrate and measuring the rate at which the substrate converts to the product. Enzymatic assays are based in the quantitative evaluation of products released or substrates consumed and do not therefore differentiate between the contributions of intracellular or extracellular enzymes and to the total enzymatic activity. For an enzymatic assay to be reliable and applicable, it must be tested and validated with soils that have different properties. Indeed, the main problems can be due to both the adsorption of substrates or products on the soil particles and the possible interference of elements or compounds present in the soil. Another problem in the quantification of enzymatic activity is the lack of standardization due to the use of diverse procedures, factors such as incubation time and the soil/solution ratio vary notably, according to the method employed. Normally, the determination of diverse soil enzymatic activities is carried out in conditions that guarantee optimal catalysis velocity, that is, optimal pH and temperature, at a substrate concentration in excess and testing conditions that allow the free diffusion of the substrate and facilitate interaction with the enzyme.

Response of Soil Hydrolases to Mineral Fertilization

Changes in the composition and function of the soil microbial community due to agricultural practices can greatly impact the health and productivity of this important natural resource. Some studies reveal that urease activity, an enzyme that catalyses the hydrolysis of urea to $CO2$ and ammonia, decreased in soils with long-term nitrogen fertilization, in comparison with unfertilized soils. The reduction in the activity of this enzyme was attributed to the absorption of mineral N by soil microorganisms, which confirms the hypothesis of that high quantities of ammonia reduce urease activity. Invertase, the enzyme that catalyses the hydrolysis of sucrose to D-glucose and D-fructose, sugars that are important sources of energy for microorganisms; xylanase, the enzyme that hydrolyses xylan to release xylobiose and xylose; and urease activity all diminished in soils fertilized with $NP2O5K$ and copper sulfate ($Cu2SO4$). Mineral fertilization (NPK) increased acid phosphatase activity (phosphatases catalyze the hydrolysis of esters and anhydrides of $H3PO4$ to release inorganic phosphorus, which is assimilable for plants) but diminished alkaline phosphatase activity in soils cultivated with corn. Nitrogen mineral fertilization stimulates phosphatase activity, most likely because phosphatase requires a substantial investment of N, and thus, adding N to the soil increases phosphatase activity. In contrast, P from mineral fertilization in the soil can inhibit phosphatase activity or slow down the synthesis of this enzyme , which is consistent with the idea that phosphatase increases the available reserves of P when this nutrient is limited, and that the addition of P to the soil is an alternative for increasing the availability of this element. Various studies have reported a negative effect of phosphorus fertilization on alkaline phosphatase and acid phosphatase soil activity N×P mineral fertilization combined stimulates phosphatase activity. This occurs if nitrogen fertilization is a stronger control on phosphatase activity than phosphorus fertilization; nitrogen dictates phosphatase production as phosphatase cannot be produced without adequate N supplies. N×P mineral fertilization combined also depresses phosphatase activity. This occurs if the effect of phosphorus fertilization is greater than the effect of nitrogen fertilization; it is not energetically favourable to obtain phosphorus through phosphatase production when inorganic phosphorus is abundant.

Response of Soil Hydrolases to Organic Fertilization

In general, recent incorporations of organic residues can stimulate enzymatic activity as a result of microbial proliferation or enzymatic induction in response to the added residues. Various works have demonstrated that acid phosphatase activity increases as a consequence of organic fertilization and decreases when mineral phosphorus fertilizers are employed. Organic fertilization can increase ß-glucosidase, an enzyme that catalyses the hydrolysis and biodegradation of various ß-glucosidases found in the organic matter, and urease activity. ß-glucosidase, urease, phosphatase and protease (an enzyme involved in the progressive decomposition of the N contained in proteins) activity in soils treated with compost was greater than in soils that were not treated with compost. Likewise, other studies have revealed that the addition of organic fertilizers increases urease activity in soils with different tillage cultivated with wheat. Protease and urease activity were not significantly different between untreated and compost-treated soils. This is most likely due to an elevated NH4NO3 content in the composts that were added to the soil. The addition of organic material to the soil in corn crops favoured invertase, cellulase (the enzyme that decomposes cellulose, the most abundant polysaccharide in plant cellular walls), urease and phosphatase activity.

Response of Soil Hydrolases to Simultaneous Organic and Mineral Fertilization

Urease activity and acid and alkaline phosphatase activity increased when nitrogen and organic fertilizers were added simultaneously to the soil. Urease and alkaline phosphatase activity increased significantly with the addition of compost and mineral fertilizers to the soil. Likewise, the simultaneous application of organic and mineral fertilizers promoted urease and phosphatase activity in soils cultivated with beans. Acid and alkaline phosphatase activity increased in soils cultivated with taro (*Colocasia esculenta)* with the simultaneous application of green composts, ½ NPK and lime. The effect of mineral (NH_4NO_3, P_2O_5 and KCl) and organic (cow manure) fertilizers on ß-glucosidase and acid phosphatase activity in soil cultivated with corn and found that the plots of land treated with organic fertilizers had a higher enzymatic activity than those treated with mineral fertilizers. The effect of 34 years of fertilization with N, NP, NPK, NPK+S and NPK+compost on the enzymatic activity of Typic Haplustepts with a corn-wheat rotation. The results revealed that the NPK+compost treatment had higher acid and alkaline phosphatase activity. The combined application of slow-release mineral fertilizers and compost increases phosphate activity in the rhizosphere of the mezcal maguey (*Agave angustifolia* Haw.). The highest value of invertase activity with simultaneous organic and mineral fertilization in a wheat-soya rotation under seasonal conditions. ß-glucosidase was higher in soils treated with long-term organic fertilization (with or without NPK) in a beet-barley-potato-wheat crop rotation in a Typic Mollisol. ß-glucosidase and alkaline phosphate activity were also higher with the combined application of vermicompost and mineral fertilizer (NPK-100:80:80), in comparison with the activity of these enzymes when the fertilizers were applied individually to soil cultivated with onion. The combined application of organic and mineral fertilizers can increase enzymatic soil activity due to the easily-available, enriched nutrients from mineral fertilization and the high levels of organic material and biological activity promoted by the addition of organic fertilizers. Among the hydrolases, phosphatase activity has been the parameter most often used to estimate changes in soil quality that are due to either management or to the presence of contaminants. With respect to the enzymes involved in the carbon cycle, ß-glucosidase has been the most used to evaluate the quality of soil that has been subjected to different types of management. Urease has also been widely used in the evaluation of management-related changes in soil quality.

Conclusion

Hydrolytic enzyme activity responded to different forms of fertilizers. Organic restitutions stimulate hydrolytic enzymatic soil activity. In contrast, mineral fertilization can inhibit or slow down the synthesis of these enzymes. The combined use of mineral and organic fertilizers generates a greater positive effect on enzymatic activity, due to the easily-available, enriched nutrients from mineral fertilization and the high levels of organic matter and biological activity promoted by the addition of organic fertilizers. The works consulted show that phosphatase and urease activity were the biochemical parameters analysed with the highest frequency to evaluate the effect of fertilization on soil enzymatic activity.

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Commodity Future Trading in India: With Emphasis on Agriculture

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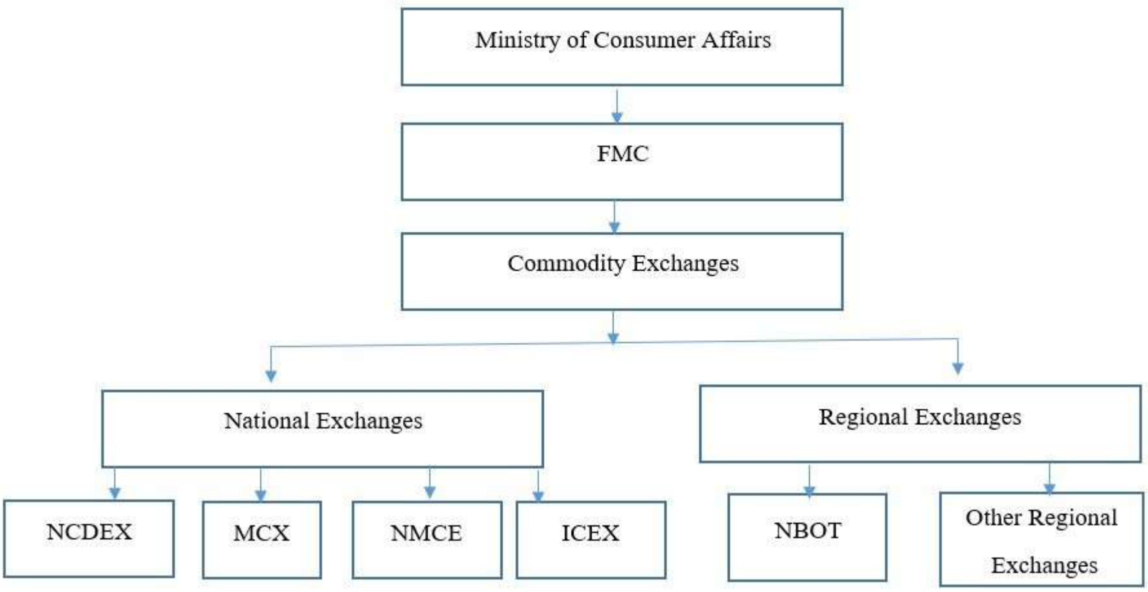
Introduction

Futures are derivative financial contracts that compel the parties to transact an asset at a predetermined future date and price. In this irrespective of the current market price at the expiration date, the buyer must purchase or the seller must sell the underlying asset (physical commodities or other financial instruments) at the previously set price. Futures contracts enlists the quantity of the underlying asset and are standardized to enable trading on a futures exchange. It can be used for hedging or trade speculation. Futures, also called futures contracts allow traders to lock the price of the underlying asset or commodity in advance. These contracts have expirations dates and set prices that are made in advance. Futures are identified by their expiration month.

Structure, Conduct & Current Status

Broadly, there are two types of commodity market i.e., over the counter (OTC) market and the exchange-based market. Further, there exists the spot and the derivatives segments as in equities. Spot markets are basically OTC markets and participation are limited to people who are involved with that commodity, for instance the farmer, processor, wholesaler, etc. Most of the derivatives trading happens through the exchange-based markets with standardized contracts, settlements, etc. The exchange-based markets are generally derivative markets and are analogous to equity derivatives in their working i.e., everything is standardized and a person can have a contract by paying only a percentage of the contract value. However, even though there is a provision for delivery, most of the contracts are squared-off before expiry and are settled in cash. Therefore, one can get an active participation by people who are not connected with the commodity. At current, there are 27 exchanges operating in India and carrying out futures trading activities in as many as 146 commodity items. According to the recommendation of the FMC, the Government of India recognized the National Multi Commodity Exchange (NMCE), Ahmadabad; Multi Commodity Exchange (MCX), National Commodity and Derivative Exchange (NCDEX), Mumbai and Indian Commodity Exchange (ICEX) as national multi-commodity exchanges.

The distinctive structure of commodity futures markets in India is as follows:



Commodities Traded

Metal	Aluminium, Copper, Lead, Nickel, Sponge Iron, Steel Long (Bhavnagar), Steel Long (Govindgarh), Steel Flat, Tin, Zinc
Bullion	Gold, Gold HNI, Gold M, i-gold, Silver, Silver HNI, Silver M
Fiber	Cotton L Staple, Cotton M Staple, Cotton Staple, Cotton Yarn, Kapas
Energy	Brent Crude Oil, Crude Oil, Furnace Oil, Natural Gas, M. E. Sour Crude Oil
Spices	Cardamom, Jeera, Pepper, Red Chilli, Turmeric
Plantations	Arecanut, Cashew Kernel, Coffee (Robusta), Rubber
Pulses	Chana, Masur, Yellow Peas
Petrochemicals	HDPE, Polypropylene(PP), PVC
Oil & oil seeds	Castor Oil, Castor Seeds, Coconut Cake, Coconut Oil, Cotton Seed, Crude Palm Oil, Groundnut Oil, Kapasia Khalli, Mustard Oil, Mustard Seed (Jaipur), Mustard Seed (Sirsa)
Cereals	Maize
Others	Guargum, Guar Seed, Gurchaku, Mentha Oil, Potato (Agra), Potato (Tarkeshwar), Sugar M-30, Sugar S-30

Advantages of Commodity Futures Markets

The authentic price discovery and an efficient price risk management are primary objectives of any futures exchange. Those who trade in the commodities being offered in the exchange as well as those who have nothing to do with futures trading are both beneficiaries. The mechanism of price discovery and risk management through futures exchanges is helping businesses and services to function smoothly.

1. Price Discovery: Based on resources regarding specific market information, the demand and supply equilibrium, market dynamics, expert views and comments, weather forecasts, inflation rates, Government policies, hopes and fears, buyers and sellers conduct trading at futures exchanges. This alters into continuous price discovery mechanism.

2. Price Risk Management: It is an approach of offering price risk that is crucial in spot market by holding an equal but opposite position in the futures market. Futures markets are used as a means by hedgers to guard their business from adverse price change. This could dent the profitability of their business. Hedging benefits those who are associated in trading of commodities like farmers, processors, merchandisers, manufacturers, exporters, importers etc.

3. Import- Export competitiveness: The presence of futures market would permit the exporters to hedge their future purchase by temporarily substituting for actual purchase till the time is ready to buy in physical market. It will be meticulous, time consuming and costly physical transactions in the absence of futures market.

4. Predictable Pricing: The demand for certain commodities is highly price elastic. The producer has to confirm that the prices should be stable in order to protect their market share with the unrestricted entry of imports. Futures contracts will aid predictability in domestic prices.

5. Benefits for farmers/Agriculturalists: Price instability has a direct effect on farmers in the absence of futures market. There would be no requirement to have large reserves to cover against undesirable price fluctuations. This would diminish the risk premiums associated with the marketing or processing margins allowing more returns on produce.

6. Credit accessibility: The absence of proper risk management strategies would fascinate the marketing and processing of commodities to high-risk exposure making it risky business affairs to fund. Even a small movement in prices can cost a massive proportion of capital owned by dealers, at times making it almost impossible to pay back the loan.

7. Improved product quality: The presence of warehouses for providing delivery with grading facilities along with other related assistances provides a very strong motive to upgrade and improve the quality of the commodity to grade that is acceptable by the exchange. It safeguards unvarying standardization of commodity trade, including the terms of quality standards. The quality certificates that are issued by the exchange-certified warehouses have the potential to become the norm for physical trade.

Disadvantages of Commodity Futures Markets

1. No Control over Future Events: There is no control over future events. Natural disasters, unexpected weather conditions, political issues, etc. have potential to disrupt the estimated demand-supply equilibrium.

2. Leverage Issues: High leverage can affect rapid fluctuations of futures prices. The prices can fluctuate daily or even within minutes.

3. Expiration Dates: Future contracts have a certain expiration date. As the expiration date comes nearer, it may happen that contracted prices for the given assets become less attractive. For this reason, sometimes, a futures contract may even expire as an insignificant investment.

Conclusion

Although there are number of considerable amount of arguments for and against the introduction of future contract especially on essential commodities, the significance of such market-based instruments cannot be disregarded in an era of linearization and economic reforms. The only things that need to be assured are the existence of a well-organized spot market and an active risk management and regulatory frame work.

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Hydroponic Feed Value to Livestock Production

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Introduction

Green fodder plays major role in feed of milch animals, thereby providing required nutrients for milk production and health of the dairy animals. Rapid urbanisation and mining areas has caused shrinkage of grazing and fodder producing lands. Due to non-availability of quality green fodder throughout the year, milk producers are forced to utilise extra concentrates for optimum milk production. On account of this cost of milk production is higher in the state as compared to neighbouring states. Non availability of irrigated lands for fodder production, higher labour cost, and small land holdings has left dairy farmer with many challenges for milk production in Goa. It is quite evident that with decreasing cultivable land and depleting natural resources, sustainable technology would be the key driver of the dairy industry in the years to come. Hydroponic green fodder needs suited growing condition for better forage grain germination with short period of time in special growing rooms. Fresh forages are developed from wheat, oat, barely and other grains. Even if there is variation in development of different forage grains, the average fresh forage mat reaches 15 to 30cm height, 7 to 9kg and 0.9 to 1.1kg dry matter. In production of hydroponics there is a recommendation to use water efficiently in semi-desert conditions. Therefore, the aim of this review is to review hydroponics feed value on livestock production. The increase in livestock production demands nutrient requirement to feed animals. Productive and reproductive performance of animals increase through feeding green fodder. Subsequently, feeding green fodder improve livestock products. For instance, provision of hydroponic fodder to dairy animal leads to sustainable economic development of dairy production and it is a fact that deficiency happens if dairy animals feed without including green fodder in their ration.

Hydroponics Technology

It is a science of growing plants in nutrients rich solutions instead of soil and can be efficiently used to take pressure off the land to grow green feed for the livestock. Plants require three things to flourish, water, nutrients, and sunlight. Hydroponics is a straight forward way of providing all these nutrients without the need of soil under controlled environment conditions to optimise the growth of plants. Technology has been tested on various crops as Maize, Sorghum, Barley, Oats for producing high quality of nutritious green fodder for dairy animals. Beside this hydroponics can be used for growing wheat grass, paddy saplings etc in seven days of time for optimum growth. Fodder obtained from hydroponics consists of grass with grains, roots, stem and leaves as compared to only stem and leaves part in conventionally grown fodder.

Advantages of Hyrdoponics

1. Conservation of water: it requires just 2- 3 litres of water to produce one kg of lush green fodder, as compared to 60-80 lts to conventional system of fodder production. Water left over in hydroponics is recycled to grow the fodder.

2. Land: Hydroponics greenhouse requires marginal land to erect the system ie 10 mts x 4.5 mts land for 600 kg green fodder / day/ unit, in comparison to one-hectare land for conventional green grass field. Reduction in the amt of land required for maximum fodder production is an asset for both regions where agriculture is difficult and densely populated areas that lacks sufficient growing space.

3. Reduced labour requirement: In conventional fodder production requires continuous intense labour for cultivation to harvesting of the grass, but in hydroponics labour required is 2- 3 hours / day only.

4. Reduction in growth time of green fodder: To obtain nutritious fodder requires just over 7 days from seed germination to fully grown plant of 25 – 30 cm height. Biomass conversion ratio is as high as 7-8 times to traditional fodder grown for 60-80 days.

5. Green fodder round the year: technology is capable to make provision for the green fodder round the year, as per demand .Constant supply can be organized irrespective of rain, storm, sunshine or drought.

6. Increasing of nutritive value of fodder: through hydroponics it is possible to enhance the nutritive value by adding additional growth promoters, nutrients, etc to have quality milk from the dairy animals.

7. Natural feed for animals: growing of green fodder through Hydroponics is completely by natural source. No pesticides are used in green fodder production that could contaminate milk and milk products.

8. Enhancement of milk production: by providing green fodder to milch animals it can compensate the concentrate feed so as to have economically viable milk producing industry.

9. Minimising loss of fodder: Green fodder produced from hydroponics will be fully utilised as there won't 'be loss of the fodder during feeding as compared to wastages of chopped traditional grasses during consumption by the animal.

Hydroponic Feed Value on Livestock Production

1. Definition of hydroponic feeds: In definition hydroponics comes from two Greek words 'hydro' and 'ponics' which means water and working respectively. This is growing of a plant without soil. It is also called sprouted grain/fodder. It needs a short period to grow and develop in green house under controlled environment. Green house is a media for plant growth with at least partially controlled environmental conditions. However, for operational purpose, the structure/media should be large enough. Development of hydroponic forage is without soil but with the use of water. In green house there is a possibility to use nutrient rich solutions for a short duration. However, this nutrient solution is not a must and only tap water can be used. The fodder is like a mat with probably a height of 20-30 cm consisting of roots, seeds and plants. It is indicated as highly palatable, digestible and nutritious for animals. There is increment in milk production of 8-13% with the use of hydroponic fodder. This is a best alternative technology to use for dairy animals with low cost materials in places where conventional green fodder production is limited.

2. Principles of hydroponic fodder production: Hydroponics is growing of cereal grains with necessary moisture, nutrient and absence of solid growing medium. The sprouted shoot and root mat are harvested and fed to animals. Germination is a response for the supplied moisture and nutrient and produce 200 to 300mm long forage green shoot with interwoven roots within 7 to 10 days. Different cereal grains can be used for fodder production with varied chemical and structural changes throughout the growing processes. Enzyme activation is found necessary for hydrolysis of nutrients to their simpler forms . Grain variety, quality, treatments like nutrient supply, pH, water quality, soaking time etc are influencing factors for the amount of sprouted and quality fodder.

3. Importance of hydroponic feeds: Hydroponics avoids problems shown in conventional methods of fodder production. This is realized through use of mall piece of land with vertical growing process that permits production of a large volume of hydroponic fodder on a fraction of area needed by conventional fodder production and thus increases stocking capacity of livestock. It is indicated that 600kg maize fodder per day is produced in 50 square meters area. However, for a production of the same amount of fodder 1ha of land is required in conventional method of production. Water required for hydroponic fodder production is less due to water recycling activities. Therefore, 1kg of maize hydroponic fodder is produced in 7 days with 1.5 litre (if water is reused) or 3 litres (if water is not reused). The water which is not reused can be utilized for garden near the production unit. For production of around 600kg of hydroponic fodder, only one person suffices. Moreover, fodder can be produced without soil preparation, constant weed removal, fencing, post-harvest loss and per daily requirement. There are also more advantages like production of fodder free of antibiotics, hormones, herbicides or pesticides, no damage from insects which leads to low maintenance requirement.

4. Nutritive value of hydroponic fodders: Hydroponic fodder from cereal grains deviate in their nutrient content. When starch content decrease, both organic matter and dry matter content decreased. Sprouting catabolize starch in to soluble sugar biochemical purpose of the plant. However, ether extract of hydroponic fodder increases due to increment of structural lipids and chlorophyll as the plant grows. There is also increment in linoleic acid concentration with sprouting. Development of structural carbohydrates increases crude fibre, neutral detergent fibre and acid detergent fibres but decreases nitrogen free extract. Sprouting process increase total ash content associate with decrease in organic matter. Root growth which increases the mineral uptake increase the mineral content of the sprout from day four. This ash content increases more as nutrient solution is used than water. Hydroponic fodder show superiorities from common non-leguminous fodders in terms of crude protein, organic matter, ether extract and nitrogen free extracts. However, during sprouting the gross energy, metabolizable energy and total digestible nutrient content decreases. This is due to energy up take during respiration of the plant.

Conventional fodders are less nutritious than hydroponic fodders. Nutrient deviation occurs during sprouting which increase in crude protein, ether extract, nitrogen free extract but decrease in crude fibre, total ash and insoluble ash. In planet earth the most enzyme rich plants are hydroponic fodder sprouts. Enzyme active of the sprouts are at highest level from germination to seven days age. They are rich with anti-oxidants especially in the form of β-carotene . In terms of palatability, hydroponic fodder preforms outshine. There is no nutrients wastage as the shoots and roots of the plant consumed together. Dairy animals take 25kg/day with low concentrate and straw level. Improvement indigestibility of feed is evident with supplementation of hydroponic fodder in dairy cows.

5. Digestibility/Degradability: Even if there is a loss in dry matter content of sprouted barley fodder there is being an advantage in their digestibility. In rumen the digestibility of the sprouts is higher than cracked grain. However, comparing the digestibility of shoot and root sprouts, shoots easily degrade in the rumen. Therefore, ruminant animals prefer leafy than stemmy.

6. Energy: Hydroponic sprouts and processed grains are both nutritious and digestible feeds. Sprouting of grains changes the starch to sugar. On dry matter bases the energy value of sprouts are less than grains with gross energy loss of 2%.

7. Protein: Animal performance is high dependent on critical element which is protein. Thus, there is a need to analyse the feed value of the fodder. In sprouts crude protein, ash and all other minerals except potassium are highly concentrated on a dry matter bases than barley grains. The increase in dry crude protein content is due to loss in dry matter content particularly carbohydrate. Moreover, nutrient absorption also facilitates the metabolism of nitrogenous compounds which lead to increase the crude protein content. Nutrient solutions improve the crude protein level of the hydroponic fodder than using tap water.

8. Vitamins: Hydroponic fodder is especially rich in vitamin C and E. Sprouting improve the vitamin content of the grain. However, the increase in individual vitamins is too small that its practical use in addressing nutritional requirement of cereal-based diets makes little difference on the feed value.

9. Minerals: In hydroponic fodder, root growth helps for mineral up take which in turn changes the ash and protein contents swiftly from day four onwards. Absorption also facilitate metabolism of nitrogenous compounds and thus increase the crude protein level. The type of irrigated water for the hydroponic fodder changes the mineral content. However, through the process of chelating sprouting make minerals more available.

10. Anti-nutritional factor versus hydroponic feed: Seed coat and germ of plant seeds has phytic acid. The main effect of this phytic acid is through forming of insoluble with minerals like calcium, iron which cause ineffective absorption in the blood. In experimental animals, provided a diet with high phytic acid and poor in mineral content lead to mineral deficiency symptoms. Sprouting decrease the level of phytic acid. Moreover, enzymes during germination eliminate other detrimental substances. The digestive enzymes in sprouts help as biological catalysts in protein, fat and carbohydrate digestions. Sprouts have hundred times more enzymes than fruits and thus the physiological activity of vitamins, minerals and trace elements depend on enzyme activity. It is indicated that from germination to seven days, it is the period of greatest enzyme activity of the sprouts. If the cereal grains are away of germination, enzymes remain in active due to the inhibitors. These inhibitors avoid seed deterioration for years. However, inhibitors like trypsin inhibitor in soybeans should be heated, cooked and grinded for inactivation prior to feeding of livestock. Luckily, germination and sprouting also neutralize the inhibitors and enhance the beneficial plant digestive enzymes. Effect of hydroponic feed on livestock productivity.

11. Milk production: Studies on improvement of milk production through hydroponic fodder feeding shows improvement than animals fed cereal grains, hay or silage. Hydroponic fodder increase milk yield by 10.07% in dairy cows. Canadian dairy farmers also indicate the increase in feed intake of their cows after feeding of hydroponic fodder and improve their milk yield by 3.6kg per day over the lactation period.

Moreover, farmers from South Africa reported a drop of 3.6 litres of milk after a leave off of 6.8 kg fed per day.

12. Meat production: Hydroponic fodder improves the body weight fain of lambs. This is realized due to having high bioactive enzymes and ingredients that improve livestock performances. Moreover, the increase in body weight also reflects microbial activity in rumen and enhanced nutrient digestibility. In beef cattle average increase of 200g is achieved through feeding the hydroponic fodder than maize. Similarly, 8% improvement is reported in birds and another animal.

Conclusion

One of the agro-technology which could be developed locally with low cost materials and is more nutritious, palatable and digestible fodder for livestock is hydroponics. Hydroponics is a smart alternative technology against scarcity of land and impeding climate changes. Now a day's several countries are practicing it for their sustainable livestock production. Developing seed culture and new activities in hydroponics reduce production cost and helps for cooperatives to produce and sell. Thus, it is very vital to use hydroponic fodder for livestock which is with low cost and highly nutritive. This technology has a solution to avoid scarcity of green feed special in dry seasons and urban areas having a shortage of land for forage production. Having a characteristic of high intake palatable and digestible properties, this technology is best chosen than cereal grains and other concentrate feeding. Progressive modern farmers can also adapt this technology for their dairy animals to enhance productivity. Therefore, further research and development endeavours should be carried out for its further utilizations.

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Effects of Main Reproductive and Health Problems on the Performance of Dairy Cows

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Introduction

Reproductive efficiency is a critical component of a successful dairy operation and acts as an important component of a profitable dairy farm, whereas reproductive inefficiency is one of the costliest problems facing the dairy industry today. Reproductive problems occur frequently in lactating dairy cows and can dramatically affect reproductive efficiency in a dairy herd.

Some of the most common problems include twinning, dystocia, abortion, stillbirth, retained placenta and metritis. These are diverse disorders that are similar in that they all can result in impaired reproductive function. Deciding whether to breed, treat, or cull dairy cows exhibiting one or more of these reproductive problems is a challenge for both veterinarians and dairy producers.

In addition, there is considerable controversy among dairy scientists and bovine practitioners regarding the economic impact of these problems in a dairy operation and the most effective management or therapeutic intervention for treating them. Because of this controversy, dairy managers should focus on prevention and control of risk factors associated with each problem rather than on prescriptive therapeutic interventions. Dairy producers should work closely with their herd veterinarian to develop such management strategies and discuss appropriate interventions when necessary.

These results, in considerable economic loss to the dairy industry due to slower uterine involution, reduced reproductive rate, prolonged inter-conception and calving interval, negative effect on fertility, increased cost of medication, drop in milk production, reduced calf crop and early depreciation of potentially useful cows. It is very difficult to diagnose those problems by one particular disorder or symptom because there is interrelation between predisposing factors.

Characteristics of the Major Reproductive Problems

1. Abortion: Abortion in dairy cattle is commonly defined as a loss of the fetus between the age of 42 days and approximately 260 days (Peter, 2000). The diagnosis of abortions often presents a challenge to the herd owner and the herd veterinarian. Although a gradual increase in the abortion rate in a herd may be noted over a period of many years, a sudden and dramatic increase is more commonly seen. For this reason, prompt and thorough action is required when abortions do occur.

Abortion is diagnosed and defined as the termination of pregnancy after organogenesis is completed but before the expelled fetus can survive. Abortion is the premature expulsion of the fetus from the dam and usually occurs because the fetus has died in utero. If death occurs at 1 or 2 months of gestation, it is usually termed "early embryonic death." When the fetus in near term and born dead it is often called "stillbirth". This stillbirth could have occurred due to difficult birth and the death of the fetus, or it may have died in utero due to disease and was expelled.

The etiologic diagnosis of abortion in livestock is difficult and often frustrating task, and the diagnosis success rate is relatively low; 30-40% for bovine and numerous factors complicate diagnosis. Often, abortion follows initial infection by weeks or month so that the causative agent is no longer apparent by the time abortion occurs. In general term the cause of abortion is classified in to two groups; infectious and non-infectious such as management at calving, hygiene and parity, stage of gestation, nutrition and environment.

Table 1: The bacterial infections which cause abortion in dairy cattle:

Bacterial Infectious Agent	Time Of Abortion	Lesion
Brucellaabortus	6-9 months. Abortion or stillbirth 2 week to 5 months after infection	Placenta: retained, cotyledons necroticred-yellow, area between thickened.

Brucellosis-Bang's disease		Calf: normal or autolytic with bronchopneumonia.
Campylobacter foetus	5-8 months	Placenta: mild placentitis, hemorrhagic cotyledons and an edematous intercotyledonary area.
Venerealis Vibriosis		Foetus: fresh or autolysed; mild fibrinous pleuritis, peritonitis, bronchopneumonia.
Leptospirainterrogans, serovarsgrippotyphosa, pomona,hardjo, canicola,icterohaemorrh agiae	Last trimester Abortion 2-5 weeks after infection	Placenta: diffuse placentitis with avascular, light tan cotyledons and edematous, yellowish intercotyledonary areas Foetus: autolysed
Arcanobacterium (Actinomyces) pyogenes	Any stage	Placenta: endometritis and diffuse placentitis, reddish brown to brown colour. Foetus: autolysed, fibrinous pericarditis, pleuritis, or peritonitis
Listeria monocytogenes	Last trimester	Dam: fever, inappetancePlacenta: retained. Foetus: autolysed Fibrinouspolyserositis and white necrotic foci in the liver and/or cotyledons.

Table 2: The viral infection which cause abortion:

Viral Infectious	Time Of Abortion	Lesion
Bovine Viral Diarrhoea Virus (BVDMD)	Abortion usually up to 4 months	Placenta: retained, no specific lesions. Foetus: no specific lesions, autolysed, Mummified
Bovine Herpesvirus type I (BHV I) Infectious Bovine rhinotracheitis virus	Possibly any stage but most commonly from 4 months to term	Placenta: necrotizing vasculitis Foetus: autolysed, foci of necrosis in the liver
Blue tongue virus Blue tongue Aspergillussp (60-80%Mucorsp,Absidia, orRhizopussp	4 months to term most common in winter	Cotyledons enlarged, necrotic, intercotyledonary area is thickened and leathery. Foetus: autolysed~30% have gray ring worm like skin lesions principally involving the head and shoulders.
Tritrichomonas (Trichomonas) foetus Trichomoniasis	First half of gestation	Placenta: retained, mild placentitis with hemorrhagic Cotyledons and thickened intercotyledonary areas covered with flocculent exudates. Foetus: no specific lesions.
Neosporacaninum Neosporosis	Any stage, but most often 5-6 months	Placenta, foetus: no specific gross lesions, autolysed. Microscopic: focal encephalitis with necrosis and Nonsuppurative inflammation, hepatitis in

2. Retained fetal membrane: Retained fetal membranes (RFM) are a condition in which a cow fails to expel her fetal membrane (after birth) within 12 hours after parturition. Retention of fetal membranes (RFM) for greater than 12 hours after parturition is associated with increased postpartum disease, decreased milk production, reduced reproductive performance, and increased culling rates.

The cotyledonary placenta of cows is usually expelled within 3 to 8 hours after parturition and is considered retained if not expelled by 12 hours. The cause of retained placenta is failure of fetal cotyledons to separate from crypts of material carbuncles; the process of separation is normally beginning during the last month of pregnancy when villi shrinks after blood flow is interrupted by rupture of the umbilical vessels.

3. Endometritis: Endometritis is an inflammation of the endometrium characterized by reddish brown, white to yellow mucoprollent, vaginal discharge along with thickness of uterine wall detected in trans-rectal palpation.

The possible factors involved in the development of endometritis are retentions of fetal membrane, injury to the reproductive tract due to the difficult in calving or excessive force used to assist at calving or injury at the time of breeding or uterine treatment contamination of the reproductive tract at calving, use of uterine boluses.

4. Dystocia: Dystocia, more commonly known as difficult calving and defined as prolonged or difficult parturition, is a problem most dairy producers encounter. There is a wide range of definitions for dystocia ranging from need for assistance to considerable force or surgery to extract. Dystocia diagnosed as abnormal or difficult birth in which the first or especially the second stage of parturition is prolonged markedly for more than 6 hours and the cow requires assistance.

The problem could be associated with one or more of the following causes; breeding faults, over conditioning of the dam, malformation of the calf or the dam, shortened or lengthened gestation, fetal maternal incompatibility, malposition of the fetus and other diseases such as milk fever where there is a decrease in calcium which will decrease muscle tone causing the cow to become too weak to push out the calf, or uterine torsion where the cervix is twisted.

5. Uterine prolapse: Uterine prolapse is the coming out of the uterus with or without vagina and cervix through the vulva commonly shortly after parturition and hanged out with the inner surface outer most. It may be caused by increased intra-abdominal pressure associated with increased size of the pregnant uterus, intra-abdominal fat or rumen distention supper imposed up on relaxation and softening of the pelvic girdle, the excessive force of delivery or uterine inertia (the uterus stops contracting) due to metabolic problems (i.e., milk fever).

It is difficult to prevent or control the problem but decreasing predisposing factors such as hypocalcaemia, lack of exercise, excessive straining to expel after birth may decrease the incidence.

6. Repeat Breeding: Repeating breeding is one of the major infertility problems of herds. A repeat breeder cow is acow that looks apparently healthy and has regular oestrous cycle. The potential causes of the repeated breeding may be including pathological endometritis, nutritional defiecience, special trace minerals and vitamin A, age of the dam, in approprer heat detection and endocrine dysfunction.

A cow or a heifer that failed to conceive for three or more consecutive services is named as repeat breeder or animals exhibiting regular estrus cycle every 18 to 24 days and normal heat signs but failed to conceive after three or more inseminations are diagnosed as repeated breeders. The possible factors involved are embryonic or early fetal mortality caused by trichomoniasis, letopirosis, and excessive manipulation of reproductive tract by rectal examination and in appropriate time of mating (breeding) i.e. breeding too early or too late in relation to time of copulation, use of low fertile sires, use of semen damaged in storage or handling, poor insemination technique, series imbalances or deficiencies of vitamins (minerals) could result in repeat breeding.

7. Anoestrus: Anoestrus is a state of complete sexual inactivity with no manifestation of oestrus for more than two months. The anestrus condition is associated with the presence of inactive ovaries, and even there is follicular development, none of the growing follicles become mature enough to ovulate Anestrus can be classified based on ovarian activity; anestrus cow has broadly been classified into ovulatory, anovulatory and inactive.

8. Twinning: Cattle (*Bos taurus*) are uniparous species meaning that, in most cases, females produce only one offspring per pregnancy. Twinning occurs relatively rarely, with the frequency generally not exceeding 1% in most beef herds. However, in dairy herds, the incidence of twin births is higher (on average 3 to 5%), and is strongly affected by age and parity of the dam The incidence of double births may have both positive and negative effects, which mainly depends on the purpose for which cattle are raised A beef cow can wean more total calf weight by raising twins. Twin births offer the potential for increased beef production efficiency, if sustainable changes in management can be made to accommodate problems inherent with twinning.

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Biosensor and its Application in Food and Dairy Industry

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Introduction

Human beings have at least five of these, i.e., noses, tongues, ears, eyes and skin. They represent the main types of sensor. In the laboratory, one of the best-known types of sensor is the litmus paper test for acids and alkalis, which gives a qualitative indication, by means of a colour reaction, of the presence or absence of an acid. A more precise method of indicating the degree of acidity is the measurement of pH, either by the more extended use of colour reactions in special indicator solutions, or even by simple pH papers. However, the best method of measuring acidity is the use of the pH meter, which is an electrochemical device giving an electrical response which can be read by a needle moving on a scale or on a digital read-out device or input to a microprocessor.

A biosensor can be defined as an integrated receptor transducer device, which is capable of providing selective quantitative or semi quantitative analytical information using a biological recognition element (IUPAC, 2000).

Basic Concepts

A biosensor consists of a bio-element and a sensor-element. The bio-element may be an enzyme, antibody, living cells, tissue, etc., and the sensing element may be electric current, electric potential, and so on. Different combinations of bio-elements and sensor- elements constitute several types of biosensors to suit a vast pool of applications.

Prerequisites for a Biosensor

While developing a biosensor system following requirements are very essential and considered for successful and commercially viable project.

1. Selectivity: The biosensor device should be highly selective for the target analyte and show minimum or no cross reactivity with moieties having similar chemical structure.

2. Stability and operating life: As such most of the biological compounds are unstable in different biochemical and environmental conditions. The biological element used should be interfaced such that the activity is retained for a long time so as to make the device marketable and practically useful in the field.

3. Sensitivity: The biosensor device should be able to measure in the range of interest for a given target analyte with minimum additional steps such as pre cleaning and pre concentration of the samples.

4. Linearity of response: The linear response range of the system should cover the concentration range over which the target analyte is to be measured.

5. Reproducibility of signal response: When samples having same concentrations are analysed several times, they should give same response.

6. Quick response time and recovery time: The biosensor device response should be quick enough so that real time monitoring of the target analyte can be done efficiently. The recovery time should be small for reusability of the biosensor system.

Principle of Biosensor

The desired biological material (usually a specific enzyme) is immobilized by conventional methods (physical or membrane entrapment, non-covalent or covalent binding). This immobilized biological material is in intimate contact with the transducer. The analyte binds to the biological material to form a bound analyte which in turn produces the electronic response that can be measured.

Types of Biosensors

1. On the basis of transducer:

a. Optical biosensors: The output transduced signal that is measured is light for this type of biosensor. The biosensor can be made based on optical diffraction or electro chemiluminescence. Optical transducers are particularly attractive for application to direct (label-free) detection of bacteria.

b. Piezo electric biosensors: Piezoelectric (PZ) biosensor offers a real-time output, simplicity of use and cost effectiveness. The general idea is based on coating the surface of the PZ sensor with a selectively binding substance, for example, antibodies to bacteria, and then placing it in a solution containing bacteria.

c. Thermal Biosensors: This type of biosensor is exploiting one of the fundamental properties of biological reactions, namely absorption or production of heat, which in turn changes the temperature of the medium in which the reaction takes place.

d. Electrochemical Biosensors: Electrochemical biosensors are mainly used for the detection of hybridized DNA, DNA- binding drugs, glucose concentration, etc. Electrochemical biosensors can be classified based on the measuring electrical parameters as:

i. Conductimetric Biosensors: The measured parameter is the electrical conductance resistance of the solution. When electrochemical reactions produce ions or electrons the overall conductivity or resistivity of the solution changes. This change is measured and calibrated to a proper scale. Conductance measurements have relatively low sensitivity.

ii. Amperometric Biosensors: This is perhaps the most common electrochemical detection method used in biosensors. This high sensitivity biosensor can detect electro active species present in biological test samples. Amperometric biosensors produce a current proportional to the concentration of the substance to be detected. The most common amperometric biosensors use the Clark oxygen electrode.

iii. Potentiometric Biosensors: These are the least common of all biosensors, but different strategies may be found nonetheless in this type of sensor the measured parameter is oxidation or reduction potential of an electrochemical reaction.

2. On the basis of biological element:

a. Nucleic Acid-based Biosensors: A nucleic acid biosensor is an analytical device that integrates an oligonucleotide with a signal transducer. The nucleic acid probe is immobilized on the transducer and acts as the bio-recognition molecule to detect DNA/RNA fragments.

b. Enzymatic Sensors: These include pure enzyme preparations or biological preparations (tissue or microbial culture homogenates) showing a certain biological activity.

c. Immunosensors: Immunoglobulins which are protective proteins secreted by the immune system of an organism in response to the ingress of alien biological compounds (antigens), are employed in this case as the biochemical receptor.

d. DNA Sensors: The biochemical components of DNA sensors are nucleic acids (DNA). Most frequently, they are not natural components isolated from a living organism, but their fragments called DNA probes or DNA primers.

e. Microbial Biosensors: In most common microbial biosensors, the biological component is separated from the recording device. This is due to the fact that the response of microorganisms to variations in the chemical composition of the medium is rather sluggish compared to the response of enzymes or antibodies, because the former is mediated by matter transfer across a bio membrane.

Applications of Biosensors

1. Biosensors in food quality: Biosensors obviously offer food industry monitoring of specific analyte at real-time and a Feedback control. This will not only increase the food safety but also provide less effective control , less employment, time and energy saving (Velasco-Garcia and Mottram, 2003).

2. Detection of microorganisms: Conventional methods to determine and specify microorganisms are time consuming and laborious. They are based on so-called colony counts on solid media and often include different enrichment and isolation steps on selective media.

3. Quality control of modified atmosphere packages: Improper package design or temperature abuse during handling may cause fruits and vegetables in modified atmosphere packages to be exposed to low, injurious O2 levels associated with the production of fermentation volatiles quality loss and eventually product breakdown (Velasco-Garcia and Mottram, 2003).

4. Fish freshness analysis: Fish freshness has been evaluated chemically and expressed as K-value which is useful index of raw fish grade. However, the K- value approach requires the sample preparation and the complicated sensor system with several kinds of biochemical substances because the K-value is calculated from the concentrations of inosine, 5-monophosphate (IMP), inosine (HxR) and hypoxanthine (Hx) in the fish-extract solution, with several kinds of biochemical process reagents.

5. Quality control of meat: Commercialized sensing instruments for quality control of meat are meat check and bio check sensors. The meat check is a four-electrode array attached to a knife which can be inserted into meat to measure the glucose gradient immediately below the surface.

6. Monitoring of wine quality: Wine is a complex mixture of several hundred compounds, present simultaneously, at different concentrations. The dominants ones are water, ethanol, glycerol, sugars, organic acids and various ions. Except ethanol and glycerol, other aliphatic and aromatic alcohols, amino acids and phenolic compounds are present at much lower concentrations.

7. Free radicals and antioxidants: Antioxidants are one of the main ingredients that protect food attributes by preventing oxidation that occurs during processing, distribution and end preparation of food. Different types of antioxidants are added to food products to increase the attributes of food product.

8. Fresh fruits and vegetables: Fresh produce quality in the intact or minimally processed/fresh-cut form is initially assessed by sight; other important quality attributes include taste, smell and texture. Each of these four quality attributes can be assessed either subjectively or objectively.

9. Tea biosensor: India is exporting a large quantity of black tea all over the world. Tea polyphenols play a crucial role in determining quality of black and green tea. Major quality attributes such as colour and astringency are directly linked with polyphenol contents. Therefore, it is necessary to know quantity of polyphenols in tea.

10. Alcohol biosensor: Online measurement of ethyl alcohol or methanol during fermentation and yeast cultivation is very important to minimize product inhibition and increase yield. Many micro-organisms use alcohols as carbon source, its concentration can be determined from the respiration activity of the cells. The respiration activity is directly measured by oxygen electrode.

Table.1 Range of analyte monitored in meat products by biosensors:

Analytes	Food matrix	Bio component
Amines	Fish	Diamine oxidase (DAO)
Amines	Fish freshness	Hypoxanthine oxidase
Biogenic amines	Fish	Diamine oxidase
Histamine	Sea foods	Histamine oxidase
Hypoxanthine	Fish and its freshness	Xanthine oxidase (XOD)
Bacteria	Chicken	Anti-Salmonella antibody
Bacteria	Beef	Anti- Escherichia coli
Bacteria,viruses, spores	Hamburger, ham	Antibody

Table.2 Range of analyte monitored in milk and milk products by biosensors:

Analyte	Food matrix	Bio component
Glucose	Milk Yoghurt	Glucose oxidase Galactosidase
Fructose	Milk	D-fructose dehydrogenase
Lactose	Milk	Galactosidase, lactozym and Saccharomyces
Laculose	Milk	D-fructose dehydrogenase, glucose oxidase
Biotin	Infant formula and milk	Anti- biotin antibody

Folate	Infant formula and milk	Anti-folic acid antibody
L- lysine	Milk	Lyase oxidase
Antibiotics	Milk	Antibodies
Pesticides	Milk	Chlinesterase
Cholesterol	Butter, cream	Cholesterol oxidase or Horseradish peroxidase

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Azolla- As Livestock Feed

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Introduction

Azolla (also known as green gold, The Super Plant ,mosquito fern) is a free-floating aquatic fern of family Azollaceae and order Pteridophyta, nowadays being used as unconventional feed and protein supplement for animals like ruminants ,pigs, poultry and fish. Dry flakes of azolla are used as feed in livestock and poultry while fresh azolla for fish. Azolla mostly is also used as mosquito-repellant, biofertilizer and bio-scavanger as it has capability to accumulate heavy metals. Azolla is good source of probiotics, protein(mainly essential aminoacids) with higher lysine, arginine and methionine content, bio-polymers, minerals , chlorophyll and vitamins(Vitamin A, Vitamin B, beta carotene, vitamin B12) while carbohydrate and oil content are low. It is easy to cultivate, moreover gives high production compared to legumes and grasses. It is highly digestible in animals because of low lignin and high protein. Azolla also acts as biofertilizer for wetland paddy. Azolla can grow both in wild and controlled conditions. It can be found growing naturally in stagnant water of pond, canal, river and other water sources. Azolla grows well in symbiotic relationship with blue green algae. It usually grows on water surface consisting of alternate leaves with adventitious roots. The fronds of azolla are triangular in shape. Optimum water pH required for growth of azolla is 4.5-7.0(Tolerable pH 3.5-10) and temperature 18-28°C. In world, atleast eight species are known of Azolla,namely Azolla pinnata, Azolla nilotica, Azolla caroliniana, Azolla japonica, Azolla circinata, Azolla microphylla, Azolla rubra and Azolla Mexicana of which most common is Azolla pinnata. In this article compilation of research related to feeding of azolla in various animals has been done along with its nutritional value and method of cultivation.

Nutritive Value of Azolla

Nutritional variations in composition have been reported in different species of azolla. Sun dried-azolla meal on an average contains dry matter (89.73%), Organic Matter (75.73-82.66%), Crude Protein(22.48-35.49%), Crude Fibre (14.7%), Ether Extract (3.7-4.5%), Total Ash (17.34-24.26%), Acid Insoluble Ash(7.94%), calcium (1.64-2.58%), phosphorus (0.26-0.34%) [7-10], potassium (2.71%), Nitrogen Free Extract (40.97%), Neutral detergent Fibre (54.85%), Acid detergent Fibre (36.57%) and Acid detergent Lignin(24.05%). On DM basis azolla contains10% carbohydrates,10-15% minerals and7-10% amino acids, bioactive substances and biopolymers. Azolla pinnata on dry matter basis mostly contain trace minerals copper-9.1,Manganese-2418,Zinc-325,Iron-1569,cobalt-8.11,chromium-5.06,boron-31,nickel 5.33,lead-8.1,cadmium-1.2ppm.Research has indicated that Azolla pinnata has ability to bioaccumulate heavy metals. The content of carotene in azolla varies from 206-619mg/Kg. Digestible protein percentage in azolla meal is 56.6%. In another experiment, azolla meal was found to contains lignin (28.24%), cellulose(12.76%), NDF(47.08%) and ADF(36.08%).

Azolla as Fodder / Feed

1. Rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12 and Beta- Carotene), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium.
2. Dry weight basis, it contains 25 - 35 percent protein, 10 - 15 percent minerals and 7 - 10 percent of amino acids, bio-active substances and bio-polymers.
3. Livestock easily digest it, owing to its high protein and low lignin content.
4. Azolla can be mixed with concentrates or can be given directly to livestock.
5. Can also be fed to poultry, sheep, goats, pigs and rabbits.

Azolla Production

1. The soil in the area is first cleared of weeds and levelled.
2. Bricks are lined horizontally in a rectangular fashion.

3. A UV stabilized silpauline sheet of 2mX2m size is uniformly spread over the bricks in such a way as to cover the margin of the rectangle made by the bricks.
4. 10-15 kg of sieved soil is uniformly spread over the silpauline pit.
5. Slurry made of 2 kg cow dung and 30 g of Super Phosphate mixed in 10 liters of water, is poured onto the sheet. More water is poured on to raise the water level to about 10 cm.
6. About 0.5-1kg of pure mother azolla culture seed material is spread uniformly over the water, after mild stirring of soil and water in the azolla bed. Fresh water should be sprinkled over the azolla immediately after inoculation to make the azolla plants upright.
7. In a week's time, the azolla spreads all over the bed and develops a thick mat like appearance.
8. A mixture of 20 g of Super Phosphate and about 1 kg of cow dung should be added once in 5 days in order to maintain rapid multiplication of the azolla and to maintain the daily yield of 500g.
9. A micronutrient mix containing magnesium, iron, copper, sulphur etc., can also be added at weekly intervals to enhance the mineral content of azolla.
10. About 5 kg of bed soil should be replaced with fresh soil, once in 30 days, to avoid nitrogen build up and prevent micro-nutrient deficiency.
11. 25 to 30 percent of the water also needs to be replaced with fresh water, once every 10 days, to prevent nitrogen build up in the bed.
12. The bed should be cleaned, the water and soil replaced and new azolla inoculated once every six months.
13. A fresh bed has to be prepared and inoculated with pure culture of azolla, when contaminated by pest and diseases.

Harvesting
1. Will grow rapidly and fill the pit within 10 - 15 days. From then on, 500 - 600 g of azolla can be harvested daily.
2. Can be done every day from the15th day onwards with the help of a plastic sieve or tray with holes at the bottom.
3. The harvested azolla should be washed in fresh water to get rid of the cow dung smell.

Alternative Inputs
1. Fresh biogas slurry may also be used.
2. Waste water from bathroom and cattle shed can also be used to fill the pit. In areas where there is a problem of fresh water availability, the water left after washing clothes (after the second rinsing) can also be used.
3. Temperature 20°C - 28°C.
4. Light 50% full sunlight.
5. Relative Humidity 65 - 80%.
6. Water (standing in the tank) 5 - 12 cm.
7. pH 4-7.5.

Points to be Noted During Cultivation of Azolla
1. Washing in a net will be useful as it will allow small plantlets to get out, and they can be poured back in to the pond.
2. Care should be taken to retain the temperature below 25°C.
3. Shade nets can be used to cut the light intensity.
4. The azolla biomass should be removed daily to avoid overcrowding.

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Assisted Reproductive Technologies in Farm Animals

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Introduction

Reproductive inefficiency is one of the most important causes of economic losses in animal industries and it is realized throughout the world. Despite of the remarkable advancement that has been made in the field of reproductive physiology in recent years, infertility due to low conception rate and high embryonic mortality rate remains a major problem.

On the other hand, there is an increasing necessity to produce animals with high genetic potential to increase the productivity of animal unit instead of increasing the number of animal herds to achieve high quality and quantity production.

Various assisted reproductive techniques have been developed and refined to obtain a large number of offspring from genetically superior animals or obtain offspring from infertile (or sub fertile) animals in addition to disease control.

Development of reproductive techniques like; estrus synchronization, superovulation, non-surgical embryo collection, embryo transfer, cryopreservation of embryos, oocytes pick- up from live animals, in vitro embryo production, and cloning could not make an impact on animal production quality due to non-availability of low-cost embryos from high genetic merit animals.

Artificial Insemination

This technology has now become a practical technology in commercial dairy cattle programs in both developed and developmental countries. Artificial insemination (AI) is the process of collecting sperm cells from a genetically superior male animal and manually depositing them into the reproductive tract of a female. The first successful insemination was performed by Spallanzani, (1784) in a bitch. Pioneering efforts to AI were begun in Russia in 1899 by Ivanoff. Ivanoff (1922) had studied AI in domestic farm animals, dogs, foxes, rabbits, and poultry. Later on, this technique was performed by various researchers worldwide in different species. Use of frozen semen (Polge et al., 1949) revolutionized the AI program through worldwide transport of semen. Initially, the AI was used to spread improved indigenous breeds.

Multiple Ovulation and Embryo Transfer (MOET)

Multiple ovulation and embryo transfer (MOET) are often referred as the ART that is “to the female, while AI is to the male”, i.e. a method of producing more offspring from a genetically valuable female than would be possible by natural breeding. Meanwhile, MOET has not yet become a widespread tool for genetic improvement for a variety of reasons including its costs, technical demands, and variable and unpredictable efficiency (Cognié et al., 2003). An early review by Callesen et al. (1996) showed the significance of MOET in dairy cattle. Meanwhile, the use of MOET procedures remains affected by a high variability in the ovulatory response to hormonal treatment and by a low and variable number of transferable embryos and offspring obtained. This variability has been classically identified with both extrinsic (source, purity of gonadotrophins and protocol of administration) and intrinsic factors (breed, age, nutrition and reproductive status) (González-Bulnes et al., 2004). In a more recent review, Menchaca et al. (2010) summarized that the application of recently acquired knowledge has resulted in relevant improvements in MOET programs in small ruminants.

Embryo transfer technology is an important tool to improve livestock at faster rate as well as gives an opportunity to utilize the genetic contribution of both male and female at the same time. Nicholas and Smith (1983) reviewed that with the help of ET (embryo transfer) or MOET (multiple ovulation embryo transfer) techniques a faster improvement of livestock, rapid expansion of elite animals, genetic gain, accelerated herd development and conservation of rare genetic stocks could be achieved. Embryo transfer and other ART technology facilitate genetic improvement and have been successively used for rapidly multiplying the population of elite breeds of cattle.

Intra-Cytoplasmic Sperm Injection (ICSI)

Intra-cytoplasmic Sperm Injection is a procedure in which a single sperm is injected directly into an egg, thus sperm and egg interactions involved with normal fertilization are by-passed. This technique is used to overcome severe male infertility. The procedure is performed by laparoscopy. Development of ICSI technique furnished a successful treatment for male infertility of different origin and has led to a resurgence of interest in its potential use in farm animal reproduction.

In Vitro Embryo Production IVP

The potential for commercial production of genetically superior embryos by in vitro ferti1ization is apparent. In the past few decades there have been unprecedented evolution of technology for in vitro embryo production of farm animals, with the rate of progress getting intensified in the last decade with the characterization of effectively defined and semi defined medium for different species. The first succeeded IVF was achieved in rabbits in 1959 (Chang, 1959), next success was with mice in 1968. The first IVF production in human was in 1978 (Steptoe, 1980) and the first-born calf produced with IVF was in 1981 (Brackett et al., 1982). Kane (2003) wrote an excellent review about in vitro gamete maturation and embryo culture.

In vitro production technologies not only help in production of high genetic merit animals, but also provide an excellent source of embryos for emerging biotechnologies like embryo sexing, cloning, nuclear transfer, transgenesis … etc. Furthermore, it allows analyzing developmental potential of embryos, including the pattern of gene expression, epigenetic modifications and cytogenetic disorders during the development (Galli and Lazzari, 2008). Early stages of bovine embryo development show many similarities with human embryos. Therefore, bovine embryos are used as a model organism (Niemann and Wrenzycki, 2000).

Oocyte / Embryo Cryopreservation and Vitrification

Continuous availability of viable, developmentally competent oocytes and/or embryos has been critical to recent progress in IVP because of the relatively short fertile life span of mammalian oocytes and/or embryos. Hence, storage of unfertilized oocytes would generate a readily available source, which allow the experiments to be carried out at convenient time and could therefore be of practical importance for establishment of gamete bank, from which particular genetic combinations could be derived. During the past few decades, significant progress in cryopreservation of mammalian oocytes and embryos has been achieved. Live offspring of at least 25 species resulted from transfer of cryopreserved embryos or oocytes have been successfully produced (Gajda and Smorg, 2009).

Zygote Intra-Fallopian Transfer (ZIFT) and Gamete Intra-Fallopian Transfer (GIFT)

Zygote Intra-Fallopian Transfer (ZIFT), also referred to as Tubal Embryo Transfer (TET), is an ART technique in which embryos are transferred into the fallopian tubes for purposes of achieving pregnancy. Meanwhile, Gamete Intra-Fallopian Transfer (GIFT) allows the transfer of gamete into the fallopian tubes. The obvious advantage of ZIFT over GIFT is that as in IVF, it is possible to document fertilization. On the other hand, both ZIFT and GIFT procedures require the female to have at least one functioning fallopian tube which is a disadvantage when compared with IVF. These different techniques are used to achieve pregnancy in high genetically merit animal with reproduction problems or to achieve implantation of produced embryos in surrogate mothers.

Cloning

Cloning is a powerful technique and potentially it could be used for multiplication of elite animals and minimize the genetic variation in experimental animals. It can be used for the conservation as well as tool for the production of stem cells for therapeutic purposes, as therapeutic cloning. Cloning using somatic cells offers opportunities to select and multiply animals of specific merits (Das et al., 2003). Numerous types of somatic cells are used as donors in somatic cloning; foetal fibroblasts, adult fibroblasts, granulosa cells, hepatocytes, lymphocytes … etc. (Campbell et al., 2007).

First animal obtained by somatic cloning was a sheep called "Dolly" (Willmut et al., 1997). She was derived from cells that had been taken from the udder of a 6-year old Finn Dorset ewe and cultured for several weeks in the laboratory. Individual cells were then fused with unfertilized eggs from which the genetic material had been removed. Two hundred and seventy-seven of these reconstructed eggs' – each now with a diploid nucleus from the adult animal – were cultured for 6 days in temporary recipients. Twenty-nine of the eggs that appeared to have developed normally to the blastocyst stage were implanted into surrogate Scottish Blackface ewes. One gave rise to a live female lamb, Dolly, some 148 days later. Dolly was born on July 5, 1996.

Transgenesis

Since the initial demonstration in 1980s that a transgenic animal can be generated harboring a transgene from a different species, genetic engineering has revolutionized all aspects of fundamental biological and biomedical research. Since then much has been accomplished in the generation of various was types of first transgenic animals (Fig. 4) like mouse (Gurdon and Ruddle, 1981), pig (Hammer et al., 1985), sheep (Simon et al., 1998), goat (Ebert et al., 1991) and cattle (Galli et al., 2003).

Several biotechnological techniques such as pro-nuclear micro-injection, cytoplasmic micro-injection, retrovirus-based vectors, transferring DNA to embryos or embryonic stem cells via retroviral vectors, sperm mediated gene transfer of lentivectors and RNA interference, are presently being used to produce transgenic animals. Transgenic farm animals can be used both in breeding and biomedicine (Rob et al., 2007; Wells, 2010). In breeding, transgenic individuals produced are equipped with disease resistance and improved.

Nanotechnology

Nanotechnology is recent advancement in cellular and molecular biotechnology. It has an enormous potential to revolutionize agriculture and livestock sector. This technology allows researchers to handle biological materials and media in minute quantities usually nanoliters or picoliters. In addition to its applications in cellular biology, biotechnology, theraputic medicine and genetics, it might be useful technique in farm animal breeding and reproduction. ualitative traits.

Laser Technology

Laser effects on sperm motility parameters improvement of oocyte maturation and characterization of semen in livestock have been reviewed (Abdel-Salam and Harith, 2014). Several applications of laser had been reviewed as assisted techniques of ART to benefit the energy from different types of laser to excite either sperm of oocyte to improve their competence toward fertilization. Also, they mentioned the promising types of laser and wave length in the applications of improving semen parameters either pre- or post-thawing, oocyte maturation for IVF.

Conclusion

Assisted Reproduction Technologies (ART) in farm animals are recently receiving renewed attention. ART can be used to meet the increasing global desire for animals' products and to overcome reproduction failure in high producing animals. On the other hand, embryo genomics are a valuable tool for studying the probable causes responsible for various defects at cellular level (i.e. early embryonic death due to defective expression of genes). Nowadays, the new breakthrough in ART techniques made it possible to manipulate embryo production with desired criteria. Moreover, introduction of ART accelerates genetic improvement toward accretion or secretion type of production.

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Biofloc Technology: A Technological Breakthrough in Fish Farming

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Summary

Biofloc is a heterogeneous aggregate of suspended particles and variety of microorganisms associated with extracellular polymeric substances. It is composed of microorganisms such as bacteria, algae, fungi, invertebrates and detritus, etc.

Introduction

The aquaculture business is expanding quickly at pace of 9% every year since the 1970s (FAO,2012). To get ready commercial feed for aquaculture, fishmeal and fish oil are one of the prime constituents. About half use for aquaculture production get from feed costs, which is transcendent because of the expense of protein component in commercial diets (Bender et al.). To expand aquaculture production, issues identified with this action like expanding the zone required for the facility, water conduction carriage and building lakes channels for remaining water must be settled. Presentation of exotic species has made a hazard by inciting the progress of new microorganisms and ailments to local organism. (De Schryver et al. 2008; Emerenciano et al. 2011; FAO, 2010).

The natural amiable and cost-effective aquaculture framework called "Biofloc Technology (BFT)" is considered as a productive substitute process since supplements could be ceaselessly reused and recycled. The technologies are strong for supportability of aquaculture, practical and environmentally sustainable. One choice to lessen the natural harms brought about by aquaculture and to enhance production is the utilization of the "Biofloc" Technology (BFT), this technology was invented during the 70's, and it is situated in the microbial communities that help limit or maintain a strategic distance from water exchange and, as an extra advantage or benefit, the production of microbial protein that can be utilized as food. (Avnimelech, 2009).

Biofloc Technology

The biofloc process was created under a similar rule that regular waste water treatment plants have, in which the microorganisms were developed from dung of the refined life forms being, changing it into less mind organic items that can be devoured by different living beings and come back to the food chain. (Avnimelech & Kochba, 2009). In aquaculture, the "biofloc" technology acts like a maintenance trap for the supplements in the lake, and diminishes support costs since it very well may be utilized as food supplement for the commercial organisms being refined, which gives an additional incentive by improving the food utilization rate (Azim & Little, 2008). On the off chance that carbon and nitrogen are even in the arrangement, ammonium added with organic nitrogenous waste will be changed over into bacterial biomass (Schneider et al., 2005).

By adding carbohydrates to the lake, heterotrophic bacterial development is invigorated and nitrogen take-up through the production of microbial proteins happens (Avnimelech, 1999). Biofloc technology is a process of increasing water quality through the addition of extra carbon to the aquaculture system, by an external carbon source or supplement carbon content of the feed. This promoted nitrogen uptake by bacterial growth decreases the ammonium concentration more rapidly than nitrification (Hargreaves, 2006).

The growth rate and microbial biomass yield per unit substrate of heterotrophs are a factor 10 higher than that of nitrifying bacteria because Immobilization of ammonium by heterotrophic bacteria occurs much more rapidly (Hargreaves, 2006). The microbial biomass yield per unit substrate of heterotrophic bacteria is about 0.5 g biomass C/g substrate C used (Eding et al., 2006). Floating growth in ponds consists of phytoplankton, bacteria, aggregates of living and dead particulate organic matter, and grazers of the bacteria (Hargreaves, 2006). Typical flocs are irregular by shape, have a broad distribution of particle size, are fine, easily compressible, highly porous (up to more than 99% porosity) and are permeable to fluids (Chu and Lee, 2004).

Table 1: Chemical Composition on dry matter basis of microbial aggregates:

Bibliography	Protein (%)	Carbohydrates (%)	Lipids (%)	Fibre (%)	Ashes (%)
Wasielesky et al. (2006)	31.07	23.59	.49	-	44.85
Soares (2004)	12.0	-	2.0-8.0	-	22.0-46.0
Emerenciano et al. (2006)	30.40	29.10	.47	.83	39.20
Tacon et al. (2002)	31.20	-	2.6	-	28.2
Mcintosh et al. (2000)	43.00	-	12.5	-	26.50

Fig 1: Tilapia production using Biofloc technology

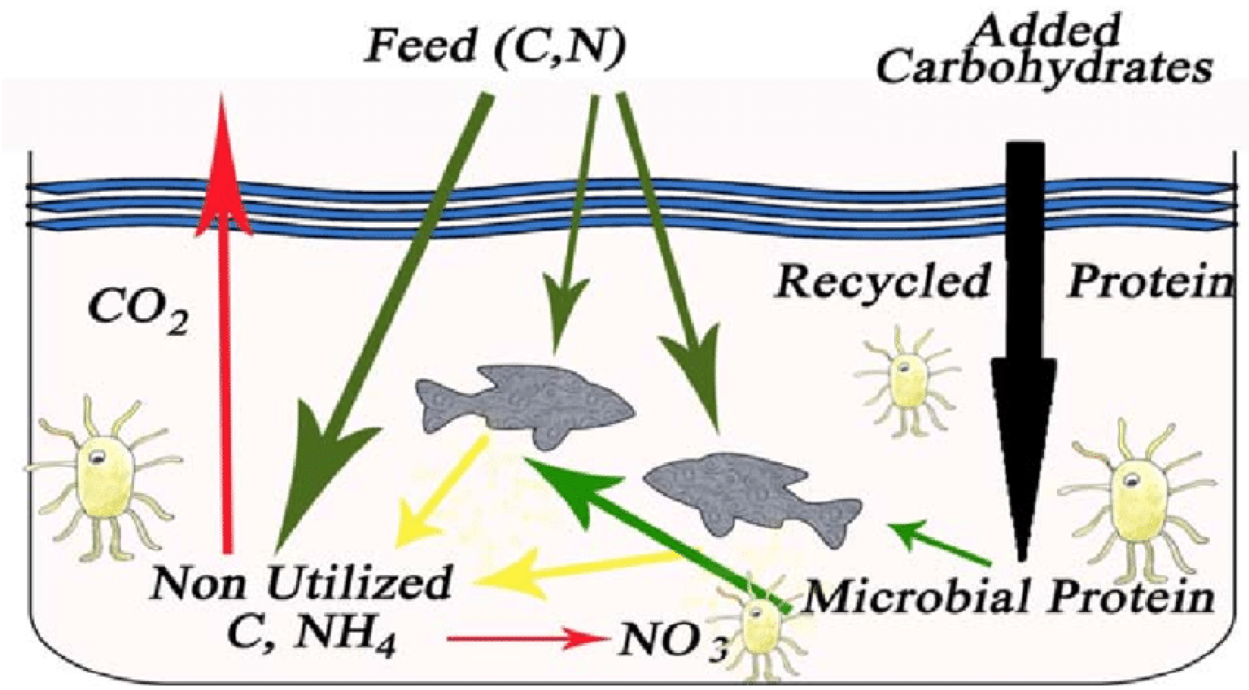

Fig 2: "Biofloc" system operation in a pond (Avnimelech, 1999).

Conclusion

To build up the biofloc technology gives advantages to the production process, for example, bringing down the thickness of the poisonous components that can influence the culture, it can likewise help decreasing or wiped out the water exchange in the lakes, which is of extraordinary assistance when there is lack of water; additionally help to keep away from contamination, since improve the water health because of the heterotrophic microorganisms that restrain the development of pathogenic microscopic organisms, lessening the potential outcomes to infect the organism resisting contagion and gigantic diseases. The ideal utilization of the supplements by the biofloc bacteria's, reduce the expense of food, for the fish flour that is expended in enormous sums on the planet and its accessibility once in a while is scarce and get significant expenses. This system license to the production farms not to be needy since the biofloc can fill in as food when the feed costs become excessively high.

The biofloc in the lakes permits an expansion in populaces of the cultured organism, and accordingly the harvests heighten without expanding the measure of space that can be for different exercises. The fate of this system is exceptionally promissory on the grounds that it can assist with getting high production required to fulfill the developing human populace needs. Another bit of advantage in the utilization of the biofloc system is the decay of the creation costs, this isn't just advantageous for makers however it could permit the entrance of more individuals to this wellspring of animal protein, and improve of person with scarce financial resources.

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Reverse Breeding: A Novel Breeding Approach

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Summary of Article

Dirks et al. (2009) proposed a novel plant breeding technology named reverse breeding, which can directly generate parental inbred lines from any hybrid. Hybrid seeds are produced by a cross between to inbreed lines. Reverse breeding, meets the challenge of fixation of complex heterozygous genomes by constructing complementing homozygous lines. This is accomplished by the knockdown of meiotic crossovers and the subsequent fixation of non-recombinant chromosomes in homozygous doubled haploid lines (DHs). The approach not only allows fixation of uncharacterized germplasm but provides breeders with a breeding tool that, when applied to plants of known backgrounds, allows the rapid generation of chromosome substitutions that will facilitate breeding on an individual chromosome level. There is a short communication related to the different methods of this approach.

Introduction

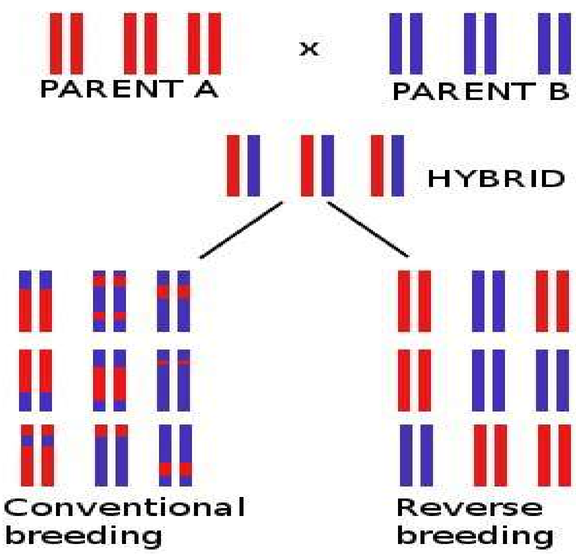
Reverse breeding (RB) is a novel plant breeding technique designed to directly produce parental lines for any heterozygous plant, one of the most sought-after goals in plant breeding.

Reverse breeding has been tested in Arabidopsis by Wiinker et al. (2012). Firstly, they crossed Landsberg (Ler-0) and Columbia erecta (Col-0) to develop an F1 hybrid. In the hybrid, the meiosis crossover is suppressed using RNAi to knock-down the DMC1 gene, which is required for the crossover formation during meiosis. Secondly, they crossed this hybrid to the centromere mediated haploid inducer line to generate haploids which were doubled into DH lines through spontaneous doubling. Genetic analysis of 69 DH lines using SNP markers at approximately 4-Mb intervals showed absence of recombination. Lastly, they recovered the original hybrid by crossing complementing DH lines.

Procedure

1. The generation of DMC1: RNAi transgenic lines (Achiasmatic parental lines)
2. Development of achiasmatic hybrids
3. Haploid induction by crossing to GFP-tail swap
4. Generation of DH lines by self-pollination of haploids and
5. Recreation of original hybrids by crossing DH lines with complementary sets of parental chromosomes.

Need of Reverse Breeding



1. To maintain the hybrid stability.
2. Genetic improvement of parental lines to enhance the hybrid performance.
3. To establish the breeding lines for uncharacterized heterozygotes.
4. To multiply a highly heterozygous plant from a homozygous parental line.

Application of Reverse Breeding

1. Reconstruction of heterozygous germplasm: For crops where an extensive collection of breeding lines is still lacking, RB can accelerate the development of varieties. In these crops, superior heterozygous plants can be propagated without prior knowledge of their genetic constitution.

2. Breeding on the single chromosome level: Generally quantitative traits are located on different chromosome there for not easy to breed. RB is applied on F1 hybrid of known parents, when this F1 hybrid crossed with one of the original parents, hybrids can be formed in which one of the chromosomes is homozygous whereas it is also possible to produce hybrids in which just one chromosome is heterozygous.

3. Backcrossing in CMS back ground: In several vegetable crops such as cabbages and carrots, breeders make use of cytoplasmic male sterility (CMS). In these systems, the presence of male sterility presents a special challenge to RB. In these cases, gynogenesis rather than androgenesis can be used to obtain DH plants. This is perfectly compatible with RB in the sense that the chromosomes from the maintainer line can be recovered directly in the cytoplasm of the sterile line in one step.

Future Aspect

Reverse breeding accelerates the breeding process considerably and increases the number of available genetic combinations which allows breeders to respond much quicker to the needs of farmers and growers with better varieties. Other main advantage of reverse breeding is that it facilitates selection of superior hybrid plants. Large populations of plants can be generated and screened and well performing plants can be regenerated indefinitely without prior knowledge of their genetic constitution. This essentially removes the randomness in earlier hybrid breeding. Reverse breeding is currently limited to crops with a relatively small, diploid genome.

Conclusion

As a breeding tool, reverse breeding may be regarded more versatile as its controlled deconstruction of complex genotypes into homozygous parental lines allows the further improvement of these lines by classic breeding methods. Reverse Breeding generates perfectly complementing homozygous parental lines through engineered meiosis. The method is based on reducing genetic recombination in the selected heterozygote by eliminating meiotic crossing over. Male or female spores obtained from such plants contain combinations of non-recombinant parental chromosomes which can be cultured in vitro to generate homozygous doubled haploid plants (DHs). From these DHs, complementary parents can be selected and used to reconstitute the heterozygote in perpetuity. Since the fixation of unknown heterozygous genotypes is impossible in traditional plant breeding, Reverse Breeding could fundamentally change future plant breeding.

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Biochar: A Tool to Improve Soil Health

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Biochar

Biochar is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at low temperatures (~350–600°C) in an environment with little or no oxygen (Amonette and Joseph, 2009).

Biochar is not a pure carbon, but rather mix of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S) and ash in different proportions. The central quality of biochar and char that makes it attractive as a soil amendment is its highly porous structure, potentially responsible for improved water retention and increased soil surface area. It is a carbon-rich organic material, an organic amendment, and a by-product derived from biomass by pyrolysis under high-temperature and low-oxygen conditions. Biochar is produced through a process called pyrolysis, which basically involves heating of biomass (such as wood, manure, or leaves) in complete or almost complete absence of oxygen, with oil and gas as co-products. However, the quantity of these materials produced depends on the processing conditions. Recently, it has been reported that biochar obtained from the carbonization of organic wastes can be a substitute that not only influences the sequestration of soil carbon but also modifies its physicochemical and biological properties (Zhang et al., 2017).

Tools for Soil Health Management

1. FYM.
2. Green manure.
3. Compost.
4. Vermicompost.
5. Mulching.
6. Biochar.

Characteristics of a Healthy Soil

1. Good soil tilth.
2. Sufficient depth.
3. Sufficient but not excess supply of nutrients.
4. Small population of plant pathogens and insect pests.
5. Good soil drainage.
6. Large population of beneficial organisms.
7. Low weed pressure.
8. Free of chemicals and toxins that may harm the crop.
9. Resistant to degradation.
10. Resilience when unfavourable conditions occur.

Physical Properties of Biochar

1. Surface area- 120 to 460 m2/g.
2. Structural composition.
3. Particle size distribution.
4. Biochar dust.
5. Pore size distribution and connectivity.

Advantages of Biochar

1. Increase water holding capacity of sandy soils.

2. Increase plant production. Increase soil pH (especially a benefit for acidic soils suffering from Aluminium toxicity).
3. Suppress the emission of N2O from soil.
4. Increase the soil sink capacity for CH4 Increase cation exchange capacity (As a soil fertility indicator) over time.
5. Reduce NO3 leaching, leading to more efficient fertilizer use.
6. Improve plant yields and nutrition.
7. Increase microbial abundance and activity.
8. Increase water retention.
9. Improve soil fertility.
10. Energy production.

Effect of Biochar Addition on Soil Corresponding Biochar Property and Possible Mechanisms

Property	Effect	Biochar properties	Mechanism
Organic matter	Increased	High C content	Increased C concentration
Water holding Capacity	Increased	Porous structure	Enhanced water adsorption rate
Porosity	Increased	Porous structure	Dilution effect & formation of macro aggregates
pH	Increased	Alkaline nature	High ash content
Cation exchange capacity	Increased	Specific surface area	High specific surface area of biochar

Conclusion

Crop residues in fields can cause considerable crop management problems as they accumulate. However, biochar amendment improves soil health and soil fertility status, especially increasing organic C, N, K and CEC. The long-term impact of biochar application on soil physical properties, nutrient availability, soil microbial activities, carbon sequestration potential, crop productivity, and greenhouse gas mitigation. The initial outcomes reveal that biochar application helps in improving soil health and crop productivity. Efficient use of biomass by converting it as a useful source of soil amendment/nutrients is one way to manage soil health and fertility.

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Hypovirulence and Cross Protection in Plant Disease Management

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Hypovirulence

Hypovirulence is a term used to describe reduced virulence found in some strains of pathogens. It is the phenomenon by which a strain of a pathogen is less virulent than normal due to the presence of double stranded RNA (dsRNA).

History

In 1940, more than 4 billion American chestnut trees were infected with the chestnut blight (Cryphonectria parasitica).

In 1960's, Italian and French scientists observed the healing cankers growing on chestnut trees in Italy.

In 1964- Grente, first discovered hypovirulence in Italy.

Hypovirulence has become a model system for the biology of fungus-virus interaction. Hypoviruses are most significant for biological control of chestnut blight belongs to the family Hypoviridae. Four species of hypoviruses have been described in *Cryphonectria parasitica Cryphonectria hypovirus* 1 (CHV-1), CHV-2, CHV-3, CHV-4.

Mechanism

Virulent strain is converted to hypovirulent strain by the transmission of dsRNA virus in hypvirulent strain through hyphal anastomosis between virulent and hypovirulent strains. In fungi, the LacCl gene encodes an extracellular laccase and which appears to be involved in lignin degradation, virulence, sporulation and pigmentation. It has been found that laccase biosynthesis was down-regulated by dsRNA containing hypovirulent strain. Gene Crp encodes a cell wall hydrophobin, which is specific to aerial hyphae and fruiting bodies of *C. Parasitica*, has been down regulated.

Transmission

Fungal viruses have no extracellular mode of transmission and under natural conditions are reliant on their fungal hosts for intracellular transmission. Virus transmission in two ways: Horizontal transmission and Vertical transmission. Horizontal transmission only occurs after hyphal anastomosis (fusion of hyphae) and the mixing of cytoplasm of one individual with another. Vertical transmission by production of asexual spores, overwintering sclerotia and more or less effective transmission into sexual spores. During virus transmission the individuals are vegetative compatible. Individuals are vegetative compatible if they share the same alleles at all loci.

Movement of Virus Within Fungi

Fungal viruses move forward by plasma streaming. Virus could drift with the cytoplasm as it extends into new hyphae. They attach to the web of microtubuli, which would drag them through the internal cytoplasmic space.

Effects of Hypoviruses on Pathogen

Altered colony morphology, reduce growth rate, pigmentation and sporulation and reduced laccase production.

Cross Protection

Is a phenomenon in which infection of a plant with a mild virus strain protects it from disease resulting from a subsequent encounter with a severe strain of the same virus? Mild strain also named as protective virus- induces mild or no symptoms at all on the host. Once the mild strain has been inoculated it can trigger strain or sequence- specific resistance against the challenge virus.

History

1929- McKinney, first reported the phenomenon of cross protection in Tobacco mosaic virus (TMV) in the Canary Islands.
1951- Grant and Costa, first demonstrated that cross protection could be used to control citrus tristeza virus (CTV) in Brazil.
1978- Balaraman and Ramakrishnan reported cross protection for control of Citrus Tristeza Virus in India.

Table. Cross Protection in Some Perennial and Annual Crops

Host plant	Protecting virus	Challenging virus	Sources
Perennials			
Cocoa	Mild strain of Cacao swollen-shoot virus	severe strains of CSSV	Posnette and Todd (1955)
Citrus	Mild strains of Citrus tristeza virus	severe strains of CTV	Costa and Muller (1980)
Papaya	Mild mutant PRV strain (PRV HA 5-1) of Papaya ring spot virus	severe strains of PRSV	Yeh et al. (1988)
Annuals			
Tobacco	Green mosaic strain of Tobacco mosaic virus	Yellow mosaic strain of TMV	Broadbent (1976); Mckinney (1929)
Tobacco	Mild strain of Potato virus X	severe strain of PVX	Salaman (1933)
Potato	Very mild strain of Potato spindle tuber viroids	severe strains of PSTVd	Branch et al. (1988)
Cereals	Barley yellow dwarf virus	BYDV	Power (1996); Rochow et al. (1983)

Mechanism of Cross Protection

Initial interaction between the plants infected with the protecting virus and the challenge virus strains. In the initial interaction, the challenge virus could be inhibited from uncoating, thereby preventing the initiation of the replicative cycle.

If replication is initiated: a number of mechanisms may be involved in controlling replication of the challenge virus: The initial translation of the incoming viral nucleic acid could be blocked. The transcription of the incoming viral nucleic acid may be prevented even if it is translated initially. The production of genome-length viral nucleic acid could be inhibited.

Even if challenge virus is replicated, movement from cell to cell could be prevented. Explanation of cross protection by one hypothesis alone is unlikely because of the contrasting observations in a variety of biological systems. However, it is acceptable that different mechanisms of cross-protection may be operating in different virus groups.

Characteristics of Mild Strain

Induce milder symptoms, should not alter the potential yield and the quality of the crop, and should not be easily transmitted by vectors. It provides a protection towards the severe challenging strain. It is easy to produce, check for purity. Simple inoculation procedure should be designed.

Mild Strain Selection

Some mild strains are obtained as naturally occurring variants. Plants with mild symptoms may be observed in the fields. Single local lesion isolations from samples with severe symptoms or from plants inoculated by severe isolates.

Limitations

Mild strain identification, transformed plants has to compromise with some amount of yield reduction. Chance of conversion of mild strain into severe strain, some apparent "breakdowns" of cross protection. Genetic recombination between the protecting strain and other viruses leads to mixed infection.

Conclusion

Whereas most mycoviruses lead 'secret lives', some reduce the ability of their fungal hosts to cause disease in plants. This property, known as hypovirulence, has attracted attention owing to the importance of fungal diseases in agriculture and the limited strategies that are available for the control of these diseases. Using one pathogen to control another is appealing, both intellectually and ecologically. Because cross protection does not rely on harmful materials or chemicals such as pesticides and fungicides, it is suitable for sustainable agriculture, which is in high demand. Because cross protection is effective in general, it is necessary to increase good attenuated strains against many severe viruses. Based on the molecular research of attenuation and cross protection, new techniques might be developed to further our progress in controlling viral diseases through cross protection with attenuated viruses. The genetic stability of attenuated viruses should be examined in each of the hosts to which they will be applied. Further molecular study and understanding of cross protection/ interference should pave the way for broadening the practical applications of attenuated viruses. The resistance in transgenic plants that is conferred by the introduction of a virus gene is lost upon infection by unrelated viruses but the cross protection is not.

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Zero Budget Natural Farming: A Novel Approach for Sustainable Agriculture

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Introduction

In India, the concept of natural farming was pulled into light by Shri Subhash Palekar, for which he was honoured with Padma Shri in 2016. According to Palekar, it is a method of farming where the cost of growing and harvesting the plants is zero. This means that farmers need not to purchase fertilizers and pesticides in order to ensure the healthy growth of the crops. This method dictates locally available natural bio-degradable materials saturated with scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes.

The Four Pillars of ZNBF

1. Jivamrita / jeevamrutha: It is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. Jeevamrutha also helps to prevent fungal and bacterial plant diseases.

Application: Apply the jeevamrutha to the crops twice a month in the irrigation water or as a 10% foliar spray.

2. Bijamrita / beejamrutha: It is used for treatment of seed, seedlings or any planting material. Bijamrita is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that commonly affect plants. It is composed of local cow dung from desi cow, cow urine, lime and soil.

Application: It is used as a seed treatment.

3. Acchadana / mulching: Soil mulch: This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil.

Straw mulch: It can be composed of the dead material of any living being (plants, animals etc) and provides dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures.

Live mulch: It is composed of symbiotic intercrops and mixed crops.

4. Whapasa / moisture: It is the condition where there are both air molecules and water molecules present in the soil, and the practice of regular irrigation is not encouraged, irrigating only at noon, in alternate furrows.

Principles of ZBNF

1. Intercropping: This is primarily how ZBNF gets its "Zero Budget" name. It doesn't mean that the farmer is going to have no costs at all, but rather that any costs will be compensated by income from intercrops, making farming a close to zero budget activity.

2. Contours and bunds: To preserve rain water, which promote maximum efficacy for different crops.

3. Local species of earthworms: the revival of local deep soil earthworms through increased organic matter is most recommended.

4. Cow dung: Dung from the Bos indicus (humped cow) is most beneficial and has the highest concentrations of micro-organisms as compared to European cow breeds such as Holstein. The entire ZBNF method is cantered on the Indian cow, which historically has been part of Indian rural life.

Asthras for Pest Management

1. Agniastra: This primarily is the mixture of chilli, garlic, neem and cow urine (all available in house or locally) and used to control the insects (leaf roller, stem borer, fruit borer, pod borer).

2. Bramhastra: mixture of several locally available plants like neem, guava, custard apple, pomogranate etc. with cow urine and is used to spray over the leaves of the plant.

3. Neemastra: mixture of cow dung, urine, neem etc. and used for leaf sucking insects and mealy bugs.

Natural Products for Insect-Pest Control

1. Darekastra.
2. Brahmastra.
3. Agneyastra.
4. Dashparni.
5. Beejamrita.

Natural Products for Disease Control Under Natural Farming

1. Fermented butter milk.
2. Jeevamrita.
3. Dry kandi.
4. Saunthastra.
5. Rambaan.
6. Plant paste / slurry.

Conclusion

Increasing use of chemicals in agriculture resulted into many environmental and health issues. Therefore, it is high time and challenge before all the agriculturists to work on the aspects using least chemicals in agriculture and ZBNF is one of them. This aspect is holistic, eco-friendly and has no harmful effects on humans and environment.

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Poultry Management in Winters

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Summary
The tremendous increase in mortality of chicks and a drop in performance of birds during the winters require an establishment of optimal micro-environment in the house as a countermeasure. It commences with the preheating of room 24 hours prior to the arrival of chicks and continued to the adult stages of birds. Feed the birds with carbohydrate and protein-rich diet to enhance heat increment in the body and their chances of survival besides maintaining production. Provide ad libitum lukewarm water in small doses at regular intervals with anti-stress medications. Maintain good litter condition as poor litter condition predisposes the birds to stress and diseases. In the end, the uniform distribution of birds in the house and their activity level will ensure better poultry production during the winters.

Introduction
Worldwide, the survival ability and productivity of poultry birds is greatly influenced by the environment. Any deviation in the normal environment deviate the normal physiological functions in the birds. Birds are homeotherms and can constantly maintain their deep body temperature but this is possible up to a certain limit i.e. 18-25°C. Beyond the limits, birds show signs of behavioural changes and discomfort leading to reduced performance. Nevertheless, by merit of physiology, the birds are better tolerant too cold than high temperature yet due to the low temperature, poor ventilation and reduced photoperiod they exhibit a higher degree of mortality, reduction in water intake, FCR, weight gain, egg production, fertility and hatchability, thereby jeopardizing the economy of poultry production. Besides, the availability of infrastructure and electricity in rural India is missing; making the management of poultry during winter an important concern for poultry owners. It is noted that different age groups of birds have unparalleled requirements and abilities to withstand cold stress where day-old chicks are the most vulnerable and a temperature of 95°F during the first week is essential. Poultry owners experience hundreds of challenges but maintaining the birds during cold environment or winter season is the greatest of all time, therefore, the following factors should be considered to optimize the poultry production during the winters.

Factors to Consider in Poultry Rearing During Winter Season
The factors are:

1. Shed management:

(Fig: A Rectangular shed aligned in east-west axis with hanging curtains)

a. Orientation of shed: The orientation of shed should be such that it influences more availability of sunlight within and on the external surfaces of the shed and spread of warmth to the birds amid cold weather. A rectangular open-sided shed aligned in the east-west axis provides the greatest possible gain of sunlight in tropical regions of the country; however, in temperate and hilly regions of the country, the shed are closed ones to conserve the warmth and aligned in south-east axis to get maximum sunlight. Meanwhile, in latter, ventilation is often compromised. Ensure pest and rodent control within the shed as they seek warm-er places for dwelling and poultry shed is the most favourable place for them to reside.

b. Ventilation in shed: Plenty of ventilation or fresh air circulation inside the shed should be maintained by making arrangements of exhaust fans within the shed and opening of curtains or slider windows during the day time. The exhaust fans should be operated at their minimum capacity to hold maximum heat or conserve maximum energy within the shed besides removal of foul air from the shed. It is recommended to have air speed not exceeding 0.2 metre/second across the birds for the first 14 days. The birds should be protected from cold drafts for which either curtain made of gunny bags or polythene sheet should be hanged or slider windows should be closed during the evening to the morning at the open-side of the shed from where the cold wind enters. Make sure the cold air entering the shed is directed to the roof and mixes sufficiently with the warm air above inside the shed and do not fall directly on the chicks. Seal all the holes, cracks and crevices in the wall and roof from where cold breeze may enter. This insulates the shed and gives an opportunity of controlling the cold air inside the shed.

In case, if the ventilation is restricted, there will be depletion of oxygen levels in the room due to continuous use of heaters and bulbs as heat source, and build-up of ammonia level in the air as birds releases a lot of moisture in their breath and droppings. This would cause respiratory tract and eye ailments among the birds and consequently hamper their health. The level of ammonia fumes in room should not exceed 25 ppm.

c. Light in shed: Make sure the birds get sufficient amount of artificial light as natural light during the winter season decreases. It is to be noted that the layers go moulting during the short-day-length period and take around 4 months to complete it. Till this time, they go out of egg production. Hence, to continue the egg production, recommended light hours should be made available to the layers during winters. The normal light requirement (hours/day) for chicks, growers and layer birds is 24, 11 and 16-17, respectively. White light should be made available to the birds as it stimulates feeding in birds. Besides, the bulbs should be cleaned at regular intervals as a dirty bulb gives only 1/3rd light as compared to the clean bulb. The clean bulb ensures correct lightning and increase in the egg production by 5-10%. Bulbs also generate heat and a 200-watt bulb is sufficient to maintain heat in the small-scale poultry houses. One must also make sure the availability of generators or lanterns in the farm in event of sudden power breakdown during night hours as broilers where 24 light hours is recommended panics leading to overcrowding and death due to suffocation. Broilers are therefore provided 23 hours light and 1 hour of darkness to get acquainted with darkness.

(Fig: Bulb as a heat source amid cold weather)

d. Heat / Temperature in shed: Traditional bukhari's, gas brooders and heaters can be used for maintaining heat in the large-scale poultry houses. The optimal heat (18-25°C) in a room can be assessed by the behaviour of birds. If the birds are huddling together near the heat source or found in patches known as 'comfort zones', it means the room is cold. In such case, increase the number of heat sources and isolate the house properly using curtains, etc. to provide uniform heat in the room which can be assessed by the uniform distribution of birds in the room. Happy birds will be seen busy in feeding, taking water, dust bathing, etc. In addition, temperature loggers can be placed at different places in the room at the bird's height to get a clear picture of uniform temperature distribution in the room.

2. Brooder management: Chicks need protection during the initial stages of life as it possesses no feathers on the body and feel cold and die due to the cold shock. During this stage, their immune system is still developing and they do not have the ability to regulate their own body temperature until fully thermo-competent at 12-14 days of age. Therefore, to maintain the uniform temperature around the chicks, reduce the mortality and for the early growth and development of their feathers; brooders and brooder guards should be installed in the brooder house. Hover-type electric brooders are commonly used. The brooder/chick guard should be placed 60-75 cm from the edge of hover and can be removed after 7-10 days of age. The temperature during the first week of life should be maintained to 95°F (35°C) which should be reduced by 5°F (2.5-3°C) every week until it reaches 70°F (21°C). The relative humidity should be maintained between 40-60%. The brooder temperature is measured with a thermometer placed 2 inches or 5 cm above the brooder floor. Start the brooders 24 hours before the arrival of chicks and make sure it is working properly. Preheating the room before covering the floor with bedding material, will ensure rapid heating of the floor and room. In case the floor is covered with bedding, preheating the room will insulate the floor from heat and lock in the cold underneath. The temperature of brooder house should be 20°F or 6.7°C below the brooder temperature. Brooding period ensures the greatest development in the musculoskeletal, gastrointestinal and cardiovascular system, provided that there is efficient feeding and watering management. This period (0-6 weeks for chicken; 3-4 weeks for quail) is the accelerated growth period for chicks which if conducted in optimal conditions can provide birds four times of their day-old body weight in just 7 days.

(Fig: Brooding of day-old quail chicks inside the brooder guard)

3. Litter management: Litter is the bedding material in form of saw dust, groundnut hulls, paddy husk, shredded newspapers, etc. made available to all the age groups of birds to fulfil the purpose of providing warmth in winter, comfort, cushion, manure-less contact and moisture-less dry bedding to the birds. A good quality litter serves as an insulator and insulate the birds from the cooling effects of the floor. Litter depth of around 6-12 inches and moisture ranging 18-24% should be maintained during winter season. The optimum moisture content in litter can be ensured by routine monitoring of ventilation and heating systems. Make sure that there are no loose water pipe connections, defective drinkers and damaged roof as water splashing from it may wet the litter, resulting in cake formation that acts as a good medium for anaerobic bacterial growth and ammonia production. Check the birds routinely for watery droppings as it may also wet the litter. Wet litter predisposes birds to various litter borne diseases like coccidiosis, etc. Correct management of litter requires frequent turning, raking and replacement of litter and can be known by feeling the warmth of litter in hand. Do not replace the litter completely from the shed as it is a source of heat, instead litter should be scrapped and removed 0.6 cm from the top. If litter gets too much wet, it is better to replace it.

(Fig: Paddy husk bedding without cake formation)

4. Feed management: Feed in poultry serves the major purpose of providing energy for maintaining body temperature besides carrying out the basic physiological functions. Feed intake is mostly affected by the environmental temperature. As temperature goes down, feed intake increases and vice versa. Birds in temperate regions of the country or during winter season should be given extra feed so that the extra energy generated can be utilised in maintaining the body temperature. In addition, feed should be made available for the whole day, the number of feeders should be increased and a new diet should be formulated by increasing the level of energy (by adding fat or oil sources in the diet) and keeping the other nutrients constant (to minimize the wastage of nutrients which in excess is voided in faeces). Feed birds with carbohydrate and protein rich diets as it increases heat increment, consequently increasing body temperature. It is experimentally proven that broilers during summer require 23% protein and 3100 Kcal ME/kg diet and during winter requires 23% protein and 3400 Kcal ME/kg diet for adequate growth. Feed should be of good quality as feed excess in salt, magnesium, wheat and barley cause watery droppings and wet the litter. Feed should also be not given in powder form as it creates dusty environment and cause respiratory distress among the birds. Nevertheless, store the feed in dry place and away from moisture.

5. Water management: Birds consume less water in the cold climate and therefore to maintain the water levels in the body it is mandatory to supply clean, fresh and lukewarm water to the birds at regular intervals. During winters, medications, anti-stress vitamins and vaccines are given in small quantity of lukewarm water however, care must be taken that waterers are uprooted couple of hours before giving water medications so that birds feel thirsty and consume total water and there is minimum wastage of water medications. In temperate regions of the country, blockage of pipes due to freezing is a major issue and requires routine inspection of the pipelines.

Conclusion

The success of raising poultry during the winter season lies in controlling the environmental fluctuations to the bird's specifications as early as possible. It begins by ensuring the optimal brooding environment for chicks 24 hours before their arrival which can later be easily recognized by the uniform distribution of chicks in the brooder room and finishes with the meticulous uphold of micro-environment in the adult stage. Besides sustaining the micro-environment, frequent turning, raking and replacement of litter and appropriate feeding and watering arrangements are compulsory to reduce the antagonist effects on poultry production during the winter season and achieve profitability.

Source of Images

The images are captured by the author's itself and can only be used by giving proper credit to the authors.

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Management of Downy Mildew of Maize

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Introduction

Sorghum downy mildew: *Peronosclerospora sorghi*
Philippine downy mildew: *Peronosclerospora philippinensis*
Crazy top: *Sclerophthora macrospora*
Symptoms:
1. The most characteristic symptom is the development of chlorotic streaks on the leaves.
2. Plants exhibit a stunted and bushy appearance due to shortening of the internodes.
3. White downy growth is seen on the lower surface of leaf.
4. Downy growth also occurs on bracts of green unopened male flowers in the tassel. Small to large leaves are noticed in the tassel.
5. Proliferation of auxiliary buds on the stalk of tassel and the cobs is common (Crazy top).



Symptoms

Pathogen

The fungus grows as white downy growth on both surfaces of the leaves, consisting of sporangiophores and sporangia. Sporangiophores are quite short and stout, branch profusely into series of pointed sterigmata which bear hyaline, oblong or ovoid sporangia (conidia). Sporangia germinate directly and infect the plants. In advanced stages, oospores are formed which are spherical, thick walled and deep brown.

Favourable Conditions

1. Low temperature (21-33˚C).
2. High relative humidity (90 per cent) and drizzling.
3. Young plants are highly susceptible.

Disease Cycle

The primary source of infection is through oospores in soil and also dormant mycelium present in the infected maize seeds. Secondary spread is through airborne conidia. Depending on the pathogen species, the initial source of disease inoculums can be oospores that over winter in the soil or conidia produced in infected, over wintering crop debris and infected neighbouring plants. Some species that cause downy mildew can also be seed borne, although this is largely restricted to seed that is fresh and has high moisture content. At the onset of the growing season, at soil temperatures above 20°C, oospores in the soil germinate in response to root exudates from susceptible maize seedlings. The germ tube infects the underground sections of maize plants leading to characteristic symptoms of systemic infection including extensive chlorosis and stunted growth. If the pathogen is seed borne, whole plants show symptoms.

Oospores are reported to survive in nature for up to 10 years. Once the fungus has colonized host tissue, sporangiophores (conidiophores) emerge from stomata and produce sporangia (conidia) which are wind and rain splash disseminated and initiate secondary infections.

Sporangia are always produced in the night. They are fragile and cannot be disseminated more than a few hundred meters and do not remain viable for more than a few hours. Germination of sporangia is dependent on the availability of free water on the leaf surface. Initial symptoms of disease (Chlorotic specks and streaks that elongate parallel to veins) occur in 3 days. Conidia are produced profusely during the growing season. As the crop approaches senescence, oospores are produced in large numbers.

Management

1. Deep ploughing.
2. Crop rotation with pulses.
3. Rogue out infected plants.
4. Treat the seeds with metalaxyl at 6g/kg.
5. Spray the crop with Metalaxyl + Mancozeb @ 1kg on 20th day after sowing.
6. Grow resistant varieties and hybrids viz. CO1, COH1and COH2.

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Predilection of Insect Ethology Vis-À-Vis Plant Defences

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Introduction

Insect-plant interaction refers to the activities of two types of organisms: Insects that seek out and utilize plants for food, shelter, and/or egg-laying sites and the plants that provide those resources. The landscape or canopy is usually heterogeneous and each site is characterized by a set of heat fluxes (net radiation, convection-conduction and evapotranspiration). These heat fluxes between the leaf surface and the environment determine directly the leaf temperature depending on the stomatal behaviour and they also indirectly influence the plant's chemical defences its nutritional quality, the emission of volatile organic compounds (VOC s).

All these traits potentially set the performance of the insect and ultimately its fitness and population dynamics. The insect by feeding on plant tissues may initiate a defence response either in the form of production of secondary metabolites or attracting a natural enemy that inturn protects the plant by feeding / ovipositing on the insect.

Types of Insect-Plant Interactive Defence

Direct defences: They could be physical or chemical and include morphological barriers such as trichomes, cell wall lignification and silica deposition, and syntheses of toxic chemicals (alkaloids, terpenoids and phenolics) which act as repellents, deterrents, anti-nutritients against herbivory.

Indirect defences: They refer to the attraction of the natural enemies (parasitoids and predators) of the herbivores and it also increases foraging success of the natural enemies, thereby facilitating better control of the herbivores.

Model of the Multi-Layered Plant Defence Response to Aphid Herbivory

1. Plant cells perceive aphid herbivore-associated molecular patterns (HAMPs) leading to HAMP-triggered immunity (HTI).

2. When the aphid is unable to secrete effectors that suppress HTI, this effective defence response deters the aphid from further feeding. For example, recognition of HAMPs may be involved in resistance of non-host plants to aphids, for example, in Arabidopsis thaliana resistance to the pea aphid *Acyrthosiphon pisum*.

3. Although plants perceive the aphid HAMPs, the defence response is effectively suppressed by aphid effectors leading to aphid colonization. this model applies to compatible interactions between, for example, *Myzus persicae* and *A. thaliana* / *Nicotiana benthamiana*.

4. The aphid species produces effectors that effectively suppress HAMP-triggered immunity responses, but in certain clones of this aphid species one or more effectors are being recognized by R genes leading to a plant effective immune response and plant resistance to the aphid clone.

R Genes-Examples

Vat (R gene) confers resistance to one biotype of the melon-cotton aphid Aphis gossypii , while Bph14 (R gene) confers resistance to the rice brown planthopper *Nilaparvata lugens*.

Abdul Rashid et. al., (2011) studied and reported the effect of Jasmonic acid (JA) as a spray on induced resistance in three groundnut genotypes namely, ICGV 86699 (resistant), NCAc 343 (resistant) and TMV 2 (susceptible) against *Helicoverpa armigera* was studied. The activity of oxidative enzymes [peroxidase (POD) and polyphenol oxidase (PPO)] and the amounts of other host plant defence components [total phenols, hydrogen peroxide (H2O2), malondialdehyde (MDA), and protein content] were recorded at 24, 48, 72, and 96 h after pre-treatment (1 day) with JA followed by infestation with *H. armigera* (PJA-HIN) and

H. armigera infestation with simultaneous JA application (HIN-JA) to understand the consequences of induced resistance in groundnut.

The plant damage, larval survival and larval weights were also recorded. There was a significant increase in POD and PPO activities and in the amounts of total phenols, H2O2, MDA, and proteins in PJA , HIN and JA .HIN-treated plants as compared to the plants treated with JA and infested with *H. armigera* individually and to untreated control plants. Among all the genotypes, the strongest induction of defence was observed in the ICGV 86699 genotype. PPO reduces the nutrient quality, digestibility and palatability of plant tissues to insects and catalyses the oxidation of phenols leading to the production of toxic quinines, a response induced by herbivory. It was concluded that pre-treatment with JA and its application during low levels of insect infestation can increase the levels of host plant resistance against herbivorous insects and reduce the pest associated losses in groundnut.

Robert et. al., (2000) recorded Pea weevil *(Bruchus pisorum)* oviposition on pods of specific genetic lines of pea (Pisum sativum) and reported that it stimulates cell division at the sites of egg attachment. As a result, tumour-like growths of undifferentiated cells (neoplasms) develop beneath the egg as well they impede larval entry into the pod. This unique form of induced resistance is conditioned by the Np allele and mediated by a recently discovered class of natural products they have identified from both cowpea weevil (*Callosobruchus maculatus* F.) and pea weevil.

These compounds, which are referred to as “bruchins,” are long-chain a,v-diols, esterified at one or both oxygens with 3-hydroxypropanoic acid. Bruchins are potent plant regulators, with application of as little as 1 fmol (0.5 pg) causing neoplastic growth on pods of all of the pea lines tested. The bruchins have the ability to induce neoplasm formation when applied to intact plants, thus protecting the plant.

Ordinarily, pea weevil larvae burrow through the ventral surface of the egg and directly into the pod to reach the immature seed. In contrast, eggs on Np pods are displaced from the pod surface by a mound of neoplastic tissue. This mound causes the larvae to wander about before attempting to burrow through the pod wall, thus exposing them to environmental hazards including predators, parasites, and desiccation.

Sergio et. al, (2000) studied and observed an insect-induced belowground plant signal, (E)-beta caryophyllene, which strongly attracts an entomopathogenic nematode. Maize roots release this sesquiterpene in response to feeding by larvae of the beetle *Diabrotica virgifera virgifera*, a maize pest.

Joshua et. al., (2008) studied and concluded that Rice plants infested by *S. frugiperda* release about 30 volatiles including MeSA and methyl benzoate, which attract the natural enemies of S. frugiperda such as *C. marginiventris*. FAW-induced volatiles emitted from rice plants were tested using a Y-tube two-choice olfactometer bioassay.

Naive female parasitic wasps were given a choice between the odor of rice plants damaged by FAW and the odor of untreated control rice plants. Of all wasps tested, 89.7% walked to the arm of the Y-tube that carried the odor of FAW-damaged rice plants. The remaining 10.3% either did not make a choice or chose the arm that carried the odor of untreated rice plants.

In this experiment Wang et. al., (2019)to assess the roles of olfactory organs in food selection in terms of the effects of individual volatile compounds from plants at various distances, the palp-opening response (POR), biting response and selection behaviour of locust *(Locusta migratoria)* nymphs in response to volatile compounds from host and non-host plants at various distances were studied,Thirty odorants were identified as the active volatiles to locust by the POR tests.

At a distance of 3 m, locusts were attracted to a few common volatiles (1% v/v) of both host and non-host plants, while few components of volatiles acted as repellents at this distance. At a distance of 1 m, locusts responded more readily to volatile compounds. At a distance of 1 cm, locusts mainly used their palps to detect volatiles.

Conclusion

There is a need to understand the ecological significance of HIPVs by integrating biochemical and molecular mechanisms in the production, and understand their ecological functions. Understanding of such interactions will open up new avenues for further studies on primary signaling cascades to the ecological consequences in various eco-systems.

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Smart Fertilizers: A Novel Way to Enhance the Nutrient Use Efficiency and Food Security

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Agricultural land systems (cropland, managed grassland, permanent crops including agroforestry and bioenergy crops) cover about 40%–50% of the Earth's land surface (Smith et al., 2007), on which humanity needs to secure food production. World agricultural cropping systems intensively using a large number of fertilizers, pesticides, and herbicides to achieve more production per unit area. Continuous fertilizer input becomes essential to sustain and increase food production. But using more doses than optimum of these chemicals and fertilizers leads to several problems like environmental pollution and several problems in the world community. So, our duty is to overcome these fundamental lapses with entirely new concepts developed. Smart fertilizers may be a solution to enhance food production as a response to food security and improving environmental quality.

Smart fertilizers include:
1. Slow and controlled release fertilizers.
2. Nitrification inhibitors.
3. Urease inhibitors.

Technological advances in phosphorous fertilization include products that increase phosphorous availability in the soil for better uptake by plants.

The history of the Indian fertilizer industry dates back to 1906 when the first fertilizer factory opened at Ranipet (Tamil Nadu). Since then, there have been major developments in terms of both the quantity and the types of fertilizers produced, the technologies used and the feedstocks employed. The fertilizer industry in India is in the core sector and second to steel in terms of investment. Before 1960/61, India produced only straight nitrogenous fertilizers [ammonium sulphate (AS), urea, calcium ammonium nitrate (CAN), ammonium chloride and single superphosphate (SSP)]. The production of NP complex fertilizers commenced in 1960/61. Currently, India produces a large number of grades of NP / NPK complex fertilizer. India imports mainly urea, DAP, and potassium chloride (MOP). The country has almost reached self-sufficiency in urea production. Besides, India also imports a small quantity of mono-ammonium phosphate (MAP) and potassium sulphate (SOP) (65,000 and 10,500 tonnes, respectively, in 2003/04).

Fertilizers are indeed essential for the healthy growth of plants but they are harmful to the environment. Fertilizers these days contain all sorts of chemicals which boost the healthy and fast growth of plants but further to this, these fertilizers are not really environment friendly. Hence, organic and natural fertilizers made from compost and manure should be used to balance the environment. The huge amounts of conventional P fertilizer need to be applied annually to maintain available P levels in soil-plant systems. N and P fertilizer application at levels exceeding plant requirements due to low acquisition efficiency leads to significant environmental consequences in many parts of the world due to N losses, such as nitrate ($NO3-$) and phosphate ($PO3-$) leaching, $NH3$ volatilization, and nitrous oxide ($N2O$) emission. Transport of P and N from agricultural soils to surface waters has been linked to eutrophication of freshwater and estuaries. In addition, current agricultural activities and fertilizer applications contribute up to 20% to the annual atmospheric emissions of GHG, such as methane ($CH4$) and carbon dioxide ($CO2$).

To enhance nutrient use efficiency, new types of smart fertilizers with the controlled nutrient release is essential. The development of such fertilizers could be based on the use of microorganisms (biofertilizers) and/or nanomaterials (nano fertilizers). Nano fertilizers are synthesized and modified forms of traditional fertilizers, fertilizers bulk materials or extracted from the different vegetative and reproductive parts of plants by different physical, chemical, mechanical and biological methods with the help of nanotechnology used to improve the soil fertility, productivity, and quality of agricultural produce.

There are several smart fertilizers to be used like:
1. Slow/controlled release fertilizers which are those containing a plant nutrient in a form, which delays its availability for plant uptake and uses after application.

2. Bioformulation / Plant growth-promoting fertilizers which are generally biofertilizers encapsulated microorganisms in carrier materials that are designed to protect them during storage and from adverse environmental conditions (pH, temperature, etc.), thus ensuring a gradual and prolonged release.

3. Nano fertilizers, as smart fertilizers, are designed to increase nutrient use efficiency and consequently reduce adverse effects on the environment compared to the application of conventional mineral fertilizers. According to Mastronardi et al. (2015) there are three main types of nanofertilizers: nanoscale fertilizer (synthesized nanoparticles), nanoscale additives (bulk products with nanoscale additives), and nanoscale coating or host materials (product coated with nanopolymer or loaded with nanoparticles).

4. Polymers, are widely used in agriculture especially for fertilizer development. Smart polymeric materials have been applied to smart delivery systems of a wide variety of agrochemicals (Puoci et al., 2008). A broad range of synthetic materials, such as petroleum-based polymers, have been used to encapsulate water-soluble fertilizers.

5. Biodegradable Polymer, have increasingly been used as substitutes of other polymers in agriculture. Biodegradable polymers have also been used in bioformulations, acting as microbial carriers. These carriers protect microbial inoculants from various stresses and prolong shelf life.

6. Lignocellulosic straw as carrier and coating material are low-cost materials such as wheat straw which are abundantly available resources in current agricultural systems. These harvesting residues contain lignin, hemicelluloses, and cellulose. Cellulose fibrils and lignin impart mechanical strength properties. Wheat straw contains surface carboxyl, hydroxyl, ether, amino, and phosphate, which enhance its reactivity and physicochemical properties, useful in the preparation of adsorbent materials for the treatment of wastewater and slow-release fertilizers.

7. Biochar as Carrier and Coating Material: Considering its physicochemical properties, carbonaceous materials like pyrogenic carbon (biochar) have been widely used as soil ameliorant with several applications in both laboratory and field studies. Recent studies have also investigated the use of biochar and charcoals as carriers in combined formulations with beneficial microorganisms. Biochar was a useful carrier for the bacterial population of Enterobacter cloacae and *Azospirillum lipoferum* (AZ 204).

In order to meet sustainable development goals, agricultural production needs to be increased in a more environmentally- ecologically safe use of agronomic inputs. Devastating long term use of chemical fertilizers in the soil is an unscrupulous practice of human civilization. Therefore, comes the use of organic matter (i.e. FYM, cow dung) along with the chemical fertilizer to improve soil health. Advances in the application of biotechnology and nanotechnology have the potential to facilitate improved nutrient management and use efficiency in agroecosystems. Smart fertilizers based on slow or controlled-release or carrier delivery systems have been shown to improve crop yields, soil productivity, and lower nutrient loss compared with conventional fertilizers. Several materials such as clays, nano-clays, degradable polymers, and agricultural wastes are suitable for the development of smart fertilizers by acting as carrier substances for nutrients and bacterial inoculants. Future research should continue to explore and evaluate the composition, manufacture, and agronomic and environmental performance of various smart fertilizers. Lignocellulosic organic waste, such as straw after chemical, physical, or thermal transformations, maybe an excellent carrier or coating material for fertilizer formulations. Such organic wastes occurring as harvesting residues in agricultural systems should be used in the sense of a circular economy to create innovative fertilizers from natural materials, which are urgently needed to ensure intensification of sustainable crop production and food security.

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Factors Affecting the Quality of Orchid Flower

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Introduction

Orchids comprise the largest family of flowering plants with 25,000 to 35,000 species belonging to 600-800 genera. They are prized for their incredible diversity in the size, shape and colour and attractiveness of their flowers and high keeping qualities even up to 10 weeks. Vase life or longevity of a cut flower was determined on the basis of attributes like diameter and length of florets, opening of flowers, changes in fresh weight, diameter or length of stem or pedicel, senescence pattern, colour of petals, total longevity and foliage burning. The post-harvest life of cut flowers is often limited by their inability to maintain photosynthesis under the lighting conditions of the interior environment where they are held, so it is important to ensure high carbohydrate levels in plants at harvest time. Many factors like Pre-harvest, Harvest and Post-Harvest factors are affected to the quality of orchid flower are discussed here under.

Pre-Harvest Factors

1. Varietal differences: Varietal differences in cut flowers had been reported due to variations in water uptake, fresh weight, flower diameter, stems lignification, vase life and senescence behaviour. Among different species, the vase life ranges from 9 – 18 days. Some of the orchids like Dendrobium, Vanda remained perfect for 7 to 30 days. The flowers of Cattleya and Phalaenopsis remained fresh for 1 to 4 weeks whereas Aranda lasted for 18 to 28 days.

2. Light intensity: Light was found to determine the carbohydrate levels before harvest which in turn influence the keeping quality. Flowers containing relatively higher amounts of carbohydrates especially mobile sugars lasted longer in the vase. Plants having few leaves, or leather like leaves required a high-light environment. If the leaves are soft and limp, the plants were probably very light-sensitive, and should not be placed in a sunny south-facing window. Most orchid's preferred indirect or filtered light and 50% shading.

a. **Low light orchids (1200-2000 f.c.):** Phalaenopsis, Calanthe.
b. **Medium light orchids (2000-3000 f.c.):** Cattleya, Laelia, Brassovola.
c. **High light orchids (3000 f. c. or more):** Cymbidium, Vandaceous groups.

3. Temperature: Generally, higher temperature resulted in higher level of respiration. Cooling was essential to reduce other metabolic changes such as enzymatic activity and to slow the maturation of flowers. Cooling prior to packaging and transport reduced ethylene production and improved longevity. Based on temperature requirements, orchids were classified into three groups:

a. **Warm orchids (Aerides, Vanda, Rhyncostylis and Dendrobium):** 32.2° C day temperature and 15.5° C night temperature.
b. **Intermediate orchids (Cattleya, Laelia, Oncidium, Miltonia):** 26.6° C day temperature and 12.8° C night temperature.
c. **Cool orchids (Cymbidium, Odontoglossum, Cypripedium):** 24° C day temperature and 10° C night temperature.

4. Humidity: As a thumb rule, orchids required 80-85% humidity for satisfactory growth. Monopodial orchids required higher humidity than sympodial ones. Many sympodial orchids like Cattleya, Oncidium and Dendrobium form pseudo bulbs, which were swollen shoots that store water and nutrients to help the plant survive periods during prolonged drought. Insufficient humidity during summer might lead to shrivelling of pseudo bulb. Excessive humidity during winter might lead to spotting of flowers usually caused by Botrytis.

5. Nutrition: Orchids were light feeders and they required nitrogen from beginning to two-third of their life cycle. During rest period, they did not need any fertilizers. During flower initiation and inflorescence development plant were fed with less nitrogen, more phosphorus and potassium. In orchids, foliar feeding was found to be ideal. Frequent application of fertilizers in low concentrations was the best way of feeding orchids. Sometimes, fresh coconut water, diluted cow urine and fish meal emulsions were also useful as foliar spray.

Harvest Factors

1. Time of harvest: Flowers should be harvested in mild temperature because high temperature causes rapid respiration rates and excessive water loss. Flowers should be harvested in the early morning or in the evening. In the early morning, flowers remained turgid due to transpiration at night and higher sugar levels. Similarly, flowering stems retain a higher amount of stored carbohydrates if cut in the afternoon and retained more vase life.

2. Method of harvest: Sharp tools or secateurs were always used to detach the stem of flowers from the mother plant. The angle of the cut was given in slanting position and the stem was not crushed during harvesting, especially hard wood stems. The spikes were dipped in a bucket containing water immediately after harvest.

3. Stage of harvest: The optimum harvesting stage of the commercial orchids was fully open and mature flowers. The stage of harvest, spike length and number of flowers of some commercial orchids are given in Table 3. Out of three Cymbidium hybrids namely 'Pine Clash Moon Venus', 'Valley Legend Steff ' and 'Pure Inca Gold', flower spikes were harvested at four stages like fully open, 75% open, 50% open and 25% open to standardize the stage of harvesting, and enhanced vase life. Vase life was noticed highest in 75 % open stage. Maximum vase life of 59 days was recorded in 'Pine Clash Moon Venus' and followed by 48.83 days in 'Valley Legend Steff ' and 53 days in 'Pure Inca Gold'.

Post-Harvest Factors

1. Temperature: Opening of flower buds and rate of senescence accelerated at higher temperatures. At lower temperature, the respiration came down and the flowers produced a lesser amount of ethylene. Temperature played an important role for flowers harvested at the immature stage for full expansion of buds and the flower buds were kept at temperatures as low as 0.5 to 4.0° C in Cymbidium and Paphiopedilum, 5-7° C in Dendrobium and 7-10° C in Cattleya.

2. Light: Light was essential for long distance transport or prolonged storage of cut flowers. Similarly, high light intensity was essential for opening of tight bud cut flowers. Florists had to maintain a light intensity of 2000-3000 lux for 12-24 hours in their shops for illuminations for most of cut flowers.

3. Humidity: Cut flowers were kept at 90-95% relative humidity for maintaining turgidity. Flowers started showing wilting symptoms when they had lost 10-15% of their fresh weight. The rate of transpiration from leaves was reduced with the increase of high relative humidity.

4. Water quality: Water quality is defined as pH and EC value, hardness contents of phytotoxic elements and microorganisms causing vascular occlusions affecting longevity of cut flowers. Saline water decreased the vase life of cut flowers. Vase life increased in tap or well water passed through a de-ionizer. The importance of low pH of the holding solutions is well known for improving vase life. A holding solution of pH 3.0-5.0 was optimum for increasing vase life of cut flowers.

5. Ethylene: Ethylene played an important role in the regulation and co-ordination of senescence in climacteric flowers. Production of this hormone was less and stable in floral buds and young flowers. A sharp increase in ethylene evolution was found during flower maturation, opening and senescence. Afterwards, ethylene production decreased and remained static. Orchid flowers were highly sensitive to ethylene. High level of ethylene production was due to herbivore damage, mechanical injuries and pollination. De capped and emasculated flowers produced more ethylene than untreated ones. Sometimes, forced unfolding of flower buds in orchids reduced vase life.

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Preparation and Interpretation of Soil Survey Report

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Introduction

Soil and land use surveys help in the assessment, mapping and proper interpretation of the basic data on soil and characteristics for various land use purposes. Soil survey can be regarded as complete only if report that describes the kinds of soil shown on the map and their capabilities for use is given to enable farmers, farm advisors, planners and other users to make full utility of the data. Soil survey reports or soil bulletins are the end products of any survey. They form the essence of all field investigations.

Pre-Requisites of Soil Survey Report

For writing a soil survey report, different approaches may be followed depending upon the inclinations of the organization and the report writer.

1. The survey report should be attractive and technically sound and convenient for the readers, most of whom are not soil specialists.

2. Besides written text, the report should be illustrated by photographs, tables, diagrams and block diagrams.

3. The report should meet the requirements of different end users viz., policy makers (development process), soil scientists (profile characteristics for improving agricultural productivity) and for others to know about the soils and their formation by themselves.

Abstract

The abstract may include broad facts, conclusions and recommendations offered by the surveyors.

How to Use Soil Survey Report

This explains the reader how to locate the fields of his interest on the map viz., map scale and symbols for land marks.

Table of Contents

The purpose of the table of contents is to help the reader to find specific items in the report.

Introduction

Explains the purpose of the survey and the circumstances leading to it. It gives a brief account of the survey area, intensity of survey and the organization which conducted the survey. A simple location map giving all the places mentioned in the report should be provided at the beginning of the chapter.

General Description of the Area

1. Location and extent: Latitude and longitude, boundaries, main geographic names like rivers, towns, main roads etc., are to be given.

2. Climate: Temperature and rainfall (precipitation) data in tabular form should be given. Information like frequency and severity of drought, detrimental wet periods and floods, form and intensity of rain, snow, hail, local variations of climate due to elevation, nearness to lakes and ombrothermic diagram should also be given.

3. Physiography, relief and drainage: If the area has two or more distinct physiographic divisions, these may be described giving the principal soils in each division.

4. Geology: Main geological formation of the area should be explained. Information on weathering of the parent material is essential for soil classification.

5. Natural vegetation: Trees, bushes and shrubs present on different soils in different land systems of the area.

6. Water supply: Sources of water for domestic use, livestock and irrigation.

7. Present land use and agriculture:

- **a. Land use:** A general description on the kinds and areas of cropped fields, forests, orchards, grasslands etc., in the various system and land types
- **b. Agriculture:** Acreage and production of principal crops, crop rotations, area under different crops with the reasons, cultural practices, harvesting and storage may be explained.

8. Socio economic condition.

Soil Survey Methodology

Details about the procedure followed for soil survey, base maps used etc.

Soils of the Area

1. Series identified: All the soil series recognized in the area may be introduced.
2. Soil genesis: Origin and character of the various pedogenic processes.
3. General description of the soil series.

Soil Survey Interpretation

The interpretation of the soil data is most important to the actual user, agricultural planner, the engineer and so on. The following interpretations are usually made from soil survey data.

1. Thematic interpretative classification.
2. Land Capability classification.
3. Land Irritability classification.
4. Land Suitability classification.
5. Productivity classification.

Problems and Suggestions

Precise conclusions on nature of the soils, their distribution and their potential uses have to be given along with broad recommendations to guide the user.

Annexures

Annexures are vital because they enable the surveyor to present essential data without mixing the main text. The following annexures are normally included.

1. Morphological description of the soil series.
2. Index to village wise mapping units.
3. Legend for soil symbols.
4. Analytical data of representative soil profiles.
5. Glossary.

Maps

The soil and interpretative maps complete the soil survey reports. Maps must be clear, attractive and self-explanatory.

Summary and Conclusions

Individual soil related constraints should be enumerated first and accordingly suggestions for better management should be given. The report should end with a brief summary about the area of survey, type of survey, soils met along with their extent and the objectives of the survey.

Soil Survey Interpretations

In recent times, the interpretations cover a wide spectrum of soil uses, both for agricultural and non-agricultural (sewage and human waste disposal, high way construction, water and gas supply, recreation, wild life, urban and industrial structures) and many specialized uses. Soil survey if correctly carried out according to scientific principles, can provide the data base for various interpretations. This is because the same soil properties determine the behaviour of a soil for a variety of different uses. For instance, the content of clay, silt and sand, the shrink and swell behaviour, the permeability of soil to water and air, content of calcium carbonate, salts, organic matter, gypsum, soil depth, depth of ground water, hard pan formation, co-efficient of linear extensibility, water holding capacity etc are examples of such properties that are important to plant growth and these properties also strongly influence non-farm uses.

Conclusion

Soil surveys are land inventories composed of soil maps, soil descriptions, some physical and chemical analyses, engineering properties and limitations for major land uses. The utilization of soils in a better way has also been reported possible through soil survey.

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Role of Plant Growth Regulators on Drought Stress Management

Article ID: 31264

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Introduction

In recent years, abrupt changes in climatic conditions are posing a potential threat to biodiversity. A rapid rise in the levels of carbon dioxide (CO2), methane (CH4) and other potent greenhouse gases due to industrial revolution are also one of the major factors for global warming. These changing environmental conditions have not only affected biotic factors, but have also severely affected several abiotic stressors like drought, salinity, flooding, cold, and high temperature and causing reduction in arable land. Since plants are sessile in nature they cannot escape from various environmental stresses.

Plants growing under such natural environment are often exposed to adverse environmental condition that has devastating effect on their normal growth and productivity. Among the abiotic stresses, drought is the limiting factor creating high impact on sustainable food production. Study reported drought has reduced the global crop production by 10%.

Drought is exacerbated by high temperature and its severity is unpredictable because it depends on several factors like intensity and distribution of rainfall, weather, evapotranspiration and soil properties for water storage. Drought causes responses at different levels and at different stages.

Water stress at different stage of plants like seedling, vegetative and reproductive stage causes severe loss in morphological, physiological, biochemical and molecular characters. Drought stress adversely affects the plant height, leaf area, number of leaves likewise photosynthetic rate, transpiration rate, stomatal conductance is also affected. Specifically, root growth and yield characters are significantly reduced. Consequently, these effects cause severe loss in yield potential of the crop.

Therefore, this becomes the great challenge for the researchers to keep up the production under adverse environmental condition. In advance, a better understanding is required on physiological and molecular basis on drought tolerance to develop a better approach to combat the drought effects.

Apart from these constraints, it is projected that the world population is expected to reach 9 billion by 2050. Indeed, global food production needs to be doubled by the year 2050 to deal with the projected demand for cereal grain to feed the burgeoning population.

To achieve this production in the face of rising atmospheric temperature, rainfall extreme events, limited land availability and increased fertilizer cost, a quantum advance in yield potential is required.

Plant Growth Regulators

To cope with the detrimental effect caused by drought plant has evolved some intricate mechanisms for the modulation of specific cellular and metabolic functions in response to external environmental stimuli. In which plant growth regulators are important network which express the responses to drought condition. Plants are capable of sensing various external environmental conditions and transducer the signals to the nucleus and cause specific changes in the gene expression, cellular and metabolic functions.

Plant growth regulators (PGRs) are the organic compounds and are active at low concentration. In response to abiotic stress PGR acts as a signalling molecule and communicates intercellularly thereby improves the defence mechanism of the plants against the damages caused by external stimuli.

In this context exogenous application of plant growth regulators such as salicylic acid, jasmonic acid, brassinosteroid, melatonin, strigolactone and polyamines like spermine, spermidine and putrescine, helps the plant to combat the effect of drought by expressing resilience or mitigation (Abid ullah et al., 2018).

Therefore, external application is sufficiently valuable to improve the growth and productivity of the crop under drought situation (Awan, et al., 2017). The following table gives you an idea about the hormonal concentration, crop stage and effect of application under drought stress.

Fig.1 Mitigation of Drought Stress Using Plant Growth Regulators

Crop	Plant growth regulator	Dosage and stage of application	Effect of application
Rice	Salicylic acid	100 mg L-1	Accumulates compatible solutes, maintains tissue water potential and enhances the potency of antioxidant system, improved the integrity of cellular membranes and facilitated the plant to sustain photosynthesis and general metabolism
Sunflower	Salicylic acid	200mg L-1 Seed treatment	Improves germination and seedling growth
Rice	Spermine	10 µM Foliar spray at Five leaf stage	Improved net photosynthesis, water use efficiency, leaf water status and membrane properties
Wheat	Methyl Jasmonate	0.5mM 1 week after drought stress	Improves dry biomass, number of grains per spike, and grain weight resulted in higher grain yield and biological yield
Pepper	Epibrassinolide	0.01 mg L-1 20-25 leaf stage (2 months old plant)	alleviate the detrimental effects of drought on photoinhibition by dissipation of excess excitation energy
French bean	Epibrassinosteroid	1 µM Prior to stress	increased root nodulation in French bean, by the induction of cytokinin production and nitrogenase activity
Wheat	Strobilurin	250g/l Foliar spray at Vegetative stage	Increased water use efficiency , chlorophyll content and yield
Maize	ABA	100µM Flowering stage	Maintains the water status and improves the enzymatic antioxidant activity
Sugarcane	ABA	15 µM 5 months old crop	Over expression of antioxidant defense system
Maize	Gibberellic acid	50 mg L−1 45 days old plant	Maintains membrane permeability, enhances chlorophyll concentration, leaf

			relative water content and nutrient concentrations in leaves
Sweet potato	Paclobutrazol	34 µM 4 weeks old plant	Acts as an osmoprotectant, Delays wilting symptoms, maintains storage root yield, improves photosynthetic rate, vine length

Conclusion

Plants are non-motile in nature and are inevitable to adverse environmental condition. In recent decades frequency of drought years are often encountered which creates yield loss and reduction in arable land. This becomes the great challenge for the scientists to improve the crop production under adverse environment by developing innovative mitigation technologies. Among which exogenous application of plant growth regulators such as gibberellic acid, ABA, brassinosteroid, jasmonic acid, salicyclic acid and some of the polyamines are playing major role on improving plant defence mechanisms against water scarcity. Thus, helps to reduce the yield loss in agriculture production and meet the food demand for burgeoning population.

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Micropedological Features of Soil and its Role in Genesis and Classification

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Introduction

Soil Micropedology is a method of studying undisturbed soil and regolith samples with the aid of microscopic and ultramicroscopic techniques in order to identify the different constituents and to determine their mutual relations, in space and time, as far as the latter is possible. This means that the investigation should be carried out on undisturbed (and mostly naturally oriented) soil samples, in contrast to the other analytical methods used in soil science (e.g., mineralogical, chemical and physical analyses) requiring mostly a mixing, crushing, solubilisation or fractionation of the samples.

The term micromorphology was originally used to refer to that field of micropedology dealing with fabric analysis only, but soon both were used as synonyms. Micromorphology as a general term, comprises both the qualitative and quantitative analysis of the soil; the latter is commonly referred to as micromorphometry. Optical microscopy is one of the few techniques that allow us to examine the soil and its components in situ, unaltered and undisturbed by preparation or analytical procedure. Micromorphological investigations are based on the principles of preservation of the fabric and structure and functional investigation. Observations made on soil materials using a hand lens have probably been performed since the very beginning of soil science. A normal micromorphological study consists of the following successive steps:

Sampling, analysis and description of the thin sections, and finally the interpretation and summarizing of the results. The purpose of sampling is to obtain information relating to solving a particular problem, or to extrapolate information gained to understanding of other similar materials or soils.

Techniques Involved in Micromorphology

The basic technique in soil microscopy and micromorphology involves the preparation of thin sections of undisturbed soil materials, the samples being collected in boxes with double lids to avoid disturbance. The outstanding developments include the use of synthetic resins for improved impregnation and the increase in size of thin sections. The introduction of acetone as a diluent of the resins made it possible to remove water from the samples by acetone exchange thus reducing shrinkage.

Over 45 ancillary techniques are used, including fluorescence, image analysis and electron microscope analyses. Polished blocks may be adequate if a fluorescent dye is incorporated in the impregnating resin as the block can then be photographed with fluorescent light to show the distribution of the pore pattern.

Purpose of Micro-Morphological Study

The purpose of micro-morphogical study of soil can be inferred from the following points:
1. Aids in micro pedological studies in understanding the soil genesis.
2. To study the durability of contaminants in the soil.
3. Study soil plant interaction, for example clay a and iron oxide coating on white walls reduce N, P and K uptake.
4. Micro-morphology recognizes the individual feature in soil. Clay particles are recognized using SEM and TEM.
5. Micro-morphology helps in recognizing of patterns. Not only patterns of single individuals but individuals among themselves. Patterns range from single quartz grain to open complex distribution of clay particles or the most difficult patterns of anisotropic matrices.

6. Interpretation is based on combination of experience, intuition and guesswork for example clay coatings are believed to be formed by translocation of clay particles, clusters of calcium and gypsum by translocation of calcium sulphate.

How Morphology Aids to the Study of Genesis?

1. The basic component of soil fabric is particle size. Individual particles larger than 10 microns can be observed as single mineral grain. The mineral grains of this size can be used in identification of parent material and with litho-logical discontinuities in soil profile using petro graphic techniques.

2. As the mineral weathers, the structural outline or simply the pseudo-morph of original mineral remains, the secondary clay mineral forming from that mineral maybe observed in direct contact with the Pseudo-morph. This is in identifying weathering and clay forming processes.

3. Mineral materials too small for individual observation are identified in comparison to surrounding material. They give information about contrasting particle mixtures.

4. Masses of organic material indicator of specific plants and animals with or without cell structure can be identified.

5. The pedo features give an idea about the processes taking place during genesis for example the presence of depletion pedo-feature give some idea of reduction due to removal of iron oxides, similarly crystalline product features are the proof of material formation within soil.

Conclusion

Therefore, micromorphology is the branch of soil science that is concerned with the description, interpretation and to an increasing extent, the measurement of components, features and fabrics in soils at a microscopic level. Optical microscopy is one of the few techniques that allows us to examine the soil and is components in situ, unaltered and undisturbed by preparation on analytical procedures.

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Integrated Nutrient Management (INM)

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Introduction

1. INM refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

2. It implies intelligent use of organic, inorganic & biological sources so as to sustain optimum yield, improve or maintain soil fertility and provides crop nutrition packages which are technically sound, economical & environmentally safe.

Objectives of INM

1. Increasing the fertilizer use efficiency.
2. Increasing the returns to investment on fertilizers.
3. To use balanced system of crop nutrition management.
4. To account for different amounts of plant nutrients.

Different Sources of Nutrients

1. Inorganic fertilizers.
2. Organic manures(bulky & concentrated).
3. Green manures.
4. Bio fertilizers: Biological nitrogen fixers.
5. P- solubiliser & mobiliser and Mycorrhiza.

Components of INM

1. Fertilizers.
2. Manures.
3. Compost.
4. Green manure.
5. Bio fertilizers.

INM Involves

1. Efficient fertilizer management.
2. Use of on form organic manures.
3. Recycling of crop residues & nutrient residues in the soil.
4. Use of microorganisms for biological nitrogen fixation & better absorption of nutrients in soil.

Efficient Fertilizer Management

1. Includes timing, rate & place of application & leads to both leaching loss & surface runoff
2. Necessary to:
    a. Use more efficient plant type.
    b. Determine the fertilizer requirement of crop.
    c. Regulate time & method of placement.

Organic Manures

1. Periodical application of organic manures will be preventing soil degradation & sustaining ecological balance.
2. Acts as soil conditioners by improving physical & chemical conditions of soil.
3. Helps in better retention of fertilizer nutrients and water.
4. Increases biological activity which helps to nutrient transformation.

Recycling of Crop Residues & Nutrient Residues in the Soil

1. In banana it is beneficial to retain psuedo-stem of the mother plant for 30-45 days after bunch harvest for effective mobilization of nutrients to ratoon suckers.
2. This will reduce initial fertilizer requirements.

Green Manuring

Classification:

a. Legumes: Diancha *(Sesbenia)*, Sunhemp, Glyricidia etc.
b. Non-Legumes: Calotropis, Neem etc.

Types of Green Manuring

1. Insitu green manuring : grown and burried in the same field either as pure or inter crop. Ex: Diancha (*Sesbenia*), Sunhemp (*Crotolaria*) *Phaseolus sps*, & *Dolichus sps.*
2. Green leaf manuring: *Glyricidia maculate,* Karanj (*Pongamia pinnata*) and Susbenia sps.

Advantages of Green Manuring

1. Improves physical & chemical properties of soil.
2. Maintains organic matter content of soil.
3. Source of food & energy for microorganisms.
4. Releases nutrients in available form.
5. Improves soil wealth.
6. Better aeration & drainage in heavy soils.

Bio Fertilizers

1. Bio fertilizers are microbial inoculants containing live or latent cells of efficient strains of nitrogen fixing, P solubilising microorganisms.
2. Accelerate certain microbial process.
3. Used for application of seed, soil or composting areas.

Types of Bio Fertilizers

1. Nitrogen fixers: *Azotobacter, Azospirillum, Rizobium.*
2. P –solubilizers: *Thiobacillus, Bacillus, pencillium.*
3. Plant growth promoting rhizobacteria: *Glomus.*
4. Sulphur solubilizing microbes.

Advantages of INM

1. Improves production capacity of farm through the application of plant nutrient sources, amendments and efficient recycling of crop residues.
2. Enhance the availability of applied as well as native soil nutrient.
3. Provides balanced nutrition to the crops.
4. Involves risk management and enhances beneficial effect between crop, water and plant nutrition managements.
5. Minimisation of losses and replenishment of nutrients from both internal & external sources.

Conclusion

1. Since INM system hold the key to soil health and sustainable agriculture production, more efficient technological innovations are needed for bio fertilizers, crop residue management composting etc.
2. Integrated nutrient management play an important role in sustaining soil health and productivity.
3. The combine use of organic manure and inorganic fertilizers which lead to increased uptake of NPK and nutrient use efficiency.
4. INM help to maintain productivity, profitability and quality of Agricultural crops.

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Water Soluble Fertilizers

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Introduction

1. Water soluble fertilizers are the fertilizers which are completely soluble in water leave no residue in the water.
2. These are having different soluble nutrients grades.
3. Available in the powder or liquid form.
4. These fertilizers are applied to crops through fertigation and foliar spray for efficient use of nutrients leading to better yields and quality.

Characteristics of Water-Soluble Fertilizers

1. The nutrient element must be present in form of readily available to the plants.
2. High purity, fully soluble fertilizer, composed entirely of plant nutrients (P & K).
3. P and K are in assimilable forms (K^+ and $H_2PO_4^-$).
4. Have lowest salt index,(EC= 0.9-1.2).
5. Sodium and chloride free.
6. No heavy metals.
7. Balanced nutrient composition.
8. Excellent physical properties.

Comparison Between the Conventional Fertilizers and Water-Soluble Fertilizers

Properties	Water soluble fertilizers	Conventional fertilizers
Solubility	Readily soluble in water	Nutrient may be in soluble form carrier material not fully soluble
Uniformity of nutrient ions	Ionic distribution uniforms depending upon concentrations & composition of base material used	Ionic distribution not uniform
Solubility time for preparation of solution	1 to 4 minutes in water	12 to 24 hours 25° C
Filtration of solution before application	Not required	Filtration is required
Salt index	8 to 40	It varies
Nutrient use efficiency	Very high	Higher if applied in split
Cost	High	Less compared to WSF

FCO Approved Water-Soluble Fertilizers (FCO Scheduled 1 of 1985)

Sl. No.	Fertilizers	Grades
1	Potassium nitrate	13-0-45
2	Calcium nitrate	0-52-34
3	N-P-K	15.5-0-0 (Ca- 18.8)
4	N-P-K	13-40-13
5	N-P-K	18-18-18
6	N-P-K	19-19-19
7	N-P-K	13-5-26
8	N-P-K	6-12-26
9	N-P-K	20-20-20
10	Mono ammonium phosphate	12-61-0

11	N-P-K	17-44-0
12	Potassium magnesium sulphate	0-0-22 (S-20, MgO-18)
13	NPK-Zn	7.6-23.5-7.6-3.5

Advantages of Water-Soluble Fertilizers

1. WSF are supplied as foliar and fertigation. They are also suitable for soil application depending on requirement.
2. Minimizes the pollution.
3. Wide ranges of nutrient grades are available
4. Even distribution of nutrients and supplying the nutrients directly to the effective leaf surface
5. Fertilizer use efficiency is more than conventional methods
6. Timely application nutrients possible.
7. In water soluble fertilizers it is easy make precise amount of nutrient solution for plants.

Limitations of WSF

1. Good quality water is very essential.
2. Costly and limited availability of water-soluble fertilizers.
3. Infestation of insect's pest and diseases increase.
4. Have scorching effect if used at higher dose.

Application of Water-Soluble Fertilizers

1. Starter Solutions.
2. Foliar Application.
3. Drip Fertigation.
4. Injection into Soil.
5. Aerial Application.

What is Foliar Nutrition?

Foliar nutrition entails the application - via – spraying of nutrient to plant leaves, stems and their absorption at those sites to meet plant needs during critical growth period.

Mechanism of Foliar Fertilization

1. In order for a foliar fertilizer nutrient to be utilized by the plant for growth, it must first gain entry into the leaf prior to entering the cytoplasm of a cell in the leaf.
2. To achieve this the nutrient must effectively penetrate the outer cuticle and the wall of the underlying epidermal cell.
3. Once penetration has occurred, nutrient absorption by the cell is similar to absorption by the roots.
4. Of all the components of the pathway of foliar-applied nutrients, the cuticle offers the greatest resistance.

How Do Foliar Sprayed Nutrients Penetrate Plant Tissue?

1. Through trichomes.
2. Through cuticle.
3. Through stomata.
4. Translocation.

Through Trichomes

They are hair like organs (epidermal outgrowth) from which nutrients penetrates. Importance of this pathway depends on:
1. Trichomes rate and position.
2. Leaf age and its origin.

Through Cuticle

Cations penetrate first as they are attracted to the negative charge of the tissue. They move according to the gradient difference. After few minutes the cations changes the electrical balance in the tissue and causes less negative and more positive. From this point anions start penetrating the tissue.

Through Stomata

There is a cuticle pore in cell walls between guard cells and subsidiary cells. From this site the nutrients are absorbed.

Translocation

After the ions have penetrated, transportation to different parts of plants starts and this is referred to as translocation. Done by;
1. Cell to cell (apoplast movement).
2. Through vascular channels (symplast movement).

Advantages of Foliar Nutrition

1. Immediate results.
2. Foliar application reduces the losses of nutrients through immobilization, volatilization, denitrification and leaching especially with nitrogen and increases the utilization rate of nutrients.
3. Increase crop yields.
4. Increase storage life of food crops.
5. Boost growth during dry spells.
6. Increase pest and disease resistance.
7. Maximize plant health and quality.
8. Increases the protein content in pulse and oil content in oilseed crops.

Foliar Application Limitations

1. If deficiencies are severe timing may be late for maximum production.
2. Provide only nutrition for this years' crop.
3. Bad weather may delay applications.
4. If concentration exceeds leads to scorching or burning of leaves.

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Organic Cultivation of Chilli Crop

Article ID: 31268

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Introduction

Chilli (*Capsicum annum* L.) is one of the most valuable crops of India which belongs to the genus Capsicum under Solanaceae family. Different varieties are grown for vegetables, spices, condiments, sauces and pickles. The crop is grown practically all over India. India is a major producer, exporter and consumer of chilli. The area and production of chilli in the country is 6.81 lakh ha and 10.09 lakh tonne. The major states growing chilli in the country are Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamilnadu, Uttar Pradesh, West Bengal etc.

For the organic cultivation of chilli often open pollinated varieties are preferred. Seed selection is the important step in organic chilly production and seeds should be carefully selected from certified organic farms. We must choose disease resistant and locally demand varieties.

Organic Production of Chilli

1. Climate: Chilli requires a warm and humid climate for its best growth and dry weather during the maturation of fruits. A temperature ranging from 20-25°C is ideal for chilli. In chilli fruit development was found to be adversely affected at temperatures of 37°C or more. It can be grown throughout the year under irrigation. It can be grown successfully as a rain-fed crop in areas receiving an annual rainfall of 850-1200 mm. Heavy rainfall leads to poor fruit set and in association with high humidity leads to rotting of fruits. Pungent chilli is susceptible to frost.

2. Soil: Chilli crop is grown on practically all types of soils except on salty land provided the soil is well drained and well aerated. Black soils which retain moisture for long periods are suitable for rainfed crop whereas well drained soils, deltaic soils and sandy loams are good under irrigated condition.

3. Land Preparation and Planting Material: For chilli cultivation n case of direct sowing, three to four ploughings are undertaken and sowing is done along with the last ploughing. The soil can be treated with azotobacter or azospirillum @ 1-1.25 kg mixed with 50 kg of farm yard manure and the same may be broadcast in the field. Farm Yard manure @ 4-6 t and 1-2 t of vermicompost can be added per acre. Chilli is propagated by seeds. For raising nurseries, seeds of high yielding varieties with tolerance to pests and diseases may be used. They should be carefully selected from certified organic farms or from own seed plot which is raised organically.

4. Varieties: The important varieties of chilli which are cultivated all over India for long pungent types are: Pusa Sadabahar, Pusa Jwala, Pant C-1, NP46A, Arka Basant, Bhagyalakshmi & K2, and for the sweet pepper group the important varieties are: California Wonder, Yolo Wonder, Arka Mohini & King of North.

5. Seed rate & seed treatment: For direct sown crop, the seeds are drilled by the end of March or first week of April. Seed rate is 2.5-3.0 kg per acre. In organic cultivation the seeds may be treated with *Trichoderma* and *Psuedomonas sp*. @ 10 g per kg of seed to prevent incidence of seedling rot in the nursery.

6. Nursery raising and transplanting: Fresh seeds are sown in well prepared nursery beds. Although it can be sown by broadcast method in the main field, transplanting method is preferred for better quality and survival. The nursery bed is usually raised from ground level and is prepared by thorough mixing with compost and sand. Seeds treated with *Trichoderma* are sown and covered thinly using sand. The seeds germinate in 5 to 7 days. 40-45 days old seedlings are used for transplantation. Transplanting is generally done during the month of April-May. A spacing of 60 cm x 30 cm with a plant population of about 22200 seedlings per acre or 45 cm x 45 cm with a plant population of 19750 per acre are considered optimum.

7. Organic manuring in chilli crop: The organic manures for chilli crops are farmyard manure, green manure, compost prepared from crop resuides and farm waste, vermicompost and biological wastes such as animal bones and slaughter house refuse. Organic manures such as farmyard manure is applied by 4-6 tonnes per acre. Restricted use of permitted chemical fertilizers under organic farming can be done by depending on the requirement based on soil analysis. The use of biofertilizers can be resorted in combination with organic inputs.

8. Inter culture operations: Chilli can be cultivated organically as an intern or mixed crop provided all the other crops are grown under organic methods. Seedlings raised by sowing through broadcasting method or in line in ridges should be thinned out by hand 25 to 30 days after sowing the seeds to maintain a plant population of about 30 to 60 plants/m2. The plant density to be maintained finally may depend on the nature and fertility of the soil. Generally, two weedings / hoeings are required to keep the field free from weeds, the first within 20-25 days of sowing and the other after 20-25 days of the first weeding/hoeing. Wherever needed, depending on the weed growth one or two more weedings may be taken up. Weeds which attract pests should be allowed to grow in the field to act as trap and removed before flowering. Earthing up is carried out as and when necessary.

9. Irrigation: In India the major area under chillies are mostly rainfed. When there is insufficient rainfall the crop should be irrigated frequently. Chilli cannot withstand heavy moisture. Plant growth, branching and dry matter accumulation are adversely affected by excess irrigation. Stagnation of water should not be allowed in nursery beds and fields in order to avoid fungal infection. Generally, in India 8-9 irrigations are given depending on rainfall, soil type, humidity and prevailing temperature.

10. Pest and disease management: There are a number of insects which attack chilli but only thrips are more serious. The other insects are aphids, pepper weevils, mites, root grubs and pod borers are the major pests in chilli. To avoid infestation of root grub, only well rotten farmyard manure should be applied in the field. Application of neem cake @ 100 kg/acre is advisable for control of root grubs. Change in the agronomic practices to disturb the life cycle of the grub is also found useful. 400 g/acre of Beauvaria bassiana may be broadcast in the field. Application of neem seed kernel extract (NSKE) can be done for control of thrips, aphids and mites. 10 kg of neem seed kernels may be boiled in 15 l of water. 200 ml of this extract may be mixed in 15 l of water and four to five sprays may be given to control sucking pests. Farmers also use seed extracts of Bakaine *(Melia azadirach*) along with Bichoo Grass (*Urtica dioica*) for control of pests. Release of larvae of *Chrysoperla cornea*, a bio control agent, once in 15 days is also helpful in controlling thrips and mites.

The two major diseases of chilli crop are fruit rot & die back caused by Colletotrichum capsici and bacterial wilt. Bacterial leaf spot, powdery mildew and mosaic disease (caused by virus) are the major diseases of chilli. Careful seed selection and adoption of phytosanitary measures will check the diseases of chilli. Seed treatment with Trichoderma takes care of seedling rot in nursery. Varieties tolerant to diseases should be used wherever the disease is severe. For effective disease control, 10 g of Trichoderma or Pseduomonas sp. per litre of water should be used for spraying.

Harvesting

The stage of maturity at which chillies are picked depends on the type and purpose for which they are grown. Chillies which are used for vegetables purposes are generally picked while they are still green and full grown. Those which are used for pickles are picked either green or ripe Harvesting should be done at the right stage of maturity. Retaining fruits for a long period on the plants causes wrinkles and colour fading. Crop is ready for harvesting in about 90 days after transplanting. About 5-6 pickings are made for dry chilli and 8-10 pickings for green chilli.

Yield

The yield of fresh chilli varies from 30-40 q/acre depending on variety and growing conditions. Out of 100 kg of fresh fruits 25-35 kg of dried fruits may be obtained. The yield of dry chilli is expected to be in the range of 7.5 to 10 q/acre. However, in the present model, yield of 8 q/acre has been assumed.

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Insect and Pest Management in Potato Crop

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Introduction

The potato (*Solanum tuberosum* L.) is a crop which has been considered as the 'poor man's food' and is one of the most important food crops of the world. Potato is a crop of the cool, temperate regions of elevation of approximately 2000 m or more in the tropics. It requires cool nights and well-drained soil with adequate moisture and does not produce well in low altitude, warm, tropical environment. In India, potato is grown in tropics as well as in sub-tropics in the cool season. Potatoes are an economical food; they provide a source of low-cost energy to the human diet. About 86% of potato crop is grown in the plains during winter under short-day conditions, about 8% in the hills during summer under long day conditions and around 6% in the plateau during the rainy season. The advantages of the potato growing over other crops are high productivity, price stability, profitability and easy market. The main constraint to potato farming in India is: It is vulnerable to pests and diseases hence implying a high risk of failure, growing potatoes requires substantial capital and the crop needs intensive care and attention. However, a proper insect pest management program will minimise losses to potato crop.

Important Insect Pest and their Management

1. Aphids (*Myzus persicae*): These are small insects, either pale yellow or dark in colour. The adult is along 1mm long and has two projections called cornicles on the dorsal side of abdomen. Aphids transmit a virus disease and cause severe damage to the plant by sucking the juice from leaves and young leaves. Both nymph and adult damage the crop and the leaves attacked become yellowish and they lose their vitality. Besides this, aphids secrete honey dew on the leaves on which black mould develops. This interferes in the photosynthesis.

Control measures:

a. The control includes spraying of Oxydemeton methyl (Metasystox) 25 EC or Dimethoate (Rogor) 30 EC at the rate of 600 mililitre in 1000 litres of water per hectare.

b. In case of seed crop, apply 5 kg of Thimet 10 G (Phorate) to the soil at the time of the first earthing up.

c. Encourage the activity of Dieretella spp., Ahelinus and Ahidius parasitoids and ladybird beetles and syrphid predators.

Aphid

2. Epilachna Beetle (*Epilachna viginatioctopunctata*): The grubs and adults both are the damaging stages of the insect. It is one of the serious pests of the potato crop. They feed the foliage. The grubs scrap away the chlorophyll from the leaves leaving only veins. These beetles are very sluggish and move very slowly while feeding on leaves. These are yellowish in colour with erect spines on their body. A severe infestation may cause a loss up to 70% in yield.

Control measures:

a. Handpicking of grubs and collection of beetles by hand nets during early stages of attack, helps in reducing the intensity of infestation.

b. Conservation and augmentation of natural parasitoids viz., Pediobius foveolatus, Pleunotrogrus faveolatus and Tetrastichus spp.
c. Application Of neem, mahua, groundnut cakes are effiecient in suppressing the pest population
d. Spraying with 0.2 per cent Carbaryl(Sevin 50 WP) at the rate of 1000 litres of water has been found quite effective.
e. Dusting of 5 percent Carbaryl (Sevin) dust at the rate of 30 kg per hectare may also control the pest.

Epilachna beetle

3. Potato Cutworms *(Agrotis ypsilon):* They are medium sized (22-25 mm longer) stout with greyish brown wavy lines and sports on fore wings and creamy white wings. The moths are active at dusk and are attracted by light. These pests damage plants and tubers during dark. They attack young plants by severing their stems, pulling all parts of the plant into the ground and devouring them. Plants with severed stems have difficulty growing again. This pest can cause serious damage; particularly when crops are at 25 – 35 days after planting. Signs of damage on tubers are boreholes larger than those made by potato tuber moths.

Control measures:
a. 5% Carbaryl poison bait at the rate of 25-60 kg/ha controls the pest effectively.
b. Heaps of green grasses may be kept at suitable interval in infested field during evening and next day early in the morning along with caterpillars to destroy.
c. Clean cultivation and mechanical destruction of caterpillars also help in reducing pest infestation.
d. Apply insecticides Coragen 20 SC 300 ml/ha.

Cutworm

4. Potato Tuber Moth *(Phthorimaea operculella)*: This is mainly a pest of stored potato but it causes damage in the standing crop also. Potato moths are small narrow winged greyish brown in colour which measures about 12 mm long. Full grown caterpillars are pinkish white or pale greenish in colour and 14-20 mm long. Potato tuber moths affect both tubers and foliage. The caterpillars mine the leaves causing patches in them. The damage done by the caterpillars to potato in stores is much more serious. The caterpillars feed inside the pulp. The tunnels made by the caterpillars are filled with excreta. Such tubers generally become unfit for human consumption and seed purposes.

Control measures:
a. Only healthy potatoes should be kept in the store.
b. Potatoes should be stored in cold stores. In case they are to be kept in ordinary store, a layer of sand about 2.5 to 5-centimetre-thick should be kept and above the heap of the potato.
c. Seed potato should be protected by dusting 5 per cent malathion dust on and around the heap at the rate of 5 kg/tonne.
d. Two sprays in standing crop of monocrotophos 36 EC at the rate of 1.5 mi/litre water at 15 days interval when infestation starts.

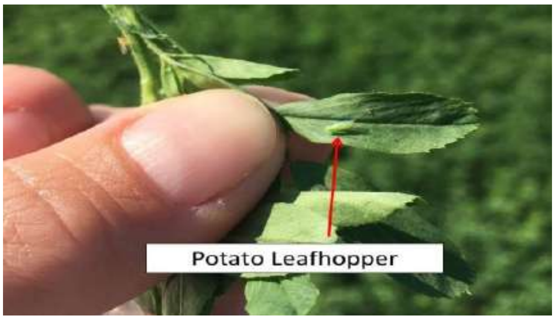
Tubermoth

5. Leaf Hopper *(Empoasca fabae)*: The nymphs and adults of these insects have piercing and sucking type mouth parts. The adults are greyish yellow with front wings having a black spot on each at the apical margin and two black spots on the vertex of the head. The nymphs are also green they suck the cell sap due to which the leaves become yellowish and plants lose their vitality. The damage leaves curl upwards along the margin and turn yellowish and burnt patches.

Control measures:

a. Seed treatment with Imidacloprid (Gaucho) @ 5 grams per kg seed. In the field with Imidacloprid @ 1ml with 3-4 litres of water

b. Spray the crop with 300 ml of Rogor 30 EC or metasystox 25 EC (methyl demeton) in 80-100 litres of water per acre.



Leafhopper

6. White Grub (*Holotrichia* spp.): White grubs are the larva form of beetles. They are large reaching 2-3 cm in length, are shaped like the letter C and have three pairs of legs on their thorax. The damage is done mainly by feeding on the underground portion viz., roots , stems and tubers of the plant. The grub in the early stage feed on the roots with the result the plant dry up. Later on, when tubers are developed, the grubs cut holes in the tubers. The market value of such tubers is very much reduced.

Control measures:

a. Collecting larvae when tilling soil, planting, weeding and hilling up

b. Avoiding to plant potatoes in fields that were previously covered with grasses

c. Apply phorate 10% granule at the rate of 10 kg per hectare or carbofuran 3% granules at the rate of 30kg per haectare at the time of sowing and mix it properly.

Whitegrub

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Organic Farming: The Present Need of Era

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Agriculture in general has played a key role in the economic and cultural development of all societies and in the Indian spectrum it is the largest private enterprises contributing 17% of national GDP, sustains livelihood of about 2/3 of the population of India, which has been and will continue to be the lifeline of the Indian economy at least in the foreseeable future.

Modern crop production technology has considerably raised output but has created problems of land degradation, pesticide residues in farm produce, gene erosion, atmospheric and water pollution and all this is due to the indiscriminate use of synthetic fertilizers, pesticides and antibiotics etc., hence there is need to avoid those factors. The only solution for this problem is use of organic fertilizers, which is called as "Organic Farming."

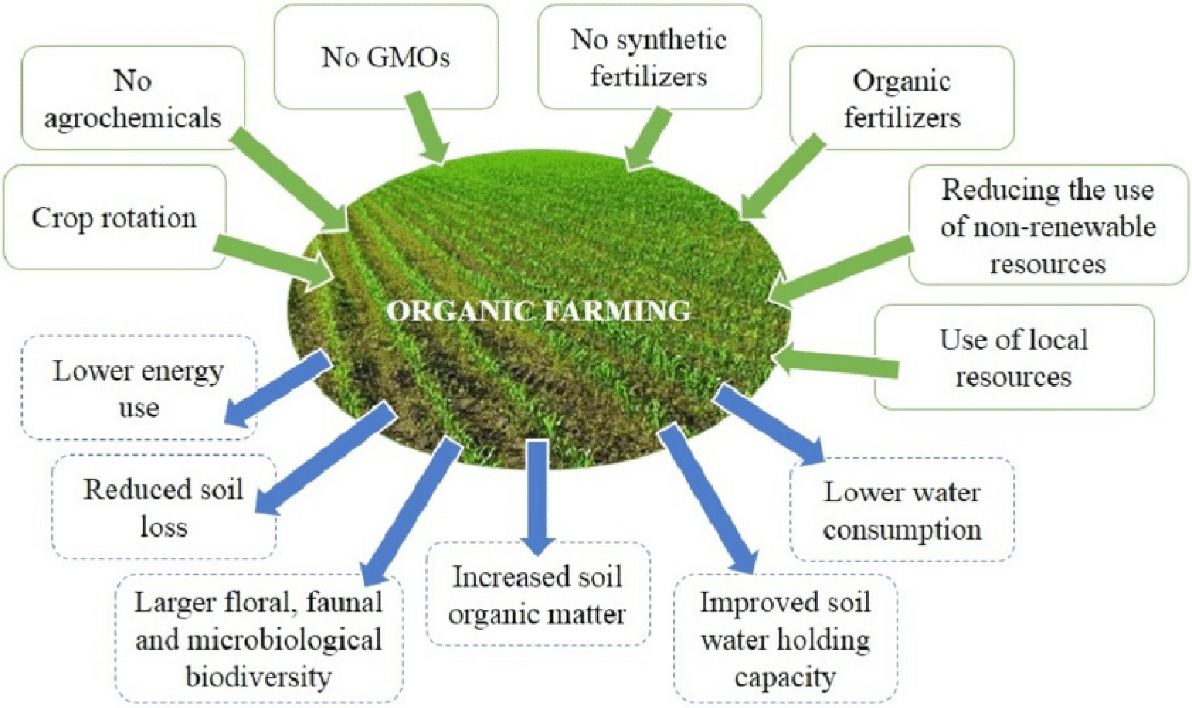
Concept of Organic Agriculture

Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment.

Need of Organic Farming

With the increase in population our compulsion would be not only to stabilize agricultural production but to increase it further in sustainable manner. The scientists have realized that the „Green Revolution" with high input use has reached a plateau and is now sustained with diminishing return of falling dividends. Thus, a natural balance needs to be maintained at all cost for existence of life and property.

The obvious choice for that would be more relevant in the present era, when these agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability. It may also cost heavily on our foreign exchange in future.



Methods / Techniques of Organic Farming

In organic farming we use the following technique:

1. Crop Rotation: It is the technique to grow various kind of crops in the same area, according to the different seasons, in a sequential way.

2. Green manure: It refers to the dying plants that are uprooted and turned into the soil to make them act as a nutrient for the soil to increase its quality.

3. Biological pest control: With this method, we use living organisms to control pests with or without the use of chemicals.

4. Compost: Highly rich in nutrients, it is a recycled organic matter used as a fertilizer in the agricultural farms.

5. Bio-fertilizer: There are the substances which contain living microorganisms which, when applied to seeds, plant surfaces, or soil, colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant.

6. Mulching: It is a process of covering the soil and making more favourable condition for the growth, development of the plant.

7. Vermi-compost: Vermicompost is the product of the composting process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast.

Growth of Organic Farming in India

In the last couple of years especially in the urban and fast-growing markets of India we have seen the massive growth of demand in the organic food industry. The organic food industry in India which is currently in its initial stages of evolution is growing at a rapid rate of 25% - 30% Y-o-Y. High disposable income and increased health awareness are the key factors which have resulted in this augmented demand. With this scenario the domestic organic food market is projected to touch $1.36 billion mark by 2020.

The organic food market in India is still at a nascent stage wherein we are noticing an increasing demand from end buyers but due to limited availability the supply remains slow. The major problem faced currently is that organic products are priced at a high rate which makes market penetration challenging. The limited availability of organic foods coupled with the fact that majority of sales is concentrated in larger cities shows that supply chains of organic food from farms to domestic consumers are not very well established.

There is a lack of knowledge about organic products leading to a low penetration amongst potential customers.

As per industry reports, India organic food market, which currently sized at 6000 crores is anticipated to grow at a CAGR of over 25% during 2016-2021. Rising popularity and awareness within the younger generation and millennials is the reason behind the growth. In a country having 1.33 billion citizens, there is immense scope and opportunity for new brands to enter and work mutually for the growth of the industry, thus making it a rewarding opportunity for the investors to enter this space.

Aim of Organic Farming

1. The main advantage is organic farming is ecological balance.
2. It reduces the cost of cultivation.
3. It provides nutritious food pesticide residue.
4. To maintain long term soil fertility.
5. Effective utilization of natural resources.

Advantages of Organic Farming

1. Less/ no depletion of soil nutrients, maintain better health of soil.
2. Helps in reducing toxic substances in the environment.
3. Creates job opportunities for the peoples.
4. It helps in preserving agriculture.
5. It leads to reduction in farm waste as the farm waste is recycled and used form making organic fertilizers out of it.

Disadvantages of Organic Farming

1. It requires knowledge of making and using effectively organic manures.
2. More time is required to obtain results of organic farming
3. Reduction in crop yield.
4. It requires more workers for managing the organic farming.

Future Prospects

The movement started with developed world is gradually picking up in developing countries. But demand is still concentrated in developed and most affluent countries. Local demand for organic food is growing. India is poised for faster growth with growing domestic market. Success of organic movement in India depends upon the growth of its own domestic markets. India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only addresses the quality and sustainability concerns, but also ensures a debt free, profitable livelihood option.

Conclusion

An environmentally sustainable system of agriculture like organic farming will be able to maintain a stable resource balance, avoid over exploitation of renewable resource, conserving inherent soil nutritional quality and soil health, and biodiversity. It will lead us to sustainable agriculture and create a sustainable lifestyle for generations to come.

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Biological Control of Crop Pests

Article ID: 31271

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Introduction

Among all the crops, the total loss due to pests in crop yield is 18-30% each year valued at Rs 900-1500 billion. Biological control is the best way to manage the crop pests as it checks pests by their own antagonists in an echo friendly manner. Biological control involves the mass-production and release of natural enemies such as parasitoids and predators to control pest insects in an environmentally sound manner. Biological control is the best way to manage the CR Environmental stewardship and food security are the most important factors that involved in agriculture. In many cases by the misuse of insecticide led to population resurgence, pesticide residues, and pest resistance. The microorganisms like virus, fungus, protozoan or bacterium are the active ingredient in this type of pesticides. Safety of food alludes to the conditions and practices that save the quality of food to anticipate tainting and food borne sicknesses.

Biological Control Agents

The biological control agents or antagonists of the pest are: predators ladybird beetles, lacewings, ants, spiders, reptiles, birds' mammals and others, parasitoids (parasitic easp and flies), entomopathogenic micro-organisms and fungal and bacterial antagonists of plant diseases and phytonematodes.

Predators

Predators are mainly free-living species that directly consume a large number of preys during their whole lifetime. Given that many major crop pests are insects, many of the predators used in biological control are insectivorous species. Lady beetles, and in particular their larvae which are active between May and July in the northern hemisphere, are voracious predators of aphids, and also consume mites, scale insects and small caterpillars. The spotted lady beetle *(Coleomegilla maculata)* is also able to feed on the eggs and larvae of the Colorado potato beetle *(Leptinotarsa decemlineata)*.

Hoverflies, resembling slightly darker bees or wasps, have characteristic hovering, darting flight patterns. There are over 100 species of hoverfly, whose larvae principally feed upon greenfly, one larva devouring up to 50 a day, or 1000 in its lifetime. They also eat fruit tree spider mites and small caterpillars. Adults feed on nectar and pollen, which they require for egg production. Eggs are minute (1 mm), pale yellow-white, and laid singly near greenfly colonies. Larvae are 8–17 mm long, disguised to resemble bird droppings; they are legless and have no distinct head. Therefore, they are semi–transparent with a range of colours from green, white, brown, and black. Hoverflies can be encouraged by growing attractant flowers such as the poached eggplant *(Limnanthes douglasii)*, marigolds, or phacelia throughout the growing season.

Dragonflies are important predators of mosquitoes, both in the water, where the dragonfly naiads eat mosquito larvae, and in the air, where adult dragonflies capture and eat adult mosquitoes. Community–wide mosquito control programs that spray adult mosquitoes also kill dragonflies, thus removing an important biocontrol agent, and can actually increase mosquito populations in the long term.

Other useful garden predators include lacewings, pirate bugs, rove and ground beetles, aphid midge, centipedes, as well as larger fauna such as frogs, toads, lizards, hedgehogs, slow–worms, and birds. Cats and rat terriers kill field mice, rats, June bugs, and birds. Dogs chase away many types of pest animals. Dachshunds are bred specifically to fit inside tunnels underground to kill badgers.

Parastoids

Parasitoids are among the most widely used biological control agents. Each parasitoid requires one host, which it kills for its development. Most insect parasitoids are wasps or flies. For example, the parasitoid has been introduced to control the glassy-winged sharpshooter *Homalodisca vitripennis*. Parasitiods comprise a diverse range of insects that lay their eggs on or in the body of an insect host, which is then used as a food for developing larvae. Parasitic wasps take much longer than predators to consume their victims, for if the larvae were to eat too fast, they would run out of food before they became adults. Such parasites are very useful in the organic garden, for they are very efficient hunters, always at work searching for pest invaders. As adults, they require high–energy fuel as they fly from place to place, and feed upon nectar, pollen and sap, therefore planting plenty of flowering plants, particularly buckwheat, umbellifers, and composites will encourage their presence.

Four of the most important groups are:

1. Ichneumonid wasps: (5–10 mm) Prey mainly on caterpillars of butterflies and moths.

2. Braconid wasps: Tiny wasps (up to 5 mm) attack caterpillars and a wide range of other insects including greenfly. It is a common parasite of the cabbage white caterpillar, seen as clusters of sulphur yellow cocoons bursting from collapsed caterpillar skin.

3. Chalcid wasps: Among the smallest of insects (<3 mm). It parasitizes eggs/larvae of greenfly, whitefly, cabbage caterpillars, scale insects, and strawberry tortrix moth.

4. Tachinid flies: Parasitize a wide range of insects including caterpillars, adult and larval beetles, true bugs, and others.

Entomopathogens

Entomopathogens are extensively used in pest control and they are disease causing organisms(such as bacteria, viruses, fungi and protozoa in insect pests), which kill their hosts or debilitate the future generations. Under certain conditions they cause disease epizootics in the field, eg. *Verticillium lecanii* on scale insects, nucleopolyhedrovirus or *Nomuraea rileyi* in lepidopterans. Entomopathogens play a significant role in management of small fruit and vegetable pests in temperate climate. Bt and baculoviruses for lepidopteran pests, EPF for hemipteran pests, and EPNs for coleopteran, dipteran, and lepidopteran pests are good candidates in multiple cropping systems. Small fruits and vegetables have a variety of pests that are good targets for one or more entomopathogens. Rotating and combining MCAs with chemical or botanical pesticides can provide effective pest control while reducing the reliance of chemical pesticides and the associated risk of pesticide resistance. Continuing field studies and developing IPM strategies that include microbial control as an important component will contribute to sustainable management practices for small fruit and vegetable industries.

Plant Disease Antagonist

These are the microorganisms which grow in association with plant diseases and manage them through competition, antibiosis, predation, hyperparasitism, microparasitism and other forms of direct exploitation. Seed coating (5-12 g/kg seed) with suitable antagonist (*Trichoderma harzianum*- PDBCTH 10, *T. Viride*- PDBCTV 23, *P. Fluorescens*- PDBCAB2) to protect gaint diseases in sugarbeet, lentil, chickpea, suagarcane, groundnut, blackgram, pigeonpea etc, have a very bright future.

Fungal antagonists- *T. Harzianum, T. Viride* have been successfully used in the management of soil borne diseases of several crops caused by *Phythium spp., Rhizoctonia solani* etc. For biological control pf phytophagus nematodes, certain fungi, bacteria, protozoa, nematodes, tardigrades as predacious which digest nematodes have shown potential. Biological control of exotic weds such as water fern with exotic weevil *Cyrtobagous salviniae*, parthenium with *Zygogramma bicolorata* have proved effective in several areas of their release.

Inoculation and Inundation

Inoculation and inundation involve the supplemental release of natural enemies to build populations of beneficial organisms. Many biological and microbial control agents are commercially available for purchase.

An inoculative approach involves the release of natural enemies at a critical time of the season to augment natural populations already present, but in numbers too low for effective pest management.

An inundative approach involves the application of a large number of organisms much in same manner as a pesticide. The applied organisms, which may or may not become established, can be used for relatively fast-acting, short-term control. Parasitoids such as *Trichogramma* are often released in vegetable or field crops at a rate of 5,000 to 200,000 per acre per week depending on level of pest infestation. Insect-parasitic (entomopathogenic) nematodes are often applied at a rate of 1 million to 1 billion nematodes per acre.

Microbial Control

Microbial control of insects is achieved through the inundative application of allowable formulations of insect-pathogenic bacteria (e.g., Bacillus thuringiensis), insect-pathogenic fungi (e.g., *Beauveria bassiana*), or insect viruses.

Information about rates and timing of release are available from suppliers of beneficial organisms. The quality of commercially available biocontrol agents is an important consideration. Biological and microbial control agents are living organisms, and must not be mishandled during shipping, storage, or application.

Conclusion

Biocontrol is environmentally friendly and active means of decreasing or mitigating pests and pest effects through the use of natural enemies. The goal of biocontrol is to promote the technology and science. Biological control is a technique of controlling pests, that is, mites, insects, weeds, and plant diseases by using other microorganisms.

Wide research is going on, and it is required much more in future to achieve the improvement. The biological methods must able to control/suppress/kill the harmful insects pests and also prevent them, relatively in proper manner to conventional methods. Researchers, producers, and farmers should widely explore the use and find the safe environment and also maximum production of crops.

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Live Cell Imaging

Article ID: 31272

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Introduction

Live cell imaging is the study of living cells using time-lapse microscopy. It is need by the scientist to understand biological function through the study of cellular dynamics. It provides spatiotemporal images of subcellular events in real-time. It helps to understand migration, cell development, intracellular trafficking and enables to capture 3D data in real-time for cellular networks (in situ) and entire organisms (in vivo). Live cell imaging is an important analytical tool in laboratories studying biomedical research disciplines, cell biology, neurobiology, pharmacology and developmental biology.

History

1. Live-cell imaging started long ago. On the simplest level it requires very little in terms of equipment. Using a magnifying glass to look at pond water, for example, is live-cell imaging.

2. In the late 17th century when Dutch scientist Anton van Leeuwenhoek made a microscope that could magnify images by about 270 times. In fact, he used this microscope to reveal many of the microscopic creatures living in a drop of water.

3. In 1839, William Henry Fox Talbot made the first photomicrograph to make static images of living cells.

4. In 1907, Swiss biologist Julius Ries filmed the fertilization and following development of a sea urchin egg.

5. In 1930s, American Scientist Warren H. Lewis filmed the process of pinocytosis using microcinematographic device.

6. In 1940s, Kurt Michel developed the phase-contrast microscopy for time-lapse imaging.

7. In parallel with improvements in imaging technology, crucial changes in labelling of living cells started in the late 1800s using the synthetic fluorescent dyes.

8. In 1962, Osamu Shimomur, discovered the Green fluorescent Protein (GFP) from jelly fish *Aequorea Victoria,* revolutionized the live cell imaging.

9. In 1992, Douglas Prasher cloned the sequence of GFP and Martin Chalfie expressed this sequence *in vivo.*

10. Later on, the group of Roger Tsien reported the first crystal structure of GFP, showing the way for the creation of GFP mutants, to finally obtain different colour variants and improve the fluorescence signal and photostability.

11. In 2008, Shimomura, Chalfie and Tsein awarded Nobel Prize in chemistry for their work on the genetically encoded fluorescent proteins.

Maintaining Cell Health During Imaging

The first concern for live cell imaging is to provide to cells an optimal physiological environment. In doing so, the scientist ensures that the cells not only stay alive but remain in a metabolic state, if any changes happen it could in alter the process being observed. Cells interact sensitively to changes in their environment. Factors such as temperature, humidity, CO2/O2 levels significantly influence the outcome of cell culture assays. In order to achieve biologically relevant and reproducible results, it is crucial to maintain optimal conditions on the microscope stage during live cell imaging experiments (Cole, 2014).

1. Imaging media: Various cell culture media are available based on the particular biochemical requirements of cells. Culture media contain various constituents, including amino acids, vitamins, inorganic salts (minerals), trace elements, nucleic acid constituents (bases and nucleosides), sugars, tricarboxylic acid cycle intermediates, lipids, and co-enzymes. In tissue culture media, an important step is to control oxygen concentration, pH, buffering capacity, osmolarity, viscosity, and surface tension.

2. Temperature: The environmental temperature strongly influences the metabolism and activity of cells. Temperature changes affect cell adhesion, protein expression, proliferation and many more cellular parameters. Fluctuations just a few degrees can disrupt cellular physiology.

Temperature can be controlled by stage top incubators or by heating the whole microscope. The objective heater can also be used because it acts as a heat sink. Temperature is also maintained by having an adequate volume of media in the cell chamber which serves as a thermal mass to reduce temperature fluctuations.

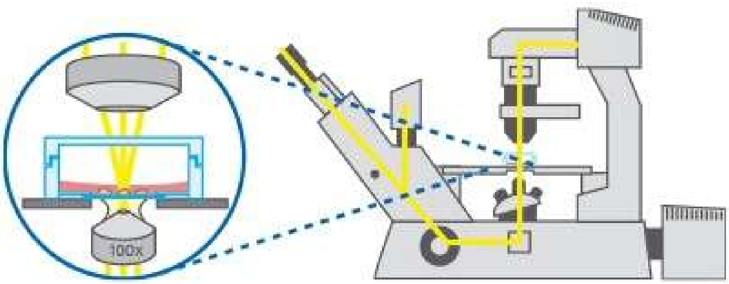
3. Carbon dioxide, Oxygen and pH: To maintain a physiological pH one has to control the CO2 concentration of the medium. Special incubation chambers can be used that provide 5% CO2 concentration. Another less expensive method is medium is buffered with HEPES which maintain the pH 7.4. Oxygenation is maintained by either changing the media often or using a large volume of media initially.

4. Humidity and osmolarity: For short term studies, humidity can be maintained by using open cell chambers and tightly sealed chambers are used for long term live cell imaging experiments. Cell lines show good growth at osmolarities between 260 and 320 milliosmolar.

Microscopic Techniques

Since many cellular processes can be visualized directly on the microscope, different imaging techniques are required. Live cell imaging microscopes are usually inverted, because most cell types sink to the bottom and onto the cover slip for adherence. In an inverted microscope living cells are observed through the bottom of cell culture vessels. We can access the sample from the top. No contact between objective and sample, as it provides sterile working conditions.

In an inverted microscope, the source for transmitted light and the condenser are placed on the top of the stage, pointing down toward the stage. The objectives are located below the stage pointing up. The cells are observed through the bottom of the cell culture vessel. To meet the criteria for successful inverted microscopy, the bottom of the culture vessel must have the highest optical features.



Schematic of an Inverted microscope

Sensitive camera should be used for acquisition of real-time image. It should have high signal to noise ratio and high acquisition speed. If the sequential acquisition of images at multiple positions is needed, the microscope should be equipped with a motorized stage. The microscope should be protected against vibrations by using a special anti-vibration microscope table.

Imaging Chambers

The cell chamber during imaging must provide conditions that keep the cells functioning and allow observation with the microscope objective. Most often live cells are viewed with an inverted microscope and are grown on glass coverslips.

Various types of imaging chambers exist, from the simplest sealed coverslip on a microscope slide for short term live cell imaging experiments to perfusion chambers for long term imaging experiments that enable control of the environment variables.

They should all allow observation of the living samples with minimal invasion. They should be easily sterilized and isolated from the environment with a cover or seal during the observation, to avoid contamination. Sometimes it is also required that they offer access to the cells for the addition of reagents, changes of the medium or microinjections.

Live Cell Imaging Probes

1. Fluorescent tags: The use of fluorescent probes has tremendously advanced the observation of cellular structures and processes. An ideal fluorescent probe should have well-separated absorption and emission spectra, a not too large emission spectrum (to avoid overlap) (Chudakov et. al., 2010).

Examples of fluorescent proteins: Engineered Green Fluorescent Proteins (EGFP), mKO2, mOrange2, td-Tomato, mRuby, DsRed, Express2, mCherry, mPlum, mEOS2, Dronpa, CFP, YFP

Use of fluorescent proteins in live cell imaging (Jensen, 2013): Fluorescent proteins can be used:

i. As genetically encoded fluorescence markers
ii. To label proteins and subcellular compartments inside living cells
iii. Track cells in tissue
iv. Monitor protein-protein interactions
v. A biological sensors to monitor biological events and signals
vi. At least five differently coloured fluorescent proteins can be imaged at the same time

Techniques: FRET, Fluorescence correlation spectroscopy, single-molecule imaging.

2. Organic fluorophores: The second family of fluorescent probes are organic fluorescent molecules. They can be coupled explicitly to biomolecules (Peptides, proteins, oligonucleotides) or cell compartments.

Example: Sulfonated rhodamine derivatives (Alexa Fluor), Cyanine (Cy2, Cy3, Cy5 and Cy7).

3. Inorganic fluorescent probes: During the past 20 years, new inorganic fluorescent probes have been proposed as alternatives to organic fluorophores. Main advantages of using this is higher fluorescence yield and lower photobleaching.

a. Semiconductor nano crystals (Quantum Dots QDs), silicon nanoparticles, lanthanide-doped oxide nanoparticles and fluorescent nanodiamonds
b. QDs are Cdse and CdTe particles, core is 2-10 nm in size and shell is made up of Zns which is necessary to stabilize the fluorescence properties, brighter than organic dyes, better photosatbility
c. These are coupled to antibodies, proteins and carbohydrates for fluorescent imaging applications

4. Bioluminescence tags: Conventional optical approaches for live cell imaging have generally relied on the use of various fluorescent proteins. In contrast to fluorescence, bioluminescence is light generated from chemical substrate and routinely demonstrated in nature by various bioluminescent marine species, arthropods, fungi and bacteria. These organisms generate light via an enzymatic reaction, in which chemical substrate (luciferin) is oxidized by an enzyme (luciferase). Bioluminescence is therefore produced without any excitation light source and persists as long as the substrate present. These are mainly used in neuroscience researches such as cellular anatomic structure, molecular interaction, brain dynamics and brain diseases (Tung et. al., 2016).

Microscopic Techniques for Live-Cell Imaging (Frigault et. al., 2009)

1. Transmission light microscopy – not require any staining:

a. Bright field microscopy.
b. Dark field microscopy.
c. Phase contrast microscopy
d. Differential interference contract (DIC) microscopy.

2. Fluorescence microscopy:

a. Widefield microscopy – mercury lamp or LED sources are used for light source.
b. Confocal microscopy – monochromatic lasers are used as light source.
c. Two-photon microscopy – live cell imaging of thick biological specimens.

Advanced Microscopy Approaches

1. Fluorescence Recovery After Photobleaching (FRAP): Study the mobility of fluorescently labelled molecules in living cells.

2. Fluorescence Lifetime Imaging Microscopy (FLIM): Study the distribution of specific cellular components, such as proteins or nucleic acids.

3. Light Sheet Fluorescence Microscopy (LSFM): Applied for live cell 3D imaging of thick biological samples as a whole, such as embryos, spheroids, organoids and whole animals.

4. Total Internal Reflection Fluorescence (TIRF): Useful to visualize membrane processes, receptor-ligand interactions, endocytosis, viral infection and cell adhesion to surfaces.

5. Super-Resolution Microscopy: Enables visualization of the smallest structures in living cells.

6. Forster Resonance Energy Transfer (FRET): Determines the precise location and spatial proximity of fluorescently labelled molecules and their interactions in living cells.

Analysis

After imaging it is very much necessary to convert the image into useful information. It is necessary to reducing background noise, enhancing contrast and quantifying the intensity of a signal. Software for analyse and annotate the image data are ImageJ and Lcy.

Applications of Live-Cell Imaging

1. To study cell shape, cell migration and organelle kinetics.
2. Can get 3D image of structure and development living cells, tissues, model organisms and small animals.
3. To study protein co-localization, dynamics and organisation.
4. Biosensing and protein-protein interaction with and without light excitation.
5. To study protein diffusion with single molecule mapping and high spatio-temporal resolution in dense samples.
6. Quantification of ion concentration.
7. Biosensing and protein-protein interaction with and without light excitation.
8. To study Protein diffusion with single molecule mapping and high spatio-temporal resolution in dense samples.

Conclusion

Live-cell imaging allows biologists to examine and analyse living samples. This capability completely changes what can be learned about life, and how that information can be used from basic research through biotechnology and medicine.

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Population Dynamics of Arthropods in Bhendi Ecosystem, *Abelmoschus esculentus* L. (Moench)

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Keywords: Arthropods, Bhendi, Diversity, Crop diversification.

Introduction

Bhendi, *Abelmoschus esculentus* L. (Moench), is an important vegetable crop grown under garden land conditions. Recent estimates reveal that in Tamil Nadu, it is cultivated in an area of 8000 ha, with a production and productivity of 56.67 thousand metric tonnes and 7.10 metric tonnes ha^{-1} (https://www.indiastat.com). A total of 26 herbivory and 23 predatory insect species were recorded in the bhendi ecosystem (Chakraborty et al., 2014). Arthropod diversity plays an important role in enhancing crop yield. Therefore, present study was contemplated to compare the diversity of arthropods in bhendi grown under organic and inorganic conditions. There should be a continuous monitoring and documentation of the arthropod diversity to know about the present status of their population and distribution which affect the crop yield due to sudden outbreak of herbivores in absence of natural enemies.

Materials and Methods

The present investigation was carried out to study the seasonal incidence of arthopods in bhendi ecosystem during September 2017 to April 2018 at different regions of Coimbatore.

1. Sampling methods: The arthropods present in bhendi crop were collected using seven different methods viz., insitu count, sweep net, yellow pan trap, pheromone trap, light trap, yellow sticky trap and pitfall trap.

2. Preservation and identification: The collected arthropods killed, Pinned, mounted and labelled insects were kept in the insect boxes for proper identification. Soft-bodied insects like whiteflies, aphids and mites were preserved in 70 per cent ethyl alcohol.

3. Statistical analysis: Correlation coefficient was worked out using Microsoft excel.

Results and Discussion

The insects were collected at weekly intervals and were identified to an extent of possible taxons (family, genus and species levels) along with their functional role. A total of 257 arthropod fauna species were recorded in the bhendi ecosystem. Among which, a total of 231 insect species under 212 genera, 94 families and 13 orders were observed in the bhendi. Amongst the insect orders, Order Hymenoptera was the most diversed with 61 species followed by Coleoptera (52 species), Hemiptera (36 species), Lepidoptera (30 species), Diptera (18 species), Orthoptera (11 species), Odonata (9 species), Dictyoptera (5 species), Dermaptera (2 species), Thysanoptera and Isoptera (2 species in each) and one species each in Neuroptera and Embioptera. A total of 26 species of spiders under 16 genera containing of 8 families and mite in 1 genera, 1 species and 1 family was observed (Figure 1).

Abundance of arthropods in bhendi ecosystem showed a significant relationship with weather variables. The incidence of arthropods on bhendi started during first week of September 2017, with 1187 population and reached peak during third week of October 2017 (3981). After that, the arthropod population gradually declined. There was a strong positive correlation between relative humidity, sunshine hours and arthropod population, as the relative humidity and sunshine hours increased arthropod population also increased (Table 4). During the month of October, maximum population of total arthropods (3981) was found at relative humidity (90.29%) and sunshine hours (9.1). However, arthropod population showed negative correlation with maximum temperature ($r = -0.161$), minimum temperature ($r = -0.232$), rainfall ($r = -0.075$) and wind velocity ($r = -0.263$), respectively and the table values showed that increase in these parameters resulted in decreased arthropod population. Similarly, Umar et al. (2003) reported that arthropod population showed a negative correlation with temperature and rainfall (Table 1).

Table 1: Influence of weather parameters on arthropods population in Coimbatore

Weather parameters	Correlation coefficient	Regression	
		Regression Equation	R2 value
Maximum temperature (0C)	-0.161	34.348-0.0028x	0.0256
Minimum temperature(0C)	-0.232	25.706-0.0042x	0.0535
Rainfall (mm)	-0.075	4.121-0.0023x	0.0057
Relative humidity (%)	0.035	85.70+ 0.0008x	0.0013
Wind velocity (km/hr)	-0.263	10.080-0.0045x	0.0697
Sunshine hours	0.252	1.7184+0.0043x	0.0636

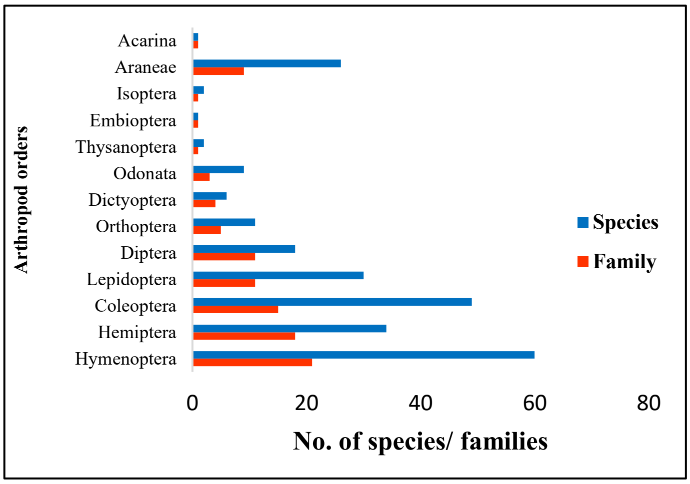

Fig 1. Diversity of arthropods at ordinal level in bhendi ecosystem

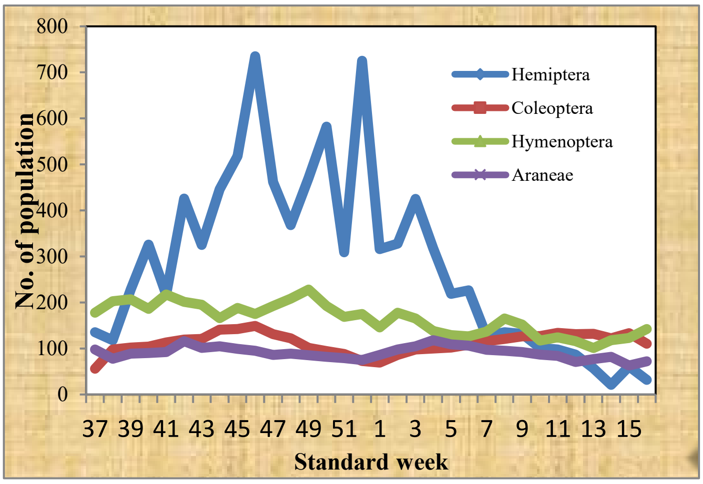

Fig 2. Seasonal abundance of arthropods in bhendi ecosystem

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Genetic Use Restriction Technologies and their Role in Crop Improvement

Article ID: 31274

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Introduction

Terminator Gene Technology or Genetic use restriction technologies (GURTs) are the methods developed to confine the illegal usage of genetic material by implementing specific genetic switch mechanisms in a genetically modified (GM) plant (FAO, 2001). The original patent of the technology was granted to U.S. Department of Agriculture (USDA) and the seed company, Delta and Pine Land (D&PL) Company of Mississippi in March 1998 (Van Acker et. al., 2007). The Canadian governmental organization, Rural Advancement Foundation International (RAFI) named this technology as “Terminator” in an international campaign against this technology. In 2006, Monsanto purchased D&PL and got ownership over a patented GURT (Van Acker et. al., 2007) and Monsanto designated this technology as a “gene protection technology”.

Goals

The main goals of GURTs are:
1. Protection of the genetic material from unauthorized use.
2. Procurement of specific and economical viable novel plant traits and benefits.
3. Encouragement of research and development in the area of crop breeding.

Classification

Broadly, GURT can be classified into two categories:
1. Variety specific (V-GURT or suicide/sterile seed/gene technology or Terminator technology).
2. Trait specific (T- GURT or Traitor Technology).

Terminator Technology

Terminator technology completely terminates or controls the plant fertility and seed development. V-GURT is designed in such a way that farmer could harvest sterile seeds only for sale as food or fodder and could not be used as seeds in next year. In general, the main type of terminator comprises of a set of three novel genes that are introduced into one plant. However, there is an alternative type that includes two or three genes on to two plants that are later to be cross-pollinated (Oliver and Velten, 2001; Gupta, 1998). But the final result of both the types is a sterile seed in the succeeding generation. Several other modifications have been done in the technology as per the requirement. In the vegetative reproducing crops, Syngenta in 2001 patented the terminator technology that was designed to increase the shelf life of the product through storage. In transgenics, RNA interference was used for specific termination (Lin et. al., 2008). The technology is regulated at the plant variety level, so it is known as V-GURT.

Traitor Technology

Traitor technology has alike or near to similar mode of action and is considered as the second generation of terminator technology (Fisher, 2002).The traitor technology is developed with special reference to switch on or off a trait without any loss to the embryo development (FAO, 2001). It may work either by omitting gene of interest (transgene) that results in second generation plant deprived of the trait under consideration or by transferring the transgene to succeeding generation in inactive form (Shi, 2006) and that trait can further be triggered by application of specific chemical inducer. The T-GURTs are designed to obtain seeds for planting with a condition that the fresh plants would not express traits of interest without the external application of input i.e. chemical application. This technology is regulated at the trait level, so named as T-GURT.

General Molecular Construction

It is similar for both T- and V-GURTs. This includes:
1. A repressor gene (the gene switch) that is responsive to an external stimulus.
2. A recombinase gene (the trait activator gene), the expression of which is blocked by the repressor.
3. A target gene.

However, mechanism of V-GURTs involve three different restriction mechanisms (Visser et. al., 2001) and for T-GURT, two mechanisms have been proposed by which it works (FAO, 2001).

Advantages

1. More emphasis on research and development in the area of crop research and development through a healthy competition between private and public sectors.
2. Increased productivity by using new, healthy and improved version of seeds every year that ultimately gives benefit to the farmers.
3. Helps in increasing the agricultural productivity and reducing the food costs.

Disadvantages

1. Every year, farmers have to buy the seed that may lead to increase in input costs.
2. Increased cost and reduced access of genetic material for breeders and researchers.
3. Reduction in genetic diversity due to the loss of landraces.
4. Monopoly risks.
5. Genetic vulnerability to pest and diseases due to use of specific genotypes across the country.
6. Chemicals used in the technology may prove hazardous for animal and human health.

Conclusion

With potential benefits and risks associated with GURTs, it is challenging to envisage the progress and commercialization of GURTs in the near future. Lack of adequate testing, openly available peer-reviewed publication on the theme, adequate economical assessment and little real data may be considered as drawbacks that create hurdles in the wide adoption of GURTs. Between V- GURTs and T-GURTs, T-GURTs seem to appear more beneficial and commercial for farmers because it allows the activation of valuable trait of interest. T-GURTs offer a solution without hampering plant sustainability and the traditional conservation practices. In contrast, the moral concerns against V-GURTs play a well-known part in the forthcoming dispute to resolve the issue of adapting this technology. However, major dependency on agriculture of countries like India, is also one of the main concern for decision making of adoption of this technology; for example this technology is better adapted in America where only two per cent of people are engaged in agricultural activities.

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Plant Disease Forecasting and their Applications

Article ID: 31275

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Introduction

Disease is a malfunctioning process in the plant body due to continuous irritation which results in some suffering. The synchronous interaction between host, pathogen, and environment governs the development of disease when three conditions occur simultaneously (a virulent pathogen, a susceptible host plant and favourable environment). The epidemiology is the study of the spread of disease in time and space with the objective to trace factor that are responsible for/or contribute epidemic occurrence or it is the study of factors affecting the outbreak and spread of infectious diseases (Vanderplank, 1963). Plant disease is governed by a number of factors, some of which can be controlled by farmers.

Forecasting is the prediction of disease outbreak or increase in disease intensity, important for crop production, protection and loss assessment. Crop diseases can be considered as an important cause of crop yield loss, so modelling and predicting these diseases accurately can help in providing prior knowledge of the time and severity of the outbreak of diseases. The plant disease forecasting has been developed to help grower make economic decision about disease management (Agrios, 2004). The prediction of plant diseases has arisen as a firm constituent of epidemiology that is utilized as one of the important disease management tools.

The disease forecasting models have been developed on the basis of amount of initial inoculum (EPIVEN – Apple scab), weather conditions within the cropping season (e.g. Stewart wilt of corn), on the basis of weather (BLITECAST-late blight of potato) and on the basis of amount of initial and secondary inoculum (e.g. leaf and stem rust).

Two types of forecasting system are Fundamental and empirical in which fundamental forecasting system are based on one of disease cyclic component e.g. BLITECAST (Krause et. al., 1975) and in case of empirical forecasting system it is further classified on the basis of single season prediction (*Venturia inaequalis*, stripe rust of winter wheat) and multiple season prediction (potato late blight forecast, leaf spot of peanut (*Cercospora* spp.).

Forecasting Model is an integral part of science, weather physical or biological as they have become valuable tools applied for benefit of humanity. They provide the opportunity for better understanding of the disease for its management. Kranz, (1974) stated that model might be a verbal statement, a hypothesis, a theory or a law and give important information to assess the seriousness of the situation. This activity precedes the choice of an appropriate action to be implemented for reducing the economic damage due to the disease.

Two methods can be utilized to forecast the disease viz., computer modelling and empirical correlations. Computer modelling of plant diseases uses systems analysis to accumulate all the factors that affect the development of a certain disease into a computer-based model, and make predictions of disease under different environmental conditions.

Some Important Computer Based Forecasting Programmes

1. Southern corn leaf blight (EPIMAY; Waggoner *et. al.,* 1972).
2. Apple scab (EPIVEN; Kranz *et. al.,* 1973).
3. *Cercospora* leaf spot of peanut (CERCOS; Knudsen *et. al.,* 1987). A computer simulation model for *Cercospora* leaf spot of peanut.

4. Early blight of tomato (FAST—Forecasting *Alternaria solani* on tomato; Madden *et. al.,* 1978).
5. Late blight of potato (BLITECAST; (Krause *et al.,* 1975).
6. *Mycosphaerella* blight of chrysanthemums (MYCOS).

Importance of Disease Forecasting Service

1. Being able to forecast plant disease epidemics is intellectually stimulating and also an indication of the success of modelling or computer simulation of particular diseases.
2. It is extremely useful to farmers in the practical management of crop diseases.
3. Enable the farmers to plan advance preventive measures for the likely losses.
4. A reliable forecasting system instils confidence in the farming community by ensuring stable yields and reducing unnecessary expenditure on excessive chemical treatment of crops.
5. A timely warning of the possibility of an epidemic will also impress on the government to initiate necessary steps for the timely procurement of chemicals, spraying equipment etc.
6. The prediction of onset periods of diseases will aid in rationalizing disease control measures. It will also ensure environmental quality by controlling pollution and residual hazards arising out of excessive use of chemicals.

Constraints to Grower Adoption

1. Grower attitude (some growers risk averse).
2. Availability & dissemination of system (equipment may not be available; grower has to take part).
3. Costs associated with monitoring equipment & scouting of fields.
4. Inconvenience (calendar sprays allow better planning of operations).
5. Real-time implementation (may not be available to treat when forecaster triggers).
6. Presence of Minor Diseases or pests (other minor diseases or pests may become a problem if number of sprays is decreased).

Conclusion

At present, with the increasing population, plant disease management is of major concern and disease forecasting is one of the preventive measures to cope with this problem. Forecasting helps in prediction of disease outbreak or increase in disease intensity. Effective forecasting system requires deep knowledge of interactions of pathogen populations with various environmental factors, including soil and plant hosts. Knowledge of amount of initial inoculum, weather conditions between the cropping seasons, weather conditions (late blight of potato) and amount of initial and secondary inoculum is the basis for developing forecasting models. The forecasting of exact and timely infectious diseases can assist the public in resolving the epidemic issues.

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Applications of DSSAT Models in Agriculture

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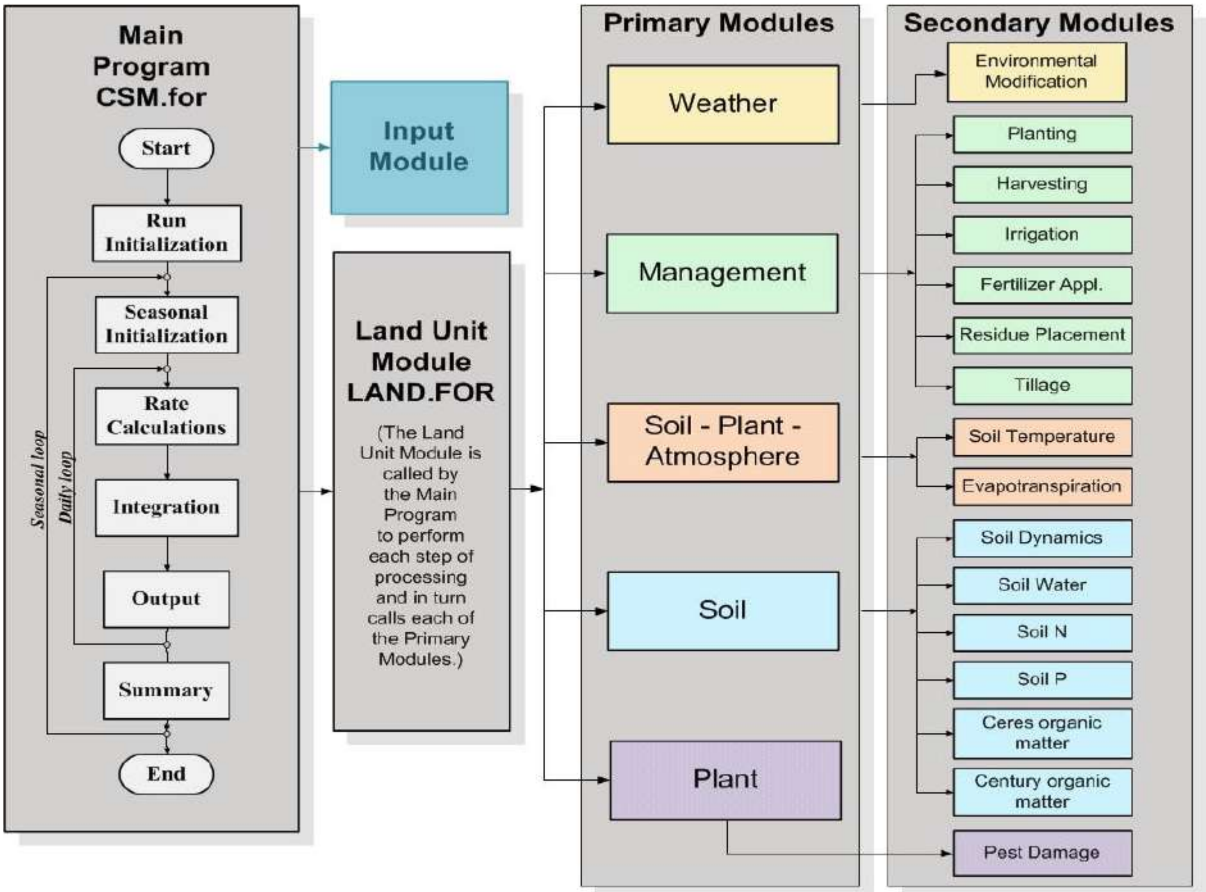
Introduction

The Decision Support System for Agro-technology Transfer (DSSAT) is a software application program that comprises crop simulation models for over 42 crops (as of Version 4.7.5). The software package that contains crop-soil simulation models, databases that describe weather, soil, crops and genotype information for applying the models to different situations and strategy evaluation programs.

The DSSAT is the model based on crop processes i.e. understanding of plants, soil, weather, management. It needs precise and daily data (inputs). It integrates the interaction of weather, soil, management and genetic factors and predicts the plant growth, yield, phonologic stages, plant weight, harvest date, water soil quantity, fertilizer & water requirements, etc.

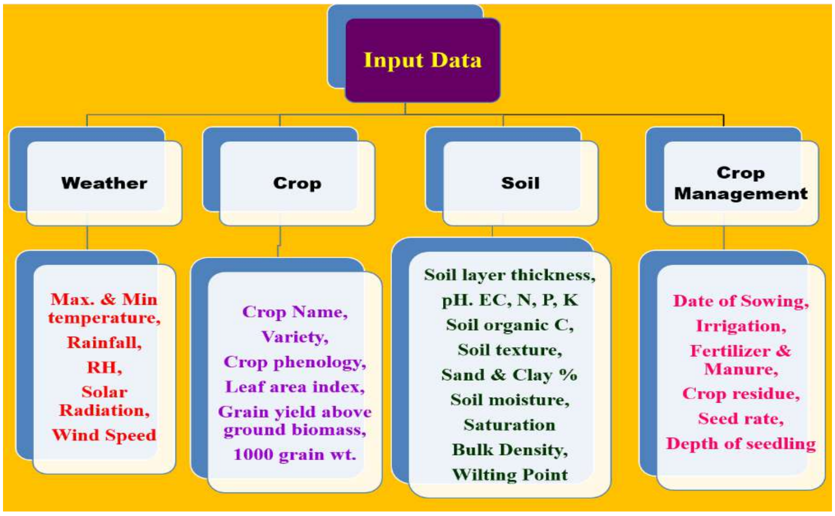
The DSSAT is developed by an international team of scientists and that facilitates the application of crop simulation models in Research, Teaching, Decision making, Outreach & service, Policy and planning.



DSSAT Cropping System Model schematic

Minimum Data Set for Simulation Models

Crop growth simulation models have DataBase Management System (DBMS) and are used to organize and store the Minimum Data Set (MDS). The minimum data required to run crop models are different for different crop growth models (DSSAT, EPIC, APSIM, INFOCROP etc.). In general, the following datasets are required to run the crop models.



DSSAT Components

The DSSAT is a collection of independent programs that operate together; crop simulation models are at its centre (Jones et. al., 2003).

Components	Description
Databases	Weather, soil, genetics, pests, experiments, economics
Models	Crop models (Maize, wheat, rice, barley, sorghum, millet, soybean, peanut, dry bean, potato, cassava, etc.)
Support software	Graphics, weather, soil, experiments, pests, genetics, economics
Applications	Validation/sensitivity analysis, seasonal strategy analysis, crop rotation/sequence analysis, spatial analysis/GIS Linkage

DSSAT Applications

DSSAT and its crop simulation models have been used for many applications which include climate change impact assessment, crop improvement, diagnose problems (Yield Gap Analysis), precision agriculture, diagnose factors causing yield variations, prescribe spatially variable management, fertilizer and irrigation management, soil fertility management, yield prediction for crop management, adaptive management using climate forecasts, soil carbon sequestration, land use change analysis, targeting aid (Early Warning), risk insurance (rainfall), investment potential risks, food security, biofuel production, on-farm and precision management, gene-based modelling and breeding selection, water use, greenhouse gas emissions, and long-term sustainability through the soil organic carbon and nitrogen balances. DSSAT has been used by more than 16,500 researchers, policy and decision-makers in over 174 countries globally.

For applications, DSSAT combines crop, soil, and weather databases with crop models and application programs to simulate multi-year outcomes of crop management strategies. DSSAT integrates the effects of soil, crop phenotype, weather and management options, and allows users to ask "what if" questions by conducting virtual simulation experiments on a desktop computer in minutes which would consume a significant part of an agronomist's career if conducted as real experiments (https://dssat.net/).

DSSAT also provides the evaluation of crop model outputs with experimental data, hence allowing users to compare simulated outcomes with observed results. This is critical prior to any application of a crop model, especially if real-world decisions or recommendations are based on modelled results.

Crop model evaluation is accomplished by inputting the user's minimum data, running the model, and comparing outputs with observed data. By simulating probable outcomes of crop management strategies, DSSAT offers users information with which to rapidly appraise new crops, products, and practices for adoption.

Conclusion

The DSSAT is useful to farmers regarding optimal crop selection, irrigation, and fertilization, and should institute strong incentives to avoid excessive water use. One can use the DSSAT models to evaluate the use of alternative existing varieties and changes in the timing of planting to optimize yield levels or water use. DSSAT and its crop simulation models have been used for a wide range of applications, from on-farm and precision management to regional assessments of the impact of climate change and climate variability. It has the potential to reduce substantially the cost and time of field experiments which is necessary for adequate evaluation of new cultivars and new management systems.

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Role of Symbiotic Bacteria in Plat Virus Transmission by Insects

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Introduction

During the process of circulate plant virus transmission by insect vectors, viruses interact with different insect vector tissues prior to transmission to a new host plant. The relationship among plant viruses, insect vectors and plant hosts are hypothesized to involve a fourth party, bacterial symbionts harboured within the body of the insect vector. An intense debate in the field of bacterial symbionts of insect vectors are known to be involved in the virus transmission process. Primary bacterial symbionts are obligate and remain confined in specialized cells called bacteriocytes. Non-vital, secondary symbionts reside either in bacteriocytes or in other tissues such as the gut, fat body and reproductive tissues. The primary symbiont contributes mainly to the nutritional needs of the insect, providing the essential amino acids that the insect is unable to synthesize or obtain from its diet in sufficient amounts. Without the primary symbiont, the insects grow poorly and have essentially no reproductive output. The interaction of symbionts and vectors are here under depicted for the successful transmission of plant viruses.

Endosymbionts Reported in Different Insect Families

The best studied, classical example is the symbiosis between aphids and the $^{\gamma}$-proteobacterium *Buchnera aphidicola* a primary symbiont. A detailed proteomics analysis of the pea aphid, *Acyrthosiphon pisum* bacteriocyte showed the expression of metabolite transport proteins and all enzymes involved in amino acid metabolism. In the pea aphid bacteriocyte, aphid-derived, cysteine-rich, secreted proteins are expressed. A hypothesis about the regulatory mechanism of circulative virus transmission by aphids proposed that *Buchnera* symbionin, the most abundant *Buchnera* protein and one of the most abundant proteins in the aphid proteome, protected luteovirids from degradation during transit in the aphid hemolymph, or insect blood. Buchnera symbionin is a homolog of the *Escherichia coli* GroEL protein sharing greater than 80% sequence identity with its *E. coli* homo- log. Symbionin is therefore referred to hereafter as GroEL.

The whitefly, *Bemisia tabaci*, harbor a primary symbiont, the $^{\gamma}$-proteobacterium *Portiera aleyrodidarum*, in specialized bacteriocytes. Several genome sequencings projects of *Portiera* revealed genes involved in essential amino acid synthesis not present in the insect genome. In addition to the primary symbiont, several secondary symbionts have been reported in whitefly *Arsenophonus, Hamiltonella, Wolbachia, Rickettsia, Cardinium, Fritschea and Orientia*. These secondary symbionts are facultative residents and play more diverse roles in the association with whiteflies, for example by conferring resistance to insecticides and high temperatures and by protecting the insects from natural enemies. Negative effects of secondary symbionts have also been reported and these negative effects may be due to a shorter evolutionary history of interaction compared to the primary symbiont or because the symbiont-insect interaction was not assessed under conditions where the symbiont would be beneficial. The iso-female, genetically identical lines of the *Bemisia* species, one Rickettsia-infected (Rick+) and the other uninfected (Rick-) over 300 generations and showed that the presence of Rickettsia is associated with improved TYLCV acquisition, transmission and retention in the insect.

Similarly, the other group of insects where this type of interaction found was reported in the western flower thrips, *Frankliniella occidentalis* has a symbiotic relation with *Erwinia* species gut bacteria. The primary beta proteobacterial endosymbiont *Tremblya princeps* harbored in the mealy bugs feeding o the plant phloem sap plays similar biological roles for their host insects. The endosymbiotic microbiota of the *Macrosteles* leafhoppers *M. striifrons* and *M. sexnotatus*, harboring obligate endosymbionts *Candidatus* Sulcia muelleri and *Candidatus Nasuia deltocephalinicola* and facultative endosymbionts, *Wolbachia*, *Rickettsia*, *Burkholderia*, *Diplorickettsia*, reported that the ecological interactions between the obligate endosymbionts, the facultative endosymbionts, and the phytopathogenic phytoplasmas within the same host insects, affected the vector competence of the leafhoppers.

Conclusion

Further study is needed for understanding the concepts regarding the role of bacterial symbionts in plant virus transmission across different vector–virus pathosystems. Future work should focus on whether symbionts influence the vector– plant relationship and if so, whether these impacts are direct or indirect and represent cooperation or conflict among the parties involved. Proof of a direct involvement would require a symbiont protein involved in protein complex formation with a virus protein. Indirect involvement would be demonstrated when a symbiont influences some aspect of the insect vector physiology that changes its ability to transmit virus. Molecular studies should be aimed at understanding how symbionts regulate circulative virus transmission and should also be focused on specific barriers for virus movement like gut, salivary glands and hemolymph.

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RNAi Silencing vs CRISPR Cas Gene Editing Technology in Combating Fall Armyworm

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Introduction

The basic primary difference between RNAi (INTERFERENCE) and CRISPR Clustered regularly interspaced short palindromic repeats is that RNAi reduces, lowers gene expression at the mRNA level (knockdown), whereas CRISPR completely and permanently silences the gene at the DNA level (knockout).

There are ifs and buts in both the gene silencing methods where in Knockouts of essential genes are lethal, providing only partial information regarding gene function where the gene of interest plays an important role in survival of the organism. In such cases, incomplete gene knockdown can provide a far better understanding of gene effect on phenotype because the effects and consequences of reducing protein levels to different extents can be studied.

Moreover, the reversible nature of knockdowns makes it possible to verify the phenotypic effect by restoring protein expression to normalcy in cells. Importantly, since a knockdown is a transient phenomenon it can be a safer option than permanent genome editing. Thus, RNAi aids in ephemeral blocking of a gene expression.

On the other hand, knockouts are effective in completely blocking protein expression, As CRISPR is well known for its simple and ease of genetic editing like CRISPRi allows silencing of genes without permanently knocking out the gene. This is achieved using a dead Cas9 nuclease that physically blocks RNA polymerase and inhibits gene transcription or by editing gene regulators to modulate gene expression.

Difference Between CRISPRa and CRISPRi

CRISPR activation or CRISPRa is a variant of CRISPR in which a catalytically dead (d) Cas9 is fused with a transcriptional effector to modulate target gene expression. Once the guide RNA navigates to the genome locus along with the effector arm, the dCas9 is unable to make a cut, and instead, the effector activates the downstream gene expression unlike CRISPRi which represses the downstream gene expression instead of activating it.

RNAi Mode of Action

The dsRNA that enters the cell (or the existing pre-miRNA in cells) is cleaved into smaller RNA fragments of around 21 nucleotides in length by an endonuclease, Dicer. These RNAs associate with the RNA-induced silencing complex (RISC), the antisense strand is separated from the sense strand and are targeted to their complementary mRNA.

Following association of the siRNA or miRNA with their target, argonaute, a protein from the RISC complex, cleaves the mRNA and inhibits expression of the protein that it encodes. If the sequences of siRNA or miRNA do not perfectly match the sequence of the mRNA, then the mRNA is not cleaved, but translation is halted as the RISC complex physically blocks the mRNA.

Bhai et. al.,(2020) studied and concluded that the fall armyworm is mainly controlled by the chemical insecticides, whereas the frequent application of insecticides would result in the resistance development. Insect cytochrome P450 monooxygenases plays an essential role in the detoxification of insecticides. In this study, five P450 genes were selected to determine the role in response to insecticides by RNA interference (RNAi). Developmental expression pattern analysis revealed that *S. frugiperda* CYP321A8, CYP321A9, and CYP321B1 were highest in second-instar larvae among developmental stages, with 2.04-, 3.39-, and 8.58-fold compared with eggs, whereas CYP337B5 and CYP6AE44 were highest in adult stage, with 16.3- and 10.6-fold in comparison of eggs, respectively. Tissue-specific expression pattern analysis exhibited that CYP321A8, CYP321B1, and CYP6AE44 were highest in the midgut, with 3.56-, 3.33-, and 3.04-fold compared with head, whereas CYP321A9 and CYP337B5 were highest in wings, with 3.07- and 3.36-fold compared with head, respectively. RNAi was also conducted to explore detoxification effects of the five P450 genes on chlorantraniliprole. The second-instar larvae became more sensitive to chlorantraniliprole with a higher mortality rate than the control, after silencing CYP321A8, CYP321A9 and CYP321B1, respectively. These findings proved that CYP321A8, CYP321A9 and CYP321B1 may play a critical role in insecticide detoxification.

CRISPR Mode of Action

CRISPR-based genome editing requires two components: a guide RNA and a CRISPR-associated endonuclease protein (Cas). The guide RNA directs the Cas nuclease to the specific target DNA sequence, which then cuts the DNA at that site.

The SpCas9 nuclease contains two protein lobes: a recognition lobe and a nuclease lobe. Upon binding the target DNA sequence with the help of the guide RNA, the recognition lobe interacts with the DNA strand to double check for complementarity. The nuclease lobe, similar to a pair of molecular scissors, then creates a double-strand break (DSB) in the target DNA.

Once a DSB is created in the DNA, the cell tries to repair it via non-homologous end to end joining (NHEJ), which is a quick-fix repair mechanism for ligation of the blunt ends of DNA and is prone to errors. The process often results in insertions or deletion of bases (indels), which can lead to protein disruption, and is the preferred pathway for knocking out a particular gene.

Wu et. al.,(2018) identified and characterized the abdominal-A (Sfabd-A) gene of fall armyworm (FAW). Sfabd-A single guide RNA (sgRNA) and Cas9 protein were then injected into 244 embryos of FAW. Sixty-two embryos injected with Sfabd-A sgRNA hatched. Of these hatched embryos, twelve developed into larvae that displayed typical aba-A mutant phenotypes such as fused segments. Of the twelve mutant larvae, three and five eventually developed into female and male moths, respectively. Most mutant moths were sterile and one female produced a few unviable eggs when it was outcrossed to a wild-type male. Genotyping of 20 unhatched Sfabd-A sgRNA-injected embryos and 42 moths that developed from Sfabd-A sgRNA-injected embryos showed that 100% of the unhatched embryos and 50% of the moths contained mutations at the Sfabd-A genomic locus near the guide RNA target site. These results suggest that the CRISPR/Cas9 system is very efficient in editing FAW genome.

Conclusion

In combating the resistance mechanism developed against different insectides by the pests, gene editing technologies like RNAi and CRISPR facilitate as novel next generation pest management strategies.

Parameter	CRISPR	RNAi
Function	Knockout	Knockdown
Transgenes	Cas9 & sgRNA (spCas9: ~4.2 kb, saCas9: ~3.4 kb)	siRNA (~20 bp) or shRNA (~80 bp
Ease of Experiment	Easy to Moderate	Easy

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Healthy Spirit of Sesame

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Introduction

Sesamum indicum L., member of the family Pedaliaceae also known as sesamum, sesame, til, gingelly, simsin, gergelim is the most ancient oilseed crop and one of the oldest cultivated plant in the world dating back to 3050-3500 B.C. (Bedigian and Harlan, 1986). Known as "queen of oil seed crops" it is used worldwide for nutritional, medicinal, and industrial purposes. It originated from tropical Africa and was taken to India at an early stage where it was domesticated and became a crop of the new world (Faulsi, 2007). Being well adapted to harsh environments and it can constitute an alternative cash crop for smallholders in developing countries like India. The seeds are widely used in culinary as well as traditional medicines for their nutritive, preventive, and curative properties. Whereas sesame oil substitute for olive oil, as a salad oil even for cooking fish and vegetables. Roasted sesame seeds are used in the preparation of bread, cookies, chocolates, ice creams, sweet wholesome tahini, sesame seed sauce, sesame pastries and hamburger buns etc. It also has non-culinary application which includes its use as an ingredient in soap, cosmetics, lubricants and medicines. The de-oiled meal is mainly utilized as cattle and poultry feed.

Sesame seeds contain 50 per cent oil and 20-25 per cent protein. The oil contains 47 per cent oleic acid, 39 per cent linoleic acid, 39 per cent mono unsaturated and 46 per cent poly unsaturated fatty acids (Toma and Tabekhia, 1979). Sesame oil is adjudging as one of the healthiest oils, loaded with phytonutrients such as omega-6 fatty acids, anti-oxidants, vitamins, and dietary fibres, potential antimicrobial and anti-cancer properties. Sesamin and Sesamolin present in sesame seeds are known to have a cholesterol lowering effect in humans and to prevent high blood pressure (Pal A et al., 2010). It even contains abundance of vitamin E along with vitamin B complex and vitamin A which helps nourish and rejuvenate skin and cure and prevent of acne due to its oil pulling properties. The resulting liquid extracted by boiling of both leaves and roots has been found to be effective against measles and chicken pox. Sesame oil is also used as massaging oil due to its warming property and ability to seep deep into the skin. Rubbing a little amount of sesame oil into the soles of feet before bed can help you get a more restful sleep.

Conclusion

Though sesame has economic and nutritional importance, it is an orphan crop as it has received very little attention from science, the crop has shown a decreasing trend both in area and production largely due to lack of suitable improved varieties, cultivation on marginal and sub-marginal lands under poor management and input starved conditions and occurrence of various diseases and pests due to which it lags behind the other major oil crops as far as genetic improvement is concerned. Therefore, concerted and systematic efforts are required to harness the potential of this extremely healthy crop through different breeding methods along with much more modernized and updated agronomic practices.

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A Trend Unfurls of *Fusarium oxysporum* f. sp. *psidii*

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Abstract

Psidium guajava L. is high profile nutrient fruit crop it is used for medicinal purposes. At present scenario the wilt caused by *Fusarium oxysporum* f. sp. *psidii* disease is common in cultivated areas and it initiates diseases during August – September. In this paper, we shortly overlook on management practices like chemical, cultural practices and also specific bioagents

Keywords: Guava, Wilt, Management.

Introduction

Common guava (*Psidium guajava* L.) belongs to Myrtle family, phylum Magnoliophyta, class Magnoliopsida and within a family of over 140 plant genera and 3000 species were included (Ellshoff, et al., 1995). Guava wilt it is a foremost fruit crop of subtropical countries and cultivated massively throughout India. A current constraint on horticultural crops losses per annually 15 -30 %.

Symptoms

Disease arose mainly on onset of monsoon during high rainfall on August/September. Initially loss of chlorophyll turns into light yellow colour epinasty, loss of turgidity. Eventually it leads premature shedding and defoliation.

Next season its pitfalls with underdeveloped fruits, roots rotting at the basal region as well as light brown discolouration in vascular tissues and older trees are more prone to disease attack.

Root injury inclines wilt disease, it spreads by stagnant water with short distance and also through sick soils. It requires minimum and maximum temperature range 23-320C with 76% relative humidity.

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Management Practices

In ancient times in the year 1949 they recommend with Chaubatia paste but disease production not declined (Anonymous, 1949). It is a soil borne disease and few authors suggested that 0.1% water-soluble 8-Quinolinol sulphate was better control of wilt (Jain, 1956), drenching with 0.2% either Benlate or Bavistin 4 times in a year and spraying twice with Metasystox and Zinc sulphate for pruning (Suhag, 1976), Bavistin, topsin M, indofil M-45, Thiram, Blitox (Misra and Pandey, 1999) were different fungicides to control wilt .Central Institute for Subtropical Horticulture (CISH) at Lucknow where, wilt was suppressed by application of 6 kg. neem cake + 2 kg. gypsum per plant (Misra and Pandey, 1994). Farmers mainly they will follow cultural practices with proper sanitation for wilted trees. Maintenance of proper tree vigour, pits may be treated with formalin and kept covered for about three days followed by transplanting should be done after 2 weeks. Intercropping with Marigold or Turmeric to assess wilting of guava (Misra et al., 2004).

Management of Guava wilt

Nowdays a graft compatibility is very fruitful and using different resistant rootstocks to control wilt disease. *Aspergillus niger* was biogent for suppression of wilt disease.

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The Science of Epigenetics and its Emerging Role in Agriculture

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Abstract

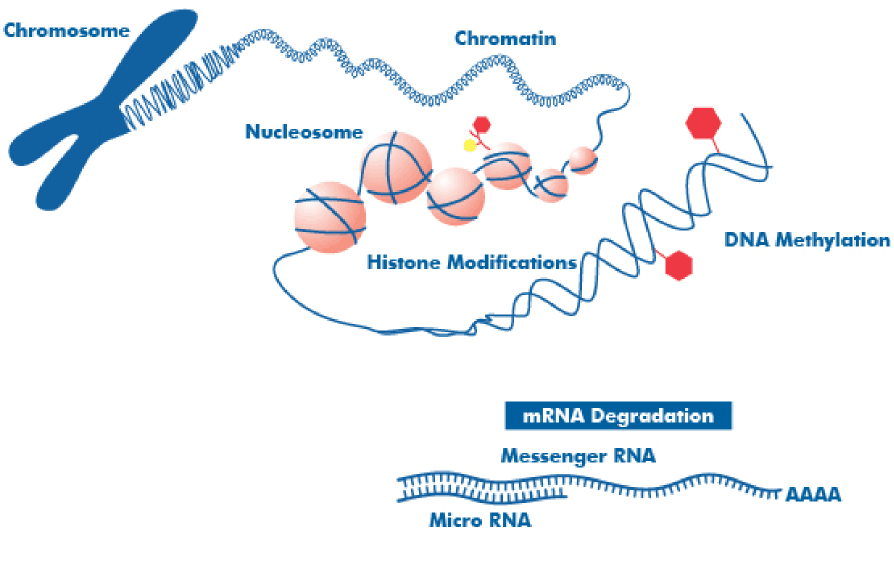
Out of several thousand genes in an organism, not all genes express themselves, which means such genes are transcriptionally inactive. The phenotypes which arise in an organism are not only the sole result of genes present in the DNA. This is clearly proved by the famous example of monozygotic twins, which possess identical genotypes but they are not always fully phenotypically identical. A newly emerging field of genetics, though known for so long known as epigenetics explains such variations. The term epigenetics was coined by C.H. Waddington in 1940. Epigenetics is defined as the study of factors that affect gene expression, but that does not alter the nucleotide sequence of the DNA. This branch of genetics explains how heritable changes other than those present in DNA are affecting phenotypes.

Epigenetic components in eukaryotes mainly include DNA cytosine methylation, histone modifications, and certain aspects of RNA interference (RNAi). It was evident after several types of research that many diseases such as cancers are generally caused by epigenetic modifications in an organism.

Mechanisms of Epigenetics

1. Methylation: It is defined as the addition of methyl (-CH3) group to the base cytosine, this reaction is catalyzed by methyltransferase enzyme. This methylation takes place in cytosine adjacent to guanine and this combination is called CpG islands. These methyl groups attach to the major groove of DNA and thus block the binding of transcription factors that are essential for transcription to occur. So, methylation causes adjacent genes to get inactive and thus they cannot express themselves and are silenced. In short, genes are switched off when methylated. Methylation is more prominent in the repetitive DNA region, transposable elements that silence these regions in an organism.

2. Histone modifications: DNA is coiled around histone proteins to form nucleosomes and this is how it is packed in eukaryotes. The amino acids in the N-terminal of these histones can be covalently modified in various ways, either by methylation, phosphorylation or acetylation. These chemical modifications in histones either make the genes accessible or inaccessible for transcription to be performed. For example, during acetylation, the addition of the acetyl group, the chromatin structure becomes open and this makes the genes available for transcription.



MECHANISMS OF EPIGENETICS © Novus biologicals

3. RNA interference: This method is a simple post-transcriptional method of silencing of expression of genes. The silencing occurs by the degradation of RNA into small pieces, which interfere with normal RNAs. This involves the degradation of dsRNA into small interfering RNAs (siRNA) by an RNAse enzyme. These small siRNAs further associate to an RNAse induced silencing complex (RISC) which acts on a homologous corresponding RNA and thereby degrades it.

Epigenetics operates like a control system in which genes would be turned on and off. Epigenetics operates through several phenomenal mechanisms to alter, change in gene expression and finally change the phenotype of an organism. It has the potential to present enormous roles in every aspect of life and also in agriculture.

Epigenetics vs. Genetics

Genetics involves alteration of DNA itself to produce a new phenotype while epigenetics operates on gene expression and silencing but no modifications in DNA sequences itself. This is a reason that genetically modified crops take years to pass through several regulations, whereas, epicrops may easily pass through stringent rules because no changes are made at the genetic level.

Role of Epigenetics in Agriculture

Several types of biotic and abiotic stresses like heat, water stress and pathogens act as a stimulus and change the genetic expression level in an organism via., various epigenetics mechanisms viz., DNA methylation, histone modifications and miRNA. Altering such mechanisms may prevent stress caused by such factors.

Several essential genes are expressed or silenced by the phenomenon of epigenetics. For example, at a certain point in time African farmers noticed that some of their palms were not producing oil. Upon research, it was found that the poorly producing palms actually suffered activation of a transposon that had lost its methylation and as a result disrupted an essential gene responsible for oil production. This clearly demonstrates that the role of epigenetic study is crucial for solving agricultural problems.

Nevertheless, loss of methylation may also expose some genes which might be rather advantageous for us and have been silenced or selected for in the due course of domestication. Releasing such genes from methylation, which may be advantageous is a research area for scientists and need to be studied to produce plants with novel beneficial phenotypes. Such phenotypes may represent the untapped sources of diversity. Using epigenetics, we may discover new sources of resistance without going towards wild species.

The beauty of epigenetic modifications is that the alterations can be reversed, that is, it could temporarily activate or deactivate genes. This is an amazing advantage that places the control in one's hand. We may alter the response of a plant to one type of stress where it exists and we may turn it off when it is not needed in other plants. Though it is not that easy as it appears to be, it still opens up a new possibility to such researches.

Conclusion

Epigenetics is a branch of genetics that deals with heritable changes that do not involve alterations in DNA. They operate by several mechanisms such as methylation, histone modifications or RNA interference. In-depth research in the field of epigenetic responses to various types of stresses has the potential to increase our understanding of plant stress adaptation and underlying mechanisms which can be exploited further for the development of improved varieties. The field of epigenetics has a unique ability to improve crop stress tolerance, yield, uncover diversity and many important traits without tampering the genes itself.

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An Overview About Soilless Cultivation of Capsicum Crop

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Summary
Soil less cultivation of capsicum offers a way of control over soil-borne diseases and pests, which is especially desirable in the tropics where the life cycles of these organisms continues uninterrupted and so does the threat of infestation. Thus, the costly and time-consuming tasks of soil sterilization, soil amelioration, etc. can be avoided with soilless cultivation system of capsicum. It also enables to cultivate vegetables in area were soil fertility is very low and unfertile soil as well as soil with low or high pH problems. It offers a clean working environment with good quality vegetables and thus hiring labour is easy.

Introduction
Capsicum is also known as bell pepper or sweet pepper and is one of the most popular and highly remunerative annual herbaceous vegetable crops. It is belonging to the family solanaceae and different from chilli (hot pepper). In other language it is also called shimla mirch, green pepper and capsicum. Capsicum is cultivated in most parts of the world, especially in temperate regions of Central and South America and European countries, tropical and subtropical regions of Asian continent mainly in India and China.

In India, capsicum is extensively cultivated in Andhra Pradesh, Karnataka, Maharashtra, Tamilnadu, Himachal Pradesh, and hilly areas of Uttar Pradesh (Sreedhara et al., 2013). In India, capsicum is grown for its mature fruits and is widely used in stuffing and baking.

It is also used in salad, noodles and soup preparation. It is a very rich source of vitamins A and C (ascorbic acid). It has been found that every 100 grams of edible portion of capsicum provides 24 kcal of energy, gram of protein, 4.3 gram of carbohydrate and 0.3 gram of fat.

In recent years a great deal of research work has been reported on the uses of soilless culture in vegetable crops. Soilless cultivation leads to ability to produce higher yields than traditional, soil-based agriculture and nutrient solution may be recycle or reuse in other areas such as potted plants and turf management. So, to evaluate the effect of different concentration of N, P and K on growth, yield and quality of capsicum in soilless media was conducted in Prayagraj, U.P. India.

Advantages of Soilless Cultivation of Capsicum
1. Better quality produce.
2. No soil borne diseases and pests.
3. Continuous cultivation is possible.
4. Efficient use of available resources.
5. No need of weeding and soil fumigation.
6. More productivity per unit area and time.
7. Cultivation of crops are possible in saline and desert area.
8. One can grow the crops who do not have their own field.

Soilless Media Used for Cultivation of Capsicum
One of the commonly available soilless materials in India is coconut coir dust also known as cocopeat, is an eco- friendly growing medium obtained after the extraction of coir fiber from the coconut husk, it is 100% organic substance and is free from any harmful substance. It is considered as a good and effective growing soilless media with acceptable pH, electrical conductivity and other chemical attributes (Awang et al., 2010).

Characteristics of Good Quality Media

The media used should be:
1. Fairly constant in volume.
2. Free from weed seed, nematodes and soil borne diseases.
3. Having proper drainage and aeration.
4. Sufficient nutrients.
5. Low in soluble salts but adequate CEC.
6. Biologically and chemically stable on sterilization.

We used growing media of FYM+Vermicompost+ cocopeat the ratio should be (1:1:5), one-part Farmyard manure, one part vermicompost and five parts of cocopeat.

Materials and Method

Water and nutrient management through drip fertigation in soilless media improves water, nutrient and air distribution in the growing medium and subsequently improves crop health and productivity. Drip fertigation in soilless cultivation is used to supply complete nutrient solution with irrigation water.

The main goal of water and nutrient management for greenhouse soilless crops is to enhance crop growth and product quality and simultaneously reduce losses of water and nutrients to the environment.

Crops to Grow in Soilless Culture Apart from Capsicum

1. Vegetables: Tomato, Lettuce, Cucumber, Muskmelon, Brinjal, Beet, Winged bean, Capsicum, Cabbage, Cauliflower, Radish etc.

2. Flowers: Gerbera, Rose, Orchid, Anthurium, Marigold, Carnation, Chrysanthemum, Lily etc.

3. Fruits: Strawberry, Raspberry.

Seedlings Grown in Soilless Culture Requires

1. Protected structure.
2. Select good quality High yielding hybrid varieties.
3. Soilless media should be free from Fairly constant in volume, Free from weed seed, nematodes and soil borne diseases.
4. Proper size grow bags used.
5. Automatic drip watering fertigation system.
6. To avoid problems like Insect pest due to weeds, nematodes and soil borne diseases mulching sheet used.

Plants Grow in Grow Bags

1. Plants are grown in grow bags have good quality and free from pest and diseases.
2. The size of grow bags: Length - 24cm, width - 24 cm and Height – 40 cm
3. Irrigation by automatic watering drip spikes system is provided to ensure proper moisture in media.

Results

From the present investigation on soilless cultivation of vegetables it is observed that mixed Growing media of Farmyard manure, Vermicompost and cocopeat used with liquid NPK fertilizer of 15:28:28 ratio concentration and proper irrigation facility with automatic watering spikes recorded best results for Growth, yield and quality parameters of capsicum (Bell pepper) in Prayagraj Uttar Pradesh, and provide a good scope to feed the over growing population countries with more yield per unit area and good quality of vegetables in areas with adverse soil and climatic conditions and in economic point of view the use of soilless cultivation is costly in initial years due to high input costs of materials like: protected structures, automatic watering spikes, growing media and other materials which is usable for long term, but after establishment it is found beneficial in future as compare to open field cultivation of capsicum because of good quality produce with more yield per unit area.

Due to over growing population in our country there is a urgent need of a technology which is based on high production in less area because land holdings of farmers are decreasing day by day, due to industrialization and high use of chemical fertilizers which makes soil unfertile, so, the soilless cultivation of capsicum provided a hope and source of income for farmers with small land holding or unfertilized land with poor soil quality, because of high yield and no land requirement it is possible for farmers to grow the capsicum in small land holdings and gain huge income as compare to field cultivation.

Limitations of Soilless Cultivations of Capsicum

1. A minor mistake can end up the crop.
2. Fewer knowledge among people about this technology.
3. High resources investment and require technical knowledge for management.
4. Soilless cultivation is not a suitable production system for all horticultural crops.

Conclusion

1. Efficient use of inputs.
2. No soil borne diseases and pests.
3. An alternative of soil fumigation.
4. No need to depend on farm land.
5. The production of vegetables can be increased manifold.
6. The capsicum and fruit vegetable in a soilless media should meets the quality of international standards
7. It is possible to produce high value horticultural crops on a sustainable source.

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Biological Control: A Scientific Approach

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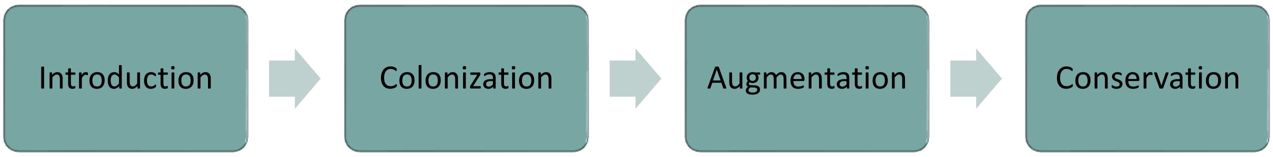
What is Biological Control?

Biological control is a simple method which involves the use of active biota or organism to manage or control undesirable insects, other animals or plants. Nowadays this is an important tool of Integrated Pest Management (IPM) programmes. Here active biota or living organisms are generally natural enemies which include arthropods (insect etc), vertebrates (toad etc), nematodes (*Steinernema* sp. etc), microorganisms (viruses, fungi, bacteria, protozoa etc).

Strategies of Biocontrol



1. Introduction: Generally, introduction refers to the bringing or importing a natural enemy into a new locality to destroy or control a pest which is already introduced. One cannot find this introduced natural enemy in the native place of targeting pest. Government authorities mostly do this introduction. In many cases inadequacy may be found when the complex of natural enemies associated with an insect pest. Especially this is evident when an insect pest is introduced accidentally into a new geographic area with the absence of its associated natural enemies. These introduced pests are called as invasive or exotic pests.

Some ecological points to be considered for successful introduction of natural enemy:

a. The natural enemy should be imported from a place with similar type of climate.
b. It should be free from alternate host.
c. Hyperparasitoids and biological competitors for host should not be present within it.
d. Low dispersal of natural enemy is essential.
e. Physiological suitability of the natural enemy to its host is also important.

2. Colonization: Process or mechanism of multiplication of introduced natural enemy to set up in a new geographic location is called colonization. It is the most complicated strategy of biocontrol and to make it easier in a successful way the following considerations are made.

a. Application of pesticides and cultural practices should not be followed at the site of colonization.
b. For successful storing of natural enemy a low temperature (16˚c) should be maintained.
c. Adult stages are more appropriate than immature stages because adults can easily cope up with in the new locality and less affected by biotic and abiotic stresses.
d. Relative humidity should be appropriate for transporting natural enemies.
e. Natural enemies should be released either early in the morning or in the late evening to avoid direct heat from sunlight.
f. Before the release, the natural enemies should be fed and mated.
g. After the initial release recovery attempts are undertaken if the released natural enemies are surviving and control is being provided.

Evaluation of Natural Enemies

Before assessing the results, a minimum period of 3 years is given. Evaluation of the effectiveness of natural enemies is done by:

1. Before and after the release of natural enemy, comparing the host population of the pest.
2. Correlating population changes of the natural enemy and the host.
3. Comparing the population on plots with and without the natural enemy.

For evaluating the effectiveness of a natural enemy 2 important systems are normally followed:
1. Experimental procedure (Natural enemy exclusion method).
2. Analytical procedure (Life table analysis method).

Augmentation

All the activities are designed here to increase the population of existing natural enemies. Here to increase its population mass culturing and release of natural enemies are important. Natural enemies that are unable to survive or persist in a new locality can be reared sometimes in huge numbers and periodically released to suppress a pest population. So, here more numbers of natural enemies used to release into an agroecosystem and greater numbers or effectiveness of natural enemies is to be promoted where modification of environment is done.

In augmentation releases differ from introduction in that these have to be repeated periodically. Two types of periodical releases are there:
1. Inoculative release: To suppress local pest outbreaks very small numbers of natural enemies are released in various critical locations. Here control of pests is expected only from the progeny and subsequent generations of the release natural enemies. Only one-time release of natural enemy to re-establish the population of natural enemy.

2. Inundate release: Here mass culture and release of natural enemies is done directly to suppress pest population. To destroy the pest population larger numbers of natural enemies are released in a single location e.g. *Bracon* sp. (larval parasitoid) and *Coccinella* sp. (predator).

Conservation

It is the preservation of those introduced natural enemies in a controlled laboratory condition. It is achieved by:
1. Cognitive use of pesticides: Pesticides always exert a bad effect on natural enemies by reducing the longevity, fecundity and searching ability and decimating the population of flying adults. These can be avoided by:
- a. Safe and selective pesticides should be used.
- b. Minimum recommended dose should be used.
- c. Use of non-persistent pesticides.
- d. Application should be in a specific time in a limited area.
- e. Microbial pesticides should be used instead of synthetic pesticides.

2. Selection of proper food and shelter:
- a. Nesting boxes and bird perches act suitable sites and encourage build-up of predator.
- b. Plantation of pollen and nectar bearing flowering plants on the bunds to provide supplementary food to predator.

3. Appropriate management practices:
- a. Chisel ploughing make easy to suppress the soil pest as it conserves natural enemies.
- b. To enhance the efficacy of entomopathogenic fungus manipulation of relative humidity and wetting periods should be done by cultural practices.
- c. Application of organic manures to conserve predaceous arthropods and soil borne microbial antagonists of insect pests.
- d. Parasitoids should be released at a time when the activity of hyperparasitoids is least.
- e. To maintain predator population, retention of crop stubble as well as grass weed heaps is needed.
- f. Keep a part of refuge in net mesh cages to allow emergence of parasitoids in the field.

4. Ants suppression: Suppression of ants or their physical exclusion increase the effectiveness or working ability of predators.

5. Determining the need for action:
- a. Suitable life stage of natural enemy and its effectiveness should synchronize with the availability of suitable stage of the pest.
- b. Based on population of the natural enemies and their feeding of parasitized potential; the need of action has to be determined for each crop ecosystem.

6. Plant type influences:

a. Leaf pubescence of plants affects efficiency of searching, oviposition, parasitism and prey consumption.

b. Leaf or flower colour plays a major role in attraction or repelling parasitoids.

c. Different morphological characteristics of the host plants and volatile contents in plants play an important role in the effectiveness of the predators and parasitoids.

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Legumes an Alternative Land Use Options for Sustaining Soil Health

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Introduction

Legumes are sustaining soil health of natural ecosystem such as forest, grassland as well as managed ecosystem. Legumes play pivotal role in food security and in achieving human health. The legumes hold special significance in agriculture sector due to their scientifically proven role in nitrogen fixation and resultant improvement in soil fertility status.

Legume-based systems improve the soil organic carbon and humus content, nitrogen and phosphorus availability (Jensen et al., 2012). Thus, inclusion of the legumes in cropping systems is of paramount importance in achieving better soil health and productivity (Binder et al., 2010; Dhakal et al., 2016).

Role of Legumes

1. Crop diversification, food and nutritional security: Legumes are important component in crop diversification because it ensures breaking of pests and diseases cycles, improve the soil fertility status and soil health.

Crop diversification of monocrop cereals with legumes particularly the pulses helps in achieving nutritional security. Thus, to achieve soil sustainability and balanced food and nutritional security legumes need to be incorporated in cropping systems (Nees et al., 2010).

2. Reduction in external inputs use: Inclusion of legumes and pulses in the cropping systems significantly decreases reliance on external inputs use particularly the nitrogen fertilizers use. Thus, legumes and pulses considerably save the costly inputs i.e., fertilizers and chemicals, and also reduced environmental pollution.

A food legume may save about 170-220 kg/ha of N fertilizer besides saving about 40-70 kg of N to the following crop (Fustec et al., 2010; Varma et al., 2017). Clovers, for example save 160-310 kg/ha of N fertilizer through biological nitrogen fixation (BNF) capacity even without any fertilizer application (Bues et al., 2013), and also supply 30-60 kg/ha N for the succeeding crop.

3. Soil sustainability: Soil sustainability implies the ecological balance, enhancement of soil functions, and biodiversity. Role of legumes in soil health improvement is widely studied and known to have positive impacts in terms of BNF, and in weed suppression and erosion control as cover crop.

However, increasing threats of soil degradation, pollution, global warming, declining soil fertility, industrialization, urbanization, and the rising price of fertilizers severely undermines the soil sustainability.

Thus, under such conditions, legumes play crucial role in soil sustainability (Dhakal et al., 2016), and thus inclusion of legumes in cropping system is inevitable due to their role in sustaining soil health and long-term sustainability as well as quality of soil (Padilla and Pugnaire, 2006).

4. Improved productivity potentials: Legumes are promising options due to their positive effects on soil processes such as benefiting agro ecosystems, agricultural productivity, soil conservation, soil biology, soil organic carbon (SOC) and nitrogen stocks.

Thus, incorporating legumes as a part of cropping systems is pertinent to better soil health and productivity (Binder et al. 2010; Dhakal et al., 2016). Legume-based crop rotation also proven effective in reducing the impact of diseases, diversify the cropping system, suppress weeds, and recover soil functions (Deutsch et al., 2006), and resultant increase in agricultural productivity.

5. Maintenance of soil nutrients reserves: Legumes and pulses are the important source for improving the SOC stock, and thus help in maintaining the soil health. Legume-based crop rotations including legume-based green manure crops are of special significance for ensuring land sustainability due to their favourable effects on soil health and productivity.

Besides, legumes play an important role in soil microbial biomass, and in several processes like nutrient cycling and SOM decomposition, and thus improves the crop productivity and soil sustainability (Knight and Dick, 2004; Lal, 2012).

6. Improvement in soil physical and chemical condition: Legumes have great potential to improve the soil physical properties by producing large quantities of biomass, and as a result more biological activity and organic matter in soil system.

Due to direct effects of legume crops residue on improving few important soil physical properties viz., soil formation and aggregation, and resultant better infiltration of water (Mousavi et al., 2009). Besides, legume-based systems also proven effective in improving the soil chemical properties such as soil pH, status of available nutrients, and SOC stock (Mugwe et al., 2004).

7. Legumes in natural and managed ecosystems: Several leguminous species occur naturally under natural as well as managed ecosystems such as forest and grassland, and agri-ecosystems. Leguminous tree species reported to have positive effects on soil physical, chemical and biological health, and thus plays important role in maintaining soil health of natural and managed ecosystems.

Khejri *(Prosopis cineraria)*, subabul *(Leucaena leucocephala)*, kikar *(Acacia nilotica)* are few of many naturally occurring leguminous species spotted widely, and suggested for soil conservation in forest, grassland and wastelands.

Framework for Future

1. Research efforts need to be directed towards development of suitable varietal wealth of legumes and pulses particularly targeting the grey areas such as desert and sandy soils.

2. Legumes and pulses may be used as alternatives sources for nutritional security and environmental sustainability.

3. Policies framework need to be oriented towards incentives for marginal and small holder farmers to give boost for cultivation of legumes and pulses.

Conclusion

Legumes as important constituents of crop rotation ensure soil sustainability through restoration of soil health by improving biological, chemical, and physical properties of soils. Besides, improving the soil health, legumes also ensures food and nutritional security as well as environmental sustainability.

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Smart Aquaculture: IoT for Intelligent Fish Farming

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Introduction

Let's sit back and think about how many smart things we are surrounded by; we have a smartphone in our pocket, a smartwatch on our wrist, drive in a smart car to the smart cities. 'Internet of Things (IoT)' technology has taken the world by storm. The IoT is about connecting everyday things embedded with electronics, software, and sensors to the internet, enabling them to collect and exchange data. It is expected that by 2025, 75.44 billion devices will be part of IoT . IoT applications are almost available in every industry from Smart Homes, Wearables, Connected Cars, Industrial Internet, Smart Cities to Agriculture, Smart Retail, Smart grids, Healthcare, Poultry and Farming.

Fisheries and aquaculture are one of the wildest-growing subsectors of agriculture. It plays an essential role in meeting out the food and nutritional security of the rising population. The sector also makes vital contributions to global food production. In the past five decades, the global supply of fish for human consumption has outpaced population growth. Amongst all the countries, India ranks second in aquaculture production and second in total fish production. During the financial year 2017-18, the total fish production in India is estimated at 12.61 Million Metric tonnes. Fish production increment was observed from 5.66 Million Metric tonnes in 2000-01 to 12.61 Million Metric tonnes in 2017-18 . In the 2020 budget, it has been announced that fish production is to be raised to 200 lakh tonnes by the year 2022. According to the National Fisheries Development Board (NFDB), the future of aquaculture depends on the implementation of new and innovative production technologies, management and utilisation of unutilised water resources and suitable market tie-ups. At the same time, the budget of 2020, has also announced tax benefits for start-ups in the AI, deep technologies, ML and big data. There is a high potential for IoT in fisheries and aquaculture, and fishers/farmers can have an edge in a competitive market.

The Internet of Things (IoT) has been producing buzz in the aquaculture business for its capability to upgrade ranch of the board procedures and increment productivity. Innovation and aquaculture are two distinct orders, but the knowledge needed for developing a sustainable aquaculture system under a blue growth paradigm requires innovations in monitoring. High-tech and big-data approaches have the potential to improve sustainability and working conditions for fish farmers and help society to understand better the interdependences that aquaculture has with the environment. In line with the vision of the SDGs, which anticipates benefits from innovation in information technologies, the aquaculture sector is rapidly introducing these technologies to improve economic, social and environmental sustainability along value chains. This alliance will result in fully monitored and precision aquaculture, with farms connected to multiple-sensor networks generating big datasets that can be used for all management purposes.

The Framework of IoT in Aquaculture

Intelligent fish farming is an innovative and practical approach of farming fish through the use of latest technologies such as the Internet of Things, Cloud and data analysis. Fish are sensitive to any variations in their conditions as they are cold-blooded organisms. Slight changes in parameters could also drastically affect the growth of fish and cause stress.

IoT supports "smart fish farming", "Things," in the context to aquaculture, can be fish, shellfish or algae, feeders or even the water in your pond. With IoT, sensors are installed to monitor in real-time the quality of water in pond based on pre-set parameters to ensure the most suitable environment for breeding fish. Water quality is monitored in tanks by installing sensors right from the source. A programming system for feeding fishes only if they are hungry. Through high performance and low power sensors, fish habitat in the fish farms is observed, and this data is stored in the cloud, viewed real-time and remotely controlled. This is a helpful technique of efficient farming for farmers, investors in aquaculture and fish farm owners.

IoT has the potential to revolutionise the approach one desires to manage their pond, removing cumbersome manual processes.

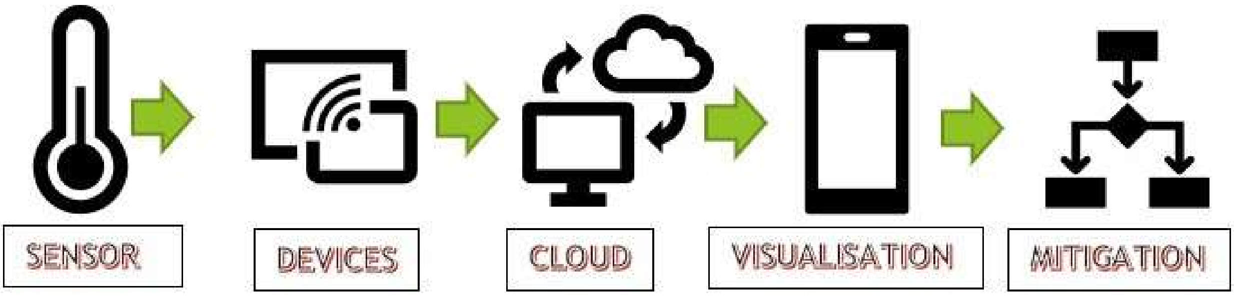

Figure 1: Basic Framework of an IoT in Aquaculture System

By reviewing several methods from various references, an ideal design of the system has five main elements: smart sensor module, local network system, cloud computing system, client visualisation data and mitigation operation module. The smart sensor module includes a microcontroller and digital sensors, for example, feeding sensors, water level sensors and water quality parameter sensors (temperature, pH, turbidity, carbonates and bi-carbonates, ammonia etc.) to monitor alterations. Local network system consists of the router, modem and battery which works for sending and receiving data packets either from sensors to cloud server or from the cloud server to sensors. It processes all the information according to the designed protocol for analysation (commonly used protocols are Constrained Access Protocol (CoAP), Telemetry Transport Message Queue (MQTT) and MQTT-SN for sensor networks).

In a cloud computing system, Debian GNU/Linux can be used with several applications installed, Mosca MQTT broker, Express JS and MongoDB. Client visualisation model system designed separately either for web or android development. In server-side, Express JS framework of Node Js is implemented for creating server application. The Express JS works for handling the RESTful API, which is consumed by client devices, either web or Android. In web applications, Angular 4 framework is used for developing the network. It is also installed MQTT client in it to read data by subscribing to a specific topic or send data by publishing to a particular topic. The application has some features to optimise and support the aquaculture process, real-time statistic data, multi-node supported, expandable sensors. Last but not least is the mitigation operations; they are the calculated strategies to overcome any discrepancy occurred in the system. A specific AI or algorithm is drafted for this purpose which can help the farmer to take appropriate action through the devices.

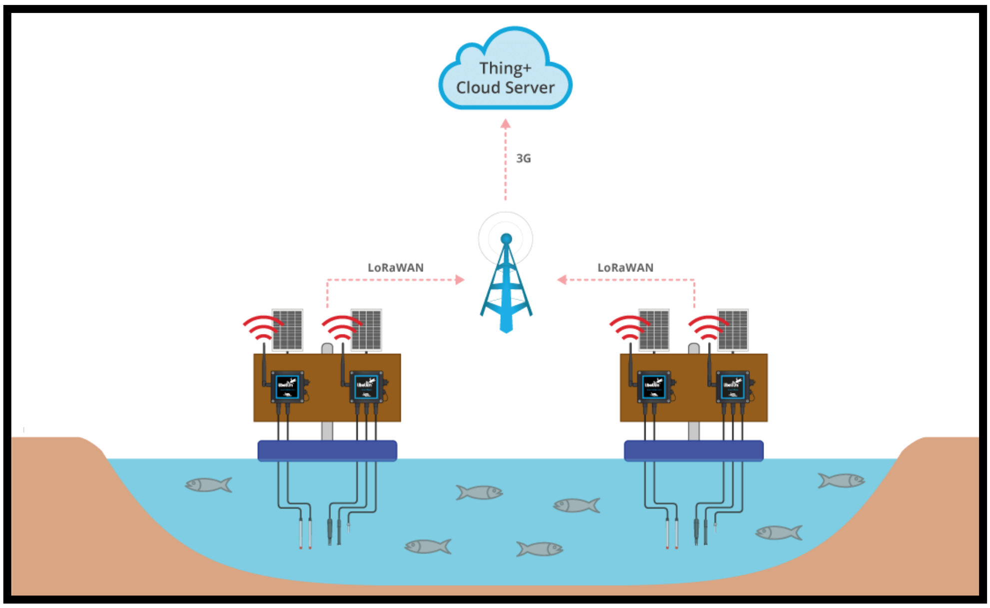

Figure 2: IoT in Fish Farming

Many applications of IoT are already observed in this field, for example, in big commercial farms, small backyard aquaponics unit and also in the home aquarium. This system brings not only automation but also ease with calculated solutions against the specific problem for the producer. Major IoT providing companies in the world are; The Australian agricultural company: The Yield, MotorLeaf from Canada, SciCrop, AgroSmart and Libelium from Iran. In India there are three companies Eruvaka technologies, C Fog, Aqua connect which are involved in developing fish farm monitoring IoTs systems especially for parameters like pH, Dissolved oxygen, temperature, ammonia, automatic feed distribution etc.

Conclusion

In aquaculture, sensors increasingly collect optical (e.g. by video camera) and physical data to monitor, for example, fish growth, health and feed loss reduction. While the past innovations focused on hardware and data collection, the problem faced now is the pressure on farmers to interpret a large amount of data consistently. Here, AI and data processing can help by identifying patterns in feeding activities and presenting strategies to farmers, ranging from cost-efficient use of feed to maintaining fish welfare. The Government of India has given this sector enormous importance, and now there is an established Ministry of Fisheries, Animal Husbandry and Dairying. Now is the time that this sector should take advantage of the Government's focus on Digital India, by embracing new technologies like blockchain, AI, IoT and mobile apps, this industry can grow further. There is an immense scope of all these new technologies in the industry with the fruitful collaboration of engineers, data scientists, aquaculture experts and technologists.

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Organic Farming for Maintaining Soil Health

Article ID: 31286

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Introduction

Soil and water are two most important natural resources to agriculture. Due to the enormous use of synthetic fertilizers, plant protection chemicals and growth regulators these natural resources are getting polluted and becoming less efficient. The inherent fertility of the soil is reducing and it is becoming barren. The main reason behind all these problems is higher demand of food to feed the increasing human population. Due to increase in population, demand for food is increasing but the natural resources for production like area of land is limited and fixed, which can't be increased. So, from the fixed area the production is to be increased and for to solve this problem the only solution is to improve the productivity. The productivity can be increased by using improved crop varieties, use of agrochemicals and synthetic fertilizers. Therefore, global population growth is a major threat to the sustainability of the agricultural production system. To save the agricultural production system and retain the fertility of the soil, organic farming is one of the best remedies. Through organic farming the productivity can be optimised without use of the harmful chemicals in agriculture. Ecologically and economically sustainable organic farming is the required for enabling wider adoptability, secured livelihoods and ensuring affordability of the common men (Barik, 2017). The practice of organic farming in India is from the ancient period, but due to the development of science and technology in agriculture, mainly due to green revolution most of the farmers have adopted the intensive farming practices by using different chemicals and synthetic fertilisers in last century.

Role of Organic Farming in Maintenance of Soil Health

The main characteristics of organic farming include protecting the long-term fertility of soils by maintaining organic matter levels, nurturing soil biological activity, careful mechanical interference, nitrogen self-sufficiency by using the legumes and biological nitrogen fixation, efficient recycling of organic matters including crop residues and livestock wastes and management of weeds, diseases and pest primarily through crop rotations, natural predators, crop diversification, organic manuring and resistant varieties. A great emphasis is given on maintenance of soil fertility by returning all the wastes to it chiefly through compost to minimize the gap between NPK addition and Removal from the soil (Chhonkar, 2002).

Different inputs used in organic farming are of organic origin or originated from the nature without using any chemical product. Different nutrient sources like FYM, vermi-compost, compost from domestic waste, livestock shed waste, crop residue, green manure etc. are used to fertilize the soil for crop production. These organic sources supply many micronutrients and growth regulators besides supplying the primary plant nutrients. Many farmers use the straw of the harvested crop for feeding and bedding of livestock. In many cases, straw is used as bedding to trap urine to increase N cycling. Wet straw along with the manures from the animal sheds are collected daily and stored or composted inside the farmer's premises. The composted manure is either applied immediately or stored for the next crop season depending upon farmer's socioeconomic conditions. In particular, different soil, water, and nutrient management strategies like reduced tillage and use of raised beds, that avoid the harmful effects of puddling on soil structure and fertility, improve use efficiency of water and nutrient, in addition to that increases the crop productivity (Timsina & Connor, 2001).

Actually, due to the use of high doses of synthetic fertilizers, the use efficiency of different fertilizers decreases with due course of time, and it also deteriorates the quality of soil. The soil become hard and unproductive; it needs more fertilizer in subsequent crop for the same yield. The application of organic matter is beneficial because after decomposition it releases macro and micro nutrients to the soil solution, which becomes available to the plants, resulting in higher nutrient uptake (Minhas & Sood, 1994). The practice of organic farming was found to be capable of sustaining higher crop productivity and improving soil health and productivity by manipulating the soil properties on long term basis. It was also observed that organic and low-input farming practices after 4years resulted in an increase in the organic carbon content, soluble phosphorus, exchangeable potassium, and pH of the soil and also the reserve nutrient pool in the soil and maintained relativity stable EC level (Clark et al., 1998). The use of compost in the farming practices, raised soil pH from 6.0 without compost to 6.5 with compost and reduced the broadleaf weed population by 29 percent and grassy weed population by 78 percent (Bulluck Iii et al., 2002). Organic matter degradation in soil reduced nutrient supplying capacity, especially, on soils with high initial soil organic matter content in rice-wheat cropping system (Yadav et al., 2000). Organic farming improved the organic matter content and labile status of nutrients and also soil physicochemical properties (Subbiah et al., 2000). Addition of different organic waste like straw, wood, bark, sawdust, pod of pulses or corn cobs improved the composting characteristics of a manure. These materials raised the C:N ratio and reduced water content. The process of joint composting of the manure slurries along with different plant residues was found more viable and profitable than its separate composting. Use of FYM and green manure in rice-wheat rotation maintained high levels of micronutrients like Zn, Fe, Cu, and Mn (Singh et al., 2002).

The organic farming also improves the soil biological properties besides the physicochemical properties. It improves the soil microbial population and activities. Compost contains different microbes like bacteria, actinomycetes, and fungi; hence, a fresh supply of humic material added microorganisms to the soil and stimulated them (Balasubramanian et al., 1972). The addition of organic matter to the soil improved the beneficial soil microorganisms, reduced pathogen population, total carbon, and cation exchange capacity, and reduced the bulk densities, thereby improved soil quality (Bulluck Iii et al., 2002).

Conclusion

Organic farming is the best option, in which quality food can be produced by maintaining the soil health in a sustainable way. It is eco-friendly and doesn't deteriorate the soil quality rather improves it by adding different macro and micro nutrients to the soil nutrient pool along with beneficial micro-organisms. Due to the slow release of nutrients from the sources in organic farming, it improves the use efficiency and reduces loss of different nutrients.

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Bacterial & Viral Diseases of Leafy Vegetables

Article ID: 31287

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Bacterial Diseases

1. Amaranthus:

a. Bacterial Leaf Spot: Causal Organism: *Xanthomonas campestris* pv. *Amaranthicola*

b. Symptoms: A few waters soaked translucent spots on the lower surface of the leaves with pale brown, round areas surrounded with yellowish halo appear on the upper surface. Later the spots become deep brown and depressed on the lower surface of the leaves and the upper surface spots are raised at margin and parched in centre. These eye spots often coalesce and form irregular lesions. The spots start from the margin of the leaves and in the centre, there may be bacterial ooze. In advance stages, the sides of the stem get cracked and become deep black in colour with the grey central portion.

c. Control: Field sanitation. Use of resistance cultivar. Seed treatment with Carbendazim. Spray crop with Bavistin @ 0.1%.

2. Spinach:

a. Soft Rot: Causal Organism: *Erwinia carotovora*

b. Symptoms: It is a post-harvest disease occurring in transit. Water soaked areas followed by rotting in the packed leaves, mainly due to lack of aeration and sanitation.

c. Control: Remove all brown leaves at harvest. Pack leaves lightly. Proper cleaning of leaves before packing. Use properly cleaned packaging material and clean storage place. Do not allow leaves to be stored for longer time after harvesting.

3. Lettuce:

a. Bacterial Rot: Causal Organism: *Erwinia carotovora*, *Pseudomonas viridilivida*

b. Symptoms: Slimy decay of large internal leaves, decaying tissues become brown. It is common only in head lettuce and not in leaf lettuce.

c. Control: Select only healthy leaves for packing. Avoid long storage. Avoid tip burn. Exposure to high temperature to be avoided.

Viral Diseases

1. Amaranthus:

a. Amaranthus Mosaic-1:

i. Transmission: By sap and grafting.

ii. Symptoms: Mosaic molting on leaves, both young and old, severe yellowing of veins to large, irregular chlorotic patches alternating with dark green areas over the entire lamina.

iii. Control: No much contol measures available. Spray of Monocrotophos (0.05%) or Dimethoate (0.05%).

b. Amaranthus Mosaic-1I:

i. Transmission: By sap and aphid vector (Aphis gossypii)

ii. Symptoms: Plants stunted. Reduced leaf size, crinkling and mosaic mottling of dark green areas interspersed with light green patches.

iii. Control: Foliar spray of Monocrotophos (0.05%) or Dimethoate (0.05%), 3-4 sprays at weekly intervals. Stop spraying at least 20 days before first harvest.

c. Amaranthus Mosaic-1I:

i. Transmission: By mechanical sap inoculation.

ii. Symptoms: Mosaic mottling of light and dark green patches on young as well as old leaves. In young and old leaves, veins and veinlets turn yellow. Leaves crinckled and puckered. Plants stunted.

iii. Control: No much contol measures available. Spray of Monocrotophos (0.05%) or Dimethoate (0.05%).

2. Spinach:

a. Spinach Mosaic:

i. Causal Organism: A strain of Cucumber Mosaic Virus (CMV)
ii. Transmission: By sap inoculation and aphid vector *(Myzus persicae)*.
iii. Symptoms: light and dark green patchesand mosaic mottling on leaves. Infected leaves reduced in size, distorted and almost white chlorotic patches. Plants stunted in growth.
iv. Control: Spraying with Monocrotophos (0.05%) or Dimecron (0.05%), one or two sprays at 10 days interval. Stop the spraying atleast 20 days before first harvest.

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Soil Carbon Sequestration and Carbon Trading

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Introduction

Soil carbon sequestration is the process of transferring carbon dioxide from the atmosphere into the soil through crop residues and other organic solids, and in a form that is not immediately reemitted. This transfer or "sequestering" of carbon helps off-set emissions from fossil fuel combustion and other carbon-emitting activities while enhancing soil quality and long-term agronomic productivity.

Carbon Capture and Storage (CCS) Technologies

It is an approach to mitigate global warming based on capturing carbon dioxide (CO2) from large point sources such as fossil fuel power plants and storing it instead of releasing it into the atmosphere. CCS applied to a modern conventional power plant could reduce CO2 emissions to the atmosphere by approximately 80-90% compared to a plant without CCS. Capturing and compressing CO2 requires much energy and would increase the fuel needs of a coal-fired plant with CCS by 25% to 40%.

1. Geological storage: Also known as geo-sequestration, this method involves injecting carbon dioxide, generally in supercritical form, directly into underground geological formations. Oil fields, gas fields, saline formations, unminable coal seams, and saline-filled basalt formations have been suggested as storage sites.

2. Oceans as carbon sequestrators: One way to increase the carbon sequestration efficiency of the oceans is to add micrometre-sized iron particles in the form of either hematite (iron oxide) or melanterite (iron sulfate) to certain regions of the ocean. This has the effect of stimulating growth of plankton. In the presence of iron nutrients plankton populations quickly grow, or 'bloom', expanding the base of biomass productivity throughout the region and removing significant quantities of CO2 from the atmosphere via photosynthesis.

3. Mineral storage: In this process, CO2 is exothermically reacted with abundantly available metal oxides which produce stable carbonates. This process occurs naturally over many years and is responsible for much of the surface limestone. The reaction rate can be made faster, for example by reacting at higher temperatures and/or pressures, or by pre-treatment of the minerals, although this method can require additional energy.

4. Forest as carbon sequestrators: Forests are carbon stores, and they are carbon dioxide sinks when they are increasing in density or area. Tropical reforestation can mitigate global warming until all available land has been reforested with mature forests.

Carbon Emission Trading

Carbon emissions trading are emissions trading specifically for carbon dioxide (calculated in tonnes of carbon dioxide equivalent). It is one of the ways countries can meet their obligations under the Kyoto Protocol to reduce carbon emissions and thereby mitigate global warming.

A central authority (usually a government or international body) sets a limit or cap on the amount of a pollutant that can be emitted. Companies or other groups are issued emission permits and are required to hold an equivalent number of allowances (or credits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, limiting total emissions to that level. Companies that need to increase their emissions must buy credits from those who pollute less. The transfer of allowances is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed.

Kyoto Protocol and Carbon Trading

The Kyoto Protocol is a 1997 international treaty which came into force in 2005, which binds most developed nations to a cap and trade system for the six major greenhouse gases.(The United States is the only industrialized nation under Annex I which has not ratified and therefore is not bound by it.) Emission quotas were agreed by each participating country, with the intention of reducing their overall emissions by 5.2% of their 1990 levels by the end of 2012. Under the treaty, for the 5-year compliance period from 2008 until 2012, nations that emit less than their quota will be able to sell emissions credits to nations that exceed their quota.

It is also possible for developed countries within the trading scheme to sponsor carbon projects that provide a reduction in greenhouse gas emissions in other countries, as a way of generating tradeable carbon credits. The Protocol allows this through Clean Development Mechanism (CDM) and Joint Implementation (JI) projects, in order to provide flexible mechanisms to aid regulated entities in meeting their compliance with their caps.

Conclusion

Soil carbon sequestration can be accomplished by management systems that add high amounts of biomass to the soil, cause minimal soil disturbance, conserve soil and water, improve soil structure, and enhance soil fauna activity. The amount of carbon sequestered at a site reflects the long-term balance between carbon uptake and release mechanisms.

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Insect as a Food: An Option to Global Food Security

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Abstract

The world population reaches above 9 billion by the 2050, feeding this growing world population with decreasing arable land for cultivation under the pressure of climate change scenario predictably increases the pressure on already inadequate resources such as land, water energy and fertilizers, which leads to deforestation and environmental degradation and increases in greenhouse gases (GHG) emissions. To fulfil need of such a large population, insect is a best alternative for livestock as it requires low investment and simple technology. Also, insect-based products can provide income to both rural and urban people through production, processing and marketing.

Introduction

Entomophagy is a Greek word, '*entomon'* means insect and '*phagein'* means to eat. The practice of eating insects is known as entomophagy. . People throughout the world have been eating insects as a regular part of their diets for millennia. Although this practice should be specified as *human* entomophagy. Insect consumption is not a new concept in many parts of the world. From ants to beetle larvae – eaten by tribes in Africa and Australia as part of their subsistence diets – to the popular, crispy-fried locusts and beetles enjoyed in Thailand, it is estimated that insect-eating is practised regularly by at least 2 billion people worldwide. More than 1900 insect species have been documented in literature as edible, most of them in tropical countries.(FAO 2013) The most commonly eaten insect groups are beetles, caterpillars, bees, wasps, ants, grasshoppers, locusts, crickets, cicadas, leaf and plant hoppers, scale insects and true bugs, termites, dragonflies and flies. Major edible insects documented in India are Termite, Dragonfly, Grasshopper, Ants, Eri and Mulberry silkworm, Honey bee and Cricket.

Per cent of insect species consumed in India:

Order	Per cent consumption
Coleoptera	34
Orthoptera	24
Hemiptera	17
Hymenoptera	10
Odonata	8
Lepidoptera	4
Isoptera	2
Ephemeroptera	1

(Chakravorty, 2014).

Why Eat Insects?

Hunger and malnutrition are a serious problem in the ever-expanding human population. With the high rate at which the world population is growing, the world food supply should grow at the same rate, if not faster. It is widely accepted that by 2050 the world will host 9 billion people. To accommodate this number, current food production will need to almost double. Land is scarce and expanding the area developed to farming is rarely a viable or sustainable option. Water shortages could have profound implications for food production.

How Insects are Eaten?

Killed by freeze- drying, sun drying or boiling

↓

Raw, fried, baked, cooked, roasted

Fried locust

Fried termites

Roasted grasshoppers

Advantages of Insect Eating

1. Environmental benefits: Many of insects such as mealworms, crickets are more drought tolerant and having higher feed conversion ratio than other live stocks, emphasizing the possibility of production of insects with less virtual water requirement. Food conservation efficiency is more for insects since they are poikilothermic, which doesn't waste much energy to maintain body temperature.

However, insect species are economically suitable for mass production has less greenhouse gas production characters remains the viable options for producing alternate food source. Also, insect farming requires less land.(Kumar et. al., 2017).

2. Nutritional benefits: Edible insects such as mini livestock appear promising and a potential option because they are a rich source of protein, essential minerals and vitamins. (Van Huis, 2013):

Insect	Protein (g)	Fat (g)	CHO (g)	Calcium (mg)	Iron (mg)
Giant water beetle	19.8	8.3	2.1	43.5	13.6
Red ant	13.9	3.5	2.9	47.8	5.7
Silk worm pupae	9.6	5.6	2.3	41.7	1.8
Dung beetle	17.2	4.3	0.2	30.9	7.7
Cricket	12.9	5.5	5.1	75.8	9.5
Large grasshopper	14.3	3.3	2.2	27.5	3.0
Small grasshopper	20.6	6.1	3.9	35.2	5.0
June beetle	13.4	1.4	29	22.6	6.0
Caterpillar	28.2	NA	NA	NA	33
Termite	14.2	NA	NA	NA	35.5

Weevil	6.7	NA	NA	NA	13.1

Nutritional value of insect per 100 gm.

3. Therapeutic food: Director of pediatric nutrition at the University of Alabama at Birmingham Frank Franklin has argued that since low calories and low protein are the main causes of death for approximately five million children annually, insect protein formulated into a ready-to-use therapeutic food similar to Nutriset's Plumpy' Nut could have potential as a relatively inexpensive solution to malnutrition.

4. Insect farming: Insect farming can be carried out in urban and rural areas (Oonincx and de Boer, 2012) and having many advantages such as require less space, high reproductive rate, income generation within a short period, easy to manage, easy to transport (FAO, 2011b).

Milkshake powder prepared from crickets

Disadvantage

One concern with eating insects is the current use of pesticides. Since insects eat plant, pesticides and herbicides can build up inside the insects through bioaccumulation. Another concern with eating insects is possibility of people having allergic reaction.

Conclusion

India being tropical country, the diversity and abundance of insects are greater. Therefore, India can be a potential land for insect bio-resource. While many get nervous at the thought of insect-tasting, they are the future of protein and there is a need to develop effective means to glamorize the consumption of these often-undervalued bio-resources. Edible insects can constitute an important part of the diet of Indians and other developing nations and help combat various global issues, predominantly malnutrition and food insecurity.

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Important Diseases of Elephant Foot Yam (*Amorphophallus companulatus* Blume) and Approach Towards Integrated Management

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Elephant foot yam (*Amorphophallus paeonaiifolius* Blume), commonly known as "Ole", an underground stem tuber, is one of the most popular tuber crops, extensively used as a subsidiary vegetable crop till decades back by millions of people in India. In West Bengal elephant foot yam and taro is one of the most important cash crops and is cultivated as vegetable. Several biotic stresses constrain viz. collar rot (Sivaprakasam et al., 1982) and leaf blight (Roy and Hong, 2007), anthracnose and mosaic (Pandit et al., 2001) hamper the cultivation of these crops and pose serious yield loss and reduce the quality of the harvested load during storage as well as transit.

Collar Rot

1. Causal agent: *Sclerotium rolfsii* Sacc.

Infection and Symptoms: The pathogen, *Sclerotium rolfsii* is a facultative saprophyte and very opportunistic fungus. Collar rot is both soil born and seed corm transmitted disease. The fungus survives in soil for several years and can infect the elephant foot yam plant during favourable condition.

a. Once the plant is infected, it grows very fast and cause rotting of the collar region of the EFY.
b. In advance condition the fungus produces profuse sclerotia at the base of the pseudo-stem and progress very quickly in to the plant and basal portion of the plant during intercultural operation and irrigation water.
c. During heavy rains the sclerotia float to the field and infect the new plant upon germination. In severe condition the crops are infected and cases huge damage. The corms from infected plant become unsuitable for transit and storage.

2. Favourable condition:

a. Heavy rains and high relative humidity and accumulation of water at base of the plant.
b. Heavy soil, high organic matter and poor drainage condition in the field.
c. Excessive nitrogenous fertilizer aggravates the disease.

Leaf Blight

1. Causal agent: *Phytophthora colocasiae*

The blight pathogen, *Phytophthora colocasiae*, has a complex life cycle and can attack taro and other aroids in several ways. The assault usually begins when airborne spores land on the foliage and either germinate directly or release swimming zoospores.

2. Favourable condition: The Phytophthora blight is predisposed with continuous high humidity (90 – 95%) and temperature (30 – 35°C) during July to October and heavy rainfall with high temperature. In either case, the pathogen penetrates the leaf or stem and grows into a dark lesion that releases thousands of new spores. Carried by wind or rain-splash, the spores can infect the same or other plants, sometimes miles away.

3. Symptoms:

a. The disease appears in the form of small dark roundish spot on the upper leaf surface.
b. The single spot enlarge itself rapidly, coalesce to latter stage and become circular in the leaf surface.
c. Later stage the entire leaf dies in case of heavy infection.
d. The boundary between the healthy and diseased tissues is usually indistinct and soft.
e. Drops of yellow liquid ooze from the infected area.
f. After harvest grey-brown to dark bluish lesion appears on undamaged corms.
g. Affected corms are almost completely decayed at one week after harvest in wet condition.

Dasheen Mosaic Disease

1. Causal agent: Dasheen mosaic disease (DsMV a potyvirus)

2. Primary spread: Planting material;

3. Secondary spread: Insect vectors viz. *Myzus persicae* Sulz., *Aphis gossypii* Glover, *A. craccivora* Koch. And *Pentalonia nigronervosa* coq.

4. Symptoms:

a. Leaves appears to mosaic, mottling, distortion of leaf lamina.
b. Corms produce by the mottled plants are much smaller than the healthy leaves.

Anthracnose of EFY

1. Causal agent: *Colletotrichum gleosproides*

Anthracnose is very common in many fields of EFY in West Bengal and causes premature crop damage of EFY. During hot summer period the disease is more and infects the leaves showing brown –black lesions and the leaves become dry. It is caused by *Colletotrichum gleosproides* and infects all stage of the crop.

2. Symptoms:

a. Due to anthracnose the whole leaf is scorched with black colour lesions. It also infects the branches and pseudo-stem of EFY.
b. The infection in the pseudo stem is manifested with dark brown to black colour sunken lesions which gradually enlarges in size and the infected plants are toppled down from the point of infection in pseudostem.
c. The severely infected plants shed off the leaflets keeping the mid ribs of the leaves.

Integrated Disease Management Approach

1. Seed corm treatment: Seed corms with cow dung slurry incorporated with *Trichoderma viridae*. Conventionally the seed corms (cut or uncut) are dipped in to the cow dung slurry for 10-15 minutes and air dried. Before sowing *Trichoderma viridae* @100 g in 20 kg FYM is mixed up and is incorporated with required quantity of fertilizer.

2. Cultural measures:

a. Use of healthy disease-free planting material without apparent rotting symptoms.
b. EFY field very clean and follow the earthing up of soil for 3-4 times after amending organics and *Trichoderma viridae* to avoid the pathogen infection Crop rotation removal of plant debris.
c. Improvement of drainage in field.
d. Roughing of infected plants.
e. Intercropping with turmeric and ginger helps in disease reduction in field condition.
f. Avoid introduction or transmission of the virus during vegetative propagation.

3. Biological measures:

a. Treatment of the whole/cut tubers with cow dung slurry mixed with Trichodermabefore planting.
b. Application of Trichoderma enriched compost @ 2.5 kg/ha mixed with 50 Kg FYM in pits.
c. Application of neem-cake @ 250g/pit.

4. Chemical measures:

a. Seed corm treatment Soil drenching with Mancozeb 50% + Carbendazim25% WP@ 3.0gm /l. of water.
b. Application of Tebuconazole 200+ Azoxtstrobin 120 SC @ 1.5ml/lt as soil drench during onset of collar rots diseases and foliar spray for controlling anthracnose.
c. Application of Dimethomorph 50 WP @ 1g/lt + Mancozeb 75% WP@ 2g/lt (Tank mixture) at 15 days interval is effective against leaf blight disease of elephant foot yam.
d. Control aphids' vector where there is a problem in vector born DsMV transmission by application of systemic insecticides viz. Imidachlorprid, Emamectin Benzoate etc. at 60 and 90 DAP.

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Leaf Blight of Elephant Foot Yam

Collar rot of Elephant Foot Yam

Anthracnose of Elephant Foot Yam

Dasheen Mosaic Disease Elephant Foot Yam

Various Diseases Symptom of infected Elephant Foot Yam plant

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Traditional Agriculture: An Over View

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Introduction

The traditional agricultural in environment has developed into a closely connected social ecological system that supports a high level of biodiversity. Traditional farming is very similar to organic farming where farmers have a mixed farm of cattle, fruits and grains.

Today, there are very few farmers in cutting-edge and developing countries, and most countries use modern technology, chemical fertilizers and pesticides. Modern agriculture does a lot of harm to the environment and human health.

An efficient traditional cultivation system is still very important. It is minimizing health and environmental risks; farmers engage in organic farming and grow food without harming the environment. The traditional agricultural environment has a long history of agricultural practices.

Definition of Traditional Agriculture

Traditional agriculture can be defined as a native farming style that focuses on indigenous knowledge, traditional equipment, natural resources, manures and farmer's cultural beliefs. It should be noted that it is still used by about 50 % of the world population.

Traditional agriculture is a basically farming without using modern ways of food production. It is not only the oldest farming system in the world, but also the important source of the stage of improvement of agricultural technology such as modern, conventional and organic farming, it is also promoting genetic diversity.

Characteristics of Traditional Agriculture

1. Extensive agriculture with indigenous knowledge and tools.
2. Native tools, such as axes, heads and sticks.
3. Method: slash and burn, transplanting.
4. Raising livestock helps to create fallow soil.
5. Reduce overproduction.

Advantages Traditional Agriculture

1. The plant is pure and there is no fertilizer, so the plant is fresher and healthier.
2. Requires less monetary input.
3. Less skill and technology are required.
4. The distribution of nutrients in the soil is more balanced.
5. It requires less skill and technology knowhow.
6. The soil is more balanced in nutrient distribution.
7. Plant waste can be used as soil fertilizer after decomposition.
8. Because they are pure, they can be sold at a higher price.

Disadvantage of Traditional Agriculture

Harvesting takes a long time, so it is sold at a higher price to regain the time it takes for the plant to mature. Farmers of traditional agriculture need to invest about 15 hours for harvesting compared to high-tech agriculture.

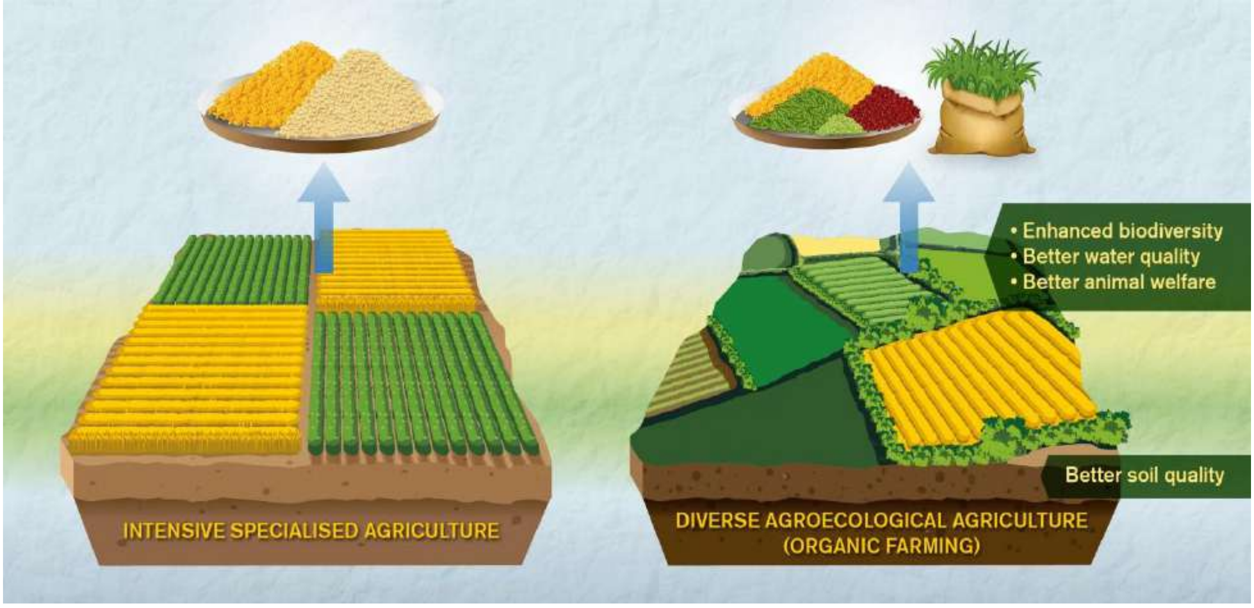

Fig. Comparison between traditional and modern agriculture

Difference Between Traditional Farming and Modern Farming

S. No.	Traditional farming	Modern farming
1.	Sustainable agriculture is risk management, flexibility, multiple uses	Modern farming focuses on high yield
2.	Uses manure and compost	Uses chemical fertilizer
3.	More farm labourers and no machines	Less farm labourers and more machines
4.	Depend on seasonal rainfall	Not depend on seasonal rainfall
5.	Animals are used to plough the field	Tractors used for ploughing the field

What are Traditional Crops?

Traditional crops/varietals are grown by local farmers who own seed land races. These seeds are very suitable for the local climate and geographical conditions. However, their output is not enough to feed the entire country.

Conclusion

Traditional agriculture is an extractable process, in which all resources (people, water and land) are immediately extracted and used. Modern agriculture emphasizes management practices for using planning techniques and conserving and updating resources. Modernization forces infrastructure and rural development, urbanization and industry to grow simultaneously. Overall economic development depends on the effective use of people and the protection of water and land resources as important environmental resources.

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Doubling Farmer's Income

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Introduction

1. Past strategy - for development of the agriculture sector in India: Focused primarily on raising agricultural output, improving food and nutrition security, did not explicitly recognise the need to raise farmers' income and did not mention any direct measure to promote farmers' welfare.

2. Strategy involved: Increase in productivity through better technology and varieties, increased use of quality seed, fertiliser, irrigation and agro chemicals, incentive structure in the form of remunerative prices for some crops, subsidies on farm inputs, public investments in and for agriculture; and facilitating institutions.

3. Key Findings: 45 per cent increase in per person food production: Last 50 years – food production multiplied by 3.7 times. Made India food self-sufficient at aggregate level, also a net food exporting country. Farmers' income remained low in relation to income of those working in the non-farm sector.

4. Impact of low level of farmers' income: Low level of farmers' income and disparity between income of a farmer and non-agriculture work. Agrarian distress and sharp increase in number of farmer's suicides (1995-2004) due to: Losses from farming, Shocks in farm income low farm income .Government constituted "National Commission of farmers" 5 reports & "Draft National Policy for farmers", "Success in agricultural progress should be measured by the growth of farmer's incomes and not just by production figures".

5. Doubling of Farmers' Income: "I wish to double the income of farmers by 2022 when India will celebrate 75 years of its Independence" Prime Minister while addressing farmers rally at Bareilly (Feb 28, 2016) Budget (2016-17). "We are grateful to our farmers for being the backbone of the country's food security. We need to think beyond food security and give back to our farmers a sense of income security. Government will, therefore, reorient its interventions in the farm and non-farm sectors to double the income of the farmers by 2022." Finance Minister Budget Speech, February 29, (2016).

6. DFI Vision - The concept and Time Frame: Time period 2015-16 to 2022 (2022-23), Annual growth rate of 10.4% required. What is to be doubled, Income of farmers, not farm incomes only, not the output or the income of the sector or the value added or GDP of agriculture sector. Real or nominal income, Real incomes. (Inflation adjusted).

a. Sources of Growth in Farmers' Income: 10.4% annual growth rate required, on-going and previously achieved rate of growth in farm income needs acceleration.

b. Major sources of growth: improvement in productivity, resource use efficiency or Total Factor Productivity, saving in cost of production, increase in cropping intensity, diversification towards high value crops, The sources outside agriculture include shifting cultivators from farm to non-farm occupations, and improvement in terms of trade for farmers or real prices received by farmers.

7. Strategies for Improving Farmers' Income (Production Centric): Need to raise output through concerted efforts on increasing productivity, TFP, input management, resource conservation. Major contributors: Pradhan Mantri Krishi Sinchai Yojana; Soil health card, Neem Coated Urea; Prampragat Krishi Vikas Yojana. Focus on zonal planning in bigger states like UP : Regional crop plans essential as per the resource endowments and demand situation, Promoting "Niche Agriculture" and regionally important and suitable commodities like horticulture in NWH Integrated farming systems important: Like paddy-cum-fish culture in eastern India and NE, Investment and subsidies in few technologies like poly-houses may help multiply the returns. Need for Risk Mitigation: insurance against crop and income loss: Pradhan Mantri Fasal Bima Yojana, Climate Smart Agriculture. Role of ICAR and SAUs crucial: Need for SAUs in certain states like Arunachal Pradesh.

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Post-Harvest Management Centric

Need for suitable strategies for reducing post-harvest management to reduce crop losses, required value addition and processing, states like MP established processing units in the major producing clusters.

Marketing Related

Essential to ensure whether the increased production is converted to money? Need for integrated and value chain approach, e-NAM would prove to be game changer, Market linkages and reforms essential. Price uncertainty needs to be given due priority, "Consumer should not become the king over farmers' welfare" Effective procurement strategies like UP: Estimation of regional, national and international demand to avoid the glut situations preventing the situation of price crash. Need for stable commodity trade policies, Abrupt policy changes do not allow harnessing the lucrative market situation.

Non-Farm and Other Concerns

Creating suitable infrastructure : In case of irrigation, requirement of capital is huge, all schemes under AIBP not sanctioned, only 99 schemes are eligible. Need for attracting private investment, Agro-tourism can be a lucrative off-farm activity, can bring substantial income in NE and NWH, to go for diversification of fruits and vegetables mainly because of the price risk and uneconomic lot for marketing. Need for separate plans for small farmers in terms of bargaining power in various transactions in the input and output market. FPOs have shown very impressive benefits to small farmers, women, tribal farmers, even in remote and disadvantaged areas.

Disadvantage of Traditional Agriculture

Harvesting takes a long time, so it is sold at a higher price to regain the time it takes for the plant to mature. Farmers of traditional agriculture need to invest about 15 hours for harvesting compared to high-tech agriculture.

Success Mantras

Certain states have the potential to more than double provided effective plans and strategies are made e.g. Arunachal Pradesh, States like Chhattisgarh and Madhya Pradesh very proactive in finalizing the strategic framework of their states, Other states need to follow such path, Prioritization of strategic framework, clearly bringing out the expected contribution of each strategy. Breaking-up the required interventions into short term, medium term and long term, Preparing the Investment plan and feasibility of financial resources.

Prospects of Doubling Farmers' Income

Sr. No.	Source	Scope	Contribution		Remarks
			7 years	10 years	
1	Crop productivity 70% seg	3.1	16.7	25.0	Same as in 2001-13. For crop sector (70%)
2	Livestock value added 30% seg	4.5	10.8	16.6	Same as in 2004 to 2014
3	Improvement in resources use efficiency	2.26	16.7	25.0	Same as in 2005 to 12
4	Crop Intensity (70% segment)	1 percentage point	3.4	4.9	Same as during 2001-12
5	Crop diversification (70% segment)	Area increase by 3.13 per cent, elasticity 0.319	5.0	7.3	

6	Better price realization: crops only	13%	9.1	9.1	
7	Shift to no-farm occupation	1.81%	13.4	18.6	Same as in 2005 to 12
Total			**75.1**	**107.5**	

Conclusion

1. Most of the development initiatives and policies for agriculture are implemented by the states.
2. States invest much more than the outlay by the Centre on many development activities, like irrigation.
3. Reform related to Agriculture Marketing, Contract Farming, Agro-forestry and land leasing: state subject.
4. Essential for states to frame suitable policy/strategy for DFI.
5. Concerted and well-coordinated effort by Centre and all the States: Country can achieve the goal of doubling farmers' income.

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Terrace Gardening: The Future for Urban Living

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Introduction

India is the second-most populous country in the world with a population of 1.35 billion where 50% of them lives in urban areas for income and better livelihood. Population explosion and migration of people towards urban area increased in the demand for food, shelter, and basic necessities. Because of this most of the agricultural lands are converted into residential areas, resulted decreased availability of land for production of agriculture products. Due to the construction of buildings in urban areas led to shortage of space for cultivation of vegetables, fruits, spices, and other agricultural products. However, the space available in the roof top, balconies, corridors and terrace can be effectively utilized for growing fruit plants, vegetables, spices, medicinal plants, flower and ornamental plants. The fine art of creating and maintaining the greenery at the roof top is known as "roof gardening" or "terrace gardening". Growing our own vegetables is important because we have to ensure that we and our next generation should get absolutely without chemicals, pesticides, insecticides and fungicides and grown naturally.

Preparation of Site for Terrace Gardening

1.Start with water proofing the roof and leakage free, so that the building does not suffer from any damage. Numerous water proofing systems exists which include bituminized fabrics, SBS modified bituminous membrane sheet set in SEBS polymer modified bitumen, polyester build-up systems, fluid applied membrane, concrete admixture.

2. Geotextiles are used as protection layer that protects roof from mechanical damage.

3.Lightweight fills such as polystyrene sheets, autoclaved aerated concrete, foamed concrete and other cements etc. are used as thermal insulating layer.

4. Drainage or water storage layer is to drain excess water that include granular materials, porous mats, etc.

5. The soil that is used should be rich, light weight, well aerated and have adequate water retention capacity.

Methods of Cultivation of Terrace Gardening

1. Through benches, containers, boxes, earthen pots, polythene bags, plastic pots, fiber pots, paraffined paper or Styrofoam cups can be used.

2. Hydroponics: Hydroponic system is a modern science of agriculture where the crops and plants are grown in soil less medium. It is a method of growing plants in nutrients dissolved water along with a growing medium to support the root systems. More over this requires very less space and allows plants to grow up to 50% faster than they would in soil.

3. Vertical gardening: Garden in which the plants are supported to grow along vertical is called vertical gardening. This requires very less space and can grow many plants. it gives aesthetic visual appeal.

Types of Plants that are Cultivated Through Terrace Gardening

1. Leafy vegetables: Coriander, mint, methi, spinach, colacasia, amaranths etc.
2. Vegetables.
3. Transplanting- Tomato, brinjal, chilli, onion, capsicum, cauliflower, cabbage, knol-knol.
4. Direct sowing- Radish, carrot, beetroot, garlic, ginger, potato, green peas, cluster bean etc.

5. Climbers: Bitter gourd, ridge gourd, snake gourd, bottle gourd, beans, cucumbers, pumpkin, watermelon, muskmelon etc.
6. Perennials: Drumstick, curry leaves, culinary banana.
7. Fruits: Banana, guava, lime, papaya etc.
8. Medicinal plants: Aloe vera, lemon grass
9. Spices: Turmeric, coriander, and fenugreek etc.

Steps to be Followed in Terrace Gardening

1. The growing media used for rooftop garden can be a combination of soil, coir pith and FYM in the ratio of 1:1:1.

2. Quick compost: pulverize kitchen waste materials. Leaf litters and mix regularly, the compost will be ready within two months.

3. If you are raising seed, the seeding over an inch above the surface of soil, showing 2-3 healthy leaves are ready for transplant to containers. While transferring them to the containers make sure to keep stones at the bottom of the containers near the holes to run away the excess water freely and not to drain out the soil along with the water.

4. Spread a polythene sheet over the growing areas to avoid water seepage through ceiling. Also take care that excess water gets drained without stagnation of root.

5. Plan location of plants such that, it remains in shade at least during afternoon.

6. Watering must be done in the early morning or in the evening after 4 p.m.

Terrace gardening in Roof top

Plastic bottles used as plant pots

Other Control Measures

1. Growing trap crops such as marigold etc.
2. Use of sticky traps will control cucumber beetles, white flies, cabbage worms etc.
3. Keep the garden clean from plant debris.
4. Encourage beneficial insects to take up residence in the garden.
5. Use some multipurpose organic insecticides cum fertilizers to control all type of pest such as
    a. 100g curd+200g molasses+100g boiled rice+5 litres of water.
    b. Garlic oil, neem oils, castor oils.
    c. Paste of garlic+ green chili + spoon of cinnamon powder+ fermented buttermilk etc.

Advantages of Terrace Gardening

1. Everyone start growing vegetables in the roof tops it definitely reduces pollution in many indirect ways and also reduces time taken to transport the vegetables. It ensures that you can grow absolutely fresh vegetables in your terrace garden. Just pick today and you can eat it on the same day.

2. To ensure the produce free from chemical Fertilizers, Pesticides, and insecticides that are harmful to humans. Because traces of toxins of different chemicals are always present on the vegetables that we get from the market.

3. One can use soil less media in pots, grow bags, turf, used household articles etc. as growing containers for raising based on need. So, one recycles household waste articles and converts organic waste from kitchen as manure in terrace farming. This also provides solution to dispose organic waste at the household level.

4. Reduce indoor temperature by 6-8 degree and can reduce air conditioning cost. It also reduces overall heat absorption of building and insulate the building against heat and cold.

5. Terrace gardening increases the oxygen levels in the air.

6. Terrace gardening reduces the monthly expenses to the poor and middle-class families.

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Integrated Disease Management Under Protected Cultivation

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The cultivation of crops in the greenhouse is nothing but protected cultivation is the most intensive form of horticultural production. Greenhouse climatic conditions provide an ideal condition for the development of many foliar, stem and soil-borne plant diseases. Diseases are a major limiting factor for vegetable that cause serious yield reduction leading to severe economic losses. Fungi enter plants through natural openings such as stomata and through wounds caused by pruning, harvesting, hail, insects, other diseases, and mechanical damage. Integrated disease management is the practice of using a range of measures to prevent and manage diseases in crops.

Hazard analysis is used to identify the potential for infection so that preventative or curative measures can be put in place to minimize the risk of disease infection and spread. During the cropping cycle, regular crop monitoring is used to decide if and what action is needed. Today, the term integrated pest management (IPM) is used to describe the use of integrated practices to manage any kind of pest including diseases. IPM is fundamentally a subset of the good agricultural practices needed to produce profitable and productive crops in a sustainable way.

Common Greenhouse Diseases

The types of greenhouse disease that home gardeners are most likely to run into are carried into the greenhouse on sick plants, floating on the wind or vectored by insects.

Fungal infections like powdery mildew, phytophthora, botrytis and root rot are often encouraged by overly wet conditions and standing water on leaves. Bacterial diseases, like bacterial blight and Erwinia, are incurable, develop water-soaked spots and tissues begin to melt into a sticky, gummy mess, get the sick ones out of the greenhouse and destroy them right away. Bacterial disease is often spread on dirty tools, containers or clothing are problems in the greenhouse. Viruses appear in many shapes and sizes and are frequently carried into the greenhouse by plant-feeding insects, like aphids and thrips.

Good IPM Practices

Establish a good integrated pest management approach right from the beginning of the crop. There are several steps before control and management tactics are employed for the reduction or elimination of the pest and disease problem in a particular greenhouse or protective structure. The preliminary steps are:

1. Hygiene: The most effective way to manage diseases is to prevent the pathogens from getting to the crop. Make sure that any materials, containers, or equipment that you bring into the greenhouse is clean. Install and maintain a foot bath at every entrance to the greenhouse. Although commercial foot bath pads are available, a container with a piece of foam and disinfectant solution is effective. Make sure every person entering the greenhouse uses the footbath each and every time that they enter and that the disinfectant solution is changed at least every fortnight. It will be necessary to change the solution more frequently if it looks muddy. Some diseases of greenhouse crops first appear on plants under the vents because airborne spores have been blown into the greenhouse. Despite this risk, good hygiene will significantly reduce losses caused by disease.

2. Control entry: It is important to understand that pathogens (and pests) are easily carried on clothing and shoes. Many diseases in greenhouse crops first appear near doorways. The fewer people entering the greenhouse, the smaller the chance that pathogens (and pests) will be carried into the crop. When people are visiting, have them wear disposable overalls. Avoid having visitors who have come directly from another greenhouse. If visitors and workers are moving between different crops, always move from the youngest and healthiest crop plantings through to the older crops (that may be infected) to reduce the risk of spreading pathogens.

3. Start with disease-free plants: If buying seedlings, inspect them upon delivery. If any plants have disease symptoms, tell the delivery person immediately. Remove the diseased looking plants and put them in sealed plastic bags and submit them for diagnostic testing. Have a special designated clean area or greenhouse to store seedlings in prior to transplanting out. Before moving new plants into the greenhouse, check them for any sign of pests or diseases. Do not plant out any plants that are, or appear to be, diseased or infested with pests. Choose crops and varieties that are resistant to pests and diseases if feasible. Many cultivars are resistant or tolerant to several diseases including Powdery Mildew, Downy Mildew and viruses. However, no cultivar is resistant or tolerant to all diseases.

4. Control the growing environment: Controlling the greenhouse environment to make conditions less favourable for disease organisms is a very effective method of disease control. Good temperature and humidity management are essential to minimizing disease in greenhouse crops, particularly for downy and powdery mildews and Botrytis. Guttation is an important way in which pathogens can infect greenhouse crops. When guttation occurs, pathogens are picked up off the leaf surface by the exudates from the leaf and then can be sucked into the plant during the day. Condensation on leaves, tissue damage such as pruning and picking wounds, chilling injury or heat damage predisposes plants to infection. Condensation can also affect fungicide activity by diluting fungicide applications. Over time, this may actually contribute to the development of resistance in pathogens to particular pesticides.

5. Inspect plants regularly: Monitoring the crop regularly will enable early detection of diseases. This greatly improves the efficacy of control strategies. Walk up and down every row and inspect at least 5% of all plants in the crop. Some diseases will occur in certain locations in a greenhouse because of localized “microclimates”. For example, Powdery Mildew usually starts in the shadier areas. Botrytis occurs where moisture sits on plant surfaces. These specific areas can be targeted when monitoring the crop to find diseases at an early stage of development. Tie coloured plastic tape or ribbon in these areas to signify “hot spots” for diseases. If required, these areas can be "spot sprayed" with a small compression or backpack sprayer rather than needlessly treating the whole crop.

6. Waste management: Remove and destroy crop residues as soon as possible after pruning and harvest. Do not pile plant material near the greenhouse. Put pruned material directly into bags or a rubbish skip bin for disposal – not on the ground. Make sure the skip bin is removed regularly to avoid a breeding place for pathogens. Crop debris can be buried if done immediately. Do not stockpile it. Burning crop debris may contravene Local Environmental Plans. Check with your local council.

7. Control insects and weeds: Control insects and weeds inside and outside the greenhouse. Weeds can harbor diseases and pests. Insects can carry the diseases. If feasible, place insect screens over all openings in your greenhouse. Be aware that screens reduce the flow of air and will impact on the venting capacity of the structure. Poor air circulation can result in diseases such as *Botrytis* (grey mould), *Alternaria* (leaf spot) and *Pseudoperonospora* (Downy Mildew). The use of a double-door entry to the greenhouse, with a footbath, greatly reduces both pests and diseases getting into the crop.

8. Fungicides: *Botrytis* is a high-risk pathogen, and over the years it has developed multiple resistance to a wide range of chemical fungicides over the years. Repeated use of fungicides with same mode of action has resulted in the development of new pathotypes of *Botrytis*. Growers must avoid repeated use of same fungicides and should consult local extension specialist for specific fungicides recommended in your region. Also check the product label to make sure that a given fungicide is registered for use in your region. Growers can follow FRAC (Fungicide Resistance Action Committee) codes on modes of action of different fungicides. Rotating applications of different chemistry may help in reducing the risk of resistance.

Growers should use approved biofungicides as preventive measures before the problem arises (rather than curative). As per different research studies, biofungicides like *Bacillus subtilis, Trichoderma viride* and *Streptomyces griseoviridis* have been shown to be highly effective against soil borne diseases. The more appropriate approach in pest and disease management would be to utilize all possible options with reduction of pesticide usage and making biological control as core component of the integrated diseases management programme.

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Pebrine Disease: The Unsolved Problem of Silk Industry

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Abstract
Sericulture is the study of silkworms with an objective of commercial silk production. It is the main industry that contribute maximum to the textile world. Among all the problems faced by silk industry, pebrine disease is the most potent one. The popular name 'Pebrine' was given by De Quadrefagues in 1860. The transovarial transmission of this disease was innovated for the first time by Pasteur during 1865-70 and hence, he suggested the mother-moth examination for diagnosis of this disease. The most frequent source of infection is through ingestion food (mulberry leaves) contaminated with spores of the parasite by silkworm larvae. The growth and rapid multiplication of the spores can be terminated by the integrated control measures. Starting from disinfection of rearing room to the detection of infestation to adult moths by mother moth examination, the whole process needs holistic approach.

Introduction
Sericulture is the study of silkworms with an objective of commercial silk production. It is the main industry that contribute maximum to the textile world. Silkworm is the pioneer organ to produce commercial silk. The growth and development of silkworm is a cumbersome process that focuses on the feeding, rearing and proper silk production processes. Among all the problems, pebrine disease is the most potent one. Pebrine is a protozoan disease of the silkworm, *Bombyx mori* L. caused by *Nosema bombycis* Naegeli (Protozoa; Microsporidia). It was first recorded in 1845 in France. The damage of cocoon crops in Europe in the middle of the nineteenth century was so great and extensive that the cocoon production declined sharply and the sericultural industry of the world suffered heavily. The menace of the disease was so intense that the total annual cocoon production of 2, 10,00,000kg during 1846- 52 was reduced to 1/3 of the production (75,00,000kg) during 1856 in short span of four years.

History
The pebrine disease is an extreme problem from the time immemorial for sericultural industry. However, it came to lime-light during the second half of 18th century when the silk industry in France got exterminated by its havoc. In 1849, Guerin - Meneville of France named the pebrine pathogen as "Hematozoid" i.e. a microorganism living in haemolymph of silkworm. The present name of the pathogen, *Nosema bombycis* was given by Naegeli in the year 1857. The popular name 'Pebrine' was given by De Quadrefagues in 1860. The transovarial transmission of this disease was innovated for the first time by Pasteur during 1865-70 and hence, he suggested the mother-moth examination for diagnosis of this disease in his book entitled "ElUDES SUR, LA MALADIE DES VERS A SOIE". In India, pebrine was first noticed during the late 1860s when it was wrongly interpreted as a sort of atrophy. Pebrine epidemic swept through Kashmir in 1878.

Symptoms of Pebrine Disease
The symptoms of pebrine vary depending on the stage of B. mori viz., egg, larva, pupa and moth and form important criteria for identifying the disease.

Egg: As a disease of transovarian transmission, the pathogen parasitizes the ovary first when the female larva infected by the pebrine disease at the 4th - 5th instar becomes a moth, moves into the egg and after the deposition of the egg undergoes multiplication and develops the disease in the embryo or in the body of the silkworm. Growth and multiplication of the pathogen in the egg are influenced by the growth of host egg. When the egg diapauses, the growth and multiplication of the pathogen stop simultaneously and when the egg starts growing by incubation and other reasons, the pathogen also starts growing and multiplying.

Larva: First instar larvae that have been infected embryonically show no growth. Two days after hatching the worms become thin, darker and exhibit sluggish growth. If infection takes place at the beginning of first instar, the symptoms are generally similar, but normally the worms moult later or in some cases, not at all. Infection at the second and third instar may, in the grown larval stage, reveal such symptoms as wrinkled silkworms, i.e. after feeding. larvae of the different instars show black pepper-like irregular spots appearing on the body mostly on the caudal horn and lateral to the prolegs usually in European breeds.

Pupa: Cocoons spun by pebrine infected worms may show many deformities and become flimsy, malformed and less coloured with thin ends and less raw silk content. Diseased pupa becomes lustreless and relatively less reactive to tactile stimulus. The abdomen of the pupae softens and irregular black spots appear on the body wall. Highly infected pupae may fail to metamorphose into adults and die within the cocoon.

Moth: Sick moths may develop clubbed wings, developed wings not spreading, moths with vesicles or black spots on wings, being dull, naked moths without abdominal scales, moths not showing mating instinct, discolouration of abdominal scales and shedding of scales from wings and body are also observed.

Source of Infection

The most frequent source of infection is through ingestion food (mulberry leaves) contaminated with spores of the parasite by silkworm larvae. The second common method and route of infection i.e. through the mother moth (transovarial transmission) known since Pasteur's time. Also, the disease into some extent transmitted from one generation to the next through the external contamination of eggs by spores (Trans-ovum transmission).

Infected worms lose appetite, become sluggish, opaque Diseased worms may spin cocoons which are flimsy and poor in silk content. In coloured cocoon races, the intensity of the colour comes down and look dull. The fast spreading nature of the disease through secondary contamination has been established, the extent of contamination being in proportion to the initial density of infected larvae in the batch.

Prevention and Control

Following methods are widely adopted to control the pebrine disease of silkworm.

1. The seed cocoons that are 100 per cent free from pebrine infection only are to be used for laying preparation.

2. The layings are surface washed with 2 per cent formalin for 5 to 10 min and cold storing of eggs is done for only required period in effective cold storage.

3. Prompt burning of pebrinised layings, moth residues after mother moth examination and used male moths to prevent further contamination.

4. Bed cleaning at regular intervals.

5. Two rounds of effective disinfection of rearing house and appliances may have to be ensured once immediately after cocoon harvest with formalin 3 per cent and the other just prior to the next brushing with 5 per cent bleaching powder.

6. Mother moth examination for detection of the spores in the adult moths.

Conclusion

Pebrine is a disease of immense importance from sericulture industry and silk production point of view. It is a transovarial disease thereby, create a problem for multiple generations. Hence, it needs to be curtailed at the initial stages of infection. The growth and rapid multiplication of the spores can be terminated by the integrated control measures. Starting from disinfection of rearing room to the detection of infestation to adult moths by mother moth examination, the whole process needs holistic approach. The sericulture farmers need to be equipped with knowledge to detect and prevent the spread of pebrine disease at the ground level. The technical know-how must be conveyed to the farmers in order to control the disease.

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Agro-Techniques for Summer Moong (*Vigna radiata* L.) Cultivation

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Introduction

Moong is an excellent source of high-quality protein. Moong is consumed as grains, sprouted form as well as in a variety of ways in homes. It can also be used as green manuring crop. Moong can be used as a feed for cattle. Summer moong can be grown after harvesting of pea, gram, potato, mustard, linseed. Cultivation of summer moong is important to increase the soil fertility in those areas where the main cropping system is paddy—wheat. Moong is one of the best off-season crops of the summer months (March-June) both under irrigated and unirrigated areas. Its cultivation enables the farmers to put their land and other resources which otherwise mostly remain idle during these months to a highly profitable use. This crop can be grown both as a pure as well as mixed stand.

Preparation of Land

1. For Rice fallow: One deep ploughing followed by two to three times by desi plough are sufficient to bring desire tilth.
2. After wheat harvest: One deep ploughing followed by cross ploughing by cultivator.
3. After potato or sweet potato: One discing or one cross ploughing by cultivator is sufficient to bring good tilth.

Fertilizer and its Application

Full quantity of recommended dose of fertilizers (@ 20:40:20:20 as N:P:K:S kg/ha) should be applied as band placement of as broadcast at the time of final land preparation.

Varieties Use

Only recommended varieties for the areas should be taken to get good yield.

States	Kharif	Summer
Andhra Pradesh	Madhira 429, Puaa -9072, WGG-2, IPM -02-14,OUM 11-5, CoGG 912	
Assam	IPM 2 -3, Pant Mung 4, Pant Mung 2, Narendra Mung 1, SG 1,	HUM—16, PDM—139,Meha, Pant Mung-5, HUM-12, Pusa vishal,
Bihar & Jharkhand	IPM 2 -3, MH 2 -l5, Pant Mung-4, HUM -1, Narendra Mugg 1 , Paint Mung 2, Sunaina, PDM - 139	HUM 16, PDM 139, Meha, Pant Mung 5, Pusa vishal, TBM-37, HUM -12
Gujrat	Gujarat Mung 3, Gujarat Mung 4, K -851, PKVAKM 4	
Haryana	IPM 2-3, MH 2-I5, Muskan	SML 668, Pant Mung 5
H.P, J & K	Pusa 672, KM-2241, Shalimar Mung 1	SML 1115
Karnataka	IPM 02-14 & 2-3, HUM 1, PVAKM-4, CoGG 912, KKM 3, LGG 460, TARM—1. OBGG 52,	
M.P. & Chhattisgarh	HUM 1, TJM 721, BM 4, Meha	Virat (IPM 205-7)
Maharashtra	HUM 1, BM 2002 -1, PKVAKM -4, BM 4, TARM 2	
Odisha.	PDM 139, OUM 11 -5, CoGG 912, IPM 2-3	

Punjab	IPM 2 -3, MH 2 -15, ML 818, ML 613	SML 668, IPM 2-3, Pant Mung 5
Rajasthan	SML 668, IPM 2-3, RMG 492, MH 2- I5	SML 668, PDM 139, Meha
U.P. & Uttarakhand	Pant Mung 5, Pant Mung 4, Narendra Mung 1	HUM 16, IPM 2 -3, PDM 139. Meha, HUM 12
West Bengal	MH 2 -l5, Pant Mung 5, Pant Mung 4, Narendra Mung 1	HUM 16, IPM 2 3. PDM 139, Meha, Pusa vishal, Pant moong-5, TMB 37, HUM 16
Tamil Nadu	IPM 2-3, Co-6, TM 96-2, Vamban 2, Vamban 3,	ADT-3, Sujata (Hybrid 12-4), Virat (IPM 205-7)

Seed Rate
For optimum plant population, following seed rates should be adopted:
1. For smaller grain varieties such as Samrat, a seed rate of 18-20 kg/ha.
2. For bold/bigger grain varieties like-SML 668, HUM 16 etc; a seed rate of 25-30 kg/ha.

Seed Treatment
Before sowing the seed should be treated with the mixture of thiram @ 2.0 + Carnendazim (1 g) per kg seed to control soil and seed borne diseases. Thereafter, to control against sucking pests the same seed should be treated with Imidacloprid 70 WP @ 7-8 g/kg. then after 24 hours, the same seed should be treated with suitable rhizobium strain and PSB culture.

Method of Rhizobium / PBS Culture Application
Take 250 g of molasses (Gur) in 500 ml of water. Boil it and then allow it to cool down. Thereafter, add one packet (200 g) of rhizobium culture in it and mix it well. Now, pour/sprinkle this mixture over 10 kg of seed and mix it with hand lightly so that a thin layer is formed on the seed cover. Dry this seed in shade for 1-2 hours after that sowing can be done avoiding strong sunlight. Care should be taken in such fields where moong is being cultivated for the first time, rhizobium/PSB culture must be used.

Sowing Time
Most suitable time for sowing of Moong is from 10th of March to 10th April.

Spacing
25-30 cm x 10 cm

Sowing Depth
Treated seeds should be placed at a soil depth of 3-5 cm having sufficient soil moisture.

Thinning
To maintain optimum plant population, thinning is necessary and it should be done in between second-third week of sowing.

Weed Management
To keep the field weed free, one hoeing or hand weeding during third-fourth week of sowing must be done for better plant growth and yield. Or by using herbicides like-pre emergence application of Pendimethalin @ 3.0 litres per hectare under irrigated condition or 2.5 litres per hectare under rainfed condition within three days after sowing in 500 litres of water for spraying one ha. After this, one hand weeding at 30 days after sowing will provide weed free environment or post-emergence application of quizalofop-p-ethyl @ 50 g ai/ha or imazethapyr @ 50 g ai/ha in third week of sowing will do the work.

Irrigation
For irrigated condition, following irrigation arrangement should be done:
1. **Pre sowing irrigation:** One light irrigation will provide sufficient moisture for good seed germination.
2. **Post sowing irrigation:** Two to three irrigation are sufficient as per the soil and climatic condition of the field.

Plant Protection Measures

Most important diseases of moong are- yellow mosaic and leaf curl. Others are-leaf crinkle, anthracnose, cercospora leaf spot etc.

Yellow Mosaic Virus

This disease is caused by the mung bean yellow mosaic virus which is transmitted by the white fly *(Bemisia tabaci)*. The tender leaves show yellow mosaic spots, which increase with time leading to complete yellowing. Yellowing leads to less flowering and pod development, Early infection often leads to death of plants.

Control Measures:

a. Diseased plants should be rogued out to prevent further spread of the disease.
b. In order to prevent white fly infestation, spray with Triazophos 40 EC @ 2.0 ml/l or Malathion 50 EC @ 2.0 ml/1 or Oxydemeton melyl 25 EC @ 2.0 ml/l at 10-15 days intervals if required.
c. Grow tolerant / resistant varieties like Narendra Mung-l, Pant Mung-3, PDM 139 (Samrat), PDM 11, MUM 2, ML 337, PM02-14, MH 421, SML 832 etc.

Leaf Curl

The symptoms are visible first in third leaf after three to four weeks of sowing. These are characterized by enlargement of leaves followed by their crinkling. Later the leaves become thicker and leathery. The affected plants, however, do not die till the harvest of the crop.

Control measures:

a. Trcat the seeds with imidacloprid 70 WS@ 5ml/kg.
b. Foliar spray of insecticide (dimethoate 30 EC @ 1.7ml/ha) at 30 days after sowing.
c. Rogue out the infected plants and keep these plants away from the field.
d. Use resistant varieties like D-3-9, K 12, ML26, RI 59, T-44.

Insect-pest management: Some of the most common insect-pest of moong are-white fly, stem fly and bihar hairy caterpillar and the crop loss in severe cases may reach up to 70 %.

White Fly

The infested plants become very weak showing downward cupping of the leaves giving a sickly look and the plants may die. Insect secretes honey dew on leaves results blackening of leaves, drastically reducing pholosynthetic site and drying of leaves. White fly is a vector of number of viral diseases especially mungbean yellow mosaic virus (MYMV).

Control measures:

1. Seed treated with Dimelhoate 30 EC @ 5 ml/kg.
2. Foliar spray of Triazophos 40 EC @ 2.0 ml/l or Malathion 50 EC @ 2.0 ml/l at 10-15 days intervals if required.
3. Grow cotton as a trap crop one month earlier between the moong rows.
4. Grow maize, sorghum or pearl millet as a barrier crop to minimize the incidence of white flies.
5. Install Sticky map.
6. Grow resistant varieties like- ML 1256, ML 1260 and ML 1191.

Stem Fly

Stem fly *(Ophiomyia phaseoli)* maggots mine the leaf petiole or tender stem resulting in withering/death of plant. The characteristic symptoms are - drooping of the first two leaves and yellowing of plants resulting in about 20 per cent loss of moong yield.

Control measures:

1. Follow clean cultivation, crop rotation, earthing up, growing trap crop, destroying alternative host like Solanum nigrum to minimize the stem fly incidence.
2. Opt for resistant varieties (Mungbean: CoGG 912 & CoGG 917).
3. Seed soaking either in Imidacloprid 17.8 SL @ 5.0 ml/kg seed in 100 ml water for one hour or Thiomethoxam 25 WG @ 5.0 g/kg seed in 100 ml water to avoid early incidence of stem fly.
4. Spray either Imidacloprid 17.8 SL @ 0.2ml/l or Thiomethoxam 25 WG @ 0.3 ml/l at 15 days after sowing.

Bihar Hairy Caterpillar

Female moths lay eggs on plants in a field. Young caterpillar eats away all the green matter of the leaves and it can be easily recognized by perforated, dusty white coloured leaves in the field. The grown-up caterpillars feed voraciously on leaves, soft stem and branches. The insect totally denudes the plants within a few days which results in total failure of crop.

Control measures:

1. Uproot the damaged plants along with the young larvae at the gregarious phase and burry under the soil.
2. Spray of Quinalphos 25 EC @ 2.5 ml/l or Dichlorvos 10 EC @ 1.0 ml/ l or Fenvalerate 20 EC @ 1.87 ml/l of water or dusting with Fenvalerate 0.4% @ 15 kg/ha.

Harvesting and Threshing

Moong should be harvested by sickle when more than 80 per cent of the pods got matured and turned deep brown to black in colour after one or two pickings of matured pods. Cut plants are taken to threshing floor for sun drying. Thereafter they are threshed by beating with sticks or by trampling with bullocks foots.

Yield and Storage

A well-managed summer moong crop may produce 12-15 quintal seeds per hectare which after sun dried for 3-4 days for bringing seed moisture content up to 8-10 % can be stored safely in bins.

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Green Manuring: Feed the Soil – Not the Plants

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Introduction

The human induced land degradation is actual woeful as adulterated agronomical practices created ample accident of soil fertility. A fertile and healthy soil is the basis for healthy plants, animals, and humans. The soil organic carbon is the very foundation for healthy and productive soils.

The soil organic matter positively influences and modifies almost all the soil properties. Maintaining healthy soils is a huge task due to high input–cost relationships, costly fertilizers, and issue of soil degradation. Under such situation green/organic manures are considered as the cheap and good source for plant nutrients and soil amendment.

Therefore, integration of green manuring crops into cropping systems brings not only positive influence on the soil properties but also enhances crop productivity, conserve soil moisture, and check weed infestations. Green manures can play a cardinal role as it has able impacts on physical, actinic and biological superior of the soil and appropriately apology of soil fertility. The use of green manure in crop production is recorded in China as early as 1134 BC.

“The practice of ploughing or turning into the soil undecomposed green plant tissue for the purpose of improving physical condition as well as fertility of soil is referred to as green manuring and the manures obtained by this method is known as green manures”.

Green manuring not alone improves soil quality, but as well fixes atmospheric nitrogen in the soil if legumes are considered. The most important green manure crops are sunnhemp, dhaincha, pillipesara, cluster beans and Sesbania sp. Among the green-manuring manures Sesbania aculata accumulated the largest amount of biomass and nitrogen contribution and among the grain legumes, cowpea ranks first both in terms of grain yield and biomass addition.

The application of green manure (incorporation of sole sunhemp) showed 13-15%, 21-36%, 4-5% and 3-14% higher soil available N, P, K and S after harvest of crops indicating increase in the soil available nutrient status.

Sustainable crop production depends upon the rational use of chemical fertilizers and pesticides along with organic manures for better soil health. Owing to the constant production of crops from the soil, the latter are being depleted gradually of its nitrogenous and other nutrients. Green manuring has been known for its improvement on the soil fertility.

The benefits of green manuring are multifold. Green manure crops ensure ecological sustainability by maintaining the productivity of the soil over a long period by protecting soil from erosion.

Depending upon the species and locations, green manure crops supply 40 to 120 kg N ha-1. This amount would equal an application of three to ten tonnes of FYM on the basis of organic matter and its N contribution.

Plant nutrients are provided in a better form and over a longer period for the crops grown after green manuring. However, the choice of green manuring crops has to be made in relation to soil, climate and time available to raise the green manure crop and the facilities for irrigation. Leguminous green manuring crop fixes the atmospheric nitrogen in the soil in available form, improves the soil health, physical structure, prevents leaching and conserve more soil moisture.

Green manuring being a low-cost practice, is an alternate way to improve soil fertility status. It has received a new impetus in recent years with an urgent need for increased food production in the country (Virdi et al., 2005).

Types of Green Manuring

1. Green Manuring in Situ: In this system, short-duration (~45 to 60 days) green manure crops are grown and incorporated into the soil at same site, either as a pure crop or as an intercrop with the main crop. In later case, the green manure is sown between the rows and is particularly well adapted to situations where the soil has to be used as intensively as possible. This system of generating nutrient resources on-site is popular in cropping systems with rice as the main crop and predominant in northern and southern parts of India. This type of green manure should be treated with caution in order to avoid competition with the main crop and consequently lower yields. The main advantages of the system are intensive use of the soil, the efficient erosion control and the reduction in weed population.

2. Green Leaf and Brown Manuring: It refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, wastelands and nearby forest areas. They are usually turned down or mixed into the soil 15–20 days before sowing of the principal/main crops based on the tenderness of the foliage or plant parts. Gliricidia maculata, Pongamia pinnata, Sesbania speciosa, Leucaena leucocephala, Azadirachta indica, Delonix regia and Peltophorum pterocarpum are used for green leaf manuring. Brown manuring is a technique to grow sesbania in standing rice crop and kill them with the help of herbicide like 2,4-D ester or bispyribac-Na for manuring. After killing, the colour of the sesbania residue becomes brown and so it is called brown manuring.

Criteria for Selection of Green Manure Plant

Criteria	Effects
High biomass production	Mobilization of nutrients from soil into vegetation and weed control
Deep rooting system	Pumping up of nutrients from lower layers.
Fast initial growth	Quick soil covers for effective soil protection.
More leaf than wood	Easy decomposition of organic matter.
Low C:N ratio	Availability of nutrients to succeeding crop.
Nitrogen fixing	Increase nitrogen availability.
Good affinity with mycorrhiza	Mobilization of phosphorus leading to improved availability.
Useful by-products	Integration of animal husbandry and forestry.

Selection of Green Manuring Crop

Green manuring crops are chosen on the basis of climate, soil and crop rotation.

1. Sunhemp: Good drainage and sufficient rainfall.
2. Dhaincha: Adverse conditions of water logging, drought, salinity and alkalinity.
3. Guar: Areas of low rainfall, poor fertility and sandy soil.
4. Lobia: Soils having good drainage sandy loam soils
5. Moong, Urd: Grown in both Kharif and Rabi season, no water logging and used as green manure after pod harvested.

Stage of Incorporation in Soil

The age at which a green manure crop should be ploughed-in is important for maximum benefit. In India, green manure crop should be turned into the soil at the point of flowering, i.e. about 8 weeks from sowing in most crops. Sesbania attained maximum growth about 8 weeks after sowing, sunn hemp was ready for ploughing in 60–70 days after sowing when flowering began all over the crop, and cluster bean reached flowering 7–8 weeks after sowing.

Method of Incorporation

Proper incorporation of the green manure into soil containing sufficient moisture is important for rapid decomposition. Green manure crops as high as 2 m can be readily buried by a soil-inverting plough after the standing crop has been planked down. The soil-inverting plough is run in the direction the crop has been laid flat in the field and again planked to compact the soil. Standard tractor drawn disc harrows can also be used.

Classification of Green Manures

Legumes	Non -Legumes

Green manure	Green leaf manure	Green manure	Green leaf manure
Daincha	Gliricidia	Sunflower	Calotropis
Sunhemp	Cassia	Buck wheat	Adathoda
Kolinji	*Pongamia glabra*		*Thespesia*

Common Shrubs and Trees Used as Green Leaf Manures

Shrubs	Trees	Green Leaf Manures
Cassia auriculata *Derris indica* *Ipomoea cornea* *Jatropha* *Tephrosia candida*	*Thespesia populnea* *Neem Glyricidia* *Cassia tora* *Vitex negundu*	*Leucaena leucocephala* *Calotropis gigantea* *Delonix regia* *Cassia Occidental* *Hibiscus viscosa*

Table 1. Common Green Manure Crop and their Nutrient Potential

Common name	Scientific name	Sowing time	Biomass (tones ha-1)	% of N on green weight	N available (kg ha-1)
Sunhemp	Crotalaria juncea	April-july	18-20	0.43	60-100
Dhaincha	Sesbania aculeate and Sesbania rostrata	April- july	20-25	0.42	84-105
Lobia	Vigna unguiculata	April-july	15-18	0.41	74-88
Urd	Vigna mungo	April-july	10-12	0.48	40-49
Mung	Vigna radiata	April-july	8-10	0.34	38-48
Guar	Cyamopsis tetragonoloba	April-july	20-25	0.34	68-65
Senji	Tephrosia purpurea	Nov-Jan	26-29	0.51	120-135
Berseem	Trifolium alexandrinum	Nov-Jan	16	0.43	60
Subabul	Leucaena leucocephala	May-June	100	3.50	500/year

Benefits

Green manure crops will offer a huge range of benefits to your soil and future crops. They are grown exclusively for the benefits and not for harvest or grazing. They are commonly used to improve the soil, for organic matter, nutrients or to control weeds.

1. Building of organic matter and improved soil structure.
2. Enhanced soil microbial activities.
3. Improvement in soil physical properties.
4. Weed suppression.
5. Nitrogen fixation.
6. Enhanced crop yields.
7. Disease suppression/control.
8. Soil and water conservation.
9. Enhanced availability of native soil nutrients.

Constraints

1. No obvious or immediate return in cash or kind, except for dual-purpose.
2. Cropping, and hence labour input considered unproductive.
3. Narrow window period between the two crops for growing and incorporating.
4. Green manure crop, if not incorporated at proper growth stage and time, may lead to immobilization of N on a temporary basis.
5. Direct costs of seed and extra cultivations.
6. Lost opportunities for cash cropping.
7. Extra work at busy times of the year.
8. Exacerbated pest and disease problems (due to the 'green bridge' effect).

9. Potential for the green manures to become weeds in their own right.
10. Low emphasis on organic manures by research and extension workers, particularly where demonstrations on farmers' fields are concerned.

Conclusion

The green manure enhanced soil organic carbon and improves soil physical and chemical properties, increase nutrient uptake, microbial activities, suppress the growth of weeds, check soil erosion and increase the yield. It proves by researcher that green manuring is appropriate and essential to achieve sustainable agricultural production by feeding soil ecologically and ultimately end benefits to crop.

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A Scenario of Sericulture in India

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Introduction

1. Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability and known as the "Queen of Textiles" the world over. On the other hand, it stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production. The very nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for socio-economic development of a largely agrarian economy like India.

2. Silk has been intermingled with the life and culture of the Indians. India has a rich and complex history in silk production and its silk trade dates back to 15th century. Sericulture industry provides employment to approximately 8.25 million persons in rural and semi-urban areas in India during 2015-16. Of these, a sizeable number of workers belong to the economically weaker sections of society, including women. India's traditional and culture bound domestic market and an amazing diversity of silk garments that reflect geographic specificity has helped the country to achieve a leading position in silk industry. Green manuring being a low-cost practice, is an alternate way to improve soil fertility status. It has received a new impetus in recent years with an urgent need for increased food production in the country (Virdi et al., 2005).

Silk Production in India

1. India has the unique distinction of being the only country producing all the five known commercial silks, namely, mulberry, tropical tasar, oak tasar, eri and muga, of which muga with its golden yellow glitter is unique and prerogative of India.

2. Mulberry sericulture is mainly practised in five states namely; Karnataka, Andhra Pradesh, Assam and Bodoland, West Bengal, Jharkhand and Tamil Nadu are major silk producing states in the country. North East has the unique distinction of being the only region producing four varieties of silk viz., Mulberry, Oak Tasar, Muga and Eri. Overall NE region contributes 18% of India's total silk production.

3. India is the second largest producer of silk in the world. Among the four varieties of silk produced in 2015-16, Mulberry accounts for 71.8% (20,434 MT), Tasar 9.9% (2,818 MT), Eri 17.8% (5,054 MT) and Muga 0.6% (166 MT) of the total raw silk production of 28,472 MT.

4. The demand for superior quality bivoltine silk is increasing in India for domestic consumption as well as value added silk products for the export market. The Ministry of Textile Government of India and Departments of Sericulture in various states provide technical and financial assistance for enhancing the bivoltine silk production.

Why Sericulture?

1. Provides vibrancy to village economies. Share of income to various groups are as follows:
   - a. 56.8 % to cocoon growers (Silkworm rearers)
   - b. 6.8% to reelers.
   - c. 9.1% to twisters.
   - d. 10.7% to weavers.
   - e. 16.6% to traders.

2. Agro-based cottage industry with very high employment potential with 60 lakh persons engaged in sericulture activities.
3. Sericulture earns foreign exchange (>2000 crores) and silk items are exported to over 50 countries.
4. Like other horticulture crops, mulberry gives quick yields with low gestation period of 3 to 4 months.
5. Mulberry is a perennial plant and can survive for 10 to 15 years and also a drought resistant crop.
6. Participation of women to greater extent i.e. upto 60%.
7. Useful as preparing dress materials, medicines, feed for fish and poultry.
8. Low gestation and high returns.


Main Branches of Sericulture

Properties of Silk

1. Silk is crystalline.
2. Homogenous in structure.
3. Hygroscopic in nature.
4. Light in weight.
5. Longest and strongest in all-natural fibres.
6. Soft, lustrous and hygienic.
7. Excellent affinity for dyes-takes colours.
8. Does not catch fire easily/quickly as nylon or wool.
9. It is elastic and has elongation of 20%.

By-Product Utilization

1. Mulberry:

a. Neutraceutical compounds in leaves: Tea made from mulberry leaves that are beneficial for diabetic and hypertensive patients.
b. Antioxidants are found in mulberry fruits.
c. Mushroom cultivation from mulberry shoots.
d. Waste from silkworm rearing and harvest can be used for biogas, compost and fuel production.
e. Mulberry waste wood is a good source of cellulose for paper and chipboard industries.
f. Hard wood used for making sports goods.

2. Silkworm larva:

a. In India chlorophyll, phytol, carotene, triacontinol, pectin is extracted from the silkworm faeces and used in food, chemical.
b. Silkworm byproducts are used in pharmaceutical industries.
c. Silkworm litter is used as fodder compost material and biogas preparation.

3. Pupa:

a. Major byproduct is pupa oil which has numerous industrial applications.
b. Uses in bakelite industry.
c. Silkworm pupa can be used as feed for fowl, fish and pig.
d. Use in genetics

4. Waste silk:

a. Waste silk is used to make silk film or silk powder used as feed additive.
b. Waste silk is used for making the cosmetic products.
c. Sericin is available material for the preparation of skin care items.
d. Used for preparation of medicine.

5. Silk moths:

a. Used as feed for livestock.
b. Used for preparation of fungal medicine like the pupa and silkworm.

Global Silk Production

1. The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. Few other countries are also engaged in the production of cocoons and raw silk in negligible quantities; Kenya, Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia, etc.

2. The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam, etc.

3. Even though silk has a small percentage of the global textile market - less than 0.2% (the precise global value is difficult to assess, since reliable data on finished silk products is lacking in most importing countries) - its production base is spread over 60 countries in the world. While the major producers are in Asia (90% of mulberry production and almost 100% of non-mulberry silk), sericulture industries have been lately established in Brazil, Bulgaria, Egypt and Madagascar as well. Sericulture is labour-intensive. About 1 million workers are employed in the silk sector in China. Silk Industry provides employment to 7.9 million people in India, and 20,000 weaving families in Thailand. China is the world's single biggest producer and chief supplier of silk to the world markets. India is the world's second largest producer. Sericulture can help keeping the rural population employed and to prevent migration to big cities and securing remunerative employment; it requires small investments while providing raw material for textile industries.

Global Silk Production (in Metric Tonnes)

S. No.	Countries	2014	2015	2016	2017	2018
1	Bangladesh	44.5	44	44	41	41
2	Brazil	560	600	650	600	650
3	Bulgaria	8	8	9	10	10
4	China	1,46,000	1,70,000	1,58,400	1,42,000	1,20,000
5	Colombia	0.5	0.5	-	-	-
6	Egypt	0.8	0.8	1.2	1.1	1.25
7	India	28,708	28,523	30,348	31,906	35,261
8	Indonesia	10	8	4	2.5	2.5
9	Iran	110	120	125	120	110
10	Japan	30	30	32	20	20
11	North Korea	320	350	365	365	350
12	South Korea	1.2	1	1	1	1
13	Philippines	1.1	1.2	1.82	1.5	2
14	Syria	0.5	0.3	0.25	0.25	0.25
15	Thailand	692	698	712	680	680
16	Tunisia	4	3	2	2	2
17	Turkey	32	30	32	30	30

18	Uzbekistan	1,100	1,200	1,256	1,200	1,800
19	Vietnam	420	450	523	520	680
20	Madagascar	15	5	6	7	7
	Total	178057.62	202072.83	192512.27	177507.35	159648.00

Economics of Sericulture

Mulberry area: 2.00 acres

1. Mulberry cultivation and maintenance expenditure:

SI. No.	Particulars	Amount(Rs.)
1	Ploughing	1,000.00
2	FYM 16 tons/ Rs. 450 / tonne)	7,200.00
3	Forming Ridges and Furrows	1,600.00
4	Mulberry cuttings/ Seedlings (@Rs. 1) per 10,000.00 Nos	10,000.00
5	Transplanting (Labour charges)	1,000.00
6	Weeding	3,000.00
7	Fertilizers cost	1,500.00
8	Foliar spray of nutrients	500.00
9	Irrigation	800.00
	Total	**26,600.00**

2. Silkworm rearing shed:

a. Silkworm rearing shed size (60' x 20'): 1200 Sq. ft.
b. Walls with Hallow blocks (7' to 8').
c. Coconut fronds for top.
d. Door - 6' to 4' (one number).
e. Windows - 6' to 3' - 13 numbers.
f. Cement floor.
g. Total cost of building construction Rs. 1, 25,000.

3. Expenditure on Silkworm Rearing Materials:

Sl. No.	Particulars	Amount (Rs.)
1	Shoot harvesting 1500 Sq.ft. (1 Sq.ft. = Rs.7/-)	10,500.00
2	Chandrike 300 Nos (@Rs. 40/- chandrike)	12,000.00
3	Bed cleaning net s (100 m) (Rs. 2. Per/m)	2,000.00
	Total	**24,500.00**

4. Silkworm rearing and cocoon production / Annum:

a. No. of silkworm rearing per annum: 10
b. No. of dfls required (10 rearing x 2000 dfls): 20,000 dfls

5. Silkworm Rearing Expenses:

SI. No.	Particulars	Amount(Rs.)
1	Cost of eggs for 20000 dfls	5,000.00
2	Spraying for mulberry (10 crops @ Rs.500/ crop)	5,000.00
3	Labour charges	30,000.00
4	Chemical fertilizers for 10 crops	5,000.00
5	Weeding (10 times @ Rs. 500/ weeding)	5,000.00
6	Cost of pesticides and foliar nutrients	2,500.00
7	Irrigation	2,500.00
8	Transport charges to cocoon market	5,600.00
	Total	**60,100**

Calculation of Profit from Sericulture

S.No.	Particulars	Amount (Rs.)
1	Cocoon harvested per annum (@ 70 kg cocoon /100 dfls)	1400.00kg

2	Return (@ Rs. 120 per / kg)	1,68,000.00
3	Annual expenditure	60,100.00
	Net profit	**1,07,800.00**

SWOT Analysis of the Indian Silk Industry

1. Strengths:

a. Large production base, availability of skills, land and labour.
b. Established infrastructure, availability of silkworm breeds / hybrids.
c. Low investment, short gestation period and higher returns.
d. Easily adoptable technologies and strong domestic demand-pull.

2. Weakness:

a. Gaps in technology transfer and extension support.
b. Inadequate market accessibility, poor linkage among different stake holders.
c. De-centralized nature of the industry inhibits financial institute from extending financial support to the sector.
d. Lack of quality-based pricing system in the market, frequent price fluctuations and large-scale imports from China at low prices.

3. Opportunities:

a. Generation of rural employment and reduction of migration to urban areas.
b. Liberalization policies of Govt. of India in line with WTO Agreements.
c. Reduction in the production of silk even by traditional silk countries like Japan, USSR etc.
d. Garment exports are on a steady increase with huge employment opportunities.

4. Threats:

a. Falling international prices and heavy dumping from China at low prices.
b. Unpredictability of China's silk policies.
c. Inability of the silk industry to react and adopt to the changing needs in terms of quality both for the domestic and export markets.
d. Lack of awareness in the domestic market to respond to the demand-driven milieu.

5. Conclusion:

a. India is the second largest producer of raw silk after China.
b. India meets 18 per cent of world's silk requirement.
c. India is the biggest consumer of raw silk and silk fabrics. So that there will be a stable domestic demand.
d. India has a great opportunity in the future as reduction in the production of silk by traditional silk countries like Japan, USSR, and Brazil etc.
e. Sericulture is characterized by low investment, short gestation period and higher returns.
f. It provides employment to a large number of people i.e. nearly 60 lakh persons.
g. It can become as the largest source for earning forex in the future (as of now it earns Rs.3200 crore).
h. Upliftment of women can be made possible by making them involved in sericulture (as of now 60 % are women).

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"Bird"- A Component That Amend or Worsen Integrated Pest Management

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Integrated pest management (IPM) has undergone a series of paradigm shifts ranging from ecological-based approaches to chemical focused principles since first being described by entomologists in the latter part of the 20th century. Despite these shifts, an integral component of IPM throughout the years has been biological control, the use of living predators, pathogens, and parasitoids to reduce the population density or impact of pests. Certain insect species such as lady beetles (Coleoptera: Coccinellidae) and green lacewings (Neuroptera: Chrysopidae) are often recognized and appreciated as natural enemies of insect pests in agro ecosystems. This level of recognition, however, has not been granted to avian natural enemies. In fact, the presence of wild birds in agro ecosystems is often perceived as an economically important threat to crops, often disproportionate to the levels of damage actually incurred.

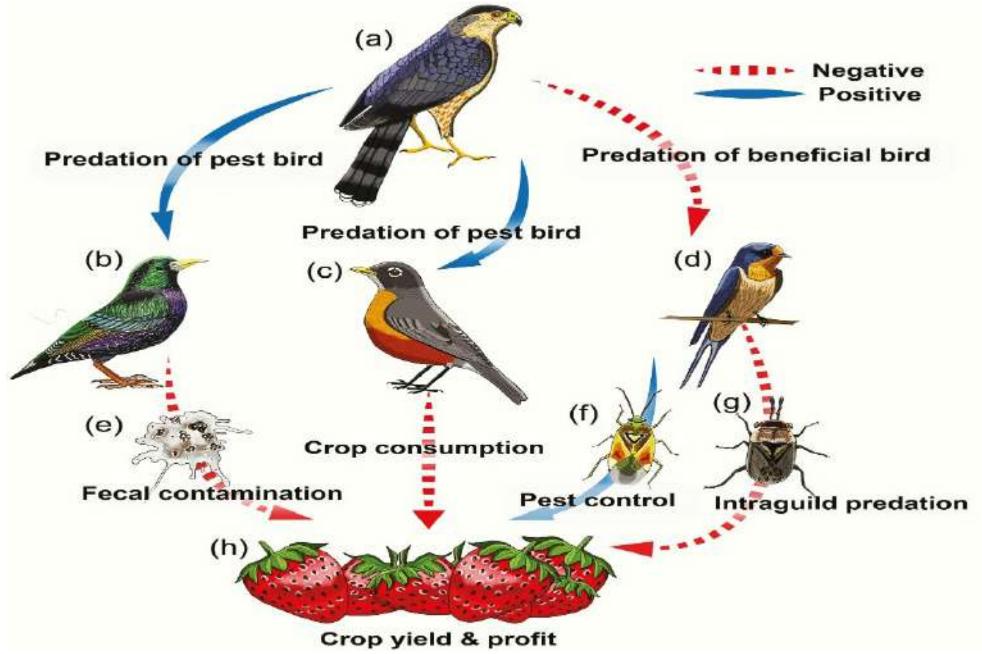
Beginning in the late 19th century and ending in the 1930s, hundreds of studies explored the role of birds as biological control agents and pests in agriculture. Proponents of economic ornithology claimed that indiscriminately killing birds was economically unwise because birds provided important services to farmers, including the consumption of insect pests. Within the last few decades, studying the benefits of birds in agriculture has resurged high.

Fruit crops present a concentrated and energy-rich food source for birds and fruits are particularly susceptible to bird damage. Frugivorous birds can inflict costly damage to fruit crops through consumption (reducing yield) or by rendering them unmarketable (reducing quality). Beyond fruit, birds can also reduce oilseed crop yields such as sunflower, and grain crop yields such as corn Indeed, found that most studies pertaining to the costs of birds focused on annual seed, grain, and cereal crops. In particular, sunflower seeds are high in oil content and often used for birdseed, making them highly attractive to birds. Birds may also provide a disservice to farmers through intraguild predation. In the case of birds in agro ecosystems, intraguild predation may occur when birds consume arthropod natural enemies, resulting in dampened pest control services. In recent years, concerns about birds in agriculture has extended beyond their impacts on crop yields to focus on their role in transmitting food-borne pathogens such as Salmonella enterica and pathogenic E. coli. Though pathogen prevalence rates are often quite low, some bird species have been shown to occasionally carry these enteric pathogens. Numerous bird deterrent and control methods are available for pest birds. These include visual (mylar strips), auditory (sound canons), tactile (spikes, sticky substances), exclusion (netting), and olfactory approaches (bird repellent chemicals such as methyl anthranilate), as well as more recent technology-based (drones) and 'natural' methods (falconry)

Birds can both improve and depress crop yields, understanding their net impacts on production is essential to inform policies, land-use planning, and farm management practices that achieve net positives for agricultural production. Growers who wish to employ strategies to promote beneficial birds and deter harmful birds at the farm or landscape level should consider potential trade-offs. For example, nest boxes installed for predatory birds and some pose a threat because of their fruit-eating diet preferences, but also due to negative ecological impacts such as aggressive competition with native cavity-nesting birds.

Comparative Analysis (Positive vs Negative)

1. Cooper's Hawks.
2. European Starlings.
3. American Robins.
4. Barn Swallows.
5. Fecal contamination or through crop consumption, negatively affecting.
6. Crop yield and profit.
7. Lygus bugs.


(a)
Negative
Positive
Predation of pest bird
Predation of beneficial bird
Predation of pest bird
(b)
(c)
(d)
(e)
(f)
(g)
Crop consumption
Fecal contamination
Pest control
Intraguild predation
(h)
Crop yield & profit

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A Review on Impact of Hydroponics: Present and Future Perspective for Farmer's Welfare

Article ID: 31300

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Abstract

Hydroponics (Greek words "hydro" water and "ponos" work) is a method of plant developing without soil utilizing with mineral supplement arrangements. It will offer development to the plants under controlled climate. Over the most recent couple of years because of the shirking of methyl bromide in the dirt culture the hydroponic framework has developed. The root and shoot length were fundamentally impeded because of the convergence of contaminated water and term of the plant introduction to it. In this procedure water culture researchers found that when contrasted with soil-based development, hydroponic plant framework needs just modest number of inorganic components notwithstanding water, oxygen, and daylight to develop the plant Hydroponics cultivating can be a significant favourable position for Indian farming; it can possibly deliver crops in each season without soil. Such practices can assist Indian ranchers with increasing their harvest efficiency indeed, even in little divided terrains. Later on, hydroponics could be rising strategies for the providing of food to the overall population.

Keywords: Hydroponics, methyl bromide, oxygen, population etc.

Introduction

Soil contains all the significant segments for the development of plants. It gives supplements; water and so on for fruitful development of plants. All the significant helpful procedure, for example, nitrogen obsession, giving dampness and entire plants age occur because of essence of soil. Plants, regardless needs a far-reaching space and open field to grow however inside the urban areas space is one of the constraining variables for such an agriculture age. To defeat this obstacle, hydroponics was made by plant researchers starting late. The term hydroponics was surmised from Greek word "hydro" suggests water and "ponos" implies work. This framework is generally suitable to help go up against difficulties of atmosphere changes furthermore has any kind of effect in age of yields and vegetable which is 100% increasingly secure to eat. For hydroponics innovation, no dirt is required to build up some chosen mentioned crops. It is furthermore named as (soil less culture) method where yields are created in liquid-based supplement well off courses of action underneath green house. As it is notable hydroponics doesn't require any dirt, where root framework is upheld utilizing dormant medium such as dirt pellets, pertile, rock and so on. The reason behind this is to permit the plants roots to come in direct contact with supplements arrangements, while approaching oxygen, which is fundamental for legitimate development.

Distinctive Available Techniques for Soil-Less Culture

Enormous quantities of hydroponic/soil-less culture strategies are accessible. In any case, following components are considered in choosing a method:

1. Space and other accessible assets.
2. Anticipated efficiency.
3. Accessibility of appropriate developing medium.
4. Anticipated nature of the produce – shading, appearance, liberated from pesticides, and so on.

Techniques of Hydroponics

It is otherwise called Liquid Hydroponics technique. Plants developed in arrangement culture have their underlying foundations suspended legitimately in a supplement arrangement. It can additionally be arranged into:

1. Circulating strategies (shut framework) / Continuous stream arrangement culture:

a. Nutrient film strategy (NFT).
b. Deep stream strategy (DFT).

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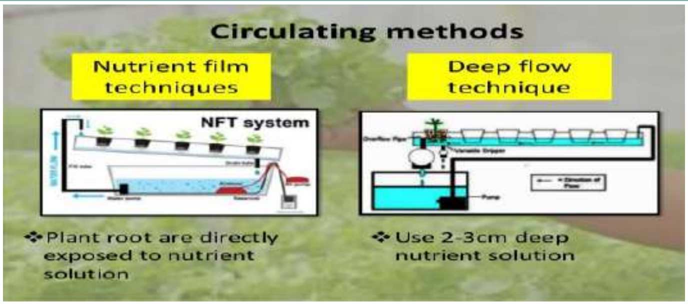
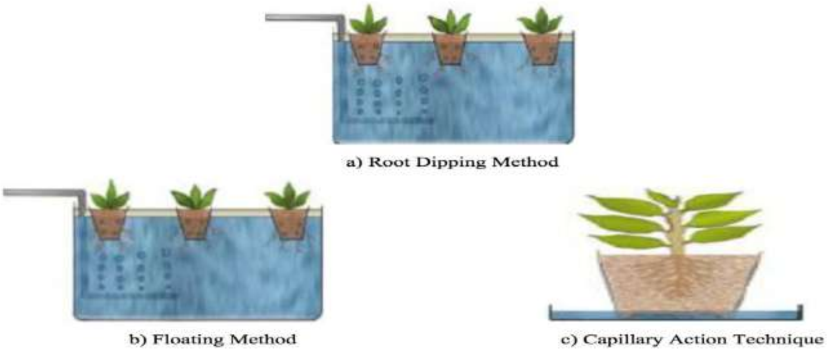


Streaming arrangement culture frameworks can give a steady supplement condition for roots. They are profoundly amiable to programmed control yet are dependent upon quick plant drying up if the progression of arrangement stops in any way, shape or form. In this way visit consideration is required.

2. Non-circulating technique (open frameworks) / Static arrangement culture:

a. Root plunging strategy.
b. Floating strategy.
c. Capillary activity strategy.



Media Culture

The media culture strategy has a strong vehicle for the roots and is named for the sort of dormant medium, for example sand culture, rock culture or rock fleece culture. There are two primary varieties for every medium, sub-water system and top-water system.

In any case, it is named follows:
1. Hanging sack procedure.
2. Develop pack procedure.
3. Channel or trough strategy.
4. Pot strategy.

Methods of Aeroponics

Aeroponics is a strategy for developing plants where they are tied down in openings in Styrofoam boards and their foundations are suspended in air underneath the board. The aeroponics culture is generally rehearsed in ensured structures and is reasonable for low verdant vegetables like lettuce, spinach, and so forth.

There are two procedures under this gathering:
1. Root mist procedure.
2. Fog feed procedure.

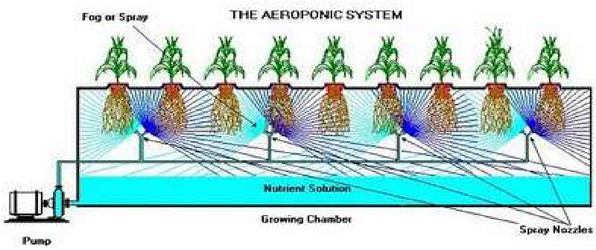


Table 2: List of Crops

Type of Crops	Name of Crops
Vegetables	Tomato, Chilli, Beet, Cauliflower, Melons, Cucumber, Cabbage
Fruit	Strawberry
Condiments	Mint, Parsley
Flower	Marigold
Medicinal	Aloe Vera
Fodder	Barley, Sorghum
Leafy	Lettuce

Table 3: Comparison B/W Soil Less vs Soil Crops Productivity / Arce

	HYDROPONIC/ARCE	TRADITIONAL/ARCE
Tomato	180 Tons	5-10 Tons
Cauliflowers	30,000lb	10-1500lb
Lettuce	21,000lb	9,000lb
Cucumber	28,000lb	7,000lb
Cabbage	10-12 Tons	6-7 Tons
Lady Finger	19,000lb	5-8000lb
Peas	14,000lb	2,000lb

Advantages of Hydroponics

1. Soil less culture gives natural food and there is no utilization of pesticides and destructive toxics as well.
2. It needs less space in utilization to soil garden, as plant with little root can be developed nearer to one another.
3. No concerns of evolving seasons, harvests can be developed the entire year around.
4. Hydroponic techniques produce sound harvests with high return, no way of soil borne creepy crawlies and nuisances; ailments assault or weed invasion as well.
5. Crops grow multiple times quicker in hydroponics and yield is multiplied prompting more creation from same sum of space.
6. No wastage of water as water is turned around utilized in this method utilizes just 1/twentieth of water to crops contrast with conventional cultivating.
7. Requires less work.
8. Environment benevolent practice, no damage to nature.
9. Hydroponics is abiotic stress less free cultivating procedure.

Potential Outcomes

1. For hydroponics urban zones ought to be anticipated to fabricate hydroponic food park in each city.
2. Providing increasingly number of preparing to ranchers.
3. Providing them hydroponics framework at moderate rates.
4. Farming should give most regarded calling in Nation with the goal that youthful ranchers could see his/her future in fields in agribusiness working with most recent rural methods
5. Agricultural colleges and Research organization should work in co-activity with Government of India to
6. perform study and attempt to bring this procedure everywhere scale with the goal that ranchers could take in something from it.

Constraints of Soil-less Culture

In spite of numerous favourable circumstances, soil–less culture has a few limitations. Application on business scale requires specialized information and high beginning venture, however returns are high. Thinking about the significant expense, the dirt less culture is restricted to high esteem crops.

Incredible consideration is required regarding plant wellbeing control. At last vitality inputs are important to run the system.

Difficulties

Hydroponics framework cost is high, so it isn't reasonable by helpless ranchers of India. It requires profound aptitudes and pragmatic information to develop crops. Less mindfulness, so result is unfocused segment of horticultural in India. Giving aptitudes and preparing to a wide range of ranchers from poor to average isn't a simple undertaking. Guarantee for better result and significant returns duty for the rancher and helping them to make intrigue is another explanation. In the event that the ranchers willing to work in this territory, and having less information about framework, they have to recruit a horticulturist or gifted staff. What's more, to employ a staff at moderate compensation is really a major issue.

Scope of Hydroponics in India

Hydroponics has been utilized effectively in certain nations like Israel which has a dry and parched atmosphere. Hydroponics is the quickest developing part of agribusiness, could be extremely valuable for food creation later on. As the populate particle is expanding step by step and land decay because of helpless administration, individuals moves their emphasis on new innovation like Hydroponics and Aeroponics to take care of country. Because of changes in climatic components and cataclysmic event like dry season and floods, are a portion of the motivations to change to new innovation, which guarantees food creations securely. Hydroponics is the fastest growing sector of agriculture, and it could very well dominate food production in the future. As populace increments and arable land decays because of helpless land the executives, individuals will go to new advances like hydroponics and aeroponics to make extra channels of yield creation. To get a brief look at the fate of hydroponics, we need just to inspect a portion of the early adopters of this science.

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Magnetic Field: A Growth Impetus in Plant Tissue Culture

Article ID: 31301

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Introduction

A living organism unsurprisingly gets pretentious by geomagnetism of Earth (MF, about 50 µT) for its optimum survival. Consequence of magnetic fields with regards to plant efficiency considering germination to its yield is premeditated in relation to growth parameters affected by static or pulse magnetic field with pertinent duration. In vitro generation of plants through tissue culture assist in sympathetic magnetic effects on varied explants at regulated stages such as growth-related parameters of in vitro shoots, roots, somatic embryos, callus, on the photosynthetic pigment contour, level of stress-induced alanine production, activity of stress-related enzymes, and endogenous levels of cytokines and auxins.

Effect of Intensity of Magnetic Field on Plant

The effects are depended on the intensity and duration of exposure of the applied field and in part on the species and in vitro conditions, such as type of explants or medium steadiness (Teixeira SJ and Dobránszki J., 2015). In vitro growth and development have been influenced in a succession of species, MFs thus serve as a novel scheme to open up novel outlook of research in plant science.

Static Magnetic Field

Magnetic field (MF) can have diverse outcome on plant metabolism depending on its applicant technique, intensity, and environmental circumstances. Strikingly, effects of static MF on germination and growth enhanced exclusively with escalating osmotic pressure or salt stress contrast to their relevant controls (Cakmak T et al., 2010). On the other way, MF application caused an increase in dry biomass accretion of root and shoots of seedlings.

In laboratory, low MF has been engendering by different methods, including shielding and compensating. In general, developmental studies on plant responses have been executed at diverse MF intensities. Early in 1963, it was found that a MF of reasonably low intensity could be effective in invigorating plant growth responses (Pittman UJ., 1963). Experimental studies prove that MF treatment to dormant seeds deliberately increased the rate of consequent seedling growth of barley, corn, beans, wheat, some tree fruits and certain tree species.

For Post-harvest seed upgrading of diverse plant species low frequency MF of 16Hz is generally used mainly for temperature sensitive species (Rochalska and Orzeszko R., 2005). Convinced studies showed that exposure of MF augments the assembly of polar lipid by 3-4-fold, which is mainly stimulated in cell membrane and organelles like Mitochondria and Chloroplast (Novitskii et al., 2014). Magnetic field exposure at 100 and 200 mT proved enlightening results in stomatal conductance and photosynthesis (Anand et al., 2012). Static MF also enhances stress tolerance capacity such as drought tolerance, etc (Javed et al., 2011).

Pulse Magnetic Field

Pulsed magnetic field (PMF) effects on plant regeneration under various stress condition were investigated in dry seeds. Further in vitro studies were done on seedlings generated via pre-treatment of pulse magnetic field at 0.1, 1.0, 10.0 and 100.0 Hz. Cotyledonary nodal explants exposed to PMF showed great stress tolerance with respect to control cultures and also enhanced the function of protein (Shine M., et. al. 2012).

PMF are also examined to increase capability of pea aged seeds when exposed in 100mT for 1h in three pulsed modes. PMF primed seeds showed exclusive activity of NADH peroxidase and superoxide dismutase in formation of hydrogen peroxide. Amplification in activity of certain enzymes was also seen such as catalase, ascorbate peroxidase and glutathione reductase following 36h of *Magnetopriming imbition* recovered seed exclusively. Magneto primed aged seeds were focused to depict germination allied events with the help of lipoxygenase.

Conclusion

Magnetic field can enhance the productivity to an extent when we prefer Pulse magnetic field for dry tissue and static magnetic field for wet tissue at optimum intensity and time. This can relief plant from any stress and can enhance quality of crop. Magnetic field treatment is helpful in reducing dormancy and enhancing germination related parameters such as water uptake, alacrity of germination, seedling length, fresh weight, dry weight, vigour indices and enhanced production of ROS arbitrated by cell wall peroxidase although ascorbic acid content, superoxide dismutase and acerbate peroxidase activity decreased in the hypocotyls of soybean germinating seeds under controlled laboratory conditions. MF treatment of 200mT (60min) and 150mT (60min) resulted in the effective seedling and further exploration of studies depicted exclusive plant growth, leaf photosynthetic efficiency and leaf protein content under field conditions. This exhibits a great biomass accumulation; seed germination enhancement and many more beneficial growth parameters can be exclusively enhanced via the treatment of magnetic field.

In laboratory condition the growth and development has been engineered in number of of plant species, including soybean, alfalfa, wheat, mojito mint, peppermint, spearmint, *Calendula officinalis,* potato, sugar beet, wild *Solanum* spp, beach plum, hybrid *Cymbidium*, hybrid *Phalaenopsis*, duckweed, *Krainzia longiflora*, *Spathiphyllum*, *Haplopappus gracilis* and trees cork oak, *Paulownia* sp. The magnetic or electromagnetic fields have shown the relevant effects on morphogenesis and development of the plant.

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Major Insect-Pest of Okra and their Management

Article ID: 31302

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Introduction

Okra *(Abelmoschus esculentus)* is most important vegetable and grown throughout the year in all over India. As we know that crop generally attack lots of pest which is shoot and fruit borer, leafhopper, whitefly, red spider, mites, sclenopsis mealy bug and root knot nematodes are most serious causing substantial reduction in crop growth and yield. In the present document the identification, nature of damage, management has been discussed to save the crop from pest damages. The productivity of okra in India is low compared to other countries due to yield losses caused by insect pest, diseases and nematodes. The crop is attacked by more than 72 insect pests and infects the crop from seedling to harvest stage. Three most important pest of okra have been discussed below.

Some Important Pest of Okra

1. Shoot and fruit borer *(Earias vittella)*

a. Identification: The *E. vittella* moths measures about 2.5 cm across the wings and have a narrow light longitudinal green band in the middle forewing.

b. Nature of damage: the female moth lay 200-400 eggs at night, singly on flower buds and tender leaves of okra.

c. Management: Spraying with quinalphos 25 EC (2 ml/liter of water) pest. Before spraying all the affected plant parts should be removed.

2. Fruit borer *(Helicoverpa armigera)*

a. Identification: it is stoutly built, large brown or yellowish-brown moth, about 20 mm long and dark specks that makes v-shaped marks on the forewings and a conspicuous black spot in the centre.

b. Nature of damage: The young larvae on hatching feed on foliage for some times and later bore into the fruits with their bodies hanging outsides.

c. Management: Spray carbaryl 50WP 2g/liter or profenophos 0.05 percent or *Bacillus thuringienesis*.

3. Whitefly *(Bemisia tabacci)*

a. Identification: Adult are winged, they are 1.05-1.5 mm long and their yellowish bodies are slightly dusted with white waxy powder.

b. Nature of damage: The milky white minute whiteflies and nymphs such the cell sap from the leaves. The affected leaves curl and dry.

c. Management: 4-5 foliar sprays of imidacloprid 17.5 SL (0.02%) or dimethoate (0.05%) or metasystox (0.02%) at an interval of 10 days effectively controls the whitefly population.

4. Leaf roller *(Syllepta derogate)*

a. Identification: Moths yellowish-white in colour as well as brown spot on the head and the thorax. It measures about 28-40 mm across the spread of wings and have a series of dark brown wavy lines on the wings.

b. Nature of damage: The larvae feed on okra leaves. In severe infestation, plants may be completely defoliated. Young larvae feed on the lower epidermis of leaves.

c. Management: Control measures adopted for shoot and fruit borer will take care of the infestation of leaf roller.

5. Leafhopper *(Amrasca biguttula)*

a. Identification: Adults are small having wedged shaped body about 3 mm long colour somewhat greenish yellow with black spot.

b. Nature of damage: This attack pest at its early stage of growth. Small, greenish leaf hoppers; nymphs and adults are found on the under sides of leaves. as a results leaf curl upwards along the margins and have a burnt look over the entire leaf area

c. Management: Spary 750 ml oxydemeton methyl 25EC or 625 ml of dimethoate 30EC or 100ml of imadacloprid 17.5SL in 500 liters of water per ha.

Conclusion

As we know pest attack serve as a limiting factor in the yield of any crop. Therefore, regular intervention is required to manage threshold level of pest population because the insect-pest may become prominent constraints to the okra production. To manage the above pests of okra we should use of chemical insecticides but in a judicious way. Integrated management is best for management in this high value vegetable crop.

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Inductively Coupled Plasma Mass Spectrometry (ICP MS) and its Application in Food Sector

Article ID: 31303

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Introduction

Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was commercially urbanized as a powerful technique for the assessment of isotopic and multielement analysis in food, agriculture, and other matrixes. It is accomplished by counting the number of ions at a certain mass of the element. It has been to the fore good deed with laboratories in the world as the piece of equipment of choice for performing trace metal exploration (Aceto, 2016). This analytical approach is being used to address specific issues in various areas of food and nutrition research. The ICP-MS is also used to examine the elemental evaluation in the field of food quality assurance at the analytical level, evaluation of food contact with various metal and non-metals and also for food contamination. ICP-MS also works at low-concentrations (ppb=μg/l) and ultra-low-concentrations of elements (ptt=ng/l). Plasma is used to lead the atomic elements by ionizing them and after ionization; these ions are sorted according to their mass. Automization, ionization, and removal of the solution from the sample occurs inside the plasma torch. The further penetrance of a small amount of the ions produced in the plasma occurs into the mass-spectrometric part.

Advantage and Disadvantages of ICP-MS

The advantages of the ICP-MS technique over Atomic Absorption Spectroscopy are:
1. Detection limits are extremely low.
2. A huge linear assortment.
3. Isotope composition of elements can also be detected (Jackson, et al., 2015).

The main disadvantages of the ICP-MS detection are the occurrence of spectral and non-spectral interferences and the its high expenditure.

ICP-MS Technique and its Attractiveness

Inductively Coupled Plasma Mass Spectrometry was commercially (ICP-MS) continues on the way to formulate inroads interested in laboratories to require the buck revealing limits and the supreme intensity of output. All type of ICP-MS systems is outfitted through Dynamic Reaction Cell Technology to diminish obstruction effect on illustration results. The recent data provided by the Joint ALSSA-JAIMA-Eurom II Global Laboratory Analytical Instruments, over 15% of every innovative instrument purchased for trace metal investigation are ICP-MS instruments. ICP-MS has scores of compensations above supplementary fundamental examination techniques like atomic absorption and optical emission spectrometry. Typical quadrupole mass spectrometers used in ICP-MS have resolutions between 0.7-1.0 amu. However, there are some instances where this resolution is NOT sufficient to separate overlapping molecular or isobaric interferences from the elemental isotope of interest.

The most important reasons for the developing attractiveness of ICP-MS are shows as follows:
1. Appliance illuminating restrictions are by the side of or underneath the sole piece per trillion (ppt) intensity in favour of much of the periodic table.
2. Investigative operational range is nine instructions of the enormity.
3. Productivity is unsurpassed by any other technique.
4. Isotopic analysis can be achieved readily (www.perkinelmer.com).

ICP-MS Workings

An ICP-MS combines a towering temperature ICP (Inductively Coupled Plasma) spring with a mass spectrometer. The ICP resource converts the atoms of the elements in the taster to ions. All of these elements are examined by the mass spectrometric data. Argon gas flows inside the concentric channels of the ICP torch. The RF load curl is associated in the direction of a radiofrequency (RF) originator. As power is abounding to the load coil from the originator, oscillating electric and alluring fields are established at the ending of the torch. At what time a glimmer is applied in the direction of the argon flowing in the direction of the ICP torch, electrons are exposed off of the argon atoms, forming argon ions (Lin et al., 2011). These ions aretrapped within the oscillating fields and have a collision in the company of other argon atoms, forming an argon discharge or plasma.

The nearly all-important belongings commit to memory on the subject of the argon ICP plasma is:
1. The argon discharge, with a temperature of around 6000-10000° K, is a tremendous ion source.
2. The ions produced by the ICP discharge are characteristically positive ions, $M+$ or $M+^2$, consequently, elements that have a preference to form negative ions, such as Cl, I, F, etc., are extremely thorny to conclude via ICP-MS.
3. The recognition capabilities of the technique can vary with the sample introduction technique used, as different techniques will allow differing amounts of samples to reach the ICP plasma.
4. Recognition capabilities will vary with the sample matrix, which may affect the degree of ionization that will occur in the plasma or allow the formation of species that may interfere with the analytic determination (Geophysics, 2011; Mermet, 2005; Stefansson et al., 2007).

Conclusion

ICP-MS is a analytical grade approach to determine the trace elements of interest present in the biological sample. ICP-MS provides various features including its elevated sensitivity, wide coverage for elements, ability to detect multielement, high throughput for sample range and easy sample groundwork. Due to high specificity of mass spectrometry, researchers should be aware about the prospective interfering, and other analytical factors for the accuracy of outcomes.

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Chromosome Elimination Mediated- Doubled Haploidy Breeding in Cereals: A Boon or Bane

Article ID: 31304

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Introduction

Doubled haploidy (DH) breeding is one of emerging science that plays an important role in crop improvement by developing homozygous lines instantly or by shortening the breeding cycle. Doubled haploids (DHs) are haploid plants (gametic chromosome number) that consist of double number of chromosomes through spontaneous or induced chromosome duplication. There are many methods of haploids production and at present chromosome elimination approach is widely adopted because of its advantages over other techniques.

Chromosome Elimination

Wide hybridization results in uni-parental chromosome elimination due to ploidy difference and incompatibility between their chromosomes. In the process of chromosome elimination, although initially zygotes contain one complete haploid chromosome set from each parent but in the later division cycles due to ploidy differences e.g. in case of wheat x maize cross, maize chromosomes are lost to produce haploid embryos containing only haploid complement of wheat chromosomes. This happens during the first few cell division cycles.

Reason of Chromosome Elimination

The actual reason behind uni-parental chromosome elimination is still under cover and needs a lot of research for finding the actual concept behind this. However, as per some relevant studies, petite affinity of poorly defined centromeres for spindle microtubules in zygotes, incompatibility between paternal centromere and maternal kinetochore proteins, lack of kinetochore activity and many other hypotheses have been suggested for this chromosome elimination.

Methods of Chromosome Elimination Mediated-Doubled Haploidy Breeding

1. Bulbosum Method of DH Production: Reported by Kasha and Kao, (1970). It involves cross of H. vulgare as female parent with pollen parent *Hordeum bulbosum*. During the first few cell divisions, chromosomes of *H. bulbosum* were eliminated as a result of chromosome elimination leaving behind embryos with one set of barley chromosomes. This technique is well-known as *Bulbosum* technique.

2. Wide hybridization methods: These mainly include crossing of wheat as female parent with different pollen parent in which pollen parent's chromosomes get eliminated during the first few cell divisions.

a. Wheat x *Hordeum bulbosum*: First reported by Barclay, (1975).
b. Wheat x Maize Hybridization: First reported by Laurie and Bennett, (1986).
c. Wheat x *Imperata cylindrica*: First reported by Chaudhary et. al., (2005).

Methodology of Chromosome Elimination Mediated-DH Breeding

1. Emasculation: Removal of immature anthers from hermaphrodite flower with the help of forecep.

2. Pollination: Dusting of the pollens of required genotype on the emasculated flowers.

3. Haploid seed formation: After 14-16 days of pollination, there is formation of pseudoseeds carrying haploid embryos.

4. Embryo rescue: After 14-16 days of pollination, haploid pseudoseeds are collected from pollinated spikelets and embryo rescue is done. Embryo rescue is the use of embryo culture (removal of developing young embyos from seeds and their cultivation in vitro) to recover such interspecific hybrids that would otherwise be lost due to endosperm abortion during early stages of embryo development.

5. Production of doubled haploids: Production of homozygous lines by doubling the chromosome number of haploids is an important goal of haploidy research. Doubling can be done spontaneously or through the use of chemicals such as colchicine that aff ect spindle tubule formation.

Uni-Parental Chromosome Elimination: A Boon or Bane for Plant Breeding

The uni-parental chromosome elimination benefits the breeding programmes by providing instant homozygosity within a short period of time and producing large numbers of haploid plants that are further subjected to colchicine application for DH production. So, it turns out to be a boon for crop improvement programmes.

However, it is a bane for crop improvement when we talk about transferring the desirable traits from wild species into the genetic background of cultivated species through wide hybridization. This is because, it may lead to complete elimination of chromosomes of donor wild species that will result in haploid production without trait of interest.

Varieties Released through Chromosome Elimination Mediated-DH Breeding in Cereals

Crop	Haploid production route	Varieties	Country
Wheat	Wheat x Maize hybridization	Glosa, Faur F, Liter, Miranda	Romania
	Wheat x Maize hybridization	Him Pratham (First DH wheat variety of India)	India
Barley	*Bulbosum* technique	Mingo, Gwylan	Canada

Conclusion

At present, with increasing population and food shortage, there is dire need of developing new and different varieties and for this purpose speed and efficiency are becoming increasingly important features for plant improvement. Haploid technology is a rapid system for developing homozygous lines, which are important biotechnological tools in breeding programmes, as well as in genetic and developmental studies. Although in vitro methods have been used since long time for haploid and doubled haploids production but their drawbacks put in vivo method i.e. chromosome elimination approaches on a better front.

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Biofortification in Crop Plants

Article ID: 31305

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Introduction

Biofortification is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering. Biofortification differs from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed. This is an important improvement on ordinary fortification when it comes to providing nutrients for the rural poor, who rarely have access to commercially fortified foods. As such, biofortification is seen as an upcoming strategy for dealing with deficiencies of micronutrients in low and middle-income countries. In the case of iron, WHO estimated that biofortification could help curing the 2 billion people suffering from iron deficiency-induced anemia.

Biofortification

Is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding or through genetic engineering. Increasing nutritional requirements of growing population has increased the need for biofortification.

Importance of Biofortification

1. Selective addition of nutrition: Biofortification allows selected nutrition to be added into a particular crop through either selectively breeding or altering it genetically. This reduces the need for multiple food to be consumed because most of the required nutrient are incorporated in a single crop. Ex: Golden rice was fortified with vitamin A for consumption by poor people who could not afford more nutritious food.

2. Reduces need for overspending on food: In poor countries where most of them cannot afford to spend more resources on nutritious food, biofortification comes to rescue. Since nutrition is concentrated on a single source, there is no need to spend on multiple food. The saved money can be used for educational and health needs.

3. Enhances human productivity: Lack of proper nutrients is a major concern that reduces efficiency of working humans. Provision of nutrients in an efficient manner can increase productivity drastically. Increasing productivity will contribute towards economic and social growth of population.

Objectives

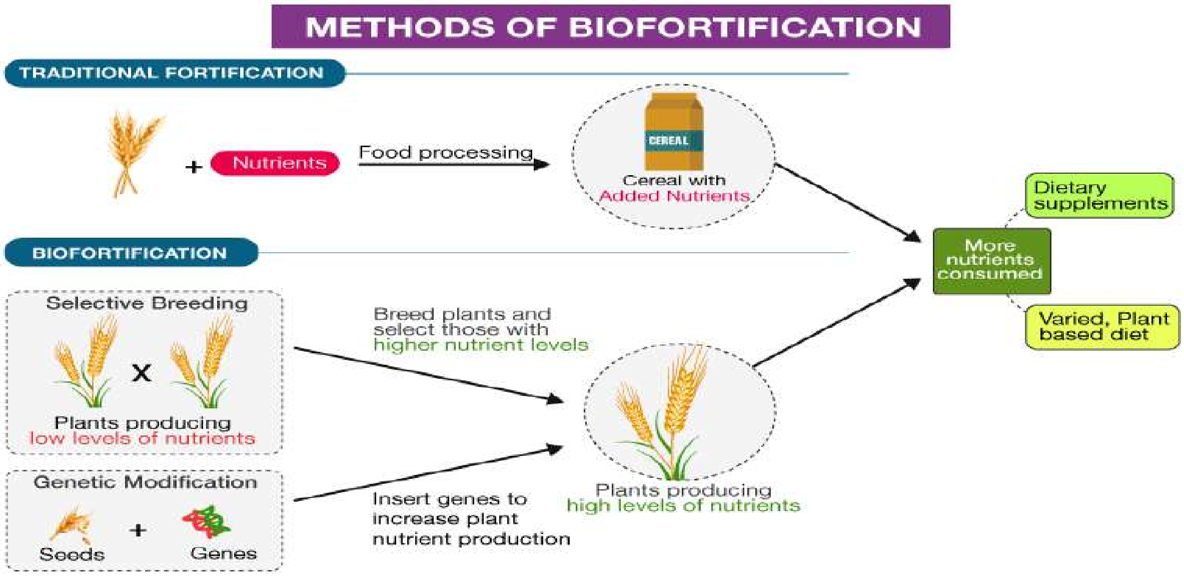
1. To improve the nutritional margin that helps the people who are suffering from malnutrition.
2. To improve the protein and mineral content in the foods.
3. Help the people who are suffering from disease like anaemia, deficiency of minerals etc.
4. It is a modern technique to produce high production of crops which will make up the demand in population.

Plants are Bred Using One of Two Main Methods

1. Selective breeding: Using this method, plant breeders search seed or germplasm banks for existing varieties of crops which are naturally high in nutrients. They then crossbreed these high-nutrient varieties with high-yielding varieties of crops, to provide a seed with high yields and increased nutritional value. Crops must be bred with sufficient amounts of nutrients to have a measurable positive impact on human health. As such, they must be developed with the involvement of nutritionists who study whether the consumers of the improved crop can absorb the extra nutrients, and the extent to which storage, processing, and cooking of the crops affect their available nutrient levels. Bread wheat with high grain iron and zinc has been developed through radiation breeding.

This method is prevalent at present, as it is less controversial than genetically engineering crops. Harvest Plus, a major NGO in the development of biofortified crops, primarily use conventional breeding techniques, and have not yet spent more than 15% of their research budget on genetically modified crops when conventional methods fail to meet nutritional requirements.

2. Genetic modification: Golden rice is an example of a GM crop developed for its nutritional value. The latest version of golden rice contains genes from a common soil bacterium Erwinia and maize, and contains increased levels of beta-carotene which can be converted by the body into vitamin A. Golden rice is being developed as a potential new way to address vitamin A deficiency.



Breeding and Release Progress

1. Maize: Provitamin A maize breeding is led by the International Maize and Wheat Improvement Center (CIMMYT) and International Institute of Tropical Agriculture (IITA) in conjunction with NARES in southern Africa. Germplasm screening discovered genetic variation for the target level (15 ppm) of provitamin A carotenoids in temperate maize, which was then bred into tropical varieties. Recent developments in marker-assisted selection technology have increased the speed and accuracy of identifying genes controlling the traits of interest in maize. Varieties that can provide 25 percent of the EAR for adult women and preschool children were released in Zambia (3 varieties) and Nigeria (2 varieties) in 2012. Varieties that can provide 50 percent of the EAR are in development.

2. Rice: In many Asian countries, rice provides up to 80 percent of the energy intake of the poor. Highzinc rice varieties for Bangladesh and India are developed by the International Rice Research Institute (IRRI) and the Bangladesh Rice Research Institute (BRRI).

The breeding target has been set at 28 ppm zinc in polished rice, an increment of 12 ppm above the baseline zinc concentration of commercially available rice. High-yielding varieties with more than 75 percent of the target are in official registration trials in Bangladesh and India; release is expected in 2013.

A high-zinc rice variety was identified in Brazil and registered for release in 2012 by Embrapa, and a high-iron rice variety was released in China in 2011; research to incorporate the high-zinc trait into this Chinese line continues.

3. Wheat: The development of high-zinc wheat for India and Pakistan is led by CIMMYT. The initial breeding target for whole wheat was set at 33 ppm zinc, an increment of 8 ppm above the baseline zinc concentration.

It is expected that adoption of high-zinc wheat will be driven by its improved agronomic properties compared to current popular varieties, and breeding has focused on both zinc content and resistance to new strains of yellow and stem rust. Multilocation trials are underway in both India and Pakistan and the first release is expected in India in 2013.

4. Pearl Millet: Pearl millet is a regionally important staple in the Indian states of Maharashtra, Rajasthan, Gujarat, and Uttar Pradesh, the target area for biofortified pearl millet. The breeding target was set at 77 ppm iron, an increment of 30 ppm above the baseline.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) carries out the pearl millet breeding research in collaboration with NARES and the private sector. The popular open pollinated variety (OPV) ICTP 8203 was improved to create the first biofortified variety, called ICTP 8203-Fe, which contains the full iron target and was officially released in 2013.

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Radio-Frequency Identification (RFID) Technology in Agriculture

Article ID: 31306

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Introduction

RFID or Radio-Frequency Identification technology uses digital data, which is encoded in RFID tags and read by a reader via radio waves. RFID is comparable to barcoding in that data from a tag is acquired by a device that stores the data in a database. RFID has the advantage over barcodes in that the RFID tag data can be read without being seen, whereas barcodes must be seen so that an optical scanner can read it. By placing RFID tags into agricultural products' packages, farmers can determine the health condition of the product, making it convenient for processing companies to concurrently add information on the tag, such as enterprise codes, the processing date, batch processing, and package weight. Radio frequency identification (RFID) transmits product information using radio waves. The agri-food industry is beginning to use this technology to enhance food quality, safety and traceability.

RFID is part of a technology that is referred to as Automatic Identification and Data Capture (AIDC). AIDC automatically identifies an object, collects data about the object, and enters that data directly into computer systems without human intervention. Basically, RFID systems consist of three parts: an RFID tag, an RFID reader, and an antenna. A RFID tag contains an integrated circuit and an antenna, which is used to transmit data to the RFID reader, which then converts the radio waves into a practical form of data. This information is transferred through a communications interface to a main computer system, where the data is stored in a database and analysed later. Items that are barcoded can easily be upgraded to a RFID system. RFID offers many improvements over the barcode. An RFID tag can hold much more data about an item than a barcode. Also, RFID tags are not susceptible to damages that often happen to barcode labels, like tearing and smudging. RFID labels are used in inventory management, asset tracking, controlling access to restricted areas, ID Badging, and supply chain management. Radio Frequency Identification (RFID) technology identifies an object by radio frequency without any contact. It has been successfully applied in many industries like supply chain management, retail management, logistics management, security supervising, traffic supervising, and more.

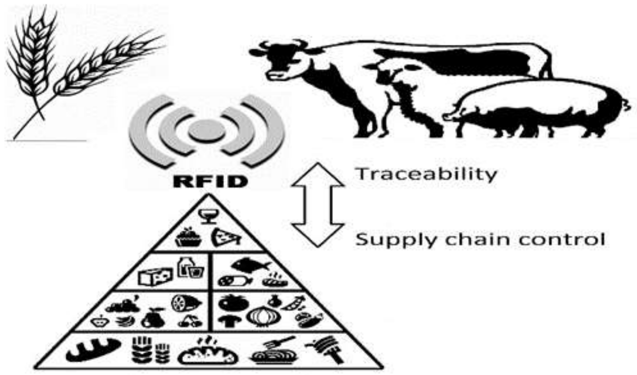
RFID in Agriculture

There are many uses for RFID technology in agriculture. Bales of hay can be tagged, capturing the date harvested, the field where it was harvested, the temperature, weight, moisture level and the nutritional information to be captured and stored. RFID has many potentials that busy farmers are seeking. RFID is non-contact. It has a high identification rate, mass memory, secure access, and can be integrated into an existing system without difficulty. Data collection in greenhouses is also doable with specialized RFID tags and readers, which are designed for warm and humid conditions.

The employment of RFID makes it possible to monitor the chain of perishable food and the expansion of new applications in fields like environmental monitoring, irrigation, specialty crops and farm machinery. RFID technology constitute a farm monitoring system whereby farmers can now protect their crops from pests. Also, livestock such as cattle can be monitored using wireless sensor networks. One common application is the scanning of codes printed on food packaging, linking the barcode to a food category or a certain batch. This method of tracing is cheap and easy to carry out. RFID is a great method for agri-food supply chain traceability. RFID solutions, including tags for agricultural can help farmers overcome the common challenges that they face every day.

Application Examples of RFID Technology

For example, Paramount Farms, the world's largest suppliers of pistachios have been relying on RFID system for some time now to automate the processing of incoming shipments of pistachios from growers. The company developed an efficient method of receiving, evaluating and paying for the nuts provided by its suppliers and this has improved the efficiency of the whole processes. Similarly, marijuana growers are using RFID tags and RFID readers to streamline plant management. A fully automated tracking system using RFID helps growers to maintain real-time tracking of the supply chain, tracking each plant all the way to point-of-sale, where taxes are calculated.

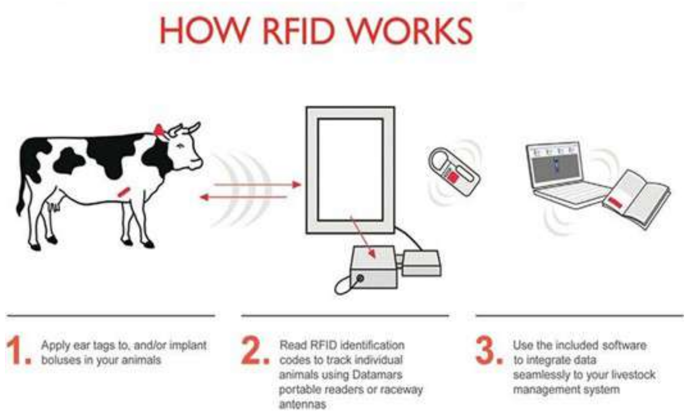


Similarly, livestock management has already made many strides by using RFID systems to help with remote monitoring of animals using dedicated hardware and software systems. The Taiwanese fruit producer Je-Nong Cooperative Farm is using a RFID solution to track the receipt and processing of its fresh fruit at its facility. By using passive ultrahigh frequency RFID tags attached to plastic crates, the company can monitor every phase that the fruit goes through, and the conditions within the coolers before the fruit is transported to stores throughout Taiwan, China, Japan and Korea.

Commenco's Smart RFID Tracking for Marijuana Growers

The farmers can track their goods via a computer network. Produce can be examined through a tag, quickly moving the inspection along. By reading the information stored on a RFID tag, a decision could be made whether a temperature shift will do harm to a fresh agricultural product or not. RFID can also be used to monitor climate conditions during transportation. RFID can be employed to detect unauthorized openings of shipments during transportation, storage, distribution and sales. Before agricultural products enter a warehouse, the data stored on the RFID tag can be transmitted to a computer. The computer will release warehousing instructions as to the suitable rack and slots. The correct inventory plan can be selected depending on the product specification and requirement. An information system will generate the picking and slotting order as soon as it receives a customer's requisition. The operator can select the right product immediately by matching the information on the RFID tag with the requisition. Additional information, such as the transportation vehicle, distribution route, and schedule, has been embedded in the RFID tag during the distribution process. The consumers can also benefit from the RFID application in sales. Consumers can gain basic information along the supply chain from the origin to the destination. RFID can help consumers to check the agriculture products' safety.

A plant's health management RFID can be used to check on a plant's health though plant health inspection and certification, as well as agrochemical management. It can also help to cut down on the proliferation of plant pathogens. RFID is been inserted in many plants for different purposes. It is used in cactus to avoid theft, in citrus trees and cypress to monitor disease, and in grapevines for traceability and cloning selection. RFID is used to evaluate the quality of apples by monitoring gases produced by apples such as ethylene. RFID tags integrated with gas sensors (O2 and CO2) is used for checking the freshness of broccoli. Semi-passive RFID is used for the calculation of the shelf life of lettuce, which is transported in refrigerated reefers, and for tracking the quality and shelf life of tomatoes.



A big-data capable IoT software platform can collect, filter, store and analyse the collected data. Growers can use state-of-the-art methods to deliver multiple crops a year by meticulously tracking growing conditions, such as light level, humidity, temperature and soil chemistry. The right IoT platform affords growers the ability to track these variables to supply real-time notification of changes and yield analytics to control and improve growing techniques. RFID has limitations, just as bar codes do. A hundred bar codes on items within a box cannot be read, but RFID tags can be read as long as the items are not in a metal box as the RF waves will bounce off the metal. RFID tags can't be always read with perfect accuracy since radio waves might be blocked or cancel each other out. Many RFID tags can be detected and read remotely and at the same time, making the adoption of the latest technology innovations being the difference between profit and loss for farmers.

Advantages of RFID in Agriculture

One of the advantages of this agricultural technology is that it can be used to tag bales of hay. These tags can store data such as the date of harvest, the field it was harvested from, the temperature, weight, moisture level and nutritional information of each bale. These specialized RFID tags and tag readers can work without any contact. They have a high recognition rate, store a bulk of data, have secured access and can be easily integrated into an existing system. Data collection in greenhouses can also be done using these specialized RFID tags and readers to measure and record growth time, moisture content, equipment management, and even personnel management.

Limitations of RFID in Agriculture

In the USA, the Food and Drug Administration in 2012, had only sanctioned the use of RFID mainly for tagging citrus fruits in an effort for paperless marking method in horticultural production. More studies are examining consumer behaviour regarding marketability and possible changes in the taste of laser-marked fruits. For food plants, the implementation of IT solutions to trace the plant-to-food chain by internal tags seems to be possible only in fruit trees due to the difficulties in labelling and tracking of herbaceous plants. RFID tags are a safe tool to identify plants and foods that are protected by rights or subjected to specific regulations for plant identification. It can be also used for studying plant pathologies such as viruses or phytoplasma monitoring. One challenge in the market is security concerns associated with RFID tags for agricultural applications. The process of encryption of data stored in RFID systems can be quite expensive. Also, the cost of RFID tags is higher when compared with other alternatives.

These are few of the disadvantages of RFID in farming but as modern farming is evolving, some of the constrains in using technology in managing farms would be dealt with. Especially in terms of cost, so as to make the food security goal achievable and sustainable, most especially in the advanced economies.

Future of RFID in Agriculture

The global RFID tags market for the agricultural sector is expected to give a CAGR of more than 11% from 2017 to 2021. Strong governmental support to farmers to adopt smart agricultural practices and technologies can help achieve that number. RFID devices can be integrated with Wi-Fi and RTLS that can assist farmers with traceability issues. At present, advanced RFID semiconductor devices are being developed for a few customers. These devices help in automating the farming process, making the farm more efficient, by managing the time, controlling access to the property, managing crop inventory, and offering better equipment maintenance. RFID cannot work alone, but needs the use of big-data capable IoT software platform to collect, filter, store and analyse the farm data. Growers are using new technology methods to deliver as many as five crops per year by tracking growing conditions such as sunlight levels, humidity, temperature, and soil chemistry. The IoT platform can provide the growers with the ability to track these variables in real-time so that they can control and improve growing techniques.

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https://www.farmpally.com/rfid-technology-in-agriculture

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E-Commerce in Agribusiness in India

Article ID: 31307

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Summary

Peoples are too busy in work; they can't manage time for shopping. E-commerce is a platform that creates an online market. Now a day's it is a growing day by day. E-commerce is facing many challenges in India. It will have many opportunities in future. It is changing the daily life. Consumer and business organization both can be benefited from e-commerce.

Introduction

The number of internet users in India is on rise. As of June 2019, 665.31 million people have subscribed to the internet in India (TRAI). People's daily life has changed radically since the advent of the internet. With the change in technology, the type of work has also changed. A big percentage of people now don't want to go to the market for shopping, they want to shop online. The demand for e-commerce is increasing in India because it allows us to shop very easily. E-commerce is a simple medium through which we can easily buy or sell goods and services. Wholesalers can sell goods directly to their buyers at low prices with the help of e-commerce and buyers are also attracted for the low price, for which the popularity of e-commerce is increasing day by day. E-commerce reduce the cost of transactions and improves transactions and help to spread their products across a wide range of people. In agriculture, e-commerce reduces the gap between farmer and buyer and giving farmer the opportunity to make more profit.

Different Types of E-Commerce

1. Business to Business (B2B): It is the business between two business organization through e-commerce. Two virtual companies can also do business among themselves, in which case the transaction is done only with the help of internet.

2. Business to Consumer (B2C): In this model, the business is done through internet between vendor and consumer like 'amazon.in'. There is no middle man between vendor and customer.

3. Consumer to Consumer (C2C): In C2C model, two end users trade among themselves with the help of internet. In this case price of product are fixed with the help of online auction through app or website and one people direct sell his product to another people (like OLX.COM).

4. Consumer to Business (C2B): In this case, a person sells something to a business organization directly at his own fixed price.

5. Business to Government (B2G): In this case, the business organization direct sells their products or services to the government by e-platform.

6. Consumer to Government (C2G): Consumer can sell directly to the governme4nt through e platform. In this case consumer can get better price for their product.

Impact of E-Commerce in Agribusiness

Ecommerce has shown a new path to agribusiness that has benefited for farmers, traders and the general public. It allows goods to be delivered directly from the producer to consumer in short time so the transaction cost of item is lower. Many people go to the market and don't understand whether the vegetable is organic or inorganic or how old the vegetable is, In the case of fish or meat, the matter is more complicated because the quality of fish can't be understood from the outside. Moreover, traders put chemicals in fish or meat which are harmful for our body. With the introduction of e-commerce system, buyers can easily know the correct information about the product or service, thus maintaining transparency in the market. Farmers will get all information about the items if they buy their required items for cultivation through online. A large number of people in India are afraid to pay online so they can buy product online and pay online or offline through e-commerce. When shopping through e-commerce, traders can easily understand which item people are looking for more and which item is in demand in the market.

E-Commerce Platforms in Agribusiness in India

The Ministry of Agriculture came up with a model law on agriculture marketing, keeping in mind the needs of traders and farmers. This law promotes the public-private partnership and also allow farmers for direct selling in market. The main purpose of this rule is to improve the agriculture market. This law also helps to maintain the quality and standard of the product and also helpful for Agri e-commerce. The APMC Act additionally presents for the formation of agricultural produce market committees (APMC) which might be answerable for the operation of the markets. Some Agri e-commerce platforms are:

1. e-National Agricultural Portal: e-NAM was founded on 14th April,2016 by honourable Prime Minister of India, Narendra Modi. With the help of e-NAM, farmers, traders and buyers can trade easily through an online portal. E-NAM allow farmers to sell their crops at better price. Farmer can sell their produce in the APMC mandi immediately and take payment online.

2. Bigbasket: Bigbasket was founded in India in 2012 by K Ganesh and Meena Ganesh. It is an online portal where peoples can purchase vegetable, fruits, milk and others grocery item. In today's busy life it is a very effective online portal which not only saves people's time but also ensure quality.

3. IFFCO BAZAR: It is an IFFCO's own e-business portal where various agriculture related item like fertilizer, pesticides etc are sold. This portal provides soil testing, plant health check-up also. Company sold 9.45 lakh MT fertilizer between 2019 and 2020. Company's turnover in 2019-20 was Rs 1222 crore.

4. Nature's Basket: It is an online portal where people can buy their daily essential like fruits, vegetable etc. It is first launched in 2005 in Mumbai. The company increasing their business every year. The organization was procured by Spencer's Retail Ltd from Godrej Group in May 2019.

5. Jiomart: Jiomart is an ideal online platform if you want to buy everything you need in daily life at home. You can buy fresh vegetable, fruit, milk and other grocery product using Jiomart. Relience Industries Ltd launched Jiomart in 2019.

6. AgriBegri: It is an e-commerce platform where farmers can buy Agri-input required for cultivation. Farmers can buy fertilizer, pesticide, herbicide, farming tool etc. AgriBegri was launched in 2016.

7. Amazon: Amazon is a popular e-commerce platform where peoples can also buy agricultural related product. It is founded in 1994 by Jeff Bezos.

8. Grofers: It is an online supermarket where peoples can buy grocery item. It is launched by Saurabh Kumar and Albinder Dhindas in 2013. Grofers currently served in 29 cities like Delhi, Mumbai Bangalore, Kolkata.

9. Bighaat: It is an online platform where people can buy Agri-input product like seed, fertilizer etc and pay online.

There are also many other e-commerce platforms that have made agribusiness.

Challenges of E-Commerce in India

The main challenges of e-commerce in India are:
1. Infrastructure is a major challenge for e-commerce. Maximum Indian road's condition is very poor.
2. Internet speed is not same all over India. Internet do not work in some places of. India. So, it is a challenge for e-commerce.
3. All people of India don't know the English or Hindi language; many languages are seen in India. So, provide e-commerce with local language is a challenge.
4. Most of the people of India afraid to do online transaction or online shopping.
5. Farmers afraid to use modern technology. Most of the farmers are uneducated in India.

Opportunity of E-Commerce in India

e-commerce is a growing sector in India. Popularity of e-commerce are increasing dayby day:
1. E-commerce can solve the farmers income problem by increasing farmers income and elimination intermediate.

2. E-commerce can help rural small enterprise to develop their business.
3. E-commerce can encourage people to use of modern technology.
4. E-commerce help to increase employment in the country.

Conclusion

E-commerce Is a growing sector in India. In present time it has great opportunity to reach out to everyone. It is benefited for farmers, traders and also for a buyer. It can make our daily life easy and save our valuable time. E-commerce become an important part in our daily life.

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Rooftop Farming is it Safe?

Article ID: 31308

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"The beautiful tomato harvest, the blooming flowers
Oh, my garden I feel relaxed and in mood of blooming like you"

The word rooftop farming creates happiness when you see it or practically apply it. In the era of urbanization, the rooftop farming fills the gap of hobbies for the peoples who loves gardening. It is one of the emerging boons for the urban civilization weather it is crop or flowers. Roof gardening carried out via aero-bridges, containers gardens of plastic clay or cement and mainly mentioned as addition al platform of gardening. These are categorized as Extensive roof gardens, semi-intensive roof gardens, intensive roof gardens. The better drainage system and recycling water use make roof gardening concept much useful (Cartera and Keeler 2008).

Early spring is the major allergy season some worst tree allergens are Juniper, Cedar, Cyprus, Birch Alder, Oaks, Hydrangia, Ferns, Caroline Jasmines, Cripple and Dogwood. The members of asteraceae, rannunculaceae, genetaliaceae and certain lilies cause allergies. The immune systems of millions of peoples incidentally come in contact of antihistamines shows responses. Moreover, the problem is selection of plants. Some bulbs and modified shoot vegetable are not harmful like discord, colocasia, raddish, carrot and many more. The pollution is one of the common threats that scare mankind in recent years so the salvage the population of 21st century open the gates for plants that's purifies air or known as indoor air purifiers.

However, non-showy flowers aren't attractive to bee pollinators, they've evolved to the barbed form in order to be wind pollinated and carried off into the air. Bulbs also bloom at a time when there's not a lot of background pollen in the air so your exposure level is a lot lower. Look for Daffodils, Tulips, Snowdrops, Calla Lilies, Dahlias, Tuberous Begonias, Asiatic Lilies, Hyacinths, And Crocuses, among others." As a general rule, the bigger the bulb, the bigger the flower. Getting kids with allergies involved in choosing and planting bulbs is a great way for them to learn about fall gardening without triggering uncomfortable reactions in the spring. The movement of Urban agriculture in recent years, fulfil the diverse goals of food equality, storm water and management, waste management, sustainable biodiversity conservation, food supply chains and ultimately food security. This decreases intense pressure of long-distance transports, crop diversification, cultivation of flower, crops and exotic varieties. The hidden irritant which create the chances of illness are mainly allergens such as pollen, moulds, stinging hairs or certain compound that cause illness and serious respiratory diseases. It is better to patch flowers in crops, create chance of high yield in crop and also creating maximum chances and frequency to visit by the pollinators. (Dariusz and Alicja 2019).

Heat island effect- when urban cities absorb molecules emission and release radiant heat energy creates a region intense heating known as heat island effect (Jaal et. al.,2012). Roof top farming lower down this heat, carbon emission and fulfill alternative need/approach of food and aesthetic needs - Make concrete jungle eco-friendlier (Harada and Whitlow,2020). It's a two edges solution of the farmers and consumers. Extensive use of herbicide, fertilizers and pesticides in rural lands provides alternative corridor for cities with organic products, purifying environment, habitat for declining plants insect and birds. The shrub, herbs and ornamental grasses by supplementing artificial substrate with designed approached of cultivation. The "climate mobilization act," or ecofriendly building policy implements in 2024, till now scientific community may enhance their data on understanding of nutrient budgets, ad economic rooftop performance and their improvement strategies. The rainwater harvesting and their utilization for crop plants reduce the risk management for sewage and reduce workload on municipal sewage system. Plant indirectly reduce the risk of soil-water pollution.

It covers more oxygen, reduce ambient temperature, reduce CO_2 emissions, harvest rain water, air quality improvement, sound insulation, rain water retention, Structural limitation is the major drawback of rooftop farming. The continuous and excessive load bearing on particular location for a long period create the risk of disaster (Li and Babcock 2014). However, aesthetically pleasing architecture and green attract attentions Green top Reduce the consumption of coolant and other application that help in insulation of rooms. Beside this, encourage bee keeping provide dual role of pollination and income on roof top areas. Green top requires addition waterproofing methods, although once it got damage, it's hard to locate the problem and to fix it under green top locations. Moreover, increase weight load threated community and invites the structural disaster so, require maintenance at regular interval. The awareness in one of the major drawbacks which may hits our passion by creating an outbreak if necessary, steps not taken before it become pandemic in some era.

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Thermogenesis: The Phenomena of Survival

Article ID: 31309

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"We strand, we survive in cross puzzle temperature
mystery have significant role, let's find the way to save us"

Chance! The foundation stone of life, continuously going to happened from the innumerable time of past sophisticates the day to day event in the life processes. It leads to array of phenomena and also their complication.

The natural fit for plant survival appears in the form of diverse beautiful phenomena. The plants can complete their both vegetative and reproductive phase in extremely chilling condition, where survival is primary challenge.

The plant generates sufficient amount of energy to fulfil the basic requirement by a process known as Thermogenesis (Umekawa et. al., 2016). Thermogenesis is one of rare phenomena where it elevates the temperature more than air, here we discuss it on the activity of alternate oxidase enzyme found in the plants. The thermogenesis promotes survival value in temperate and alpine plants of different families such as Araceae, Cycadaceae, Nelumbonaceae and Nymphaeaceae reported so far (Anneke et. al., 2008).

The thermogenesis helps to maintain inflorescence and release the volatilizing scents, pollen germination and pollen tube growth under extreme environmental condition. The event of thermogenesis is initiated by the plant growth hormone, Salicylic acid.

Sauromatum guttatum have appendix (club-like) inflorescence having both male and female flower and just prior to pollination, the rate of respiration via alternative oxidase is going to be increased.

Another interesting plant, Titan Arum blooming once in 8-10 years having warm inflorescence and horrible scent smell attract more and more insects. So that, the temperature has been raised to be 25˚C for 7 hours. The exaggerated heat production also signals to volatilized the terpenes, indole and amines to attract the pollinator for its task. The substrate degradation for the energy production follows the final step of electron transport chain.

It involves the complex I, III and IV and finally terminated by Complex V with the generation ATPs. In thermogenesis the electron transport route is shifted toward alternative oxidase where it is unable to create the proton gradient and the energy is lost in the form of heat (Zhu et. al., 2011). In this mechanism, the usual path of electron transport diverted toward the alternate oxidase to release the energy in the form of heat.

This single step proves magnificently beneficial for plant in the chilling condition. The synchrony between the life cycle of pollinator and the action of alternate oxidase is highly coordinated. Thus, one more rope of evolution tied up in the complexity of biological world. Earlier it was considered that alternative oxidase pathway come to action after the saturation of cytochrome oxidase (enzyme involved in electron transport chain pathways).

But now it is cleared that alternative oxidase is still in working prior the saturation of cytochrome oxidase. Hence alternative oxidase is the cursor of mitochondria to adjust the ATP production and the also the biosynthesis of carbon skeleton. Thermogenesis also help to maintain pollination efficiency, via production of pleasant compounds, in tropical and temperate prevent them from winter frost (Zachary et. al., 2016).

In water lily it creates structural changes and open their petal for short interval during night, whereas increase 10˚C heat attract insect. However, in same time petal close in prisoned form for short interval. The insect never visits the same plants; but indirectly it helps in cross pollination. In eastern skunk cabbage, melting of overlying snow occurs due to thermogenesis in early spring (Marinho et. al., 2013).

The huge demand of energy for thermogenesis still make plant different from other but maintain temperature similar to humming bird or a rodent is unclear. The major reason for not continuously maintain this heat is yet not defined, but no one knows what these plants can do with this energy in future.

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Integrated Nutrient Management (INM)

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Introduction

For crop growth, development and to obtain high yield with good quality providing proper amount of nutrient is very much important. Nutrients are supplied through both organic & inorganically. Inorganic supply of nutrients i.e. use of chemical fertilizers increases the crop production but declines the soil fertility and productivity. Physical, chemical and biological properties of soil are declining due to long term use of chemical fertilizers. So, this problem can be overcome by following integrated nutrient management which plays a vital role in supply of nutrients to the plants for their better growth and development. In medicinal plants INM is important as they are used directly or indirectly to treat many health issues.

Components of INM - Organic Manures

Organic manures are capable of supplying plant nutrients and improving the soil physical and microbial environment with no definite chemical composition and low analytical value. Organic manures are broadly classified into bulky organic manure and concentrated organic manures based on their nature and amount of nutrients present in it.

Bulky Organic Manures

Bulky organic manures generally contain fewer amounts of plant nutrients as compared to concentrated organic manures. The concentrated organic manures are mainly derived from raw materials of animal or plant origin.

1. Farm Yard Manure (FYM): The term farm yard manure refers to the well-decomposed mixture of dung, urine, farm litter (bedding material) and left over or used up materials from roughages or fodder fed to the cattle. The FYM collected daily from the cattle shed consisting of raw dung and part of the urine absorbed in the refuse.

2. Green Manuring: Green manuring can be defined as a practice of ploughing or turning into the soil un-decomposed green plant tissues for the purpose of improving soil physical chemical and biological environments.

> **Kinds of Green Manuring:** The practice of green manuring is performed in different ways according to suitable soil and climatic conditions of particular area. Broadly the practice of green manuring in India can be divided into two types. Green manuring in situ and Green leaf manuring by collecting green leaves and tender twigs from some other places.
>
> **i. Green manuring in Situ (green manuring):** It can be defined as a system by which green manure crops are grown and incorporated into the soil of the same field, either as a pure crop or an intercrop with the main crop. Common green manure crops in this system sun hemp *(Crotolaria juncea)*, dhaincha (*Sesbania aculeata* and *Sesbania rostrata*) etc.
>
> **ii. Green leaf manuring:** It refers to turning into the soil green leaves and tender green twigs collected from outside the field. The common green manure crops are Glyricidia (*Glyricidia maculata*), Karanja (*Pongamia pinnata*) etc.

3. Compost: Well-rotted plant and animal residue is called compost. Composting means rotting of plant and animal remains before applying infields. The essential requirements of composting are air, moisture, optimum temperature and a small quantity of nitrogen. It is an activity of micro-organisms and same people recommend addition of suitably prepared inoculums to introduce micro-organisms for decomposing the material.

Concentrated Organic Manures

Concentrated organic manure may be defined as a material of organic origin derived from raw materials of animal or plant, without bulky in nature and contain higher amounts of plant nutrients. Some of the organic manures are oil cakes edible to cattle (e.g. mustard oil cake, groundnut oil cake, till oil cake etc.) and non-edible to cattle (e.g. neem oil cake, mahua oil cakes etc.), blood-meal, fish manure, bone meal etc.

Different Sources of Organic Manures

1. Cattle shed wastes - Dung, urine and slurry from biogas plants.
2. Poultry jitter and goat dropping.
3. Slaughterhouse wastes - Bone meal, meat meal, blood meal, horn and hoof meal, fish wastes.
4. Bi-products of agro industries- Oil cakes, bagasse, press mud, fruit and vegetable processing waste etc.
5. Crop wastes- Sugarcane trash, stubbles and other related material.
6. Water hyacinth, weeds and tank silt.
7. Green manure crops and green leaf manuring material.

Advantages of Organic Manure Application

1. Organic manure provides all the nutrients that are required by plants.
2. It helps in maintaining C:N ratio in the soil and also increases the fertility and productivity of the soil.
3. It improves the physical, chemical and biological properties of the soil.
4. It improves both the structure and texture of the soils.
5. Due to increase in the biological activity, the nutrients that are in the lower depths are made available to the plants.
6. It increases the quality of produce.

Crop Residues

There are two types of agricultural crop residues. Field residues are materials left in an agricultural field or orchard after the crop has been harvested. These residues include stalks and stubble (stems), leaves, and seed pods. The residue can be ploughed directly into the ground, or burned first. Good management of field residues can increase efficiency of irrigation and control of erosion. Simple line transect measurements can be used to estimate residue coverage. Process residues are materials left after the crop is processed into a usable resource. These residues include husks, seeds, bagasse, molasses and roots. They can be used as animal fodder and soil amendment, fertilizers and in manufacturing.

Bio Fertilizers

Bio fertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. Use of bio fertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of bio fertilizers. They can be grouped in different ways based on their nature and function.

1. N2 fixers:

- **a. Free living:**
    - i. Aerobic – *Azotobacter, Beijerinckia*, Anabaena.
    - ii. Anaerobic – Clostridium, *Faultative anaerobic* – Klebsiella.
- **b. Symbiotic:** Rhizobium, *Frankia, Anabaena*, azolla
- **c. Associative symbiotic:** *Azospirillum*

2. Phosphorus solubilizers:

- **a. Bacteria:** Bacillus subtilis, Pseudomonas striata, Pseudomonas flouresense
- **b. Fungi:** Penicillium sp. Aspergillus awamori

3. Phosphorus mobilizers:

- a. AM fungi
- b. Ectomycorrhizal fungi
- c. Ericoid Mycorrhiza
- d. Orchid mycorrhiza

4. Silicate and Zinc solubilizers: *Bacillus* sp.

5. Plant growth promoting Rhizobacteria: *Pseudomonas* spp. and many more.

Conclusion

Now a day, reducing soil fertility, soil structure degradation, vulnerating beneficial microbes and insects, ground water pollution, soil erosion, atmospheric pollution and agriculture produce having chemical residues, supply of poor-quality produce all pose a greater challenge. Hence, we can overcome these problems by using Integrated Nutrient Management

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Fruit Ripening and its Chemical Regulation

Article ID: 31311

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Introduction

Ripening is the process by which fruits attain their desirable flavour, quality, colour, palatable nature and other textural properties. From a scientific point of view, fruit ripening is seen as a process in which the biochemistry and physiology of the organ are developmentally altered to influence appearance, texture, flavour, and aroma. Ripening is a term applied to fruit that describes the transition from physiological maturity to senescence. Ripening is associated with change in skin colour, internal flesh softening, aroma development, changes in composition i.e. conversion of starch to sugar, etc. It begins after fruit has reached maximum size and is physiologically mature.

Physiological and Biochemical Changes Associated with Ripening

1. Physical changes:

a. Increase in fruit size, weight and volume.
b. Increase in moisture content.
c. Change in fruit shape, skin and flesh colour.
d. Change in seed size and colour.
e. Softening of the fruit.

2. Biochemical changes:

a. Cell wall changes: Pectic polysaccharides present in the middle lamella of cell wall gets degraded, solubilised and softened during ripening. The major enzymes involved during the softening of fruits are pectinesterase, polygalacturonase, cellulase and β-galactosidase (e.g., Polygalacturonase and cellulase activity increases gradually during ripening in mango, guava, date and strawberry fruits).

b. Conversion of starch to sugar: Some green mature fruits like banana, apple and mango contain significant amount of starch which gets converted into sugar as the fruit ripens. While fruits like pineapple and grape contain very low or no starch and accumulate all sugars in the form of sucrose, glucose and fructose. During early stage of ripening process, sucrose is the predominant sugar whereas fructose and glucose predominate during later stages.

c. Organic acids: In most of the fruits, the levels of organic acids decrease with the ripening due to utilization of organic acids during respiration or their conversion to sugars except in banana, where malic acid gets increased by 1-5 %.

d. Pigments or colour compounds: The development of different colours during ripening is due to the conversion of chloroplast into chromoplast which contain various carotenoid pigments.

Mechanism of Fruit Ripening

The fruit ripening process has been viewed over the last decades under physiological, biochemical, and molecular nature. Fruit ripening is followed by a number of biochemical events, including changes in colour, sugar, acidity, texture, and aroma volatiles that are crucial for the sensory quality. At the late stages of ripening, some senescence-related physiological changes occur that lead to membrane deterioration and cell death. In that case, fruit ripening can thus be regarded as the first step of a programmed cell death process. All biochemical and physiological changes that happen during fruit ripening are driven by the coordinated expression of fruit ripening-related genes. These genes encode various enzymes that participate directly in biochemical and physiological changes (e.g., softening, colour development). They also encode regulatory proteins that involve in the signalling pathways, and in the transcriptional machinery that regulate gene expression and set in motion the ripening developmental program. The whole process is under the control of hormonal and environmental signals, amongst which ethylene plays a major role. Schematic representation below depicts the molecular mechanisms controlling the ripening of climacteric fruit.

Chemical Regulation of Ripening

1. Chemicals that Hasten Ripening (Accelerate Ripening):

a. Ethylene and Ethylene Releasing Compounds: A more important breakthrough in ethylene effects and physiology is the chemical synthesis of ethephon because ethylene is released from this compound. 2, 4-Chlorophenylthio-triethyl amine hydrochloride (CEPTA) is also an ethylene releasing chemical which is used early in the season to fetch early premium price. In mangoes where in anthracnose is a problem; ethephon treatment reduces the ripening period, giving no time for the development of Anthracnose, and in some citrus hastened chlorophyll degradation.

b. Abscisin: Application of Abscisin promotes faster senescence in detached fruits and leaves. Treating orange fruits with ABA resultes in increased synthesis of carotenoids and accelerated breakdown of chlorophyll.

c. Ascorbic Acid and Hydroxyethyl Hydrozine (BOH): Ascorbic acid, Cu-EDTA (Cupric ethylene diamine tetracetate) and BOH have shown properties to cause ethylene formation, when sprayed before harvest.

d. Acetylene and Calcium Carbide: In some areas, treatment with Calcium carbide (CaC2) to generate acetylene is also implied to hasten fruit ripening in banana and citrus.

e. Alcohol: It is reported that among the several alcohols, such as Ethanol, Hexanol, Octanol, Heptanol etc, used in dip treatment of green tomatoes prior to ripening.

f. Fatty Acids: Olerification has been known as a practise to hasten fig fruit maturation. Eye of fig fruits treated with several vegetable oil began to increase in size reaching full colour and maturity within few days. Through fatty acid oxidation in the cells of fruits, acetaldehyde or C2H4 are derived which are known as volatile substance that induces enzymatic activities for early ripening.

2. Chemicals that Delay in Ripening:

a. Kinetins: Delay chlorophyll degradation of leafy vegetables, spinach peppers, beans, cucumber and others. The growth effect of Kinetin is a retardation of yellowing through maintaining high protein level on the applied tissue.

b. Gibberellins: Post harvest treatment of gibberellin markedly decreases ripening of tomatoes, guava and banana by lowering their respiratory rate. Pre-harvest sprays of GA has shown to have a striking effect in decreasing the rate of development, maturation ripening of lemons and navel oranges. GA probably increase peroxidise and catalase activities.

c. Some Auxins (CIPA and NOA): Pre-harvest foliar application of CIPA at 25 ppm and NOA at 25 ppm extends the physio-chemical deterioration of 'Coorg' mandarins during storage condition. The improved marketable condition of treated fruits after storage is due to reduced weights loss and retention of Vitamin-C.

d. Metabolic Inhibitors (Cycloheximide and Actimomycin–D): Flesh softening, chlorophyll degradation and ethylene synthesis is severely inhibited by cylocheximides and pre-climacteric fruit treated with Actinomycin-D.

e. Ethylene Absorbents: Waxing, low O2, high CO2, and ripening inhibitors are sometimes combined to extend the storage life of fruits. A commercial preparation of absorbent is known as "Purafil". Alkaline KMnO4 on a silicate barrier has proved effective in the complete absorption of C2H4 from bananas held in sealed polythene bags.

Conclusion

Fruit ripening is an important phenomenon in the life cycle of the fruit. After the maturity stage, fruit transits towards the ripening phase followed by senescence. There are several factors which are responsible for the deterioration of the fruits after harvesting, Through the chemical regulation of fruit ripening or by adopting novel technologies, one can prolong the shelf life of fruits with maintained quality which can fetch premium price in off season.

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Bio-fortification: Probe to Hidden hunger

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Burgeoning population with a blend of varied socioeconomic cult has always focused on diet to combat their energy demand. Feeding the mushrooming people has been priority of every farmer. Dug their life like soil and nourished the crops with toil. Grinding a way into and out of every catastrophe which could have cease the food to reach the stomach, our scientists and farmers have put an equal and combined effort dispensing all golden solutions.

Green revolution during 1960s feeding the mankind had entirely converted the scenario of food demand and supply. Needless to say, hungry population is now fed sufficiently but the hidden hunger is still unmarked. Hidden hunger is a situation when food eaten by people are severely lacking vitamins and minerals and inefficient to meet the nutritional requirement. Essential nutrients are nutrients which are not synthesized by human body but play a vital role for growth and development and are briefly composed of vitamins and minerals. Deficiency of various essential nutrients like vit A, zinc and iron are common. This leads to weaker immune system, impaired eye sight, stunted growth etc. The golden solution to beat hidden hunger rendered by scientist from lab to land is biofortification.

Biofortification or biologically fortification is defined as the process by which the nutritional quality of food crops i.e. vitamins and minerals is improved through agronomic practices, conventional plant breeding or modern biotechnology. On contrary to ordinary fortification, biofortification aims at improving micronutrients and other essential minerals in plant produce. Thus, this idea of breeding crops enriches the nutritional value of crops. The plants bred for biofortification follows two main methods.

Selective Breeding

Selective breeding involves selecting a plant identified with good genes combining for desired trait and the plant is then grown where self-fertilization or cross fertilization is carried out with other plants of similar phenotype of interest. The plants expressing the phenotype of interest in the F1 generation is chosen to be parents for the following generation. In this way biofortified seed are collected for large scale production.

This method is mostly accepted at present defeating all controversies regarding genetically engineered crops. Plant breeders and agricultural scientist toil hard to search seed or germ-plasm banks for persisting crop varieties to breed them with crops naturally high in nutrients. The crossbreeding is done between high-nutritional varieties with high yielding ones, to produce a seed with high yielding and enriched nutritional value.

A concern from nutritionist is important to come out with beneficial produce. The nutritionist corroborates the efficiency of produce in being absorbed by the consumers, the extent of availability of nutrients affected by storage, processing and cooking.

Examples:
1. Pro-vitamin-A biofortified- sweet potato(orange sweet potato).
2. Zinc- biofortified – rice (zinc rice).
3. Iron – biofortified – beans.
4. Iron, beta-carotene biofortified- carrot (madhuvan gajar).

Genetic Modification

This technology involves inserting the desirable gene into the genome of an organism. GM plant is produced when new DNA is inculcated into plant cell to get a desirable trait. GM could involve change in growth and development of plant, making it disease resistance, changing its traits, making it adoptive to abiotic stress etc. The new genotype developed through GM restores the desired quality through seeds to be used at farmer’s field.

Examples – Golden rice (vit A), GM lettuce, sorghum beans etc.

Advantages of Biofortification

1. Biofortification crops are rich in essential nutrients, vitamins and minerals to enhance the overall health of people.
2. These crops are generally high yielding and resilient to pests, diseases and other abiotic stresses.
3. This method of breeding crop can bridge up between food-based, sustainable and low-dose alternative to nutritional supplementation.
4. The biofortified crops can reach out to poorest of society and local farmers.
5. Nutritional quality doesn't deteriorate rather restores them throughout making it cost- effective and sustainable.
6. This can be easily carried out through non-genetically modified method.
7. Bio-Fortified crops can always be accepted as it doesn't go unethical.
8. Not only for human food but are also highly practiced for fodder crops to nourish animals under animal husbandry.

Constrains for Biofoertification

1. Sometimes biofortification through selective breeding is a long process extending up-to 20-30 years depending on crops, its growing season and traits.
2. It may be denied by consumers due to certain changes. Example – color change (Golden rice)
3. Even though affordable, but reaching to consumer is a big challenge.
4. Adaptation by farmers with bit changed cultural practices of biofortified crops and its initial cost involved are also a great question summoned.
5. Genetically modified crops are sometimes not accepted on basis human ethics.
6. The extension system to rural areas for expansion of idea and dissemination of method is a dare in itself.

Future Perspectives

1. Owing to diversity in food practices and geographical conditions, the prevalence of biofortification needs to have higher adaptation and consumption rate.
2. Biologically fortified crops need to justify nutritional content of staple crops.
3. Several ways adopted for delivery of biofortified crops must be in easy reach of local farmer for early adaptation.
4. It has to be more cost effective, playing a pivotal role to offer an alternative to supplementation and commercial fortification.
5. Government schemes focusing on eradication of malnutrition should be attached and acknowledged by scientists and bureaucrats to bring up biofortification as alternative solution.
6. The government and private organization should be duly funded and encouraged to carry out the very breeding methods for scaling up food fortification.
7. Initiatives by individuals and local farmers to be reached out.
8. Biofortification can become a partial solution in efforts to reduce poverty, food insecurity, disease etc.

World Health Organisation (WHO) has issued statistics where near about 2 billion of people worldwide are suffering owing to malnutrition. Deficiency even after providing with enough food is not only altering the economy but also affecting the national strength in round. The stink less and rampant adversity behind curtain i.e. "Hidden hunger" has spread its root deep beneath. To rinse out such problems, a partial but an effective technique widely accepted is biologically fortifying the agricultural produce or staple crops. Mankind urging the link for better feed has always been at their doorstep. And to surprise this breeding technique i.e. biofortification is a joint effort of both scientists at lab and farmers in field.

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Different Physiological Mechanisms of Plant to Mitigate Salinity Stress

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Soil salinity is one of the most brutal environmental stresses that hamper growth, yield and productivity of crops in many areas of the world. Worldwide, more than 20% of total cultivated and 33% of irrigated agricultural lands are afflicted by high salinity stress and the amount is increasing day by day and increasing @ of 10% annually (Shrivastava and Kumar 2015). Some recent estimates were proved that the more than 50% of total arable land would be salinized at year 2050 (Jamil et. al., 2011). In India, soil salinity stress for agriculture crops also a major abiotic stress in different states of country. Gujarat, Uttar Pradesh, Maharashtra, West Bengal and Rajasthan Madhya Pradesh states are most affected to salinity stress problem due to highest areas of under saline and sodic soils in the country.

Introduction

Salt stress is the accumulation of excessive salt contents in the soil which eventually results in the inhibition of crop growth and leads to crop death.

Salinity

Salinity is caused due to high accumulation of calcium, Magnesium as well as sodium and then anions such as SO_4^{-2}, NO_3^-, CO_3^{-2} and HCO_3^-, Cl^- etc. The process of increasing the salt content in soil is known as salinization.

Why Area is Increase Under Salinity Stress?

In India, salinity issues are increase rapidly due to poor quality of irrigation water and high concentration of salts present in irrigation water, low precipitation rate, high surface evaporation rate, weathering of native rocks, and poor agronomic practices.

How Salinity Stress Effect on Plant Growth?

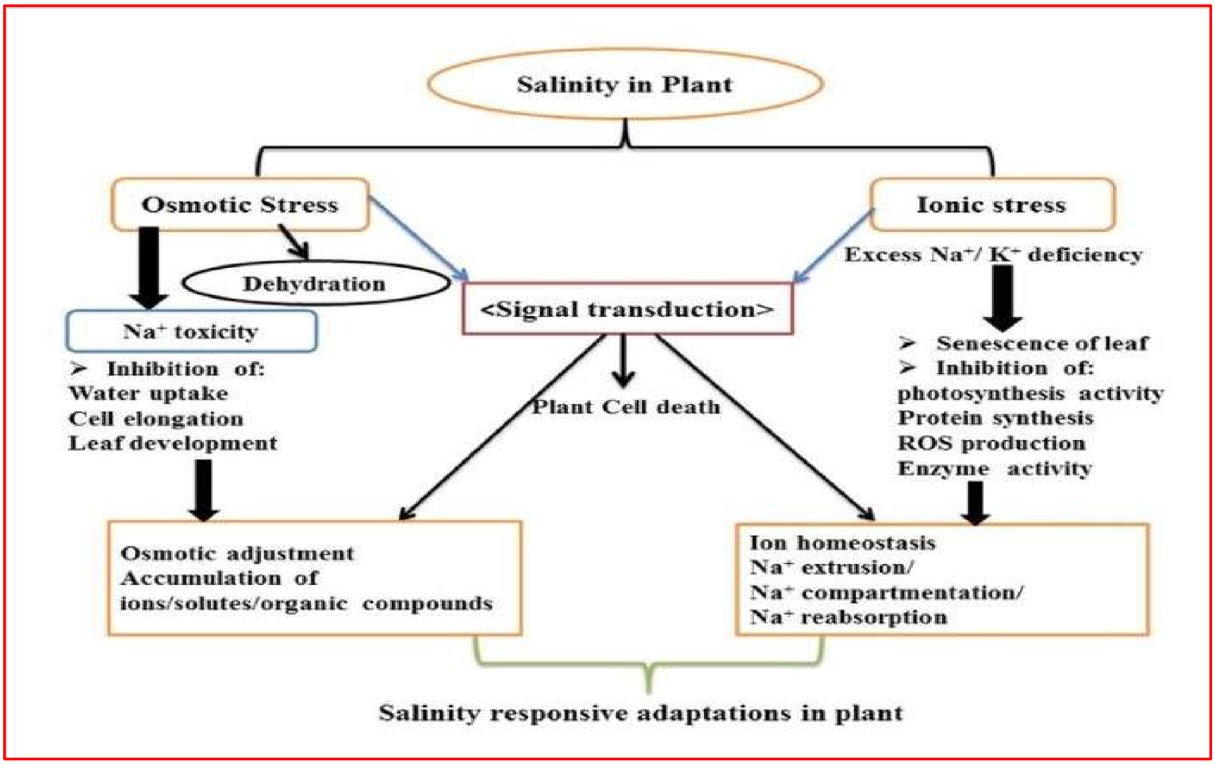

Figure 1. Effect of salinity and salinity response adaptions of plant.

When plant growing in saline soils and salt stress is affecting the growth of plant in three different ways:
1. Osmotic stress: when a high concentration of salts presents in the soil solution, which makes it harder for roots to extract water, resulted the inhibition of water uptake and water transport with in plants. It may call physiological drought to plant. Osmotic stress reduces cell expansion in root tips and shoot tips it was decrease the plant growth and development.

2. Ionic stress: when a high concentration of salts (Na^+, K^+, Cl^-) absorb by the plant which results in a high concentration of salts in plant caused ion imbalance with in the plant and causes ion toxicity, disturbance of K^+ acquisition, disruption of cell metabolic functions, reduce photosynthetic rate, protein synthesis, plant growth hormone imbalance and enzyme activity within plant.

3. Oxidative stress: Due to increase osmotic and ionic stress was reduces the rate of photosynthesis and increase the rate of generation of reactive oxygen species (ROS) like oxygen radical (O_2^-), superoxide (OH^-), and H_2O_2 it caused imbalance of free radicals and antioxidants in the plant body and finally caused programmed cell death.

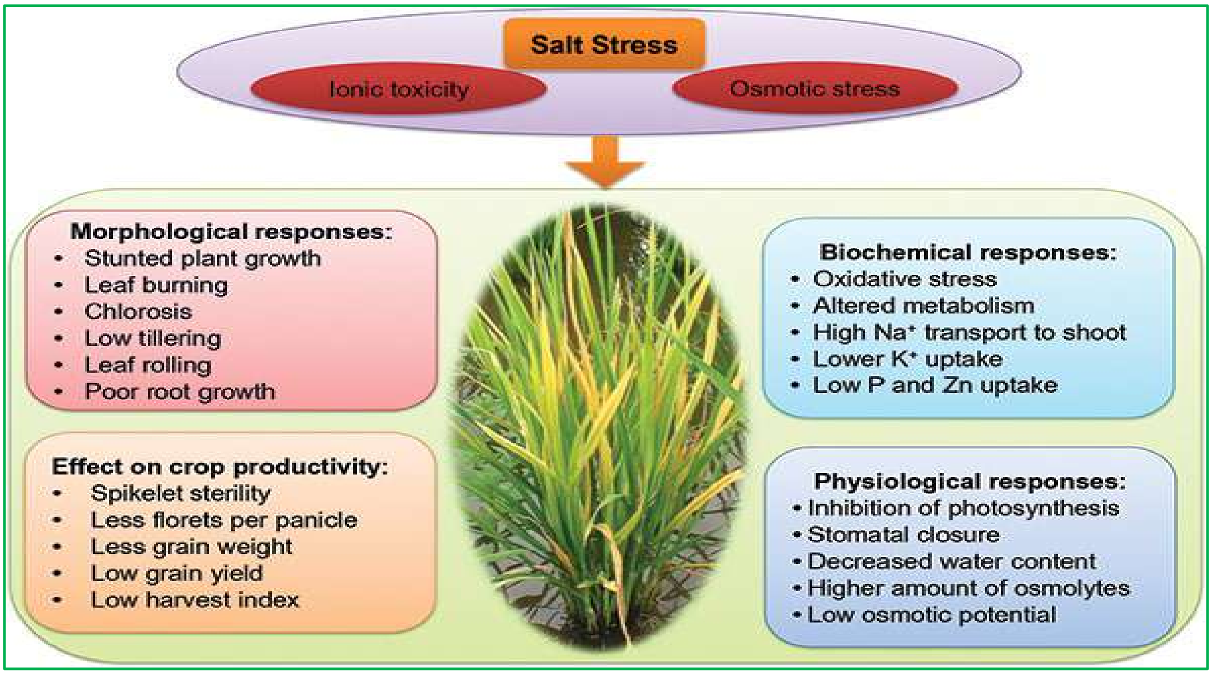

Figure 2. Effect of salinity on plant morphology, crop productivity, biochemical and physiological basis

Plant Physiological Mechanisms to Mitigate Salt Stress

In different plants some natural physiological mechanisms are present that helps of plant to survive in salinity stress condition such as:
1. Osmotic adjustment: Osmotic adjustment is most important physiological mechanism of plant to endure concentration of different toxic ion (Na+ and Cl−) in cytoplasm and compartmentalization in vacuoles in plant. In osmotic adjustment plant activate different enzymes and synthesize different osmolytes. Glycine betaine, proline, glycerol, sugars and inorganic ions are main osmolytes that synthesize in plant to alleviate the effect of different environmental stress.

2. Ion homeostasis and compartmentalization: Maintaining ion homeostasis by ion uptake and compartmentalization an essential physiological process for growth of plant during salt stress.

3. Na+/K+ discrimination: Selection of ions by plants is a clear way to increase tolerance under salt conditions. For example, the Na+/K+ discrimination concept, Na+ uptake can be substituted by K+ to allow the plant to tolerate salt conditions.

4. Activation and Synthesis of antioxidant compounds: Antioxidant enzymes and nonenzymatic compounds play a critical role in detoxifying ROS induced by salinity stress. Salinity tolerance of plant is increase due to increase the activity of antioxidant enzymes, such as superoxide dismutase (SOD), glutathione peroxidase (GPX), catalase (CAT). ascorbate per-oxidase (APX), and glutathione reductase (GR) and with the accumulation of nonenzymatic antioxidant compounds.

5. Synthesis of stress hormone regulation: During salt stress plants synthesize different stress hormone such as ABA, salicylic acid (SA) and brassinosteroids (BR) that mitigate the harmful effects of salt stress in plants.

Different Approaches to Reduces the Salinity Stress of Plant

1. Field filled by water to drain or leeched down the soluble salts from the root zone.
2. Use of gypsum ($CaSO4 \cdot 2H2O$) in salt affected field
3. Use of organic manure because humic acid improves nutrients availability and enhanced soil microbial, enzymatic and physiological activities.
4. Use of plant growth promoting bacteria to mitigation of salinity stress.
5. Use of plant growth hormone to increase salt tolerance in plants.
6. Stress resistance breeding.

Conclusion

In India agriculture, salinity stress for agriculture crops also a major abiotic stress in different states of country. Salinity stress is big problem in India due to high concentration of salts present in irrigation water, poor agronomic practices and uncertainty of Indian monsoon. Use physiological mechanisms that helps of plant to survive in salinity stress condition and appropriate use of plant growth hormones also activate stress tolerance in plants.

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Ctrl+Alt+Delete Meat: Where Do You Stand on Plant-Based Protein?

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"Nothing will benefit human health and increase the chances for survival of life on Earth as much as the evolution to a vegetarian diet."

— Albert Einstein

Background

As the world's population increases, the need for reliable protein sources is growing. Meat is considered a good source of high biological value protein, but meat is not sustainable. In Western countries, the shift toward a diet with reduced meat consumption demands healthy and tasteful meat-free food products. Following this trend, the market turned toward vegetable proteins, such as pulses, wheat gluten and soy protein, which are processed into meat-like products, also known as meat analogues. These products approximate certain aesthetic qualities, such as texture, flavour, and colour, and nutritional characteristics of specific types of meat. The development of new, attractive food products is a challenge already, but this challenge becomes even greater considering that these products are meant as a substitute for meat.

Introduction

Researchers from the University of Bath, the Good Food Institute, and the Center for Long Term Priorities collaborated on the first quantitative comparison of consumer attitudes towards plant-based and cultivated meat across China, India, and the U.S. The open-access, peer-reviewed research was recently published in Frontiers in Sustainable Food Systems. With over 3,000 participants surveyed, this exploration of market demand is also the most extensive to date. Here's what they learned:

There's a Big Big Big Consumer Base for New Methods of Meat Production

1. The observation: 33 percent of U.S. consumers, 62 percent of Chinese consumers, and 63 percent of Indian consumers were "very or extremely likely to purchase plant-based meat regularly." Cultivated meat clocked in at 30, 59, and 56 percent, respectively.

2. The takeaway: The three most populous countries in the world have robust consumer interest in plant-based and cultivated meat. Interest in cultivated meat is expected to grow once there is a product on the market and consumers are more familiar with it.

More Familiarity = More Acceptance (In Every Country)

1. The observation: In every country, the more familiar they were with plant-based or cultivated meat, the higher their acceptance.

2. The takeaway: Continuing to normalize and get the word out about plant-based and cultivated meat will likely lead to greater and greater acceptance over time.

Indian Consumers Really Get the Necessity Thing

1. The observation: Plant-based and cultivated meat acceptance both correlated with perceived necessity among Indian respondents. Sustainability drove plant-based meat acceptance, and ethics drove cultivated meat acceptance.

2. The takeaway: Indian consumers seem most attuned to the environmental and ethical challenges of conventional meat production. Sustainability- and ethics-forward marketing may be more effective in India than China and the U.S.

So, What is a Plant-Based Meat?

Well, think about our own experiments with plants that have a meaty taste. All over India, chefs have used jackfruit or kathal as a meat substitute. ITC Hotels makes a meaty-tasting kathal biryani for vegetarians at all its properties whereas, in Washington DC, one of the fastest moving items on the menu at the new, super-hot Punjab Grill is a vegan biryani made from jackfruit. The idea of trying to mimic the taste and texture of meat with vegetables is hardly new. The Chinese have been making mock meats from wheat gluten and other plant derivatives for centuries. These are made to look like duck or pork and cooked in the same general way. One theory is that these foods were created for the Buddhist fasting period, but they continue to be popular across the board today. All that the new generation of vegetarian meats does is to take the process a couple of steps forward with the aid of science. Those 'meats' are made from things like pea or wheat or potato protein. Beet juice is used for colour. Some of the new food companies extract heme, a component found in animal blood, from various plants (where it is also found) and add it to their meats. When the meats are cooked, the plant-based heme makes it seems as though the 'meat' is 'bleeding', a true meat characteristic that makes it look more like the real thing.

Functional Plant-Based Meat Ingredients and Food Additives

There are many meat products that are consumed for their textures, or used as binding agents, that are added to products such as prepared foods. Plant-based meats in this category place most importance on texture instead of flavour. They are frequently used to achieve price parity with meat products, increase shelf life; and retain their shape and flavour after freezing, thawing, and cooking. Typically, both meat and plant-based meat products in this category are not the main feature of the dish being served. Products in this category include a wide range of fresh and frozen prepared meals.

Naturally Occurring Plant and Fungal Meat Mimics

Products within this category are found in nature and are commonly used as meat substitutes. Examples include: a variety of mushrooms, pulses, jackfruit, and others. These naturally occurring plant-based meat substitutes mimic properties of meat by being similar in texture and/or protein content. The texture similar to meat products produced by some plants and mushrooms is through structure of fibrous material found within them, creating a "fleshy" appearance and feel. For example, the jackfruit is often used as a replacement for pulled pork.

Innovation Opportunities Within the Plant-Based Meat Industry

There are ~350,000 accepted plant species on earth, and only 150 out of approximately 30,000 edible plant species are cultivated for food production around the world. According to the Food and Agriculture Organization of the United Nations (FAO) 90% of calories around the world come from only 30 plant species. Plant-based meat products benefit from having the ability to draw upon hundreds of thousands of plant species for new and improved ingredients. There is a lot of opportunity to discover plant proteins with desirable properties for plant-based meat products such as: desirable amino acid profiles, denaturing temperatures, textures, tastes, and shelf lives.

Innovation opportunities within the plant-based meat industry include:
1. Discovery of plant proteins with desirable properties.
2. Development of techniques for efficiently isolating desired plant proteins.

3. Formulation of plant derived proteins with other ingredients.
4. Manufacture and processing of specific plant proteins.
5. Distribution of plant-based meat products.

Are Plant-Based Meat and Fish Healthier than the Real Thing?

With the heightened focus on eating plant-based foods, food manufacturers have been developing plant-based animal foods. Now, you can find foods like beef, tuna, shrimp and eggs in plant-based form on supermarket shelves. But are these foods really a healthier alternative to their animal counterparts? Here's a comparison between the animal and plant-based alternative these foods.

Beef

1. The Real Thing: Because of increased trimming practices, there are many more cuts of lean beef available at the market. When a cut is labelled as "lean," it contains less than 10 grams of fat, 4.5 grams or less of saturated fat and less than 95 milligrams of cholesterol per 3.5 ounces.

You can tell a steak is lean if you see the words "round" or "loin" in the name such as top sirloin steak, top loin steak, and tenderloin steak. Beef also provides a healthy dose of 10 nutrients. It's an excellent source of protein, vitamin B12, zinc, selenium, niacin, vitamin B6 and phosphorus, and it's a good source of riboflavin, iron and choline.

2. Plant-Based Alternative: Two companies, Impossible Foods and Beyond Burgers, sell plant-based beef that has become popular in supermarkets and in restaurants. Impossible Foods created a plant-based beef made from soy protein that has the taste and texture like beef. The scientists at Impossible Foods created a plant-based heme through the fermentation of genetically engineered yeast that helps create that feel of traditional beef. Beyond Burgers also looks and tastes like a beef burger and even "bleeds" like one.

The protein comes from peas, rice and mung bean, while the fat comes from canola oil, coconut oil, and cocoa butter. Both Impossible Burger and Beyond Burger have a rather long list of ingredients and vitamins and minerals that were added in order to have a similar nutrient composition of traditional beef.

Eggs

1. The Real Thing: One egg provides 72 calories and 14 essential nutrients, many of which many Indians do not get enough of. It also provides 5 grams of fat, 1.5 grams of saturated fat, and 10 grams of protein. Eggs are known to be the "perfect" protein providing all your essential amino acids.

They are full of vitamins A and D and provide the antioxidant lutein, which helps promote healthy eyes and skin. Many folks toss the nutrient-packed yolk, but that's a big no-no. The yolk contains almost half the protein of the entire egg. It also contains the saturated fat, which has been shown to increase blood cholesterol. But the small amount of saturated fat found in the yolk can certainly fit into a healthy eating plan.

2. Plant-Based Alternative: JUST Egg is a plant-based egg that comes in a squeeze bottle. It scrambles and tastes like eggs. Three tablespoons of JUST egg contain 70 calories, 5 grams of fat and 5 grams of protein. It's free of saturated fat, cholesterol and sugar and contains 4% the daily recommended amount of iron (and 0% of vitamins A and C, and calcium). No other vitamins or minerals are listed on the label.

The ingredient list includes mung bean protein isolate, expeller-pressed canola oil, dehydrated onion, gellan gum, soy lecithin, sugar, tapioca syrup, tetrasodium pyrophosphate, transglutaminase and nisin.

So, Which is Healthier?

It's nice to have both animal and plant-based options, but just because it is plant-based doesn't mean it's necessarily healthier. One of the biggest issues with these plant-based alternatives is the massive amount of ingredients listed on the label, including numerous additives.

In addition, the plant-based alternatives don't usually have the same list of nutrients compared to its animal alternative.

Yes, you may find they have less sodium, but the other nutrients don't usually equate. So, the next time you're faced with the choice between plant-based alternatives and the real deal, it's possible having a moderate portion of the real deal in your balanced diet may be a better choice.

Reasons to Choose Plant-Based Food Alternatives in India 2019

According to a survey conducted by Rakuten Insight in September 2019, nearly 52 percent of respondents in India said they had consumed plant-based food products to follow a vegetarian or vegan diet. Furthermore, 50 percent thought this variety of food is healthier, while 24 percent chose this because of food allergies or dietary restrictions.

India consumes a primarily cereal-heavy diet mainly due to price, varying in details across cultures and regions. While Indians are largely believed to be vegetarian and a model for a world that arguably requires a substantial decrease in the consumption of animal food sources for sustainability, the south Asian country ranked 102 out of 117 on the Global Hunger Index 2019. Research from early 2019 showed only the rich could afford meeting their recommended nutrition needs in the country.

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Physiological Tools for Crop Stress Detection

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Introduction

Stress is an altered physiological response of living organisms caused by physical, chemical or biotic environmental factors that tend to shift their equilibrium away from its optimal thermodynamic state (Gaspar et al., 2002).

Drought, flooding, high temperature, cold, salinity, and nutrient availability are abiotic factors that have a significant impact on world agriculture and account for more than 50% reduction in average potential yields for most major food and fodder crops. These comprise mostly of high temperature (40%), salinity (20%), drought (17%), low temperature (15%) and other forms of stresses (Ashraf, 2008).

The demand for food and livestock production will continue to rise with the increase in global population. Therefore, improving production and productivity to ensure sustainable yields under changing environmental conditions is essential. To achieve this predicted global food security, we need to increase our understanding of plant responses to abiotic stress. Knowledge of natural selection, stress breeding and genetic manipulation of plants that can maintain higher photosynthetic rates, better foliage growth and improved yield under stress conditions are must for achieving this goal.

An appropriate experimental design with a selection of the most sensitive parameters to be measured is a prerequisite for an effective and time efficient study. Several groups of quantitative or qualitative parameters exist which have been applied to characterize plant development and growth, physiological status, symbiotic interactions, stress symptoms, photosynthesis, etc. during or at the end of an experimental growth period.

1. The simplest and most obvious parameters are: fresh and dry weight, root and shoot biomass production, root to shoot ratio, leaf area, grain yield, reproductive index. Most of them can be measured by using optical imaging techniques, e.g., plant height, shoot diameter, leaf number, number of nodes, colour of leaves, the state of flowering, potting or grain filling, as well as observations of growth morphological dynamics, visible impacts of stress-based wilting symptoms, senescence, leaf necrosis, and phenotypical variations. Chlorophyll Stability Index (CSI) and Carotenoids Stability Index (CSI), Relative Water Content (RWC), Membrane Stability Index (MSI), Water Use Efficiency (WUE), Abscisic acid and proline content, Photosynthesis (stomatal conductance), Canopy Temperature Depression (CTD), High K+ / Na+ ratio or low Na+ / K + ratio -for tolerant genotypes. Root aerenchyma formation (RAF), Root volume and Root length, Antioxidant enzymes, Seedling Vigour Index (SVI), Relative growth rate (RGR). Root to shoot ratio, Leaf area ratio (LAR), Flag leaf area, Leaf area per plant, leaf Area Index, Net assimilation rate (NAR), Plant water content. Plant responses characterized by the nutritional status of plant shoots, roots or yield. Water relations of the plant: leaf water potential, relative water content in leaves, absolute and relative transpiration rates.

2. Parameters related to photosynthesis measured by destructive methods, such as chlorophyll concentration or intracellular CO2 concentration in leaves, whereas they are already determined mostly non-destructively and can be measured several times during an experiment, e.g., chlorophyll fluorescence measurements SPAD (Soil Plant Analysis Development) units, stomatal conductance or photosynthetic water use efficiency.

3. Protein, free amino acid, proline, glycin-betaine, soluble sugar and endogenous abscisic acid content of plant tissues or metabolic fingerprinting values describe plant biochemical processes, and they are potential stress indicators.

4. Measurement of enzyme activities, e.g., ATPase, superoxide dismutase, catalase, ascorbate peroxidase, glutathione reductase, or characterization of oxidative damage or lipid peroxidation are also sensitive tools on the biochemical level.

5. Electrolyte leakage and membrane stability indices may provide valuable information about the condition and the potential resilience of plant cells.

6. The presence or absence and the developmental state of symbiotic relationships may indicate plant physiological status and sign stress effects indirectly.

7. Measurement of electrical capacitance in root–soil systems are a promising non-destructive method for assessing root growth and activity.

8. The study of the dynamics of plant metabolism and regulatory mechanisms under stress often requires a combination of the traditional physiological approaches with functional genomic characterization using transcriptomic, proteomic, metabolomic or ionomic analysis (Chaves et al. 2009).

Remote Sensing Technology

Early Detection of Plant Physiological Responses to Different Levels of Water Stress Using Reflectance Spectroscopy (Gerhards et al., 2019). NDSI (Normalized Difference Snow Index) is a measure of the relative magnitude of the reflectance difference between visible (green) and shortwave infrared (SWIR).

It controls variance of two bands. This is useful for snow mapping. Snow is not only very reflective in the visible parts of the electromagnetic spectrum but also highly absorptive in the NIR or the short-wave infrared part of the spectrum, while the most cloud reflectance remains to be high in the same parts of the spectrum, this allows good separation of most clouds and snow.

Remote Sensing of Water Stress

Remote sensing is one of the key technologies in precision agriculture, which has an enormous demand for geospatial information. Besides the information needs for soil properties, crop nutrients, crop biomass, and diseases, farmers and decision makers have a major interest in the detection of plant responses to environmental and water stresses. In general, remote sensing provides a fast, cost-efficient, non-destructive, and spatio-temporal measure of numerous physiological, biochemical and structural crop characteristics at different scales (ground, airborne, and satellite). Plants can be irreversibly affected before visible symptoms of water stress appear. Therefore, a pre-symptomatic or pre-visual detection of plant physiological changes can essentially contribute to avoiding severe crop damages. Hyperspectral imagery, with its continuous spectral data, has the potential to provide further insights into the relationship between the spectral features and associated plant conditions. Focusing on the detection of plant responses to environmental stresses, the main multi-hyperspectral remote sensing techniques are thermal imaging, visible, near- and shortwave infrared reflectance and sun-induced fluorescence.

Thermal Infrared Domain (TIR)

Since the 1970s TIR remote sensing (8–14 µm) has been recognized as a potential tool for early plant water-stress detection. In general, emitted radiance in the TIR contains two intrinsic kinds of information:

1. Surface temperature directional radiometric surface temperature as defined by the object of interest.
2. Its spectral emissivity.

Temperature and Emissivity Separation (TES)

To derive both accurate surfaces temperatures and emissivity spectra, from hyperspectral TIR data, two fundamental problems have to be solved. First, atmospheric correction is needed, hence, the spectral radiance measured at sensor consists not only of the radiance emitted by the object of interest itself but also includes thermal radiation emitted by surroundings and reflected from the surface of the object [down-welling radiance (DWR)].

Conclusion

Early detection of stress is critical for precision farming for improving crop productivity and fruit quality. Sensitivity Analysis for Early Stress Detection, water stress symptoms in the early stage are not visible. To avoid yield loss, the stress factor must be removed before irreversible damage occurs. Therefore, it is important to test the capability of newly-identified remote sense technologies like NDSI and other physiological screening tools for early drought, cold, salt etc stress detection.

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Insects Pests Under Green House Cultivation and their Management Practices

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Introduction

Greenhouses are frames of inflated structure covered with a transparent material in which crops are grown under controlled environment conditions. Greenhouse cultivation as well as other modes of controlled environment cultivation have been evolved to create favourable micro-climates, which favours the crop production could be possible all through the year or part of the year as required. Greenhouses and other technologies for controlled environment plant production are associated with the off-season production of ornamentals and foods of high value in cold climate areas where outdoor production is not possible. The primary environmental parameter traditionally controlled is temperature, usually providing heat to overcome extreme cold conditions. However, environmental control can also include cooling to mitigate excessive temperatures, light control either shading or adding supplemental light, carbon dioxide levels, relative humidity, water, plant nutrients and pest control.

Pest Management

Pest management is an integral part of any greenhouse operation. Pests can include weeds, nematodes, algae, insects, spiders, diseases, or any unwanted organism that directly or indirectly damages plants. Many greenhouses use Integrated Pest Management (IPM) strategies to manage their pest problems. In greenhouse production, the objective is usually to produce undamaged pest-free plants. This allows for some tolerance of minor insect or mite pest damage. There also may be a preference for the use of nontoxic or low-toxicity pesticides. This is particularly important in regard to the potential contamination of surface and groundwater. Financial constraints also play a role in determining the overall objective. All of these factors significantly affect the selection of pest management tactics.

Crops Grown Under Green House

Flowers	Chrysanthemum, Carnation, Gerbera, Rose, Lilium, Orchids and Gladiolus
Vegetables	Tomato, Capsicum, Cucumber, Broccoli, Cabbage, Leafy vegetables, Radish, Okra, Lettuce and Beans
Fruits	Strawberry

Pests Associated with Crops Under Green House

Insect and non-insect pests		Host plants of different insect pests
Common name	**Scientific name**	
Aphids	*Macrosiphoniella sanborni*	Chrysanthemum
	Myzus persicae	Capsicum and Gerbera
	Toxoptera aurantii	Orchids
Thrips	*Scirtothrips dorsalis*	Rose
Whiteflies	*Bemisia tabaci*	Gerbera, capsicum
Caterpillars	*Helicoverpa armigera*	Capsicum, tomato, carnation
Leaf miner	*Liriomyza trifolii*	Chrysanthemum, gerbera, cucumber, tomato
Mites	*Tetranychus utricae*	Carnation Tomato, capsicum, cucumber, carnation, gerbera
Slugs and snails	*Helix* sp. *Achantina fulica*	Flower crops

Damage Caused by Pests Under Controlled Atmosphere

1. Sucking pests: Sucking insects are small, soft-bodied, sluggish insects that cluster in colonies on the leaves and stems of the host plants. They are sucking insects that insert their beaks into a leaf or stem to extract plant sap. They are usually found on and under the youngest leaves, and, in general, prefer to feed on tender, young growth.

Aphid

Whitefly

Mealy bugs

2. Defoliators: All caterpillars are the immature stages of moths. They chew on leaves, stems and fruits of many kinds of plants. Infestations may begin when moths enter through ventilators or when infested plants are brought into the greenhouse. Cutworms can be serious pests of younger plants. They hide during the day in soil or mulch and feed on the plants at night.

Fruit borer

Fruit borer

3. Mites: Mites are sap-sucking pests which attack a wide range of greenhouse plants. Two species, the two-spotted spider mite can cause serious and persistent problems. These mites feed by piercing tissue with their mouthparts and sucking out cell contents.

4. Slugs and Snails: Slugs and snails can become greenhouse pests when the humidity is high. Slugs are fleshy, slimy animals that feed mainly at night. They prefer cool, moist hiding places during the day. Slugs rasp on leaves, stems, flowers and roots. They produce holes in the leaves or just scar the leaf surface. Small seedlings are especially vulnerable to these creatures. Silvery slime trails are evidence of snail and slug infestations.

Integrated Pest Management

IPM is based on keeping pest populations to levels which the crop and fruit yield and quality can tolerate. It is about taking action to manage pests when they are at their most vulnerable life stages. IPM is not about accepting a financial loss instead of controlling a pest. Effective pest management requires correct identification of the pest in its different life stages and regular, routine monitoring of pest populations. Routine monitoring for pests allows you to act to manage pests in a timely manner.

Management decisions are based on the stage of crop growth as well as the actual pest population levels.
1. Monitoring crops for pests.
2. Accurately identifying pests.
3. Developing economic thresholds.
4. Implementing integrated pest control tactics.
5. Record keeping.

The focus of IPM is to use a combination of integrated pest management control tactics, whether it be cultural, mechanical/physical, biological, biorational, or chemical.

Conclusion

Pest management technology under protected environment with emphasis on avoidance and selective use of pesticides. Safe waiting intervals based on harvest time pesticide residues needed to be established for the crops under protected environment as this information is lacking completely. Apart from this, emphasis to improve the awareness level of the growers for timely diagnosis and judicious use of insecticides needs to be taken up on priority.

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Hydroponics: Best Source of Farming Without Soil

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Introduction

Hydroponics is the farming technique that uses up to 95% less water than traditional agriculture and yet water is what it relies on instead of soil. Hydroponics does not relay on soil, instead of growing in the earth, the plants are placed afloat circulating nutrient rich water. The nutrient content in the water is adapted to the plants need. By changing the nutrient formula, you can grow almost any plant in hydroponics while using 20 times less water than traditional agriculture. Agricultural flood irrigation in large field loses water to simple evaporation, runoff, and dispersion beyond the reach of plant roots. The agricultural industry is changing its practices to be more water-wise, but even the best drip irrigation only cuts flood irrigation losses by about one-fourth, nothing close to hydroponics and the second resource that is used effectively is space because all the plants need is provided and maintained in a system, you can grow in your small apartments or houses as long as you have the spaces.

In the early 1930s, W.F. Gericke of the University of California put laboratory experiments in plant nutrition on a commercial scale. In doing so, he termed these nutrient culture systems as hydroponics. The word was derived from two Greek words hydro (“water”) and ponos (“labor”)—literally “water working.” Hydroponics can be defined as the science of growing plants without the use of soil, but by the use of an inert medium, such as gravel, sand, peat, vermiculite, pumice, perlite, coco coir, sawdust, rice hulls, or other substrates, to which is added a nutrient solution containing all the essential elements needed by a plant for its normal growth and development. Since many hydroponic methods employ some type of medium it is often termed “soilless culture,” while water culture alone would be true hydroponics.

In future this hydroponic gardening will be very much useful, because population explosion and migration of people towards urban area increased in the demand for food, shelter, and basic necessities. Because of this most of the agricultural lands are converted into residential areas, resulted decreased availability of land for production of agriculture products. Due to the construction of buildings in urban areas led to shortage of space for cultivation of vegetables, fruits, spices, and other agricultural products. So, using this hydroponics we can produce more yield in less space. Water is also almost reducing on the earth due to population and wastage so by using less water also we can produce more. Even labour cost is also increasing now a days, and in future we may not able to pay labour cost, so hydroponic system will be the best adaption for growing plants in so many ways as this does not even require too much labour.

Advantage of Hydroponics

1. No soil is required. Your plants will grow in water-based system.
2. Requires less space. In soil the roots have to extend in search of nutrients and water. But in hydroponics there are no such problems. Since roots don’t have to expand in search for nutrients and oxygen, you can grow your crops much closer to each other.
3. You can grow your plants anywhere, anytime of the year, regardless of the climate.
4. Nutrients and fertilizers are used in lesser quantities when compared to soil culture.
5. Less labour is required.
6. Can be grown everything in all the locations all over the world. because of this we can eliminate the need to import many fruits and vegetables from far away countries.
7. No weeding and no herbicides required. As there is no competition the growth of the plant is faster and healthier too.
8. Another yield increasing factor is lack of pests and diseases. Many diseases are soil borne, so are many organisms that potentially feed on the plants. No pesticides are used.

9. No need to change medium in gravel, sand, or water cultures: no need to fallow. Sawdust, peat, coco coir, vermiculite, perlite, Rockwool, may last for several years between changes with sterilization.
10. Easy to master and replicate results. hydroponics gives us the opportunity to reduce logistics costs and thus helps fight climate change.

Growing Media Used in Hydroponics

This growing media acts like a nutrient carrier, but contains no nutrition in and of itself, like soil does. In fact, the purest form hydroponics, water culture grows plants with their roots directly submerged in well oxygenated and temperature-controlled nutrient solution. No soil, or any other stuff required. Here we may raise the question that, if hydroponics is the science of growing plants directly in a nutrient rich solution, what the deal of using these hydroponic growing media such as coconut coir, perlite, expanded clay balls, stone wool, peat, moss, grow stones, and soil less mixes? Thus, hydroponic growing media is required because they enjoy the buffer of moisture and nutrient uptake. It also affords their plants some thermal insulation for the roots. Any growing media has many characteristics but mainly you have to know about water holding capacity (WHC), air filled porosity (AFP), cation exchange capacity (CEC).

1. Water holding capacity: how much nutrient solution it can absorb.
2. Air filled capacity: the amount of air space in the media.
3. Carion exchange capacity: how readily the growing media can hold onto and release positive ions in the roots.

Growing media	WHC	AFP	CEC
Coconut coir	good	good	good
perlite	poor	good	good
Expanded clay balls	poor	good	good
Stone wool	good	good	poor
Grow stones	poor	good	good

Different Hydroponic Systems

Sl. No.	System	Used
1	Drip system	One of the most popular systems and used fot both personal and commercial use.
2	Flood and drain system	Popular for home growers
3	Nutrient film technique	Best for small and quick- growing plants
4	Water culture	Used for commercial farming as it is inexpensive method for large- scale usage
5	Wick irrigation	This is simplest method. And is cost effective
6	aeroponics	Used for personal and commercial use
7	Bottle hydroponics	Used indoors, outdoors
8	Verticle garden	Used where there is less space and this is used for both personal and commercial users
9	Floating rafts	Mainly used to grow greens and herbs

Plants that Can be Grown Using Hydroponic Systems

1. Vegetables: lettuce, pumpkins, peppers, leeks, eggplant, spinach, tomatoes, cucumbers, radish, green beans, cabbage, broccoli, kale etc.
2. Fruits: melons, strawberries, tomatoes,
3. Herbs: rosemary, basil, chives, oregano, basil, chives, fennel, coriander, mint, mustard, ginger etc.
4. Flowers: marigold, roses, carnations, chrysanthemum.

Nutrients Required for Hydroponics

Since hydroponic systems don't use soil, the nutrients added to the water must contain all the minerals that plant required for survival. The selection of the appropriate nutrient solution is one of the most important decisions of your hydroponic garden. Healthy plant growth depends on having the right balance of nutrients. There are 16 essential elements that plants need. These elements are absorbed by the plant in different ways. Some get transferred to the plant through the roots, while others are taken in through the pores on the leaf. Carbon, Oxygen, and Hydrogen, three of the most necessary, are available in both air and water. These need to be monitored and balanced. One common problem in hydroponics is a lack of sufficient carbon dioxide. So, when we talk about the fertilizers, there are 13 minerals nutrients.so there are primary, secondary macronutrients and micronutrients. The primary macronutrients nutrients are the nutrients that are basically are used in the highest quantities and the most required for growth and development and these are building blocks for the plants. Secondary macronutrients are needed almost badly as primary and there have been arguments for including many of the secondary macronutrients as primary nutrients. However, for time being they are classified as secondary macronutrients and there are still very important, but not quite as important as primary plant nutrients. The micronutrients are required in much smaller quantities by the plant for growth and reproduction. The primary macronutrients, Nitrogen, Phosphorus, and Potassium, are provided in the fertilizer nutrient blends made for growing hydroponic plants. A fine balance of these is extremely important. Calcium, Magnesium, and Sulphur are the secondary macronutrients. They are also supplied by fertilizer supplements. The remaining 7 essential elements are micronutrients, Copper, Zinc, Boron, Molybdenum, Iron, Manganese, and Chlorine, are rarely deficient. If there is an Iron deficiency, you can supplement your plants with chelated iron. To make sure your plants get everything they need, specially crafted fertilizer mixes are made for hydroponic crops. These mixes can be added to the water in your reservoir and distributed to your plants through the hydroponic system. Specific fertilizers are created for specific crop. Nutrient mix fertilizers are available as liquid fertilizers and dry or granular fertilizers. Liquid fertilizer is easy to use. You just pour it into the water reservoir as per the instructions given on the bottle. These fertilizers are mainly used by non-commercial users. Because of using these liquid fertilizers is more expensive and bulkier to store. Granulated or dry fertilizer is more cost effective, easier to store, and often comes in bulk. These dry fertilizers are commonly used by commercial users. However, it isn't as easy to use because it has to be mixed prior to use and it doesn't always dissolve completely. Either one will work fine, so it’s a matter of personal preference and what’s required by your particular system. Hydroponic nutrients can be organic or synthetic. Organic fertilizers are best for systems that recirculate or reuse the nutrient solution. Calcium Nitrate ($CaNO3$) that provide both calcium and nitrate nitrogen any additional nitrogen required should be provided by potassium nitrate, which also provides potassium. All phosphorous may be obtained from monopotassium phosphate, which also provides some potassium. The remaining potassium requirement can be obtained from potassium sulphate, which also supplies some sulphur. Additional Sulphur comes from Magnesium Sulphate ($MgSO4$) which also supplies magnesium.

Steps to be Followed While Preparing Nutrient Solution to Your Hydroponics

1. first check the pH of you water. If your pH is high then you can add pH down to get it to neutral. Wait for some time to make it settle down.
2. Mix the solution as per the package instructions and add it to your reservoir.
3. Check your pH balance on a daily or weekly basis. pH depends on the timing on the type of crop you are growing.
3. Change your solution weekly.
4. Flush your crop before harvesting. (Flushing your hydroponic crop means allowing it to grow without nutrient solution for a brief period before harvesting).

Some of the Problems Due to Hydroponic Gardening

1. Nutrient deficiencies: chlorosis, necrosis, tip burn,
2. Infestations due to algae, fungi gnats and shore flies, aphids, thrips, spider mites.
3. Seedling problems: wilting, mushy brown roots.

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GPS: Digitization Tool for Precision Farming

Article ID: 31318

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Introduction

Farm mechanization at every stage of crop production is playing a pivotal role in agriculture. Due to which, there is an augmented yield and labour productivity over conventional agriculture. Skilled drivers are needed to operate the tractor efficiently with farm machinery. The requirements placed on farm equipment operators have changed drastically with increase in equipment size, power, multiple functions and speeds well as monitors reporting on specific system performance involving agricultural operations. These increasing demands on the operator can result in increased errors in different functions, costs, environmental problems, and operator fatigue. Automated guidance of agricultural vehicles (tractors, combines, sprayers, spreaders) by Global positioning systems (GPS) has come up the ranks to relieve the operator from continuously making steering adjustments while striving to maintain field implement performance at an acceptable level.

Potential Areas of GPS Application in Agriculture

Global positioning systems are applicable in the following potential agricultural operations:

1. Soil Sampling.
2. Land preparation.
3. Variable rate planting.
4. Variable rate lime and fertilizer application.
5. Yield monitoring and mapping.
6. Field mapping for record keeping and insurance purpose.
7. Parallel swathing navigation guidance.

Overview of Global Positioning System

Global Positioning System of United States Department of defence is a navigational system made of 24 satellites. GPS uses satellites and computers to determine positions anywhere on Earth 24 hours a day. The orbital patterns and spacing of the GPS satellites (their constellation) provide 9 to 12 satellites above the horizon at any point on the Earth. This allows every point of the Earth's surface to have a unique address. There are essentially three parts that GPS is composed of; space, user and control segments. The space segment is of the constellation of 24 active and 3 spare satellites orbiting the Earth. The control segment is a system of 5 monitoring stations located around the world, with the master control facility located at Falcon Air Force Base in Colorado. The fastest growing segment is user segment which is made of GPS receivers and the user community. GPS receivers convert the satellites signals into position, velocity and time. This information is used for navigation, positioning, time dissemination, and research.

GPS Navigation Devices

The parallel-tracking devices are navigation devices that assist operators to visualize their position with respect to previous passes. One such system is a lightbar guidance consisting of horizontal series of light emitting diodes linked to a GPS receiver and a micro-processor. Lightbar is usually positioned in front of the operator and if light is on centreline, machine is on target. If a bar of light extends to the left or right, the machine is off the path to left and right respectively.

Software allows the operator to specify sensitivity to and distance between swaths. Similar GPS navigation systems have been used for aerial application since the early 1990s. Also, GPS system gives current location of implement and with past traffic patterns, computer interface provides the operator directions to maintain proper swath width to match adjacent traffic paths. If an operator leaves the field to refill the applicator or is forced out of the field due to weather, upon return, the operator can resume and maintain accurate swath widths, and over-spraying on previous sprayed areas is eliminated.

Fig. 1. Lightbar navigation

Fig. 2. Display screens for GPS

More advanced systems have a screen showing swath of machine as it moves through the field. Early models only allowed straight-line parallel swaths, but current models are available for any contour traffic pattern. The advanced navigation system coupled with a variable rate spreader drive and software has the capacity to generate as-applied maps showing previous coverage and the application pattern. This provides an excellent record of the pattern and timing while operating in the field. Portions of the field that are not treated, such as wet areas, can be marked in the computer and stored for later operations when conditions permit application. All of this is done without having to physically mark the field area with flags.

Differential GPS

In agricultural applications, the most common way to counteract GPS errors is by using Differential GPS (DGPS). In DGPS system, a GPS receiver is placed at an accurately known location on rover. The base station receiver will calculate the error between its actual location and location computed from GPS signals. The error information is communicated to the rover receiver being used in the field, which is then able to correct the position information it computes from the GPS signals. Differential corrections may be used in real-time or later, with post-processing techniques. Real-time corrections can be transmitted by radio link or satellite signal. Corrections can be recorded for post processing. A number of public and private agencies record DGPS corrections for distribution by electronic means.

An improvement over the standard DGPS is Kinematic DGPS or Real Time Kinematic (RTK) GPS. An RTK system counts the number of wavelengths of the carrier frequency radio signal between the satellite and receiver, thereby achieving accuracies of less than one foot. These systems are expensive and require users to set up and maintain their own base stations; therefore, they are not commonly used in agricultural applications except for topographic map generation, tractor guidance and accurate placement of crop beds and drip tubing.

Benefits of GPS in Agriculture

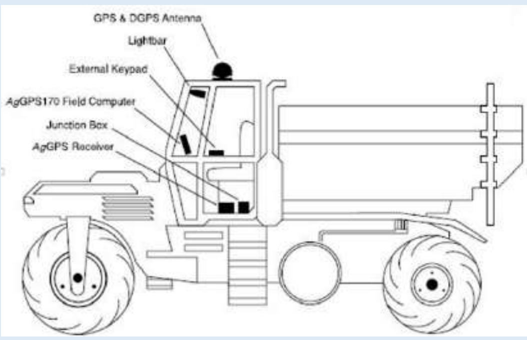

Fig. 3. GPS components

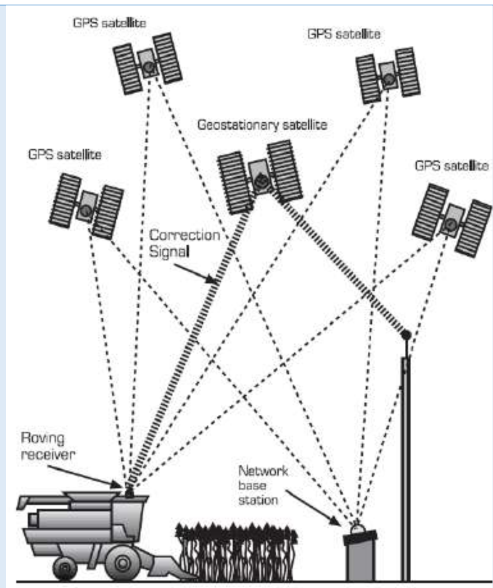

Fig. 4. DGPS system

1. Wide range of agricultural applications in planting, spreading, spraying, cultivating, etc.
2. Saves time and money in agricultural operations by maximizing efficiency.
3. Minimises overlaps and skips in field operation.
4. Automates field operation record-keeping.
5. Reduces operator fatigue.
6. Hours of operation are extended because of the ability to work at night or in fog.
7. Avoids hassles with data management by directly working with shapefiles.
8. Saving of seed, fertilizers, chemicals, fuel, labour etc.

Conclusion

GPS navigation has advantages over conventional marking devices like foam markers and over visual estimation method for spinner spreaders. GPS with yield monitoring, field mapping, soil sampling etc. increases efficiency of farm or agribusiness while minimizing adverse environmental impacts associated with overlapping. GPS also reduces operator fatigue and anxiety during different agricultural operations. Finally, use of this technology can demonstrate to agricultural community that advanced technology can be used to farm efficiently and safely. The as-applied maps provided by advanced GPS systems, is the documentation that applications make at appropriate location and rate. The map enables farmers to look at field as a group of small zones and determine if the field is uniform or not. This information can improve efficiency and profitability of the farm.

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MAGIC Population: A New Resource for Plant Genetics

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Summary

MAGIC population create novel challenges and opportunities in crops because of their complex pedigree structure. MAGIC population is a good genetic resource population with large phenotypic diversity suitable for high-resolution trait mapping as this was developed through several generations of intercrossing of multiple parents.

Multi-parent Advanced Generation Inter-Cross (MAGIC) is a simple extension of the advanced intercross (Darvasi and soller, 1995). This method was first proposed and applied in mice by Mott et al. (2000). Kover et al, 2009 first developed and described MAGIC population in Arabidopsis. Multi-parent Advanced Generation Inter-Cross allows the identification of genes controlling quantitative traits by crossing different combinations of multiple parents. Multi-parent Advanced Generation Inter-Cross combines high diversity (from multiple parents) with high recombination. The increased recombination and diversity of MAGIC population gives greater precision in QTL location and greater opportunity to detect more QTLs. MAGIC lines derived from early generation can be used for QTL detection and coarse mapping.

Development of MAGIC Population

A simple approach to generate a MAGIC population is to produce a complex cross involving multiple, typically eight, parental lines and to isolate Recombinant Inbred Lines (RILs) from this cross. The eight parental lines are crossed in pairs to produce four different single crosses, and these single crosses are crossed in pairs to generate two double crosses. Finally, the two double crosses are mated together to produce an eight-parent complex cross. This complex cross is handled as per the Single Seed Descent (SSD) procedure to develop the required number of RILs, which together constitute the MAGIC population.

Stages in the Development of MAGIC Populations

1. Founder Selection: Prior to initiating population development, founder lines must be chosen based on genetic and/or phenotypic diversity, either in a constrained set of material (e.g., elite cultivars, geographical adaptation) or material of more diverse origins (worldwide germplasm collections, distant relatives). More diverse lines as founder sets may provide biological insight into a wide variety of traits but selection of founders based on relevance to a breeding program for specific traits may result in a MAGIC population which more quickly translates into superior breeding lines.

2. Mixing of parents: Multiple parents are intercrossed to form a broad genetic base. Parents are mixed together in predefined patterns and intermated. The inbred founders which are paired and inter-mated known as funnel. The result of this stage is a set of lines whose genome is contributed by each of the founder parent.

3. Advanced intercrossing: The mixed lines from different funnels are randomly and sequentially intercrossed as in the advanced intercross (AIC) which was proposed by Darvasi and Soller (1995). Selection is phenotypic to further reduce the frequency of deleterious allele from the donor. The main goal of this intercrossing is to increase the number of recombinations in the population. Yamamota et al. (2014) reported that at least six cycles of intercrossing is required for constructing a good QTL map.

4. Inbreeding: The individuals resulting from the advanced intercrossing stage are progressed to create homozygous individuals. Selfing of individuals is done either directly from funnels or after advanced intercrossing to form inbred lines. Homozygous individuals can be created through either single seed descent method or doubled haploid production. Doubled haploid production is much often faster than SSD and also the multiple generations of selfing will introduce additional recombination, albeit less than during the mixing and advanced intercrossing stages.

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Use of MAGIC Lines in Breeding Programs

1. MAGIC populations may be used directly as source materials for the extraction and development of breeding lines and varieties.
2. In the development of variety with several agronomically beneficial traits .
3. In the development variety which can adopt to several diverse regions of the world and suitable for diverse climatic conditions.
4. MAGIC lines can provide solutions to a range of production constraints (particularly stress tolerance)
5. MAGIC lines help in the assessment and understanding of the potential of enhanced recombination in generating novel diversity.

Conclusion

Genetic analysis of MAGIC Population is a powerful method to increase the precision of genetic markers linked to the QTLs. MAGIC populations are likely to bring major changes QTL analysis, gene mapping and variety development through Marker Assisted Selection in plant breeding.

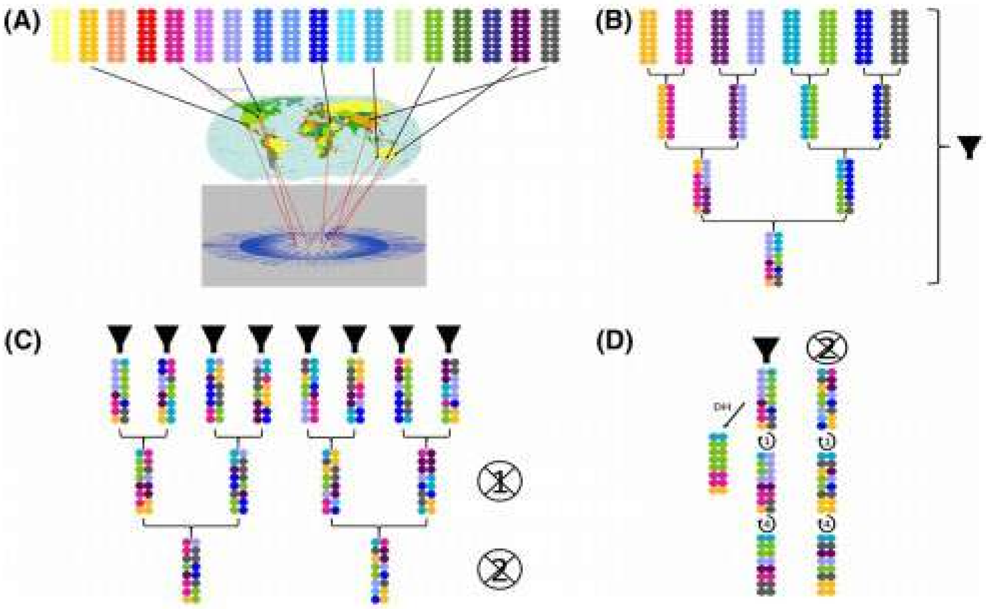

Fig. 1 Stages in the development of MAGIC Populations for eight founders. A. Founder selection, B. Mixing of parents, C. Advanced crossing, D. Inbreeding. (Source: Huang et al., 2015)

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Digitization of Indian Agriculture: A Paradigm Shift

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Introduction

To meet the challenges of climate change, ever increasing population, scarce resources and food wastage; the digitization of agriculture is necessary to attain optimal operations of farm, supply chain, post-harvest management etc., in India. Digitization or E-agriculture opens up opportunities for non-traditional players in the agriculture value chain. It provides reliable data for research and policy-making, and the fill the current information gap. Better data will allow government as well as non-government organisations to design farmer-friendly policies and planned interventions. It also brings transparency in agricultural supply chains, removing the huge inequality that exists and guaranteeing adequate income to the farmers.

Fig. Challenges of Agriculture

The digitization of agricultural sector can play a significant role in increasing employment opportunities, improving the standard of living in the agricultural sector and reducing the risk and uncertainties that our farmers have to deal presently. Both private and government sector should complement each other in providing latest information and communication technologies to empower rural population. Technology is key in increasing growth through providing better services and innovative delivery models. Crop health can be measured from pest infestation levels to moisture readings of the crop to satellite imagery of the warehouses. Mobile telephony is connected to satellites and data delivered to centralized servers which is instrumental in converting grain into monetized assets. This type of high-tech intervention will allow financial institutions to use agri-crop as the primary collateral helpful in promoting financial inclusion.

Digital farming provides real time flow of data from the fields to the data analytics dealers and satellites with regard to day to day farming operations. This enables to take care of entire value chain, right from sowing to harvesting through agribusiness. With the help of digital system, advice can be given to farmers and ensure best practices on their fields. Through digital monitoring fields are digitally managed by giving the right course correction advice and taking regular updates on the health of the farm through pictures. This can be done through Big Data Analytics, with indicators like Normalized Difference Vegetation Index (NDVI), Red Edge Index etc. It will be immensely helpful in weed and pest management. The digitisation of agricultural practice provides traceability across the entire supply chain. It also helps farmers to connect with the buyers and initiate sale by availing online market place, it gives farmer more independence and option to choose a buyer. Digitisation boosts income and also lowers cost by optimally using chemicals and fertilizers and managing bottlenecks.

Digitization Tools

1. Artificial Intelligence.
2. Internet of Things.
3. Big data analytics.
4. Block chain.
5. Cloud computing etc.,

Better plant and varieties are one aspect of technology, another big piece which is possible through improved farm machinery and agronomic management driven through information technology, IOT, real time data, predictive farm advisory, machine learning can bring farm automation, farm management efficiency last mile delivery efficiency, can only be driven by Artificial Intelligence. Complex operation of agriculture needs pool of information that too timely and farmers relies on diverse sources for this starting from their own experiences, fellow farmers, agriculture specialists, advisors, input suppliers and input dealers, the relevance and usefulness of all this information remain worthful if it is available on time, which always remain limitation. In order to overcome this, Artificial Intelligence orientation is to be promoted in a big way.

Fig. Smart farming

The term 'artificial' in AI can be taken as non-biological, and 'intelligence' as an ability to accomplish complex activities and actions. Robotics, Machine Learning (ML), Automated Reasoning, Knowledge Representation, Expert Systems, Computer Vision, Speech Recognition, Automated Data Analytics, Virtual Reality, Augmented Reality, Internet of Things (IoT), Cloud Computing, Statistical Computing, Deep Learning etc. are some major sub-areas of AI having huge potential in solving complex problems of agriculture, all these technology can be effectively leveraged for providing information to growers on soil management, time of sowing, spray schedule of various pesticides and information on congenial conditions for pest infestations. This will help farmers to take informed decisions and will ensure better management and efficiency in agronomy. It will also help the world to counter the emerging challenges in farming through efficient and smart farming.

Benefits

1. Improved crop health.
2. Nutritious food products.
3. Better support price for crop.
4. Easiness of production, supply and marketing.
5. Comfort in operation.
6. Retained soil fertility.
7. Forecasts of climate.
8. Boots agriculture finance.
9. Enables real time decision making.
10. Assured credit for farmers and industry.
11. Hassle free marketing.
12. Conservation of ecosystem.
13. Disease resistance of crops.
14. Real time analysis of farming problems.
15. Increased profit.

Conclusion

It requires planning, capacity building, identification of right stakeholders, mechanisms for implementation and monitoring of digital tools for farms. This technology creates a platform for farmers, sellers and consumers which reduces costs, improves productivity and quality, reduces risks and creates a sustainable ecosystem. Digital technologies offer the potential to achieve necessary conditions for scale, with distributed low cost and customised deliver. For India, at a time when national, regional and international research institutes have already developed yield-enhancing, cost-efficient and environment-friendly technologies, farmers get motivation and encouragement to adopt these through digital tools. Finally, digitization will change the scene of Indian agriculture in near future and guarantee higher income to farmers and reduce distress in farming sector.

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Rice: Drought Stress Response

Article ID: 31321

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Introduction

Rice is one of the world's most important cereals and more than 50% of the population worldwide consume it as a staple food. Rice is a Semi-aquatic plant and its productivity is strongly affected by low soil moisture and drought-like situations. In Asia alone, about 34 million ha of rainfed lowland and 8 million ha of upland rice are subject to frequent drought stress (Vikram et al., 2011).

The term 'drought' refers to a lack of moisture for an extended period which in turn causes a deficit of moisture in the soil. It can be defined as the inadequacy of water availability, including precipitation and soil moisture, in quantity and distribution during the life cycle of a crop plant, which restricts the expression of the full genetic potential of the plant. Drought is a complex quantitative trait physiologically, biochemically, and genetically. Shoot and root traits are important determinants to impart drought tolerance in plants.

The possession of a deep and thick root system, which allows access to water deep in the soil profile, is considered crucially important in determining drought tolerance in rice. In O. sativa, the growth and development of the plant are greatly affected by a series of morphological, biochemical, and physiological changes caused by drought stress (Quinones et al., 2017).

Drought stress restricts rice productivity and generally inhibits its growth by adversely affecting water absorption and nutrient uptake. However, various management strategies have been proposed to cope with drought stress.

The Response of Rice During Drought Stress

Plant growth and productivity are seriously hampered for proper crop production due to drought stress as it generates abiotic stresses. The plants during drought stress disrupt plants antioxidant function by producing reactive oxygen species (ROS). Drought-induced ROS results in morphological, biochemical, physiological, and molecular responses as a consequence of the up and down-regulation of genes and proteins. The plants also face a stiff reduction in cell growth, cell elongation, and cell expansion which results in retarded plant growth. Drought stress induces various genes and proteins elucidating functional genomics, proteomics, and metabolomic approaches.

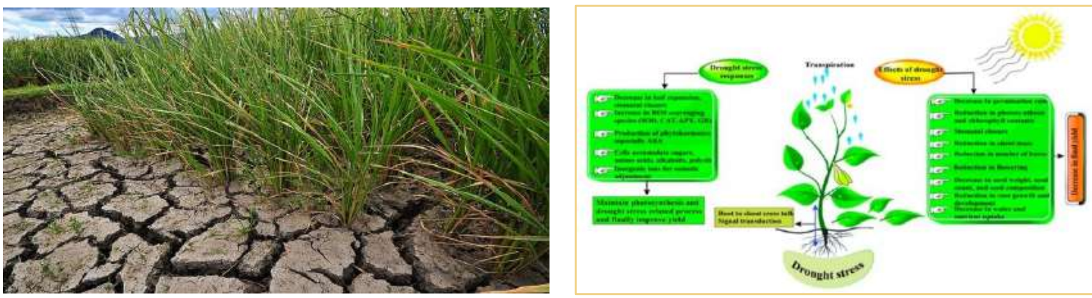

Fig: Drought stress and its responses in rice

Morphological Responses of Drought Stress in Rice

Morphological parameters are used as an indicator to study the various aspect of plant responses to drought stress (Zaher-Ara et al., 2016). These morphological traits include shrinkage of leaf size, decrease in the number of stomata, cutinisation of leaf surface, and thickening of leaf cell walls, etc., The distinguish impact drought stress has on rice plants is reduction in-depth, distribution, number and length of primary roots. Reduction in root and shoot length. Leaf rolling, curling, leaf area reduction, and wilting. Decreased plant biomass and growth inhibition. Reduction in flowering and fruiting leading to a decrease in crop yield.

Physiological Responses of Drought Stress in Rice

Physiological processes in the rice plant are adversely affected by Drought which alters the Growth and productivity of the crop. Relative water content (RWC), leaf water potential, stomatal resistance, rate of transpiration, and leaf temperature are the physiological traits that influence plant water relations. During drought-stressed rice plants have a lower RWC than non-stressed and the temperature increased due to decreased leaf water potential and transpiration rate (Fahad et al., 2017). Nitrogen metabolism in plants is also affected by drought stress. Nitrogen metabolism and increase in Nitrogen provides adaptability of rice photosynthesis to water stress by mitigation of stomatal and maintenance of higher Rubisco activity, and increased nitrate and ammonium assimilation. (Zhong et al. 2017). Drought stress altered Photosynthetic activity of the plants by limiting CO2 availability impairs ATP synthesis and decreases phosphorylation (Fahad et al., 2017). Mineral nutrition plays an important role in abiotic stress acclimation as it regulates cellular ionic homeostasis. Drought stress also impacts many important mineral nutrition in plants such as nitrogen, silicon, magnesium, calcium, and other essential minerals. The macronutrients like N, K, and Ca and micronutrients like Si, Zn, and Mg decrease the toxicity of ROS by increasing the antioxidant levels such as superoxide dismutase (SOD). Various physiological responses of rice plants during drought stress: Recognition of root signal, Loss of turgor, and osmotic adjustment. Transient decrease in photochemical efficiency, reduced leaf water potential, decreased stomatal conductance to CO2. Reduced internal CO2 concentration, the decline in net photosynthesis, reduced peduncle elongation, and spikelet sterility. Reduced pollen pistil interaction, reduced growth rate, and crop yield.

Biochemical Responses of Drought Stress in Rice

The biochemical process such as redox reaction, or the transfer of electrons is a natural cellular metabolism during energy transduction in the inner mitochondrial and thylakoid membranes. Drought stress induces over-accumulation of prooxidants referred to as oxidative stress which leads to loss of redox homeostasis. Plant metabolism and development is adjusted by Redox regulation during abiotic stress. Alterations in carbon and energy metabolism have been reported in both mitochondria and chloroplasts during drought stress .various Biochemical responses during drought stress are Alteration in redox homeostasis and ionic balance. Osmolyte (proline, glycine betaine, sorbitol, mannitol,)biosynthesis. ROS metabolism (1O2, O2–, RO., OH–,H 2O2, etc). Oxidation of lipids (MDA) and proteins(Carbonyl compound etc). Antioxidant function (Enzymes like CAT, SOD, POX, GR, APX....etc); Non –enzymes-Asc, GSH, α -tokopherol, carotenoids, phenolics, and other secondary metabolites.

Molecular Responses of Drought Stress in Rice

Molecular studies during drought stress in rice have identified multiple changes in gene expression which led to the characterization of their regulatory elements and design an innovative plant type for better adaptations in extreme situations. The genes produce during Drought stress response well to ABA treatment. There are ABA-independent as well as ABA-dependent regulatory systems of gene expression controlling drought escape mechanisms in rice. There are several key transcription factors (TFs) such as MYB, MYC, DREB/CBF (drought-responsive cis-element binding protein/C-repeat-binding factor), ABF/AREB, NAC, and WRKY TFs which regulate transcription of drought-responsive genes. Various molecular responses during drought stress are Signal perception and transduction via MAPKs, Ca+2, etc. Increased expression of drought stress-responsive and ABA biosynthetic genes. Expression of ABA and dehydration responsive genes, Synthesis of specific proteins like LEA, dehydrin, aquaporin, DSPs.

Various Approaches for Drought Stress Management in Rice

1. Plant breeding and marker-assisted selection: Plant breeding approaches are used to achieve the identification of stress-tolerant traits and transfer of those traits to the known cultivar for producing a cultivar having high yield along with a tolerant gene. MAS approach helps to identify the genes that usually inherit in association with a desirable trait, which may be of agronomic importance. Marker-assisted breeding (MAB) introgress gene governing tolerance at all stages of growth and early reproductive stages in drought-tolerant donors through careful QTL identification and fine-mapping studies. QTL mapping in rice genotype is used to identify the loci that control abiotic stress including drought stress tolerance in crop plants. Dixit et al. (2017) have identified three QTLs for grain yield under drought conditions, qDTY3.1, qDTY6.1, and qDTY6.2, which show a high effect in the background of TDK1 rice variety.

2. Role of plant hormones: ABA phytohormones play an important role in orchestrating signals during drought stress and controlling downstream stress responses. Ethylene response factors (ERFs) were reported to enhance plant tolerance to drought stress. Fu et al. (2017) reported that by regulating jasmonic acid (JA) and ABA signalling in O. Sativa OsJAZ1 attenuates drought tolerance. Exogenous application of IAA, rescued pollen viability and spikelet fertility during drought and heat stresses in rice.

3. Transgenic approach: Transgenic rice is developed by using gene transformation techniques. It involves modifications in both the qualitative and quantitative traits through the transfer of genes that encode growth regulators, compatible solutes, antioxidants, photosynthetic enzymes, and TFs involved in drought stress tolerance. Ravikumar et al. (2014) developed transgenic rice using the AtDREB1A TF through Agrobacterium-mediated transformation. AtDREB1A Expression in transgenic rice induces highly tolerant to drought stress in both the vegetative and reproductive stages without affecting their morphological or agronomic traits. Thus, transgenic technologies become a new strategy in plant breeders for crop improvement by developing crop cultivars resistant to various biotic and abiotic stresses.

Conclusion

Drought stress results in lower rice production by altering morphological, biochemical, physiological, and molecular responses by regulating stress-induced genes and protein functions. As mention above various strategies can be adopted to combat the drought stress and generate plants having high adaptability along with high yield. High -throughput tools and techniques including studies in proteomics, transcriptomic, and metabolomic have been promising to identify drought-regulated genes, transcriptions factors, and cellular signalling components whose functions are critical in providing stress tolerance to rice. However, more attention is needed to understand the responses of O. Sativa L to drought stress and its interaction with other environmental stress for the development of a climate-resilient crop in the future.

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Crop Diversification: A Sustainable Option for Indian Agriculture

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Introduction

Crop Diversification and Intensification is the third principle of Conservation Agriculture based Sustainable Intensification. Generally, Crop diversification is to alternatively sow different crops in a sequence in the same piece of land in the same year to next year. Crop intensification is that instead of sowing one crop, two crops are sown and instead of two crops, three crops are sown in a sequence in same year.

Principles of Crop Diversification

Crop intensification depends on some of the principles. The first principle is “Less profitable to high profitable with more sustainability”. If the cropping system is less profitable and unsustainable then it can be turned in to an efficient, profitable and sustainable system.

The second principle is “more water loving to efficient water loving cropping system”. If the cropping system is very water loving i.e., requires a lot of water, then replace it with a less water loving crop within the same system. The crop that requires less water optimizes for other crop.

The third principle is that in some cropping systems, farmers repeat the same crop and extract more and more yield and biomass. This causes high nutrient uptake. So instead of practicing a high nutrient uptake, if transition is made towards optimum and efficient nutrient uptake cropping system then sustainability can be attained.

The last principle is that if farmers keep repeating the same type of crop then this increases the biotic stresses like diseases, insects etc. So, to contain this, a cropping system with less biotic stresses needs to be adopted.

Benefits of Crop Diversification

1. If a cost-effective crop diversification and a more or less requirement crop is adopted, then the income of small and medium scale farmers can be increased.

2. If same crop is repeated like rice and wheat in Punjab and Haryana, it has an effect on the prices due to the excess crop availability and the government is unable to buy and the prices fall.

3. Instead of sowing rice and wheat, if diversified crops like legumes and oil seeds are adopted, then the fluctuation of agricultural commodity prices would be in the normal range.

4. If only one crop cycle is adopted, then it is more prone to climatic shocks. If the cropping system is diversified, the cropping system becomes more resilient to climatic shocks. When one crop gets damaged, then profit is gained from the next crop. If a third crop is added, then farmers can benefit from at least two crops in case, if one gets damaged. So due to crop diversification, the climatic resilience increases.

5. The biggest benefit is that if just rice is grown then farmers only eat rice and the same is true for wheat. But if different crops are grown in the farm then at least the diet would be balanced and the nutrient intake would be better. Besides this, livestock and fisheries are also dependent on the cropping system. If different types of crops are grown, then the quality of fodder for livestock would improve and this can increase livestock production and dairy products quality.

If crop diversification is practiced in a proper way, then the environment pollution decreases and especially air quality improves unlike residual burning. Instead of rice, if another crop is grown then burning of crop residue is stopped and used for other things. Legume crop has very less biomass and it decomposes quickly in case if it is kept it in the farm. Also, if a third crop like Moong bean is added in the rice-wheat cropping cycle, then the deterioration of soil is restored, nitrogen fixation takes place and its residual increases soil quality and structure.

The use of farm or external inputs like fertilizers, seeds, pesticides and agro chemicals would decrease if proper and optimum cropping cycle of crop diversification is adopted. For example, if legume or oilseed crop is grown after rice, due to their Allelopathic effects they break the cycle of diseases and insects and are able to control pests. This is the reason why some weeds are particularly associated with specific cropping systems. Like in the rice-wheat system, there are weeds such as Phalaris minor and particularly in rice, Echinochloa. If the same cropping system is followed for years, then the seed bank of these weeds keeps increasing in the soil and the problem increases. But if we replace rice-wheat with rice legume or oil seed or vegetable, then the weed seed bank can be exhausted and subsequently can control the weed population. This is true for diseases as well. The carry forward diseases which have its inoculum and spores stayed in the soil, their cycle can be breached. So, the disease, weed and pest population can be controlled and get benefit from it.

Conclusion

Lastly, the community of food can be increased. If rice is grown year after year, problems get increased but with diversification of crop there would be no storage problem and better-quality food and security is obtained. So, these are the benefits of Crop diversification and adopting this is the only sustainable option for Indian agriculture. The linkage of Crop diversification with Conservation Agriculture based Sustainable Intensification is that it is an integral part and principle of Conservation Agriculture based Sustainable Intensification. If all the three aspects of Conservation Agriculture based Sustainable Intensification like Zero Tillage Technology, Crop Residue Retention and Crop Diversification are followed then the overall holistic benefits derived out of this would have a large-scale impact on soil, environment, system, crop productivity, natural resources and more importantly our farmers get benefitted immensely.

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Micropropagation in Fruit Crops

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Introduction

India is the second-largest producer of fruits in the world after china. Due to diverse agro-climatic conditions, many tropical, subtropical and temperate fruits are being cultivated in India. Large-scale cultivation of some important fruit crops has been impeded due to the unavailability of quality planting material. Thus, the micropropagation is a proven means of producing millions of clonal, true-to-type quality plants through a variety of tissue and cell culture methods. Micropropagation implies the aseptic culture of small sections of plant tissues and organs such as leaf, stem, seed, etc., in a closed vessel with defined culture medium and under controlled environmental conditions. The technique has been referred to as micropropagation because of the size of the tissue in culture medium is smaller than the conventional method. The size of meristem tissue used for in vitro raised plants is about 0.1-0.5 mm, having only one or two leaf primordia. Micropropagation is the most popular and widely commercialized global application of plant biotechnology in horticulture for production of disease-free elite planting material. A large number of plants are being cloned and exploited commercially worldwide through micropropagation.

Types of Micropropagation

1. Regeneration from existing meristems: This is also termed as axillary shoot proliferation. The existing meristems including shoot tip or nodal bud are cultured on the various types of media fortified with different plant hormones, alone or in combination. Generally, shoot proliferation depends on the kind of growth regulator used. For axillary shoot proliferation, the mostly used plant hormones are kinetin, benzyl aminopurine (BAP) and 2-isopentenyl adenine (2-ip). The regenerants are considered to be genetically stable. Normally, the process of shoot tip culture is more successful in banana micropropagation.

2. Regeneration from adventitious meristems: Shoot multiplication (either directly or via callus formation) can be obtained through inducing adventitious shoot production on mature plant organs like leaves, stems, and roots. For the initiation of adventitious meristems, a proper combination of hormones is required in the culture medium. In general, shoots are formed when a high ratio of cytokinin to auxin is present, and the reverse is true for root formation. The plants regenerated through this method are not always genetically stable, because of the formation of mixoploids.

3. Regeneration by Somatic Embryogenesis: The somatic embryos are bipolar structures that possess both shoot and root meristem and originate from somatic or/and vegetative cells. It requires a high level of auxin in culture medium for induction, followed by low auxin and cytokinin concentration in the culture medium. Somatic embryos may arise directly on explants or liquid suspension cultures or through callus formation. The somatic embryos may act as synthetic seeds after encapsulation, which is an attractive alternative for the propagation of plants. Embryos developed via tissue culture techniques are mixed with sodium alginate and dropped with a pipette into a calcium salt like calcium chloride solution to form calcium alginate capsules. The capsules are washed with the help of water and then placed on a culture medium for germination. Artificial seeds have been produced in some fruit crops like kiwi fruit banana, mango, citrus, olive, and apple.

Stages Involved in Micropropagation

Stage 0: Explant source and mother plants: The success of micropropagation is mainly dependent on the quality and growing condition of the source plant. Effective selection and maintenance of source plants should provide assurance that the plant has the characteristics like true-to-type, free from disease and endogenous contamination; or may become pathogen-free when using in vitro culture and viable and vigorous. Stock plants should be grown and maintained in air-locked conditions, environmentally controlled glasshouses or screen houses and tunnels, or in well-marked field plots and forests.

Stage I: Explant Establishment: The establishment of explants largely depends on several factors such as size of explants and type of explants used like root, leaf, and stem from mature and immature plants or seedlings, types of sterilizing agents, explant sterilization process used and the micropropagation culture conditions like culture media, composition, humidity, temperature and light. The explants showing growth are considered established.

Stage II: Rapid multiplication: The well-established explants are subculture on shoot multiplication culture medium. The medium is fortified with such growth regulators or hormones that avoid callus formation and cause multiplication of established explants. Thus, the proper use of hormonal combinations results in multiplication. Hence, careful use of auxins such as IAA, NAA, and 2,4-D and cytokinin (known to enhance shoot multiplication) such as BAP and kinetin is done in the culture medium.

Stage III: Rooting of shoots: The in vitro regenerated shoots are transferred into the medium which containing auxins (known to enhance rooting) viz. IAA, NAA, and IBA. The rooting can also be induced on medium devoid of growth hormones because of stress conditions. The rooting should also be preferable without the formation of callus, thus avoiding soma clonal variants.

Stage IV: Hardening and transfer to soil and field: The in vitro rooted plants are weaned and hardened before transferring to the field. In general, the hardening is done by growing the in vitro rooted plants in the greenhouse under high to low humidity and low light intensity to highlight intensity. The plants are then transferred to an appropriate substrate including sand, peat, compost, etc and finally in fields.

Methods of Disinfection of the Explants

Sterilization, disinfection and personal hygiene are playing a vital role in creating and maintaining an aseptic environmental condition and production of contamination-free plants. Generally, commercial laboratories are equipped with autoclaves a bulk media sterilizer which are used for media, container, and tool sterilization. For large-scale sterilization may carry out by using gamma irradiation or ethylene oxide gas treatment. Contamination in tissue culture media can occur from two sources: either through carryover of microorganism in the tissue itself (endophytic microbes) or on the surface of explant. Explants such as shoot tips, stems and seeds are first cleansed, often with combinations of disinfectants, detergents, agitation, and water rinses. Disinfection treatments usually include household bleach and alcohol. The surface sterilizing agents such as calcium hypochlorite, sodium hypochlorite and mercury chloride can be used for sterilization of explants. The systemic sterilizing agents such as Bavistin (fungicide) and streptocycline (bactericide) can also be useful for the prevention of contamination. The above chemicals may be used alone or in combination to enhance the survival rate of explants during sterilization.

Problems Encountered During Micropropagation

1. Contamination: Due to the bacterial or fungal contamination in the cultures do not allow the explant to grow. The problem can be overcome by growing source plants within growth chambers, application of systemic fungicide prior to explant removal, effective explant sterilization and using sterilized surgical instruments during an operation. Fumigation of the inoculation room or chamber with the help of a dilute formaldehyde solution also helps to reduce the problem.

2. Release of phenolic compounds: The cultured explants of certain plant species such as date palm, banana, guava, etc. are secreting phenols into the medium, that cause browning as a result of oxidation of phenols and formation of quinones. The application of antioxidants such as polyvinylpyrrolidone (PVP), citric acid or ascorbic acid, activated charcoal and polyvinylpolypyrrolidone (PVPP) during sterilization and in the culture medium which helps to prevent the browning.

3. Variations in tissue culture-raised plants: In micropropagation variability occurs as a result of callusing and regeneration of plants from callus instead of direct shoot induction and proliferation. The variability is highly undesirable in micro propagated plants. The plants regenerated through adventitious meristems than axillary meristem is more susceptible to mutations, as it is originated from either a single cell or a small group of cells. This may account for variation in regenerated plants. The variation because of callusing can be stopped via the addition of plant hormones that inhibit callusing like phloroglucinol, triiodobenzoic acid (TIBA), and phloridzin and also by reduction of inorganic salt concentration in the culture.

4. Mortality in greenhouse: Generally, micro propagated plants have different leaf morphology, malfunctioning of stomata (open), poor photosynthetic efficiency, and reduced epicuticular waxes and thus are amenable to transplantation shock. Thus, the hardening of such plants is needed before transplantation under field conditions.

Advantages of Micropropagation

1. It may produce disease-free plant material with the possibility of eliminating viral, fungal, and bacterial contamination.
2. The ability to safely transport or store large quantities of plant material quickly, efficiently and relatively inexpensively.
3. Round the year availability of plants irrespective of seasonal constraints.
4. Fast and large-scale multiplication of true-to-type planting material in a short time period.
5. It may help in the conservation of plant diversity
6. It is highly beneficial in dioecious fruit plants such as date palm and papaya, where the production of female plants in a large scale is possible.
7. Very small pieces of plant tissues and organs are needed to initiate aseptic cultures.
8. It is applicable to many such plant genotypes for which in vivo vegetative propagation is difficult or impossible.

Disadvantage of Micropropagation

1. Its facilities are very costly.
2. It required highly technical skills to carry out different procedures.
3. If once pathogens appear in the system, multiply at a very fast rate and deteriorate the entire culture.
4. Some plants such as mango, date palm, coconut, etc. having high levels of phenols which usually do not respond to micropropagation.
5. The establishment of in vitro raised plants in the field is a very difficult and challenging task.

Conclusion

In the very fast developing scenario of biological science, the in vitro propagation has taken lead as the most promising areas of application of biotechnological tools in horticulture. The rapid production of uniform, high quality and disease-free elite planting material is only possible through micropropagation. Plant production can be carried out throughout the year irrespective of seasonal constraints. Shoot culture with the proliferation of axillary shoots is a reliable and simple method of in vitro propagation to maintain the genetic integrity of clones. Meristem culture is widely used to obtain virus- and disease-free plants. Recently, methods of regenerating adventitious shoots or embryos from explants, callus or protoplasts have met with increasing success with fruit crops and may have the potential for rapid propagation, provided genetic integrity of the micro propagated plants with respect to the mother plants is retained.

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Locust and Grasshopper: Behavioural Penchant

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Introduction

Difference between Locusts and Grasshoppers: Locusts are members of the grasshopper family Acrididae, which includes most of the short-horned grasshoppers. Locusts differ from grasshoppers because they have the ability to change their behaviour and physiology, in particular their colour and shape (morphology) in response to changes in density. Adult locusts can form swarms which may contain thousands of millions of individuals and which behave as a unit. The non-flying nymphal or hopper stage can form bands. A band is a cohesive mass of hoppers that persists and moves as a unit. In general, most grasshoppers do not form bands or true swarms.

Tree locust have never been known to form bands and some of the grasshoppers do form bands (e.g. *Melanoplus, Acridoderes, Hieroglyphus* sp.) or small loose swarms (e.g. *Oedaleus senegalensis*). At high densities, Senegalese grasshoppers show incipient gregarious behaviour, with a clear tendency to form hopper bands and swarms. This gregarious behaviour has been reported several times, with respect to hopper instars, by (Joyce ,1952).

During December, 2019 numerous immature swarms continued to form in west Rajasthan, Bikaner, Jodhpur, Nagaur, Suratgarh districts of Rajasthan and Bhuj, Rann of Kutch of Gujarat area and treated 1,60,228 ha. Total 3,08,802 ha area has been treated in SDA of India up to 30th December, 2019 (FAO, 2020).

Swarm Formation

The first swarms usually form some tens or even hundreds of kilometres downwind from the main laying area. Swarms can occur as low-flying sheets (stratiform) or the locusts may pile high in the air (cumuliform), similar to hanging curtains, with the top level as much as 1500 m above ground. Stratiform swarms are flat, usually tens metres deep, and often occur during cool, overcast weather or in the late afternoon.

Cumuliform swarms are associated with convective updrafts on hot afternoons, especially common during the warmer and drier months of the year. Swarm densities vary considerably. The generally accepted figure for an average medium-density settled swarm is about 50 million locusts/km2 (50 locusts/m2) whereas the range is 20-150 million/km2. Swarms spend the night roosting in vegetation. At sunrise, they descend to the ground and warm up by basking in the sun.

By mid-morning, swarms take off and will often continue flying until just before sunset when they land and feed. If the weather is unusually hot, swarms may settle at midday before flying off again in the afternoon. A 1 km^2 size swarm contains about 40 million locusts, which eat the same amount of food in one day as about 35,000 people, 20 camels or 6 elephants (Zhang et.al., 2019).

Migration and Seasonal Distribution

The seasonal changes in the mean wind flow bring locusts into particular zones during particular seasons. For example, locusts move southwards from northwest Africa into the Sahel of West Africa at the beginning of the summer. During the autumn, they move northwards again but low temperatures at night limit the movement of night-flying solitaries compared with day-flying swarms.

Studies have shown that Senegalese grasshoppers, like many acridian species in West African Sudanian and Sahelian areas, can fly very long distances carried by the winds at night. These movements represent a form of seasonal migration between successively suitable breeding areas. Increasing evidence has been reported over the last 30 years that Senegalese grasshoppers and many Sahelian locust species undertake long-range nocturnal migration flights (Reynolds and Riley, 1988).

Reasons for Outbreak

Overgrazing is a common cause of outbreaks for some species such as the Moroccan locust (*Dociostaurus maroccanus*) in North Africa and central Asia where sheep create favourable conditions for gregarization (Latchininsky, 1998). For the grasshopper *Oedaleus asiaticus* in northern China, heavy livestock grazing and consequent grassland degradation promote outbreaks, perhaps by reducing plant protein content (Cease *et. al.,* 2012).

Tools Used to Predict Locust Outbreaks

1. eLocust2
2. SWARMS (Schistocerca Warning and Management System)
3. RAMSES (Reconnaissance and Management System of the Environment of Schistocerca).

Anstey et. al., (2009) studied and concluded that Desert locusts, *Schistocerca gregaria*, show extreme phenotypic plasticity, transforming between a little-seen solitarious phase and the notorious swarming gregarious phase depending on population density. An essential tipping point in the process of swarm formation is the initial switch from strong mutual aversion in solitarious locusts to coherent group formation and greater activity in gregarious locusts. They show here that serotonin, an evolutionarily conserved mediator of neuronal plasticity, is responsible for this behavioural transformation, being both necessary if behavioural gregarization is to occur and sufficient to induce it.

Gregarious behaviour in desert locusts is evoked by touching their back legs was proved by Simpson et. al., (2001) where they studied Desert locusts in the solitarious phase which were repeatedly touched on various body regions to identify the site of mechanosensory input that elicits the transition to gregarious phase behaviour. The phase state of individual insects was measured after a 4-h period, A significant switch from solitarious to gregarious behaviour occurred when the outer face of a hind femur had been stimulated, but mechanical stimulation of 10 other body regions did not result in significant behavioural change.

Lockwood et. al.,(2002) studied the Reduced agent-area treatment (RAAT) as a pest management strategy in which the rate of insecticide is reduced from traditional levels and untreated swaths (refuges) are alternated with treated swaths:
1. For infestations of 0-15 grasshoppers/m2 treatments are very unlikely to yield a profit for the producer.
2. For moderate infestations of 15–30 grasshoppers/m2, the 280-50 (280 g ai/ha applied to 50% of the infestation using 30 m swaths) RAAT strategy is predicted to yield optimal or near-optimal results.
3. For heavy infestations (>30 grasshoppers/m2) it may be necessary to increase the rate of application from 350 to 450 g ai/ha while treating 50% of the infested land.

Effects of FABP knockdown on flight performance of the desert locust, *Schistocerca gregaria*-was studied by Rajapakse et. al., (2019) in which they observed that During migratory flight, desert locusts rely on fatty acids as their predominant source of energy. Lipids mobilized in the fat body are transported to the flight muscles and enter the muscle cells as free fatty acids. It has been postulated that muscle fatty acid-binding protein (FABP) are needed for the efficient translocation of fatty acids through the aqueous cytosol towards mitochondrial β-oxidation.

To assess whether FABP is required for this process, dsRNA was injected into freshly emerged adult males to knockdown the expression of FABP. Three weeks after injection, FABP and its mRNA were undetectable in-flight muscle, indicating efficient silencing of FABP expression. At rest, control and treated animals exhibited no morphological or behavioural differences. In tethered flight experiments, both control and treated insects were able to fly continually in the initial, carbohydrate-fueled phase of flight and in both groups, lipids were mobilized and released into the haemolymph. Flight periods exceeding thirty minutes however, when fatty acids become the main energy source were rarely possible for FABP-depleted animals, while control insects continued to fly for more than 2h. These results demonstrated that FABP is an essential element of skeletal muscle energy metabolism in vivo.

Conclusion

Locusts are not dangerous as long as they are individual hoppers or small isolated groups of insects, what is call as solitary phase as all Locusts are grasshopper but not all grasshoppers are Locusts , a transition in their behavioural ethology is observed based on number of factors like grazing, serotonin level, presence of fatty acids as energy sources etc.

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Different Methods of Detection of Phytoplasma

Article ID: 31325

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Phytoplasma

Phytoplasmas are obligate parasites of plant phloem tissues. Phytoplasmas are cell wall less organism. size of the phytoplasma is ranges from 0.1μm to 0.8 μm diameter. It has pleomorphic or filamentous shape. Phytoplasmas are very difficult to identify because of their erratic distribution and low concentration in the phloem of infected plant.

Detection of *Phytoplasma*

BIOLOGICAL METHODS
- SYMPTOMALOGY
- HOST RANGE
- TRANSMISSION

MICROSCOPIC TECHNIQUES
- LIGHT MICROSCOPIC
  - **DIENE'S REAGENT**
- ELECTRON MICROSCOPIC
  - **SEM**
  - **TEM**
- FLUORESCENCE MICROSCOPIC
  - **DAPI STAIN**
  - **FISH**

SEROLOGICAL TECHNIQUES
- ELISA

MOLECULAR TECHNIQUES
- PCR
- NESTED PCR
- RT-PCR
- RFLP
- LAMP

MICROSCOPIC TECHNIQUES

Light Microscopic Technique by Using Diene's Stain

Mycoplasma colonies with Diene's stain

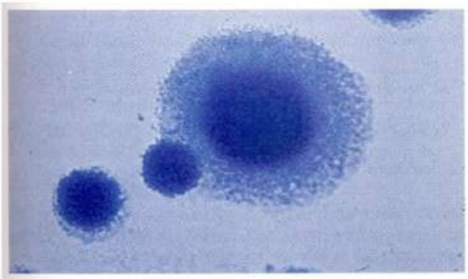


Figure 21-16
Diene's stain of *Mycoplasma* spp. colonies demonstrating typical "fried egg" appearance.

1. Take a portion from both infected and healthy plant
2. Portions are cut into small pieces
3. Pieces are washed with distilled water
4. Incubated with diene's stain for 10 minutes
5. After incubation section are washed with distilled water
6. Observed under the light microscope
7. Section from infected plant emit blue under microscopic observation

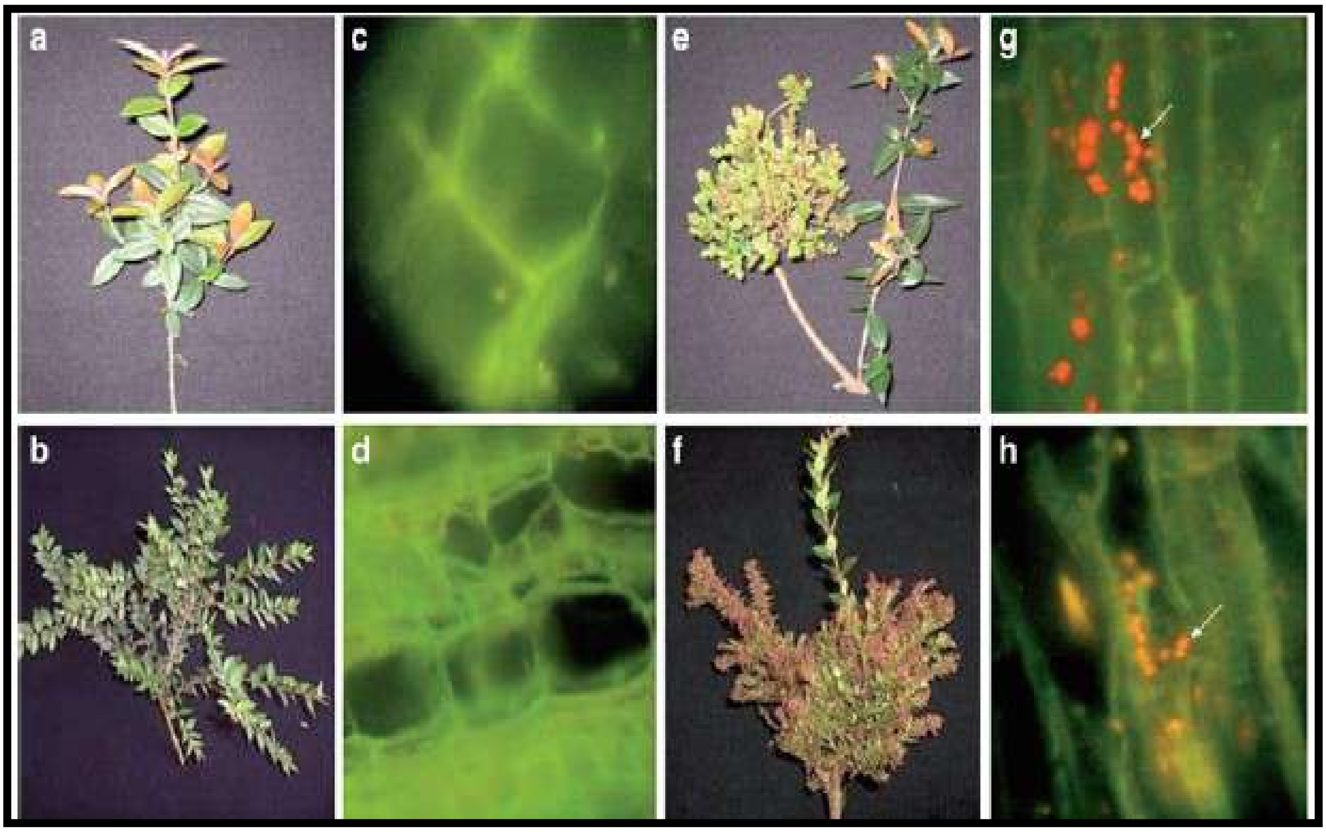
Fluorescence Microscopic Techniques by Using Dapi Stain

1. Requirements:

a. Ugni molinae, Gaultheria phillyreifolia.
b. DAPI stain(4,6 diamidino-2-phenylindole).
c. 5% gultaraldehyde.
d. 0.1 M phophate buffer.
e. Freezing microtome.
f. Fluorescence microscope.

2. Procedure:

1. Take petiole or leaf from both healthy and infected plant
2. Taken portions are cut into small pieces with size of 1cm
3. And then washed with 5% gultaraldehyle and kept for 25 minutes
4. After 25 minutes, washed with distilled water
5. Then pieces are placed into freezing microtome for make the pieces in 2-5µm
6. After that, pieces are dipped in the solution contains DAPI stain kept for 20 minutes
7. After 20 minutes, washed with distilled water and immediately mount on the slide and observed under fluorescence microscope.
8. a, b: Symptomless plant tissues (control) of *Ugni molinae*, *Gaultheria phillyreifolia*
9. c, d: Phloem tissues stained with DAPI
10. e, f : Witches' broom symptoms in *U . molinae* and *G . Phillyreifolia.*
11. g, h: Phloem tissues stained with DAPI emits fluorescence.



Conclusion

1. Before molecular techniques were developed, the diagnosis of phytoplasma diseases was difficult because they could not be cultured.
2. Thus classical diagnostic techniques, such as observation of symptoms, were used. Ultrathin sections were also examined for the presence of phytoplasmas in the phloem tissue of suspected infected plants.
3. Diagnostic techniques such as ELISA test which allowed the specific detection of the phytoplasma began to emerge in the 1980s.
4. In the early 1990s, PCR-based methods were developed that were far more sensitive than those that used ELISA, and RFLP analysis allowed the accurate identification of different strains and species of phytoplasma.

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e-Gram Swaraj And Swamitva Portal

Article ID: 31326

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Prime Minister Narendra Modi on 24 April 2020, Friday (On the occasion of Panchayati-raj day) launch of e-Gram Swaraj and Swamitva App. A portal for the e-Gram Swaraj has also been launched by the government of India. Purpose of this portal to strengthen e-Governance in Panchayati Raj Institutions (PRIs) across the country, Ministry of Panchayati Raj (MoPR) has launched e-Gram Swaraj, a user-friendly web-based portal. E-Gram Swaraj aims to bring in better transparency in the decentralised planning, progress reporting and work-based accounting. The scheme is to be initially launched in six states namely Karnataka, Maharashtra, Uttar Pradesh, Haryana, Uttarakhand and Madhya Pradesh.

Key Point of e-Gram Swaraj Portal Web Portal

To bring in better transparency and strengthening of the e-Governance in Panchayati Raj Institutions (PRIs) across the country through decentralized planning, progress reporting and work-based accounting.

1. It will also assist in enhancing the credibility of Panchayats which would induce greater devolution of funds to PRIs.

2. It will help in establishing a strong financial system by integrating the Panchayati Raj Institutions Accounting Software and Public Financial Management System (PFMS).

3. The PRIASoft (Panchayati Raj Institutions Accounting Software) is the Online Payment Module where by Gram Panchayats are carrying out online payments to the vendors and service providers.

4. The main objective of introducing such a module is to have a sound financial management system in the Panchayats leading to their greater credibility and image.

5. These endeavours are also congruent to that of Digital India Programme which is to transform India into a digitally empowered society and knowledge economy.

Key Point of Swamitwa App

1. The scheme aims to provide an integrated property validation solution to rural India. In order the demarcation of the lands and village properties, the Ministry of Panchayati Raj is to use drone technology.

2. To reduce the dispute of land and properties.
3. Facilities of bank loan on properties given by the government.
4. The ministry is to be joined by State Revenue Department, Panchayati Raj Department and Survey of Indi.

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Goat Farming - A Profitable and Productive Enterprise Producing Quality Milk, Meat, Hair Skin, Wool, Pelt, Mohair and Pashmina Etc.

Article ID: 31327

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Introduction

Goat is considered as the first ruminant to be domesticated by human beings between 10000 and 6000 years before Christ (BC) in South-western Asia. Goat significantly contributed to the national economy by providing, meat, milk, skin, fibres, manure etc. Goats also contributed appreciably to nutritional security of rural livelihood by providing animal protein through meat and milk. In India, about 24 breeds of goats have been identified phenotypically and registered at National Bureau of Animal Genetic Resources, Karnal.

Goats are generally managed under extensive production system followed by semi intensive production system, where only night shelter is provided. However, now-a-days farmers are taking more interest for rearing under intensive production system for commercial purposes.

Goat rearing in India has certain limitations such as lack of genetic improvement programme, lack of health care facilities, limited feed and fodder resources and marketing problems etc. In addition, inefficient and inappropriate production systems along with poor strategies for improved natural resource management and inadequate support have led to low productivity of small ruminants. The level of adaption of breeding, feeding and nutrition and health related techniques by the farmers are not satisfactory.

Medicinal Values of Goat Milk

1. Goat milk is finer than cow milk i.e. the fats and proteins are present in a finer state and are more easily digestible, especially by children and invalids. Goat milk has lesser allergic problems than other species of livestock.
2. Goat milk is used as an ayurvedic medicine for personas ailing with asthma, cough, diabetes etc.
3. Goat milk has higher buffering qualities and this enhances its value for patients suffering from peptic ulcers, liver dysfunction, jaundice, biliary disorders and other digestive problems.
4. Goat milk has higher phosphate content, which is beneficial for vegetarian communities.
5. Goat milk has a higher content of B-complex vitamins.
6. Goat milk is suitable for preparing various milk products.
7. Goats can be milked as often as required, preventing milk storage problems and refrigeration costs.
8. Goat milk has 9 minerals more in number than any other milk used for human consumption.

Utility of Goat Meat

Goats are the main meat-producing animals in India, whose meat (chevon) is one of the choicest meats and has huge domestic. Due to these fast-socio-economic changes in the recent past, a rapid shift has taken place in the dietary habits in favour of non-vegetarian diet. Goat meat has high demand in India which accounts Rs. 380-450/kg presently.

Advantage of Goat Meat

1. It contains lower value of saturated fats, cholesterol and high value of unsaturated fats thus it is safe for the heart and reduces the risk of cardiovascular disease and other chronic problems.

2. Unsaturated fats found in it improves the good blood cholesterol levels, provides relief from inflammations and etc.

3. It contains lean proteins in high amount, low saturated fat thus helps in controlling weight and reduces the risk obesity.

4. Proteins found in it acts as a hunger suppressing agent and keeps the stomach full for longer time thus helps in controlling weight.

5. It contains lots of vitamins and nutrients which help in burning fat.

6. It prevents from anaemia during pregnancy to both mother and baby by increasing the blood haemoglobin level in mother and enhancing blood supply to the baby as it contains high iron level (3mg iron/100g of goat meat).

8. It prevents from other iron-deficiency diseases, reduces the risk of birth defects among new born babies, neural tube defects and etc.

9. It contains B group vitamins, selenium and choline which is very beneficial to be prevented from cancer.

10. It helps in iron recovery among women during menstruation and provides relief from the menstrual pain.

11. It provides better nourishment to the skin and makes it healthy, soft, supple, glowing and smooth.

12. It provides relief from the skin problems like psoriasis, eczema or acne and other problem by nourishing the skin.

13. It also provides relief from the dry skin and rashes problems by making the skin soft and supple.

14. It reduces the risk of infections, type 2 diabetes and other diseases if eaten regularly.

15. It contains low sodium level and high potassium level thus safe food for the heart and prevents from the high blood pressure, risk of stroke, kidney diseases and etc.

16. It contains niacin vitamin which involves in promoting the energy metabolism.

17. It provides better nourishment to the bones, teeth and hairs thus prevents from osteoporosis, joints pain, tooth ache and hair loss.

18. It helps in improving the power of immune system and prevents from various infections.

19. It helps in maintaining the functioning of thyroid gland and prevents from the early ageing as it protects from the free radicals.

20. It normalizes the blood sugar level thus keeps blood sugar level under control among diabetic patients.

21. It enhances the memory power among kids by helping in proper brain development.

22. Goat meat is called as chevon and so chevon leg soup is very famous, delicious and healthy for the health especially bones. It is rich in calcium and helps in bone building and teeth strengthening. It enhances producing new body cells thus delay the aging.

23. It is good for weight watchers as it is rich in protein which keeps stomach full longer.

Goat Manure

Manure are the excreta of the animals and bedding materials of the animals. Goat manure is great for fertilizing to the fields. An average goat produces over a ton of manure every year, and the feces are in pellet form, which makes them easy to handle. Goat manure is a good source of NPK possibly other minerals as well. Goat manure helps maintain the soil fertility. Goat urine is equally rich in both nitrogen and potash, and is more valuable than that of any other animal. Goat manure fetches ready cash to the owner. He usually leaves the goat to graze on stubbles in the field and is paid by the farmer for his field being thereby manured. It is said that one hectare of land receives a sufficient dressing of manure if 4800 goats are folded there for a night. Goat manure is 2.5 times richer in nitrogen and phosphoric acid than cow manure.

Goat Skin

The outer coverings of small domestic animals and wild animals are called skins. Skins are smaller in size, thinner in substance and lighter in weight than hides. The maximum numbers of goat skins are produced in India due to an annual removal of goat of approx. 45%. The finest quality skins for the leather industry are obtained from the Black Bengal goat, and are exported to many countries, particularly to the USA, where they are mostly used in the shoe industry.

Goat skins are of two types viz. Amritsar and Calcutta. The former is used as lining for shoes and the latter are used for shoe uppers. The importance of goat leather is well known in spite of the fact that their availability is less than 10% of total leather production. The classic glazed kid leather is among the best in high quality shoe leathers, having a steady position in the area of orthopaedic women's shoe upper. This is because one can use the skin almost in its full thickness on the shoe uppers of less than 1.0 mm. this is due to the specific structure of the goatskin, it is tight fibred and has a very tough grain layer, providing an outstanding form-stability and therefore an excellent support for the foot.

Uses of Goat Skin

Leather is used for car & furniture upholstery, luggage, wall painting, gloves, hats, coats, dress, handbags, wallets, bookbinding's & numerous other products. In the world of sports, leather is essential-cricket, soccer & rugby ball are made by leather. And then there are such items as boxing gloves & head guards, football, boots, saddles & harnesses, ski & riding boots, leather gloves & leather covered steering wheels help racing drivers to keep they're under precise control. Protective motorcycle racing leather has helped to reduce serious injuries in accidents. The biggest use of leather is in the manufacture of shoes.

Utility of Goat Pashmina

Pashmina can also be defined as the undercoat fibre derived from Cashmere goats with a diameter of 30 microns or less. Pashmina has derived its name from the Persian word meaning soft gold or the king of fibre. It is well known for its fineness, warmth, softness, desirable and aesthetic value. It is most luxurious fibre which is much softer than superfine merino wool of the same diameter with the result it commands much higher price. It has occupied a unique position among the fibres of animal origin because of its warmth, lightness, handle and its better ability to absorb dyes and moisture. On equal weigh basis, it is having 3 times more insulating capacity as that of wool. The term Pashmina is also known as Cashmere, kashmir, pashm, tiflit, tiftik, tivit, tibit. In India, Pashmina is obtained from Ladakh region of Jammu and Kashmir, Lahul and Spitti valley of Himachal Pradesh, Uttar Kashi, Chamoli and Pithargarh districts of Uttranchal. The Pashmina obtained from Jammu and Kashmir is known as Changthangi Pashmina whereas that obtained from H.P and Uttranchal is known as Chegu pashmina.

Harvesting of Pashmina

Pashmina fibres can be collected during spring moulting season when animals naturally shed their winter coat. On the basis of weather conditions and region, the goats start moulting over a period from Feb to late May. In India combing is the major way of harvesting Pashmina. Since combing and manual separation is labour intensive so combing is sometimes replaced by shearing. Shearing followed by mechanical dehairing has become a common practice in Australia and New Zealand but in Iran the process of shearing was combined with laborious manual dehairing. In India combing/shearing followed by laborious manual dehairing was a common practice but has now changed to combing/ shearing followed by machine dehairing on the modified cotton cards.

Utilization of Pashmina

Pashmina is utilized for the development of aesthetic products like Knitwear in Scotland, woven fabrics as blends in Italy and Switzerland. After spun into yarns, pure Pashmina can be knitted into jumpers, hats, gloves, socks and other clothing or woven into fabrics than cut and assembled into garments such as outer coats, jackets, pants, pajamas, scarves, blankets and other items. However, in India, majority of Pashmina is utilized for preparation of shawls in Kashmir valley. The shawl preparation is hand woven only and involving labour in sorting, spinning and weaving on specified handlooms.

Goat Mohair

It is produced by Angora goat and similar to the wool in chemical composition, but differ in mohair fibre are smoother surface and non-insulating used for summer cloth. It is more lustre than wool and also 2 to 2.5 times stronger than wool. Mohair is also known as Diamond fibre. Mohair is warm in winter as it has excellent insulating properties, while remaining cool in summer due to its moisture wicking properties. It is durable, naturally elastic, flame resistant and crease resistant.

Utilization of Mohair

Mohair is used in scarves, winter hats, suits, sweaters, coats, socks and home furnishing. Mohair fibre is also found in carpets, wall fabrics, craft yarns, and many other fabrics, and may be used as a substitute for fur. Mohair is a very soft yarn when compared with other natural and synthetic fibres.

Sheep Wool

Wool production begins with several basic concepts. Along with the fibre diameter, fibre length, and the amount of vegetable matter and any other foreign material in the fleece affect wool quality. fibre diameter varies by breeds of sheep and is used to determine the purpose of the wool. Wool made up of smaller diameter fibres or fine wool is used for clothing while wool made up of larger diameter fibres or coarse wool is used for carpets and rugs. Below are more details about wool production and wool quality.

1. Wool Yield: As wool comes off the sheep it is called grease wool. This is because the lanolin in the wool gives it a greasy feel and appearance.

2. Fibre Diameter: fibre diameter is probably the most important factor for determining the quality of wool and its value. As the fibre diameter increases, it changes the way wool is used.

3. Crimp: Crimp is another wool characteristic highly related to fibre diameter.

4. Vegetable Matter: Vegetable matter in wool comes from feed particles as well as burs, seeds, twigs, leaves, and grasses.

5. Fibre Length and Strength: The staple or fibre length affects how the wool can be used.

6. Fibre Colour: The whiteness of wool is very important if the fibres are not expected to be dyed or will be dyed a light colour.

7. Cotted or Felted Fleeces: Occasionally, the wool fibres may become matted or felted together.

Improving

8. Wool Quality: Wool quality can be affected by genetic and environmental influences. Genetic influences would be to select sheep with higher quality wool, while environmental influences might include nutrition, sheep management, and shearing management.

Conclusion

Sheep & Goat farming has huge scope and demand in India as purchasing power of majority of people is increasing. Goat provides nutritious milk, meat, mohair, pashmina with good fertilizing manure, whereas sheep provides meat, wool, pelt & faeces with high fertilizing capacity. Hence small ruminant rearing has a great promise as source of income and employment and livelihood security of resource poor rural people throughout the country in general and the arid and semi-arid regions in a particular. However, there is a need for appropriate policy and institution for transfer of need based technologies, linking with smallholders with the market, value addition and safeguards mechanism in face of increased competition due to globalization and climate change.

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Interaction Between *Pasturia* spp and Plant Parasitic Nematodes

Article ID: 31328

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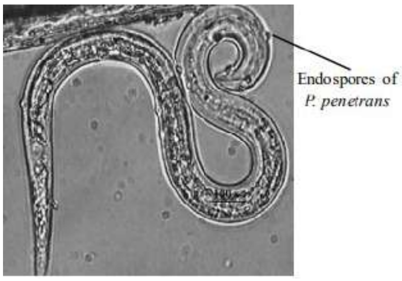
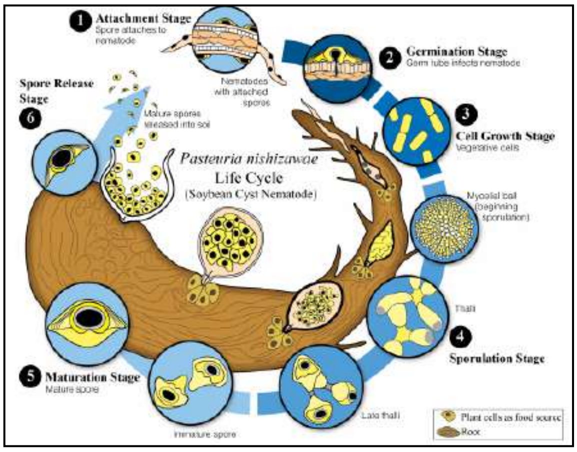
Introduction

Pasteuria penetrans is an endospore-forming bacterium that persists in the soil until a suitable nematode host encounters the spore (Bekal et al., 2001). The *Pasteuria* spores adhere to the nematode cuticle (outer surface), infect the nematode and develop inside of the nematode body. The endospores produced by *Pasteuria* spp. are both a resting propagule, highly resistant to adverse conditions such as high temperature or desiccation, and an infective stage responsible for the parasite horizontal transmission (Aurelio 2018). *Pasteuria* spp. are probably the best characterized endosymbionts of plant-parasitic nematodes against which shown a great potential as biological control agent.



Species of *Pasteuria* and their Hosts

1. *P. penetrans*: Root knot nematodes, *Meloidogyne* spp.
2. *P. thornei*: Root-lesion nematodes, *Pratylenchus* spp.
3. *P.nishizawae*: Cyst nematodes of the genera *Heterodera* and *Globodera.*
4. *P. usage*: Sting nematode *Belonolaimus longicaudatus*.
5. *P. goettingianae*: Pea cyst nematode, *H. goettingiana.*
6. *P. hartismerei*: Nematode pathogens of birch (Sharad et al 2018).



Interaction of the *Pasteuria nishizawae* and *Heterodera glycines*

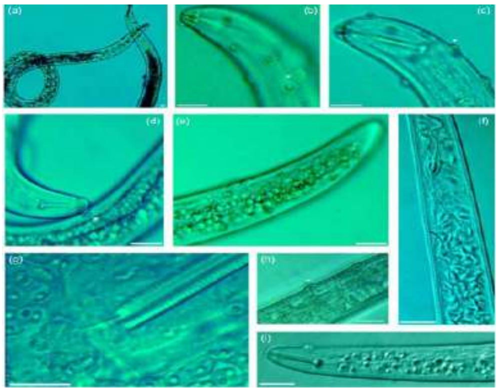
Life Cycles on the Root of Soybean

The endospores of the bacterium started germination and penetrated into the host nematode in about three days after infection. After penetration, bacterial thalli started spreading inside the post-parasitic second-stage juvenile nematode. Spherical colonies of the bacterium were formed with dichotomously branched mycelium in about 14 days after infection, coinciding with the nematode reaching third-juvenile stage. Four-celled stage of the bacterium was observed in about 18 days after infection. This parasite then fragmented into 2 cell stage which developed into unicellular stage on the 24 th day by further fragmentation. The mode of infection, developmental stages, sporogensis are similar as those described by

Mankau and Imbriani (1975). Mature spores of the bacterium were formed in about 30 days after infection synchronizing with females reaching the adult stage (Swarnakumari et al 2016).

Pathogenic Mechanisms of *Pasteuria*-Nematode Interaction

Endospores of *Pasteuria* spp. bacterial parasites adhering to or within host nematodes. Endospore-encumbered living *Helicotylenchus* sp. in water mounts (a). The cup-shaped aspect of endospores (arrowhead) is visible in top (b) or lateral views (c). Specimen of *Tylenchorhynchus ventrosignatus* scrubbing its cuticle to remove endospore attached at mid body (d) and tail (e). Endospore-filled *Dolichodorus* sp. (f), *Labronema* sp. (g), and juvenile *Tylenchulus semipenetrans* (i). Germinating endospore penetrating the cuticle of a juvenile *Heterodera goettingiana* (h).



Mass Multiplication

The most common method of mass multiplying was developed by Stirling and Wachtel (1980).

1. J2 of Meloidogyne spp. encumbered with at least 4-5 spores per J2 are inoculated on tomato plants.
2. The roots are harvested after 45-50 days and air dried for at least 2 days.
3. The dried roots are then ground in a willey mill to obtain root powder containing spores, which is then used as inoculum.

Effect of *Pasturia* on Root Knot Ant Cyst Nematodes

1. Larvar mobility is affected.
2. Reduced penetration capacity of nematodes.
3. Inhibits egg formation.
4. Reduction in juvenile and cyst formation in soil.

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Detection of *Rhizoctonia solani*: A Continuum from Conventional to Latest Trends

Article ID: 31329

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Introduction

Rhizoctonia solani described by Julius Kuhn on potato in 1858. It is a basidiomycete fungus that does not produce any asexual spores (called conidia) and occasionally produce sexual spores (basidiospores). It reproduces asexually and exists primarily as vegetative mycelium and/or sclerotia. Cells lack clamp connections, but possess a complex dolipore septum and multinucleate. It does not produce conidial structure, and produce ellipsoid to globose barrel shaped cells named moilioid cells produced in chains and can give rise to sclerotia. Sclerotia are irregularly shaped, and light to dark brown in colour. It is a heterogeneous species, with different anastomosis group varying in cultural, morphology and pathogenicity.

R. solani is a soil borne pathogen having broad host range, causing diseases of cereals, pulses, vegetables, turf grasses, ornamentals, and fruit and forest trees. It causes 20% yield loss in India and 50% in Asia solely due to sheath blight (Sridevi *et. al.,* 2009). Yield loss in China due to sheath blight 1.092×10^6 tonnes (Huang *et al*, 2009. The Mutinucleate *Rhizoctonia spp.* included 14 AG of which AG 1-4 were strong pathogen and AG 6-10 were orchid mycorrhizae. Binucleate *Rhizoctonia spp.* divided into 19 AGs named as AG-A to AG-S (Ogoshi *et. al.*, 1983; Sneh *et. al.*, 1991).

Symptoms

R. solani primarily attacks underground plant parts such as the seeds, hypocotyls, and roots, but is also capable of infecting above ground plant parts (e.g. pods, fruits, leaves and stems).The most common symptoms are damping-off of seedlings, but the pathogen can also cause seedling stem canker ('soreshin' in tobacco and cotton); root lesions (brown patch in lawns and turf); affect tubers (potato – 'black scurf'), bulbs, and corms; and rots on fruits and pods lying on or close to the soil (tomatoes, eggplant, and beans).

Why Detection is Required?

To determine threshold levels of inoculum of seed and soil as *R. solani* is both seed and soil borne. For quarantine and certification programs in global trading of potato tubers.

Detection Techniques for *Rhizoctonia solani*

Different techniques are used for detection of *R. solani* such as microscopic identification, Immuno-detection, nucleic acid-based detection, spectroscopy and Imaging based techniques.

Microscopic Identification

For microscopic identification pathogen Isolate on a suitable nutrient medium and microscopically examined the hyphal structures. For isolation of *Rhizoctonia solani* 3 different methods used:

1. Plant debris particles isolation method.
2. Colonization method using stem segments of Flax, buckwheat and table beet seeds.
3. Soil-pellet method.

Morphological Characteristics of *R solani* Used for Identification

The vegetative mycelium is colourless when young but become brown coloured when grow and mature. The hyphae branch at a 90o angles. Formation of septum at hyphal branches near origin. Cells lack clamp connections, but possess a complex dolipore septum and multinucleate. Sclerotia irregularly shaped, and light to dark brown in colour.

Fluorescence Microscopy

The number of nuclei present in each cell of *Rhizoctonia* spp. used for identification and differentiation through fluorescence microscopy, using the DNA-binding dye 4,6-diamidino-2-phenylindole (DAPI) used to determine number of nuclei / hyphal cell. Differentiate *R. solani*, from *R. cerealis* as *R. solani* is multinucleate and *R. cerealis* is binucleate. Lacuna associated with this is time required to induce sufficient mycelial growth for staining. Advantages of microscopic identification is simple and disadvantages is accurate identification of *R. solani* is difficult due to absence of spores.

Immuno-Detection

Dunsunceli & Fox (1992) developed ELISA for detecting range of AG. Then mouse monoclonal antibodies (mAbs) and rabbit (polyclonal) antiserum were used to develop DIAGNOSTIC-ELISA, double-antibody-sandwich-ELISA (DAS-ELISA), DIP STICK and immunofluorescence colony staining immunoassays for the specific detection of *Rhizoctonia solani* in soil by Thoronton *et.al* 1999.mAbs were raised against AG 4 isolate of *R,solani*. The advantage is DIP-STICK techniques useful in *R.solani* detection under field conditions and disadvantage is monoclonal antibodies raised against an AG-4 isolate of *R.solani* also recognized AG-3 isolates and teleomorph *T.cucumeris* and it cross-react by ELISA, with antigens from *R.cerealis.*

Soil where pathogen is at low or dormant, earlier immunoassays ineffective and it does not allow recovery of fungus for further analyses so Thoronton *et.al* 1999 developed method for detection and recovery of *R solani* in naturally infested glasshouse soils using a combined baiting double monoclonal antibody ELISA. Advantage is detecting only live propagules of fungus, and inclusion of baiting step allowed accumulation of fungus to a level detectable by ELISA.

Lateral Flow Device

ELISA for detection of *R. solani* in soil, based in laboratories and access to specific antibodies and it unable to differentiate actively growing, quiescent, and dead propagules of fungus. So, test that can be performed by untrained personnel improve availability of *Rhizoctonia* diagnostics. Thoronton *et.al.,* (2003) develop a quick and easy diagnostic test for determination of *R. solani* in naturally infested soil .Advantage is rapid, simple, and relatively inexpensive means of detecting *R. solani* and disadvantage is positive reactions were exhibited with antigens *from Ceratobasidium cornigerum* and *R. fragariae*.

Nucleic Acid Based Detection

1. PCR and Real Time PCR: Bounou *et. al.,* (1999) developed method for specific detection of AG-3 using a PCR-based restriction mapping technique. Although this method is specific for AG-3, it requires enzyme restriction of PCR products for differentiation of AG-3 group. Also, they did not measure sensitivity of detection. So, Lees *et. al.,* (2002) developed conventional and quantitative real-time PCR assays for the detection and identification of *R solani* AG-3 in potato and soil. For that a conventional primer set (Rs1F2 and Rs2R1) designed from nuclear ribosomal ITS regions (ITS1 and ITS2) of *R. solani*. Then confirming specificity of primers for AG-3 only and detect of 5 x 10^{-4} g sclerotia /g soil in potato tissue and soil inoculated with sclerotia. In addition, specific primers RsTqF1 (based on the Rs1F2sequence) and RsTqR1, and a TaqMan™ fluorogenic probe RQP1, were designed to perform real-time quantitative (TaqMan) PCR.

2. Real Time PCR: Earlier quantitative real-time PCR assay for detection *Rhizoctonia solani* developed. These include Lees *et. al.,* (2002) and Budge *et. al.,* (2009) in which primers and probes were designed for rDNA ITS region and β-tubulin gene respectively. But areas where several solanaceous crops grown, assay which detects all subgroups of AG3 not informative for potato so a new quantitative real-time PCR assay for *Rhizoctonia solani* AG3-PT associated with potato in soil and tuber samples in Great Britain developed by (Woodhall *et.al.,* 2013) .So real-time PCR assay designed to rDNA ITS region of AG3-PT isolates which was highly specific for AG3-PT, detected directly in tuber and soil samples. It detects one sclerotia (200µg) equivalent to 8×10^{-7} g sclerotia/g of soil. Advantages are specific and sensitive for detecting and quantifying the pathogen. Disadvantages are it is costly.

Spectroscopy and Imaging Based Techniques

Severity of RCRR assessed by a visual rating based on amount of rot on taproot. This is destructive method because entire plants removed from soil and visual disease assessments affected by differences rating roots by fatigue, bias, and human error. So remote sensing an alternative method to non-destructively assess plant diseases based on measuring reflectance of electromagnetic radiation from a subject of interest, in visible, NIR, mid-IR, and thermal infrared ranges. So, Reynolds *et.al.,* (2008) use hyperspectral remote sensing for detection of rhizoctonia crown and root rot in sugar beet. For that Sugar beet planted with susceptible and partially resistant to RCRR. Then inoculated both varieties with *R. solani* AG 2-2 IIIB. And reflectance data acquired with a hand-held spectroradiometer. Advantage is non-destructively assessing plant diseases rapidly, over a large area without physical contact with sugar beet foliage and disadvantage is disease cannot detect until sugar beet roots reach ratings of 4, when they are 25 to 50% rotted.

Nuclear Magnetic Resonance

Traditionally, destructive methods used to observe belowground symptoms caused by *Rhizoctonia solani*. It leads to a loss of sensitive parts, which later cannot be evaluated in more detail. Hillnhutter *et.al,* (2012) used MRI for non-invasive detection of belowground symptoms caused by RCRR on sugar beet. Seeds of sugar beet susceptible *R. solani* sown in polyvinyl chloride (PVC) tubes. These tubes customized with cables and loops to place them vertically into MRI spectrometer.

Experiments included four treatments:
1. non-treated/control.
2. infection with *R. solani*. *R. Solani* were added to PVC tubes 28 DAS of sugar beets.

Then plants were positioned in borehole of 4.7 T MRI systems at controlled temperature of 20^0C during MRI measurements, which took 60 min.

Red signifies little signal (thin roots), and blue and yellow indicate thicker roots or regions with more water.(A) thickest beets, few lateral roots produced and more water content (B)Root rot on above area of inoculation observed and expressed by a decrease in signal intensity. It clearly indicates dehydration of infected region as thickness of root section is not severely reduced. Advantage is non-destructive in nature and sufficiently high spatial resolution of the method and disadvantage is detect in advanced stages of plant development.

Conclusions

Microscopic methods are simple and cost effective, but cumbersome and require taxonomic expertise. Immunological techniques demonstrated to be sensitive, simple, rapid and cost-effective and can be automated for large scale applications. The nucleic acid-based test such as PCR, Real time PCR are reliable, specific and sensitive for detection and quantification of pathogen. Spectroscopy and imaging-based techniques indirectly detect pathogen but detects at advanced stages.

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Climate Change and its Impact on Agriculture

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Introduction

In past few decades, the gaseous composition of earth's atmosphere is undergoing a significant change, mainly due to increase in emissions from energy, industry and agriculture sectors and widespread deforestation practices. These anthropogenic activities have increased the concentration of the atmospheric 'greenhouse gases' (GHGs) viz. carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) (Table 1).

Table 1: Sources and Concentrations of Major Greenhouse Gases Source: IPCC (2007)

Greenhouse gas	Major sources	Pre-industrial concentration (ppb)	Current concentration (ppb)	Global Warming Potential, 100-year time horizon	Atmospheric Lifetime (years)
Carbon Dioxide (CO2)	Fossil fuel combustion; Deforestation; Cement production	290,000	380,000	1	100
Methane (CH4)	Fossil fuel production; Agriculture; Landfills	722	1774	25	12
Nitrous Oxide (N2O)	Fertilizer application; Fossil fuel and biomass combustion; Industrial processes	271	324	298	114
Chlorofluorocarbon-12 (CFC-12)	Refrigerants	0	3-5	4750-10900	75

These greenhouse gases (GHGs) trap the outgoing infrared radiations from the earth's surface. Thus, raises the atmosphere temperature. According to Inter-Governmental Panel on Climate Change (IPCC), the global mean annual temperature was observed higher by 0.40□-0.76°C at the end of the 20th century than that of the end of the 19th century due to increased concentration of greenhouse gases (IPCC, 2007). The global mean annual temperature will likely be higher by 0.3-0.7°C for the period 2016-2035 relative to 1986-2005 due to the greenhouse effect (IPCC, 2014).

Increase in GHG concentration will lead to global changes in the climate-related parameters such as rainfall, soil moisture, and sea level. Recent observations have shown an increase in number of hot days, hot nights and heat wave events. Changing climate will certainly have impact on agricultural production.

Potential Impacts of Climate Change on Agriculture

This changing climate will have both direct and indirect effect on agriculture through the crops, soils, livestock and pests. Global climate change indirectly may have effect on land use pattern due to snow melting and submergence of coastal lands, availability of irrigation water, frequency and intensity of seasonal droughts and floods, soil organic matter transformations, soil erosion, changes in pest behaviour. This will ultimately affect the food security, socio-economic condition, capital availability, land reforms, etc. Some of the detail effects are following:

1. Crop:

a. Rising temperature can reduce the crop duration, increase crop respiration rates, alter photosynthate partitioning, increase evapo-transpiration rate, affect the abundance and distribution of pest populations and hasten nutrient mineralization in soil. Although elevated temperature will harmfully affect crops, however this can be compensating with fertilization effect by increased atmospheric CO2 concentration through C3 photosynthetic pathway

b. More number of extreme weather events like floods, droughts, cyclones and heat waves will adversely impact agricultural productivity.

c. Minimum temperature change is more vital than a change in the maximum temperature. Rice grain yield declined by 10% for each 1 °C increase in minimum temperature above 32 °C (Pathak et al., 2003). Temperature increased at 1 °C, 2 °C and 3 °C, would reduce the grain yield of rice in Punjab (India) by 5.4%, 7.4% and 25.1%, respectively (Aggarwal et al., 2009).

d. Changes in rainfall pattern during monsoon season would reduce yield in rain fed areas and may increase crop water demand.

e. Quality of fruits, vegetables, tea, coffee, aromatic, and medicinal plants may be reduced due lack of particular climatic requirement.

f. Incidence of pest and diseases of crops to be altered because of more enhanced pathogen and vector development, rapid pathogen transmission and increased host susceptibility.

g. Agricultural biodiversity is also threatened due global climate change.

2. Soil:

a. Organic matter content, which is already quite low in Indian soils, would become still lower due to higher mineralization.

b. The crop residues under the elevated CO2 concentrations will have higher C:N ratio. This may reduce their rate of decomposition and nutrient supply.

c. Higher soil temperature will fasten the N mineralization, but its availability may decrease due to increased gaseous losses through volatilization and denitrification.

d. Extreme and irregular rainfall due to climate change may alter the severity, frequency and extent of soil erosion.

e. Rise in sea level may lead to salt-water intrusion in the coastal lands, turning them unsuitable for agriculture.

3. Water:

a. Elevated temperature will increase the evapo-transpiration rate which will ultimately increase demand for irrigation. This may result in lowering of groundwater table at some places.

b. The water balance in different parts of India will be disturbed.

4. Livestock:

a. Climate change will affect fodder production and nutritional security of livestock. Higher temperature would enhance lignification of plant tissues and thus reduce the digestibility. The production of feed and fodder would also decrease due to increased water scarcity.

b. Changes in rainfall pattern may also influence expansion of vectors during wetter years. This will lead to a larger outbreak of diseases.

c. Requirement for water, shelter, and energy would increase due to global warming for meeting the projected milk demands.

d. Global Warming is likely to aggravate the effect of heat stress in dairy animals, and their reproductive performance.

5. Fishery:

a. Increasing temperature of sea and river water is likely to alter the breeding, migration and harvests of fishes.

b. Impacts of rising temperature and tropical cyclone would adversely affect the capture, production and marketing costs of the marine fish.

c. Higher sea surface temperature will likely to increase coral bleaching.

Conclusions

Global climate change and increasing climatic variability are likely to aggravate the problems of future food security by exerting pressure on agriculture. If not managed properly, climate change could seriously compromise the ability of the agriculture sectors to feed the world, and severely undermine progress toward eradicating hunger, malnutrition and poverty.

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Mating Type in Fungi: Understanding its Role in Morphogenesis and Pathogenicity of Smut Fungi

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What is Mating Type?

Mating types are molecular mechanisms that regulate compatibility in sexually reproducing eukaryotes. Depending on the group of fungi different mating types are referred to by numbers, letters, or symbol "+" and "-" instead of male and female. Filamentous ascomycetes are usually having two mating types referred to as "MAT1-1" and "MAT1-2".

However, yeast a non-filamentous single cell ascomycete has MATa and MATα type as the mating partner. In ascomycetes mating type genes are called idiomorphs rather than alleles. The proteins they encode are transcription factors that regulate the sexual cycle. The gametes produced in heterothallic ascomycetes contain only a single Mat idiomorph, therefor syngamy will only be possible between gametes carrying complementary mating types.

Contrary, homothallic ascomycetes produce gametes that can fuse with every other gamete in the population most often because each haploid contains the two alternate forms of the Mat locus in its genome. Basidiomycetes on the other hand can have thousands of different mating types called tetrapolar system. More than 50% of basidiomycetes fungi are known to be tetrapolar in which two unlinked loci (A and B) must differ between the two cells for sexual reproduction to occur (Morrow et. al., 2009).

Role of Mating Type in Morphogenesis and Pathogenicity of *Ustilago maydis*

U. maydis belongs to the basidiomycetes plant-pathogenic smut fungi causing mainly cereal crops. The pathogen also known as gall inducing smut fungi that transform the infected tissues into galls. In General *U. maydis* lives saprophyticaly outside the host plant by exist as budding yeast and only the sexual stage is virulent. The fungus is virulent only after mating occurs preferentially in association with the plant host.

Cell fusion between two compatible mating type populations by forming conjugation tubes resulting dikaryotic hyphae are infectious (Banuett 2007 and Morrow *et. al.*, 2009). *U. maydis* has two unlinked sex determinants referred as a and b loci which different from other smut fungi (Hanna 1929 and Rowell *et. al,* 1954). The locus is bi-allelic consist of a1 and a2 whereas the b locus is multiallelic of at least 25 alleles (Kahmann and Schirawski. 2007).

Both a and b loci determined the mating between compatible population of fungi. To complete sexual reproduction both alleles must differ at locus example as a1b1 mates with a2b2 but not with a1b2 or a2b1. The b locus has two homeodomain transcription factors bW and bE which divergently transcribed into different functional classes HD2 and HD1 respectively. The intergenic space between two homeodomain gene bW and bE are less than 200 bp and this avoid the generation of progeny with self-compatible of bE-bW combination due to inseparable by meiotic recombination (Kahmann *et. al.*, 2007).

The homeodomain bW-bE forming a heterodimer following the fusion of two compatible cells. The heterodimer bW-bE complex act as a regulator and initiate activation subsequent developmental steps for infection, colonization of host plant including invasive hyphal growth and tumour formation. The dikaryotic state of bE/bW heterodimeric complex controlling the expression of key target genes both directly and indirectly via other induced transcription factors following the post fusion stages of sexual reproduction.

Bakkeren reported that 350 differentially regulated genes were identified including directly and indirectly regulated by bE/bW heterodimeric complex. Biz1 and Rbf1 zinc finger transcription factors and the homeodomain protein Hdp2 are the key targets of bE-bW heterodimer direct the b transcriptional network toward the formation of appressoria.

Rbf1 zinc finger transcription factors were found to play a key role in promoting the expression of subsequent genes which indirectly controlled by bE/bW. These findings suggested that a homeodomain-zinc finger transcription act as central network controlling downstream gene regulatory events and initiate the dimorphic transition from yeast to hyphal growth, other biological and morphological events common on pathogenic dikaryotic state.

The locus known to encodes the pheromone response pathway including pheromones and their receptor regulating cell-to-cell recognition. Cell fusion between two compatible haploid cells and initiation of hyphal growth regulated by a locus (Rowell *et. al.*, 1954, Banuett 1989). The a1 and a2 alleles consist of genes encoding the pheromone (mfa1) and pheromone receptor (pra1). The gene encoding pheromone and pheromone receptor being diverged arranged between alleles.

The a1 locus about 4.5 kb long containing mfa1 and pra1.Whereas a2 allele comprising mfa2 and pra2 and three additional genes lga2, rga2, and a pheromone pseudo-gene (Urban *et. al.,* 1996). The lga2 and rga2 genes are mitochondrial inheritance and both the gene found to play important role during sexual reproduction and infection (Bortfeld *et. al.,* 2004, Fedler *et. al.,* 2009 and Mahlert *et. al.,* 2009).

Alberto *et. al.*, 2015 reported the Hos2 Histone Deacetylase controls *Ustilago maydis* virulence through direct regulation of mating-type genes. The deletion of hos2 annihilate the cAMP-dependent expression of mating type genes. These suggest that Hos2 acts as a downstream component of the cAMP-PKA pathway to control the expression of mating-type genes.

Conclusions

Fungi are eukaryotic highly diverged important organism for evolutionary studies. The mating type is important for fungi to evolve and reproduce through sexual reproduction. Mating type locus known to have highly conserved domain throughout fungal kingdom and these will help in understanding few questions to answer.

Why primitive lower fungi are mostly homothallic, whereas higher ascomycetes and basidiomycetes are heterothallic? How fungi transit from saprophytic to pathogenic upon interaction with host plant? Morphological changes are critical for plant pathogenic fungi for penetration, infection and host colonisation. In response to environmental signals morphological changes occur at specific stages of their pathogenic cycle and are mediated by transcription factors.

Histone deacetylases play crucial roles in regulating gene expression and has been reported that play important roles in the virulence of plant fungi. Recently, reported that Hos2 one of the histone deacetylase is required for the dimorphic switch and pathogenic development in U. maydis. This will help in managing the disease by deactivation of Hos 2 leads to termination of dimorphic switch from saprobic to pathogenic development in *U. maydis*.

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Recent Advances in the Detection of Apple Stem Pitting Virus

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Introduction

Among temperate fruits, apple (*Malus × domestica* Borkh., family Rosaceae) is the most important and nutritious fruit crops in the world. According to FAOSTAT of the United Nations, in 2018 about 86 million tonnes of apple were produced worldwide. India ranks seventh in total apple production (2.37 million tonnes) with a productivity of about 7.7 MT/Ha.

According to National Horticultural Board of Department of Agriculture Cooperation and farmer's Welfare, Govt. of India, in 2017-18 in India, among the major apple producing regions, Jammu & Kashmir is by far the largest producer of apple, contributing 77.71% of total apple production in India, followed by Himachal Pradesh (19.19%) and Uttarakhand (2.52%). But due to the prevalent agricultural practices, healthy apple trees are being infected by a number of viral and sub-viral pathogens like *Apple mosaic virus* (ApMV), *Apple stem pitting virus* (ASPV), *Apple chlorotic leafspot virus* (ACLSV), *Apple stem grooving virus* (ASGV) and *Apple scar skin viroid* (ASSVd). Among these, *Apple stem pitting virus* (ASPV) is a major constraint for apple production, causing latent infection alone or mixed infection with other latent viruses of apple such as *Apple chlorotic leafspot virus* (ACLSV).

Apple Stem Pitting Virus (ASPV)

The genus *Foveavirus* of a newly established family *Betaflexiviridae* contains the type species *Apple stem pitting virus* (Martelli and Jelkmann, 1998; Adams *et. al.,* 2004; Martelli *et. al.,* 2007). Other important species of the genus are *Asian prunus viruses*, *Rupestris stem pitting-associated virus* (RSPaV) and *Apricot latent virus* (ApLV).

ASPV particles are flexuous and filamentous in shape measuring about 800 nm x 12-15 nm, having helical symmetry. Its genome consists of a monopartite, +ssRNA molecule of 9.3 kb excluding the poly A tail. It has five open reading frames (ORFs) which encode the replicase protein (ORF1), the putative movement proteins (as a triple gene block: ORFs 2 to 4), and the coat protein (ORF5).

Need of Detection

1. Symptomless infection: It is very difficult to detect the ASPV infection at the very early stage as many commercial apple cultivars remain symptomless, though susceptible cultivars of different pome fruit species (apple, quince, pear) and indicator plants exhibit various kinds of symptoms such as xylem pitting, epinasty and decline in apple, chlorotic veinal bending, red mottling, stony pit in pear, chlorotic spots on leaves, epinasty and deformation of leaves along with longitudinal grooving on the xylem in *Pyronia veitchii*, black sooty lines and rings around veins, chlorotic spots on leaves, and fruit malformation having depressions and bumps in quince (Desvignes *et. al.,* 1999; Paunovic, 1995).

Small localized necrotic lesions can be seen on *N. occidentalis* plants 4-7 days after inoculation followed by systemic vein yellowing, veinal necrosis, and necrosis of leaf partly or as a whole.

2. Geographical Distribution: ASPV occurs throughout the world wherever its infected hosts apple, pear, quince etc. are grown.

3. Diseases: ASPV causes many diseases either alone or in association with other latent viruses such as apple stem pitting disease, apple green crinkle disease, star crack disease of apple, pear stony pit, pear vein yellowing disease, quince fruit deformation and top working disease of apple.

4. Losses: ASPV either alone or as mixed infection causes decline of grafted apple plants due to scions-rootstock incompatibility. Pear cultivars showed slightly lower percentage of bud taking, lower cropping, decrease in tree vigor, reduced stem girth and shoot growth. ASPV can reduce fruit quality and yield significantly as in pear stony pit and quince fruit deformation, and the ratio of damaged fruits may vary (between 18-94%) from year to year on the same tree.

5. Transmission: No vector has been reported to transmit ASPV. It is spread mainly by budding, grafting, infected clonal rootstocks. It is also transmitted mechanically, although with some difficulty, to the most sensitive test plants: *N. occidentalis* subsp. *Obliqua* and *N. occidentalis*. Root contact transmission has been reported. So, it is necessary to maintain proper isolation distances between certified propagating material and nursery plants of poor health status.

Detection Techniques

1. Biological Indexing: For indexing of ASPV, field inoculation of indicator plants such as 'Virginia crab' and 'Spy 227' (*Malus pumila*), 'Jules d' Airolles', 'Beurrre Bosc' and 'Doyenne du Comice' (*Pyrus communis*) and *Pyronia veitchii* is still the standard procedure. But since field indexing requires lot of time and space, and also shows variable or no symptoms from year to year due to uncontrolled environmental conditions, it is advised to conduct indexing under controlled conditions in a greenhouse as it can considerably increase the accuracy, efficiency, and economy.

2. Laboratory techniques:

a. Electron microscopy: Hibino and Schneider (1971) demonstrated the presence of filamentous virus particles in the leaves of pear trees with vein yellows by electron microscopy. Later on, Yanase *et. al.*, (1989) detected a sap-transmissible, 800 nm x 12-15 nm flexuous particles in pear necrotic spot, pear vein yellows, and apple stem pitting diseased plants.

b. Serological techniques: After the development of polyclonal antibodies, a number of detection techniques such as ISEM, PTA-ELISA, western blot and dot blot analysis could be possible (Jelkmann *et. al.*, 1992; Jelkmann and Keim-Konrad, 1997; Paunovic *et. al.*, 1999). Now monoclonal antibodies have also been developed for accurate detection of ASPV in DAS-ELISA (Gugerli and Ramel, 2004). The advantages are fast, reliable and specific with a sensitivity of 1-10 ng/ml. The limitations are it is less sensitive than RT-PCR and antibody production is required which is laborious and time consuming.

c. Nucleic acid based techniques: RT-PCR based methods are proving to be more reliable and superior tools than woody indexing for virus detection in woody tissues/plants due to the easy access of commercial RNA extraction kits, methods preventing enzyme reaction-interfering components such as polyphenols and polysaccharides, more and more studies on variability of ASPV strains. Jelkmann (1994) successfully sequenced the whole genome of ASPV which led to the development of numerous RT-PCR based methods for specific, quick, reliable and sensitive detection of ASPV. Further Klerks *et. al.* (2001), through RNA amplification and probing with fluorescent molecular beacons developed a quick, reliable and sensitive system (AmpliDet RNA) which avoids the use of gel for ASPV detection. Several real-time RT-PCR assays which use fluorogenic-3' minor groove binder DNA probes have been designed to detect ASPV in dormant wood bark tissues (Roussel *et al.*, 2005). Multiplex and one-tube pentaplex RT-PCR have been developed to detect ASPV along with other pome fruit viruses: ASGV, ACLSY, and ApMV (Menzel *et. al.*, 2003; Hassan *et. al.*, 2006).

d. Sero-nucleo detection (Aptamer / biosensor-based techniques): Aptamers are single-stranded small nucleotide sequences which bind to a variety of target molecules by an in-vitro procedure called SELEX (systematic evolution of ligands by exponential enrichment). The targeted molecules can be even small organic molecules, macromolecules or whole cells. The basic SELEX protocol includes mining of a DNA or RNA library of 10^{12} to 10^{15} different sequences to select specific target binding sequences. Aptamers, after being folded into a well-defined spatial structure, bind with their targets much like of antibody-antigen interactions, but they are easy to reproduce as well as chemically modify.

Advantages of Nucleic Acid-Based Techniques

1. These techniques prevent polysaccharides and oxidizing compounds from hampering PCR in woody tissue.

2. These techniques provide enriched virus concentration.
3. Rapid and more sensitive than RT-PCR.
4. Some techniques like AmpliDet RNA system are gel free detection system.
5. Most of these techniques do not require any post-PCR detection step.
6. They are fully compatible with high-throughput analysis and automation.
7. Some techniques detect all isolates overcoming the virus molecular variability like Spot nested RT-PCR assay.

Limitations of Nucleic Acid-Based Techniques

1. Since some of the ASPV isolates have variability in the targeted RdRp region, techniques like 5'-nuclease RT-PCR assays are unable to detect them.
2. Complex procedure.
3. Prone to contamination.
4. More chance of false positive detection.

DOS-ELONA

This approach was developed by Zsofia Balogh et. al., in 2010. It is an excellent approach for quick, sensitive and precise detection of ASPV. In Double oligonucleotide sandwich-enzyme-linked oligonucleotide assay (DOS-ELONA), aptamers are used for determining protein concentration thus avoiding use of antibody. Through DOS-ELONA, Zsofia et. al., 2010, could detect virus coat protein accurately in a complex protein matrix with general instrumentation.

SPR Imaging

This method was also demonstrated by Zsofia Balogh and co-workers (2010). This is a direct and label-free method with a sensitivity of as low as 10 pg/ml. Zsofia et. al., 2010, selectively detected the ASPV coat proteins (PSA-H, MT32) through original DNA aptamers. Surface plasmon resonance (SPR) imaging in combination with aptamer-based sensor chips was used for optimizing the aptamer immobilization for higher sensitivity and for characterization aptamer-virus coat protein binding. Thus, it shows the potentiality of aptamers as receptor molecules for numerous virus detection and identification methods in raw samples, and a number of simple, cost-effective virus diagnostic systems can be developed in future using this valuable tool.

Double Imprinting Method

This method was demonstrated by Wei Bai and David A. Spivak (2014). By using imprint-lithography method, a virus-bioimprinted hydrogel is micromolded into a diffraction grating sensor to produce a "Molecularly Imprinted Polymer Gel Laser Diffraction Sensor" (MIP-GLaDiS). Diffraction was measured by a simple laser transmission apparatus, and ASPV could be detected by reading the system through the naked eye at a concentration of 10 ng/ml.

Advantages of Double Imprinting Method

1. Easy to acquire data with high accuracy.
2. Automated for quick and easy measurements, as well as allow incorporation into a multi-array format.
3. Impure/crude virus extract can be used as a source of template.
4. No need of expensive equipment or trained personnel.
5. System can be read by the naked eye for recording results.
6. Sensitivity- 10 ng/ml.

Conclusion and Future Prospects

Apple stem pitting virus (ASPV) is a latent virus causing significant losses to apple orchards, and because of its latent nature, it is very difficult to detect the infection of ASPV in apple orchards. Biological indexing acts as a baseline test for routine ASPV Detection. PTA- ELISA, western blot and dot blot analyses were possible only after the production of polyclonal antibodies. Now monoclonal antibodies have also been developed for accurate detection of ASPV in DAS-ELISA. Numerous RT-PCR based methods have been developed for specific, quick, reliable and sensitive detection of ASPV. Aptamer based techniques have great potential for the quick, specific and sensitive detection of ASPV. Though there are a number of established pathogen detection systems, still there is a need for quick, highly selective, and economic approaches. So, in the coming future, many more new techniques may come up for more rapid, more specific and more sensitive detection of this particular virus.

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Areas, Schemes, and Challenges in Food Processing Industries

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India is a country with a population of over 1.25 billion. The growing middle class has a net income that provides 1.25 billion opportunities in the domestic market segment. India's food industry is estimated at $ 130 billion on average. This is expected from this will attract local and foreign investors. The increase in demand for processed meals in the coming years is one of the key factors in the growth potential of the food processing industry. Due to the urgency of the city, the eating habits associated with added food change from day to day. The main reason for this change is that more than 65% of the population of India is 35 or younger than this and this category prefers processed and ready to cook foods. India is one of the fastest-growing economies in the world after China. World Bank Ease of Doing Business rankings from 100 to 130 show a good business situation in India and also show the potential to attract foreign investment in the region. On an average, about 40 percent of all food waste products are wasted annually by insufficient methods of transportation, storage, processing, and marketing resources. If these shortcomings are overcome, then there is great potential for growth in this area.

To take benefit of the above discussed points, Indian government has introduced the following steps to improve the food processing phase:

1. Pradhan Mantri Kisan Sampada Yojana (PMKSY): In August 2017, the CCEA (CCEA) granted its approval to PMKSY. It includes many schemes such as Mega Food Park, Cold chain Integration, Extension Infrastructure, Food Security, and Ensuring Infrastructure, Agro-processing Cluster Infrastructure, Back-to-Referral Construction, and Processing, and ongoing food processing and expansion programs included.

2. Scheme for Mega Food Park: Its purpose is to connect farmers, processors, and retailers together to link agricultural production and market, increase value and reduce waste, increase farmers' income, and especially in rural areas. Provide job opportunities mainly to the youth of rural areas. Mega Food Park has an area of at least 50 hectares and operates under a cluster-based approach based on the harp and speaker model.

3. Schemes related to Cold chain, Value Addition of products, and Protection Infrastructure for products: The purpose of this scheme is to provide integrated cold chain and infrastructure construction sites to the consumer without any form of obstruction. This scheme includes products pre-cooling chambers, reefer vans, mobile cooling units, and value-adding centers.

4. Modern Slaughterhouse Scheme: The main purpose of this program is to increase and improve skills efficiency, conservation, and available food depletion facilities to reduce waste and maximize print value additions by providing modern methods.

The food processing sector has been identified as one of 25 areas of focus as part of the Make in India campaign. Therefore, the policy ecosystem was revitalized to attract financial, technical, and human resources to the region. An important step was taken in this area to allow 100% FDI by default. To provide cheap credit to food units in mega parks and designated, a special Rs 2000 crore NABARD fund was designated as a food preparation fund at FY 2014-15.

In addition to the above programs and measures, the food processing sector faces the following challenges:
1. Lack of adequate infrastructure: Although the government has introduced a number of measures to improve food-related infrastructure, it is not sufficient to address the growing needs of the sector. Lack of cold storage, road, and rail connections remain a major problem.

2. Credit Facilities: In addition to creating a food processing fund over the past few years, the sector is facing a shortage of resources. Although foreign investment does not meet the needs of the food processing sector.

3. Lack of comprehensive policy: Now a day, food processing industry is a promising sector. The lack of a comprehensive policy to meet the various needs of the food processing industry is hampering its development. MoFPI must announce a National Food Processing Policy in advance to eliminate policy shortcomings.

Conclusion

According to estimates, the consumption of food grains in India currently stands at USD 370 billion and is expected to reach the US 1 trillion by 2025. The development of the food processing industry is necessary as it leads to an increase in the revenue of medium-sized food. Changes in city practices and rapid growth and popularity of targeted and mixed food products, a well-known food processing category with a high level of processing, reduces spoilage, improves value, promotes crop flexibility, ensures better farmer returns, increased productivity, and increased sales revenue. The region is able to solve major food security problems, food shortages, and provide the community with healthy food.

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Climate change in Agriculture: Adaptation and Mitigation

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Introduction

Over the years, increasing concentrations of carbon dioxide (CO_2) (≥370 ppm) and other active green-house gasses (CFCs, CH_4, N_2O, etc.) have headed to global warming. The report of Intergovernmental Panel on Climate Change (IPCC, 2007) has showed a strong evidence of global climate change and projected that the average global temperature of the earth's atmosphere would rise by 1.4-4.8 ºC by the end of this century. According to Inter-Governmental Panel on Climate Change (IPCC), the global mean annual temperature was observed higher by 0.40°-0.76°C at the end of the 20th century than that of the end of the 19th century due to increased concentration of greenhouse gases (IPCC, 2007). The temperature increase during the winter seasons is likely to be much higher than rainy seasons. Rainfall is likely to increase by 15-40% by the end of the century. Agriculture will be adversely affected by the increase or decrease in temperature and also by an overall increase or decrease in rainfall at different growth stages of crops. Several initiatives have been undertaken to mitigate the possible impact of climatic change on agriculture. These include selection of better adaptable genotypes, genetic manipulation to overcome extreme climatic stresses, measures to improve water and nutrient-use efficiency and exploiting the beneficial effects of CO_2 enhancement on crop growth.

Mitigation Strategies to Climate Change

The strategies for mitigating greenhouse gas (GHGs) emission could be:
1. Water management: promoting mid-season aeration by short-term drainage.
2. Organic matter: improving organic matter management by promoting aerobic degradation through composting, incorporating it into soil during off-season drained period.
3. Cultivar: use of rice cultivars with few unproductive tillers, high harvest index; and application of fermented manures like biogas slurry in place of unfermented farmyard manure (Pathak and Wassmann, 2007).
4. Methane emission: CH_4 from ruminants can be reduced by altering the feed composition, either by reducing the percentage which is converted into methane or by improving the milk and meat yield.
5. Nitrous oxide emission: Site-specific nutrient management (SSNM), efficient nutrient management (Pathak, 2010). Application of nitrification inhibitors such as nitrapyrin and dicyandiamide (DCD). There are some plant-derived nitrification inhibitors such as neem oil, neem cake and karanja seed extract.
6. Carbon di oxide emission: Soil management practices such as reduced tillage, manuring, residue incorporation, improving soil biodiversity, micro aggregation, and mulching can play important roles in sequestering carbon in soil which will ultimately reduce the CO_2 emission from agriculture.
7. Technologies: intermittent drying, site-specific N management, etc. can be easily adopted by the farmers without additional investment, whereas other technologies need economic incentives and policy support.

Adaptation Strategies to Climate Change

To deal with the impact of climate change, the potential adaptation strategies are: developing cultivars tolerant to heat and salinity stress and resistant to flood and drought, improving crop management practices and water management, adopting new farm techniques such as resource conserving technologies (RCTs), crop diversification, improving pest management, better weather forecasting and crop insurance and harnessing the indigenous technical knowledge of farmers. Some of these strategies are discussed below.

1. Developing Climate-ready Crops: Development of new crop varieties with higher yield potential and resistance to multiple stresses (drought, flood, and salinity) with higher water-use and nitrogen-use efficiencies through breeding. It is also important to improve the root efficiency for mining the water and absorption of nutrients in soil. Farmers need to be provided easily these cultivars with a broad genetic base. So the adaptation process need to be strengthened with availability of new varieties having tolerance to drought, heat and salinity and thus, minimize the risks of climatic aberrations.

2. Crop Diversification: Diversifications of crop and livestock varieties, including replacement of plant types, cultivars, hybrids, and animal breeds with new improved varieties intended for higher drought or heat tolerance, are being advocated as having the potential to increase productivity in the face of temperature and moisture stresses in future climatic conditions.

3. Changes in Land-use Management Practices: Changing land-use and land cover practices such as the location of crop and livestock production, rotating or shifting production between crops and livestock, shifting production away from marginal areas, altering the intensity of fertilizer and pesticide application as well as capital and labour inputs can help reduce risks from climate change in farm production. Adjusting the cropping sequence, including changing the timing of sowing, planting, spraying, and harvesting, to avoid the heat and moisture stress during the growing seasons is another option.

4. Adjusting Cropping Season: Adjustment of planting dates can help in minimizing the effect of temperature induced spikelet sterility, by avoiding the flowering period to coincide with the hottest period. Adaptation measures which can reduce the negative effects of increased climatic variability in arid and semi-arid tropics may include changing of the cropping calendar to take advantage of the wet period and to avoid extreme weather events (e.g., typhoons and storms) during the cropping season.

5. Efficient Use of Resources: Soil and water management is most critical for adaptation climate change. The resource-conserving technologies (RCTs) includes practices which enhance resource- or input-use efficiency and provide immediate, identifiable and demonstrable economic benefits like reduction in production costs; savings in water, fuel and labour requirements; and timely establishment of crops, ultimately resulting in improved yields.

6. Relocation of Crops in Alternative Areas: Climate change impact will vary across crops and regions. There is a need to identify the specific crops and regions that are more sensitive to climate changes/variability and relocate them in more suitable areas.

7. Harnessing Indigenous Technical Knowledge of Farmers: Traditional ecological knowledge of people have developed and carried which have stood the test of time and could provide the viable options for adaptive measures. Tribal and hill knowledge systems are expecting with potential indigenous practices used for conservation of rainwater, nutrient and weed management, crop production and plant protection.

8. Improved Pest Management: Changing pattern of temperature and variability in rainfall will affect the incidence of pests and disease and virulence of major crops as climate change will potentially alter the pest/weed-host relationship by affecting the pest/ weed population, the host population and the pest/weed-host interactions. Some of the potential adaptation strategies for better pest management could be:

a. developing cultivars which is more resistant to pests and diseases attack.

b. adopting integrated pest management with more emphasis on biological control and changing in cultural practices.

c. using recent tools such as simulation modelling to anticipate pest occurrence.

d. developing alternative production techniques and crops, as well as better suitable locations, which are more resistant to infestations and other risks.

e. Management of pests and diseases with use of resistant varieties and breeds; alternative natural pesticides, bacterial and viral pesticides, pheromones for disrupting pest reproduction, etc. could be adopted for sustainability of agricultural production process.

f. Promote bio agents like release of predators and parasites, improving the habitat for natural enemies, facilitating beetle banks and flowering strips; crop rotation and multiple cropping should be integrated in pest management practices.

9. Better Weather Forecasting and Crop Insurance Schemes: Weather forecasting and early warning systems will be very useful in minimizing risks of climatic aberrations. Effective crop insurance schemes should be implemented to help the farmers in reducing the risk of crop failure due to these events.

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Conclusion

Even the most stringent mitigation efforts cannot nullify some of the impacts of climate change over the next few decades. This makes adaptation an essential to address near-term impacts. Therefore, It is essential to develop a multidisciplinary or mix of strategies that includes mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research (on climate science, impacts, adaptation and mitigation).

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Biofortification in Rice: A Progress in the Quantity of Micronutrients Zinc and Iron

Article ID: 31335

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Introduction

Biofortification is the process of increasing the contents of vitamins and minerals through plant breeding or biotechnology of food crops. Micronutrients play an important role in human health and its deficiency may cause many serious diseases in human. Rice (*Oryzasativa* L.) is considered as staple food by more than half of the world's population.

Micronutrient transportation in rice is controlled at several stages including up takes from soil, transport from root to shoot, subcellular micronutrient transport and most importantly, transport to seeds. To improve micronutrient build-up in rice seeds, it is necessary to get well about the regulatory mechanism of these processes.

Many attempts have been done in this matter such as increasing the expression of genes coding metal chelators and transporters, Festorage protein ferritin and phytase which were effectively undertaken to considerably boosting up the micronutrient content of rice. Here, it will be briefly reviewed the biofortification of rice for micronutrient elements especially Iron and Zinc.

Why Zn and Fe Fortification in Rice?

A limited nutritional range and a shortfall of necessary minerals like zinc (Zn) distinguish the diet of underfed people. Zn insufficiency is a universal nutritional problem and in developing countries this issue is even more severe. As rice is the chief cereal food in most of countries, it should have the essential dietary requirements including Zn.

But this has been found to have low Zn quantity especially when grown in Zn-deficient soils. Zinc deficiency can be addressed in numerous ways like dietary diversification, food improvement and biofortification etc. Zn fortification in rice can lead to a potential solution for malnutrition as it becomes a burning problem for most of the developing countries. Plant breeding and biotechnological approaches give effective biofortification to resolve Zn deficiency.

The role of Zn in plants, its uptake, and translocation and screening efficiencies in rice is determined by various agronomic, breeding and biotechnological approaches. The problem of Zn deficiency in nutrition demands to integrate Zn in rice production systems by using combination of biotechnology and breeding tools. Agronomic biofortification is economically and practically effective solution to defeat the Zn deficiency issue in rice. The Zn accessibility in soil has negative correlation with higher levels of phosphate and pH values, which caused Zn deficiency problem in rice (Sadeghzadeh, 2013).

Rice is a predominantly appropriate goal for biofortification because Fe-deficiency anaemia is a severe trouble in developing countries where rice is a major staple crop (WHO 2002; Juliano 1993).Fe participates in cellular actions including respiration, chlorophyll biosynthesis, and photosynthetic electron transport. In young leaves, Fe deficiency symptom is visible by low chlorophyll content (Marschner, 1995).

Fe deficiency also appears to activate oxidative stress (Bashir et al., 2007). Fe is important for the function of chloroplast and mitochondria. Fe is transported to mitochondria through mitochondrial Fe trans- porter (Bashir et al., 2011). Iron (Fe) is avital micronutrient for most organisms, including all plants and animals.

Fe deficiency is one of the most prevailing micronutrient deficiencies internationally, affecting a probable two billion people (Stoltzfuset al.1998) and causing 0.8 million deaths annually worldwide(WHO 2002). Fe deficiency is ranked sixth among the threat factors for death and disability in developing countries with high mortality rates (WHO 2002).

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Biofortification of Zinc in Rice

The most obvious symptoms in rice were; wilting of leaves due to loss of turgidity, basal leaf chlorosis, late growth, leaves bronzing and in some cases death of the rice seedlings. Agronomic biofortification is the process of moving cereal grains during crop growth with required nutrients such as Zn, While, genetic biofortification is breeding crops to increase their nutritional value.

This can be done either through conventional breeding, or through genetic engineering .Agronomic biofortification is generally done through soil application of proficient Zn sources. It has been reported that the highest point of Zn biofortification in rice make sure when Zn was applied through soil treatment (Nattineeet al. 2009). Zn- coated urea fertilizer is very useful in increasing absorption of Zn into leaves as well as protein.

Most of the Zn build up in grains is used up by the roots and not remobilize in the cells. Zn application to the soil is more efficient biofortification as compared with foliar application (Liu et al. 2016). Combined treatment of agronomic and genetic biofortification is more useful and successful (Swamyet al. 2016).The seed treatment for Zn application can be done by two ways: seed priming and seed coating (Farooq et al. 2012).

The seed priming is a simple and economic technique of soaking seeds in nutrient solution. Seed treatment is comparatively superior to soil application due to the requirement of fewer nutrients. The most regular method for Zn fertilizer application is soil treatment. It can be applied to soil through spreading and band position.

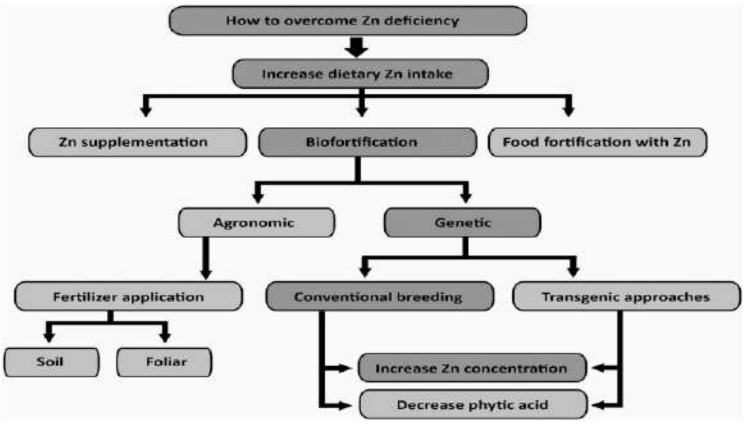

Fig.1: Different approaches to overcome dietary Zn deficiency (adopted from Nakandalageet al. 2016).

Seedling root dipping is accomplished to defeat Zn deficiency issue in rice crop. As compare to the effectiveness of root dipping was lower than soil and foliar application in terms of number of panicles bearing tillers, panicle length, number of kernels per panicle and 1000 kernel weight.

Plant breeding approaches (e.g. genetic biofortification) or selection based capable crop genotypes are also used to reduce Zn deficiency problem. It is more reasonable, gainful and easily applicable to the target populations , but it is time consuming. Zn level is low in cultivated varieties with inadequate genetic variation, while wild type and primordial germplasm has proved as high Zn accumulator.

Variations in genetic concentrations of Zn in grain have also been found in different germplasms of maize and rice. Locus Gpc-B1, influencing both Zn and protein concentrations, located on the short arm of chromosome 6B, had been studied with various recombinant substitution lines derived from Triticumdicoccoide (Distelfeldet al. 2007).

Biofortification of Iron in Rice

From several studies, it has been revealed that to deal with the difficulty of iron-deficiency anaemia, one of the most established human micronutrient deficiencies internationally, iron-biofortified rice was produced using three transgenic approaches: by increasing iron storage in grains via expression of ferritin using endosperm-specific promoters, increasing iron translocation through overproduction of the natural metal chelatornicotianamine, and improving iron flux into the endosperm by means of iron (II)-nicotianamine transporter OsYSL2 expression. The study results show that the iron concentration in greenhouse-grown T2 polished seeds was six-fold higher and that in paddy field-grown T3 polished seeds which were non-transgenic seeds, with no defect in yield.

Endosperm is the rice-seed tissue that builds up a high concentration of starch and becomes the edible part. Ferritin is an omnipresent protein for Fe storage and stores about 4,000 Fe atoms in a complex5. Gotoet al. produced transgenic rice plants that expressed the soybean ferritin gene, SoyferH1, in the endosperm using the endosperm-specific 1.3-kb GluB1 rice promoter.

Nicotinamine (NA) is a metal chelatorand it is biosynthesized from S-adenosyl methionine via NAsynthase (NAS). From reviews it has been reported that NA plays a crucial role in Fe translocation to seeds. Overexpression of the NA synthase gene increased the Fe concentration in polished rice seeds threefold with greenhouse cultivation. Knocking down of OsYSL2, mutant plants show a 30% decrease in Fe concentration in the endosperm17. But simple overexpression of OsYSL2 by the 35S promoter did not increase Fe concentration in seeds.

Moreover, introduction of mugineic acid synthase gene was showed as another approach to increase Fe concentration in seeds. In graminaceous plants, NA is the predecessor of mugineic acid family phytosiderophores (MAs), which are natural Fe(III) chelators. Each of these approaches could increase Fe concentration in polished rice seeds. But the combination of three approaches show desired result in rice and developed new transgenic rice lines with enhanced Fe accumulation.

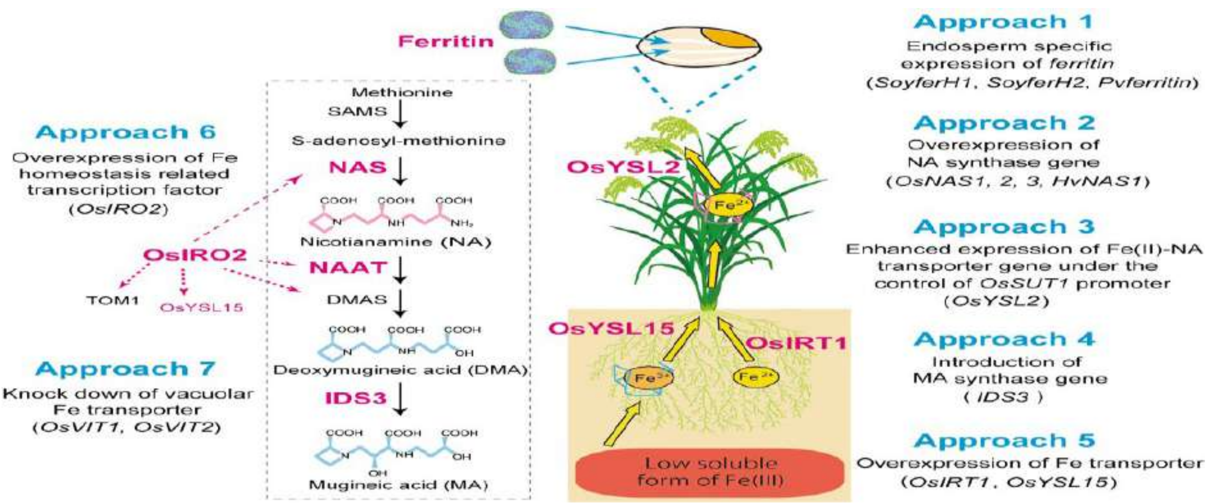

Fig 2: Seven transgenic approaches to Fe biofortification of rice (Masuda et al, 2013)

Three more approaches have been reported which were successfully implemented in rice: enhanced Fe uptake from soil by overexpression of the Fe transporter gene OsIRT1 orOsYSL15, enhanced Fe uptake and translocation by overexpression of the OsIRO2 gene and enhanced Fe translocation from flag leaves to seeds by knocking down of the vacuolic Fe transporter gene OsVIT1 or OsVIT2.

Future Prospects

The definitive purpose of rising biofortified crops is to develop these crops in the field; however, no serious efforts have been reported for the commercialization of biofortified rice. Thus far, transgenic rice varieties have not been commercialized yet. Therefore, the hope will be possible after the initial commercialization of golden rice; commercialization of micronutrient-biofortified rice will proceed at a faster rate and also depend upon its recognition by farmers for field.

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Nanotechnology and Need of Nanotechnology in Development of Agricultural Sector in India

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Introduction

Nanotechnology came into existence in 1981, when the scanning tunnelling microscope allowed scientists and engineers to see and manipulate individuals' atoms. IBM scientists Gred Binning and Heinrich Rohrer won the 1986 Nobel Prize in physics for inventing the scanning tunnelling microscope. Nanotechnology is science and engineering at the scale of atom and molecules. It is the manipulation and use of materials and devices so tiny that nothing can be built any smaller. The term Nanotechnology was coined by Professor Norio Tangiguchi. Physicists Richard Feynman is known as the father of nanotechnology.

What Exactly Nanotechnology is and what are its Areas or Fields of Application?

Nanotechnology (or "nanotech") is manipulation of matter on an atomic molecular and super molecular scale. "Nanotechnology is the design, fabrication and utilization of materials and devices through the control of matter at nanometre length scale and exploitation of novel phenomena and properties (physical ,chemical, biological) at that length for the benefit of human population".

The areas or fields in which nanotechnology has its application are as follows:

1. Agriculture
2. Physics
3. Chemistry
4. Imaging Tech.
5. Mechanical Engg.
6. Info. Tech.
7. Mat Science
8. Chemistry
9. Biology

What is Nano Agriculture?

Including of nanotechnology concepts and principles in agricultural sciences to evolve products that precisely deliver output in production systems that endure food and Nutritional Security and Environmental safety is referred to as Nano Agriculture.

Need of Nanotechnology for Indian Agriculture

1. Population of is India is expected to reach up to 1.6 billion by 2025.
2. Due to rapid urbanization & excessive exploitation fertile land is getting depleted.
3. Demand for agricultural land will grow up to 200-400 Million hectares, by 2025.
4. Urgent need to use currently available fertile land resources to their best use.
5. More food from every inch of land.
6. Molecular breeding / Genetic engineering.
7. Breaking of yield barriers.
8. Development of efficient, reliable and quick diagnostics.
9. Efficient management of pests and diseases.

Fields of Nanotechnology in Agricultural Sector

1. Fertilizers: India ranks third in fertilizers production and consumption. Nano Fertilizers may be defined as nanoparticles or nanomaterial-based fertilizers which can supply essential nutrients for plant growth and soil fertility. Carbon Nanotube as Nano Fertilizers to promote germination of tomato seeds and shortening the germination time. Zeolite based Nano fertilizers are natural super porous minerals, having honeycomb like structures. The network of interconnected tunnels and cages acts as nutrients reservoirs. It releases nutrients slowly mainly sulphur.

2. Nano Pesticide: Pesticide is encapsulated inside artificially synthesized nanomaterials . Nanomaterial is artificially synthesized in such a way that it facilitates release of pesticides on the target environment. Example:- Pesticide may release in the intestine as synthesized nanomaterials will dissolve in specific environmental conditions of intestine and will kill targeted insect only.

3. Nano Fungicides: Silver nanoparticles has great potential for use in controlling plant pathogenic fungi .Silver is less toxic to human and animals than synthetic fungicides. Silver nanoparticles have been applied for control of *Bipolaris sorokinian*, *Magnaporthe grisea*. Nano copper is effective in controlling bacterial diseases, bacterial blight of rice *(Xamthomonas oryzae)* and leaf spot of mung *(X. Compaestrics).*

Merits of Nanotechnology in Agricultural Sector

1. The agricultural sector will be benefited greatly from nanotechnology as it can be used as tool to detect diseases in a rapid manner, improve the ability of plants to absorb nutrients and promote molecular treatment of diseases.

2. It can also play a vital role in productivity through control of nutrients as well as it can also participate in the monitoring of water quality and pesticides for sustainable development of agricultural.

3. It can also be used in treatment for agricultural wastes. Nanofibers from cotton waste for improved strength of clothing.

4. It can help in stress tolerance through engineered nanomaterials for improving anti-oxidant status of plants exposed to environmental stresses.

5. It can help in precision agriculture through nano sensors linked to GPS for real time monitoring of soil conditions and crop growth.

Demerits of Nanotechnology in Agricultural Sector

1. Nano ecotoxicology and risks due to the "naноness" properties of NPs, the surface structure and reactivity are responsible for processes such as dissolution, redox reaction and the generation of reactive oxygen species. These are the proper that can lead to biological/ toxicological effects that would not be produced by bulk particles of the same chemical composition.

2. There are many uncertainties of nanotechnology in agriculture.

3. There is a lack of ethical concern, public awareness and different people have different perception about nanotechnology.

Conclusion

The above detailed description can prove that applications of Nanotechnology can prove helpful for growth and expansion of agriculture and its allied sectors in India. Thus, it can also be helpful in economic growth and development of the country in long run.

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Intelligent Packaging: A Novel Approach to Save Food Losses and Food Waste

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Introduction

Previously packaging was used to facilitate trade and transportation of goods but nowadays packaging has various functions like to protect the product, to increase the shelf life of the product, to preserve the product etc. Traditionally, the basic functions of packaging have been classified into 4 categories: protection, communication, convenience, and containment (Paine 1991). Food packaging exists to make our lives easier. We need packaging to contain foods, protect foods from the outside environment, for convenience, and to communicate information to consumers about the food inside the package. Packaging provides protection of food from adulteration by water, gases, microorganisms, dust, and punctures, to name a few. A food package communicates important information about the product, how to prepare it, and information about the nutritional content. Packaging also allows for consumers to enjoy food the way they want, at their convenience. Nowadays consumers are more aware about the quality of the products, they are ready to pay for quality this type of consumer behaviour results in innovative or creative packaging. Such foods are "quality convenience foods" that offer the consumer great quality and appearance - better than typical packaged foods. A good example of an innovation is active packaging of food in which the package, the product and its environment interact to extend the shelf life of food or to improve its safety or sensory properties, while maintaining the quality of the packed food. Intelligent packaging provides information about the status of the food or its surrounding environment to the processor, retailer and/or consumer of the (Kerry, O'Grady, and Hogan 2006).

Definition: Intelligent Packaging

According to the legal definition of the EU (EC, 2009), "intelligent packaging contains a component that enables the monitoring of the condition of packaged food or the environment surrounding the food during transport and storage". An intelligent packaging system is capable of detecting, sensing, recording, tracing, or communicating information about the quality and/or the state of the product during the whole food chain (Yam et. al., 2005).

The intelligent systems are aiming to monitor the quality of the food product or its surrounding environment to predict or measure the safe shelf-life better than a best before- date. Intelligent packaging can be also defined as a packaging system that is capable of carrying out intelligent functions (such as detecting, sensing, recording, tracing, communicating, and applying scientific logic) to facilitate decision making to extend shelf life, enhance safety, improve quality, provide information, and warn about possible problems (Yam et. al., 2005). Intelligent packaging systems attached as labels, incorporated into, or printed onto a food packaging material offer enhanced possibilities to monitor product quality, trace the critical points, and give more detailed information throughout the supply chain (Han et. al., 2005). In this system; sensor technologies, indicators (including integrity, freshness and time-temperature (TTI) indicators) and radio frequency identification (RFID) are evaluated. Many intelligent packaging concepts involve the use of sensors and indicators. Sensors can be applied as the determinant of a primary measurable variable or, using the marker concept, as the determinant of another physical, chemical or biological variable.

Sensors

Sensors are considered the most promising and innovative technology for future intelligent packaging systems (Bagchi, 2012). A sensor is a device or system with control and processing electronics, an interconnection network, and software. A sensor is used to detect, locate, or quantify energy or matter, by giving a signal for the detection or measurement of a physical or chemical property to which the device responds. Sensors incorporated with dedicated signal processing functions are called intelligent sensors or smart sensors. Sensors are used for the functions like, electronic tongue for inclusion in food packaging consisting of an array of nanosensors extremely sensitive to gases released by spoiled food, giving a clear and visible sign if the food is fresh or not, nanosensors to detect humidity or temperature changes due to moisture, sensor for detecting Escherichia coli in a food sample, by measuring and detecting scattering of light by cellular mitochondria, biosensor for instantly detecting Salmonella in foods and sensor to detect CO_2 as a direct indicator of the quality of the food, biosensor for the detection of the pathogen food, *Bacillus cereus*.

Indicators

In contrast with sensors, indicators cannot provide quantitative information like concentrations, temperature etc. and cannot store the data of measurement and time. Indicators provide immediate visual, qualitative (or semi-quantitative) information about the packaged food by means of a colour change, an increase in colour intensity or diffusion of a dye along a straight path. In most of the cases, the basic requirement of an indicator is that the colour or intensity changes or diffusions are irreversible. If not, this may cause possible false information (Pavelkov, 2012). All indicators can be categories in three sub sections: time-temperature indicators, freshness indicators and gas indicators.

Time-Temperature Indicators

Temperature is the most important factor which is responsible for most of the deteriorative changes including physical, chemical and microbiological changes in the food products. A time-temperature indicator (TTI) may be defined as a device used to show a measurable, time temperature dependent change that reflects the full or partial temperature history of a food product to which it is attached (Taoukis and Labuza 1989). They provide visual information of temperature history during distribution and storage, which is particularly useful for warning of temperature abuse for chilled or frozen food products (Pavelkov 2012). Applications of TTIs are particularly seen in chilled or frozen foods, where the cold storage during transportation and distribution are important for food quality and safety. TTI's works on the basis of biological, chemical and physical mechanism. There are various commercially used time-temperature indicators discuss briefly as follows:

1. 3M Monitor Mark: It is based on a special substance having a selected melting point and blue dye. The heart of the indicator is a porous wick layer over a reservoir pad containing the blue dye. A film strip separates the wick from the reservoir that is removed at the activation stage. At this point, the porous wick, white in color, is shown in the window. Upon exposure to a temperature exceeding the critical temperature, the substance melts and begins to diffuse through the porous wick, causing a blue coloring to appear. The working principle is based, as above, on the melting and diffusion of a dye (Fig 1).

Fig 1: Time temperature indicator (Source: www.researchgate.net)

2. Fresh-Check LifeLines: This integrator is supplied as self-adhesive labels, which may be applied to packages of perishable products to assure consumers at point-of-purchase and at home that the product is still fresh. It is a full history indicator whose working mechanism is based on the color change of a polymer formulated from diacetylene monomers. It consists of a small circle of polymer surrounded by a printed ring for color reference. The polymer, which starts lightly colored, gradually deepens in color to reflect the cumulative exposure to temperature. The polymer changes color at a rate proportional to the rate of food quality loss: the higher the temperature, the more rapidly the polymer changes in color. Consumers may be advised on the package not to consume the product if the color of the center is darker than the reference ring. This device is self-activated, i.e., it is produced in an active form. Therefore, it is supplied and requires storage under deep frozen conditions, typically –20ºC.

3. Vitsab Indicator: This is a full history integrator based on an enzymatic reaction. The device consists of a bubble-like dot containing two compartments: one for the enzyme solution, lipase plus a pH indicating dye compound and the other for the substrate, consisting primarily of triglycerides. The dot is activated at the beginning of the monitoring period by application of pressure on the plastic bubble, which breaks the seal between compartments. The ingredients are mixed and as the reaction proceeds a pH change results in a color change. The dot, initially green in color, becomes progressively yellow as product approaches the end of shelf-life. The reaction is irreversible and will proceed faster as temperature is increased and slower as temperature is reduced.

Fig 2: Time temperature indicator showing changes (Source: www.vitsab.com)

Freshness Indicators

Freshness indicators monitor the freshness of the food product in different ways such as microbial growth or metabolism. (Smolander, 2008). Most of these concepts are based on a color change of the indicator tag due to the presence of microbial metabolites produced during spoilage. Chemical changes occurring in meat during storage are indicators of the freshness of muscle-based food products.

Changes in the concentration of metabolites such as glucose, organic acids (e.g. L-lactic acid), ethanol, carbon dioxide, biogenic amines, volatile nitrogen compounds or sulphuric compounds during storage indicate microbial growth and therefore present the possibility of using them as freshness indicators for meat products.

By integrating the indicator into the food package, the freshness indicators can be realized as visible indicator tags going through a color change in the presence of the analyte (Pavelkov 2012). COX Technologies' "FreshTag" color-indicating tags consist of a small label attached to the outside of the packaging film. It is used to monitor the freshness of seafood products, and consists of a reagent-containing wick contained within a plastic chip. As the seafood ages, spoils, and generates volatile amines in the headspace, these are allowed to contact the reagent, causing the wick in the tag to turn bright pink.

Gas Indicators

Gas concentration indicators, in the form of labels, are placed inside the package to monitor changes in the inside atmosphere due to permeation phenomena across the packaging material, microorganism's metabolism, and enzymatic or chemical reactions on the food matrix (Yam et. al., 2005). Examples of commercially available dual action combined carbon dioxide generators/oxygen scavengers are Ageless G (Mitsubishi Gas Chemical Co., Japan) and FreshPaxM (Multisorb Technologies Inc., USA).

Carbon dioxide emitting sachets or labels can also be used alone. The Verifraise package, manufactured by SARL Codimer (Paris, France) has been used to extend the shelf life of fresh meats. There are also some other companies producing commercial O2 indicators to confirm proper O2 removal by O2 absorbers. A typical oxygen indicator consists of a redox-dye (such as methylene blue), an alkaline compound (such as sodium hydroxide, potassium hydroxide) and a reducing compound (such as reducing sugars). Carbon dioxide indicators are also used in modified atmosphere packages (MAP) in which high carbon dioxide levels are desired.

The indicators display the desired concentrations of carbon dioxide inside the package. Cryovac Sealed Air Ltd has produced a label containing a visible carbon dioxide indicator. It can be used in MAP to identify machine faults and gas flushing problems. The desired gas mixture composition (oxygen and carbon dioxide) can also be checked by this indicator.

Radio Frequency Identification (RFID) System

Radiofrequency identification (RFID) tags use RF electromagnetic fields to store and communicate real-time information of the product for automatic product identification and traceability (Lee and Rahman, 2014). RFID tags are the most advanced example of a data carrier device.

An RFID system includes three main elements: a tag formed by a microchip connected to a tiny antenna; a reader that emits radio signals and receives answers from the tag in return; and middleware (a local network, web server, etc.) that bridges the RFID hardware and enterprise applications.

Two distinct features of RFID technology are the high number of various codes that can be stored in the tag and the possibility of transferring and communicating information even at a long distance, thus improving automatic product identification and traceability operations. Most advanced RFID systems (2.45 GHz—super high frequency active tags) have a reading range of up to 100 m, with up to 1 MB data in storage capacity (Ghaani et. al., 2016).

Many advances have been made in this field such as the development of a pH sensor embedded in a radio frequency transmitter without batteries, for in situ monitoring of deterioration processes of fish products; RFID tag to control the freshness of meat; RFID tag with an optical oxygen indicator for use in MAP; RFID tag with a temperature sensor, a gas sensor, a reader, and a server, making up a tracking system for the freshness of pork; RFID tag with sensors capable of measuring temperature, humidity, and the presence of volatile amine compounds, to estimate cod fish freshness; system real-time evaluation of the freshness of packaged milk, marketing, and distribution using RFID tags.

Fig 3: RFID tag on strawberry package (Source: www.mwee.com)

Conclusion

Intelligent packaging is emerging as a new branch of packaging science and technology that offers exciting opportunities for enhancing food safety, quality, and convenience. Assuming intelligent packaging can effectively provide solutions to current producer and consumer problems, it appears likely that intelligent packaging systems for food products will become more commercially viable and common-place in the years to come. Anyway, despite the hurdles that have to be overcome in the near future, there is a strong view that intelligent packaging will be a technical tool in the market with a high potential, covering both more transparent communication to consumers and the need for the retail and food industry to better control the food production chain.

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RNAi : A Novel Tool for Plant Disease Management

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Introduction

Minimization of crop loss has been in the central of the era of burgeoning human population. Every year 30% crop loss occurs due to plant pathogens. Use of chemical pesticides remained as one of the cheap methods of plant disease management. Beside development of resistance against chemicals they have a harmful effect on human and environment. During the time of green revolution exploitation of resistance genes against major pathogens through conventional breeding (back cross breeding) gained its importance. But as plants and pathogens coevolved, with time pathogen also developed the mechanisms of breaking the resistance provided by major and minor resistance genes. With the advent of biotechnology recently transgenics for disease and pest resistance came into the scenario. But due to the complexity of regulations most of the transgenics didn't released. In this situation RNAi (RNA interference), as an alternative to transgenics, emerged as a novel tool for engineering the target plant trait.

What is RNAi?

RNA interference is the RNA based processes found almost in all the eukaryotes that inhibits the expression of a gene through homology-based sequence specific interaction at transcription or post transcription level.

Simply it can be said that RNAi is associated with production of some short dsRNA oligonucleotide processed by a RNase enzyme called dicer. That with some protein form complex and regulate the expression of sequence specific site.

Components of RNAi

1. Small interfering RNA (siRNA): 20-25 base pairs long non-coding dsRNA which interfere the expression of specific gene.
2. Micro RNA (miRNA): a class of endogenous RNA molecule processed from single stranded RNA and contains hairpin like structure.
3. Dicer: it is an enzyme member of RNase III family which has the ability to cleave dsRNA molecule into siRNA or miRNA.
4. Argonaute: it is an endonuclease protein that form the core in association with RISC complex. Small RNA guided argonaute protein plays a key role in degradation of complementary target RNA molecule.
5. RNA Induced Silencing Complex (RISC).

Mechanism of RNAi

1. Gene silencing or inactivation of a particular gene in plant is associated with mainly three mechanisms.
2. siRNA directed epigenetic regulations (transcription level gene silencing).
3. si or mi RNAs associated with developmental gene regulations.
4. Sequence specific inactivation of target mRNAs by RISC. 21 nt dsRNA duplex guide this complex.

RNAi and Plant Disease Management

1. RNAi has been successfully utilized in controlling viral disease like papaya ring spot virus, bean golden mosaic virus, mosaic in squash, potato, potato leaf roll etc through RNAi based transgenic approach.
2. Similarly in case of fungal disease like rust of wheat, powdery mildew of barley, Fusarium head blight RNAi approach successfully introduced using virus induced gene silencing (VIGS) or RNA spray.
3. Bacterial disease canker, gall and nematode infestation by corn root worm was managed through silencing of gene by dsRNA following transgenic approach.

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Herbal Management of Brown Plant Hopper in Paddy

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Introduction

Rice (*Oryza sativa* L.) belonging to the family Gramineae is the staple food for one third world's population and occupies almost one fifth of the total land area covered under cereals. Rice is a high energy or high calories food and of high biological value of the proteins. More than 100 species of insect have been recorded to infest the paddy crop but out of these 20 insect pests are of major economic significance. The most damaging pest is brown plant hopper, *Nilaparvata lugens* (Stal.) suck the plant sap from the phloem vessels through their proboscis, due to this plant starts wilting with outer most leaves drying first and then the entire plant dries up. Under severe cases field gives a burnt appearance in concentric circles known as "hopper burn". Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellency, antifeedance, insect growth regulatory activities against pests of agricultural importance. In fact, botanical pesticides are in use in Indian agriculture for over a century to minimize losses caused by pests and diseases. (Prakash et al., 1997 and Parmar and Devkumar,1993).

Treatment Details

Tr. No.	Treatments
T1	*Metarrhizium anisopliae* (1x108 cfu/ml) (dose 4 gm/lit of water)
T2	5 % neem oil (dose 5ml/lit of water)
T3	5 % NSKE
T4	5 % bitter gourd (*Momrdica charantia)* leaf extract
T5	5 % custard apple (Annona squamosa) leaf extract
T6	5 % garadi *(Cleistanthus collinus)* leaf extract
T7	5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract
T8	Control (water spray)

Preparation of Bitter Gourd Leaf Extract, Custard Apple Leaf Extract and Garadi Leaf Extract

Freshly collected tender leaves (50 g/litre) were washed thoroughly under tap water. The washed leaves were rewashed with distilled water and drained out excess water and the excess moisture on leaves was removed by using muslin cloth which further allows to shade dry. The leaves were completely dried without any trace of moisture. These dried leaves were taken and prepared into fine powder by means of mixture and kept for 16 hours in water. The crude extract slurry was prepared and the concentrated pure leaf extract thus obtained through a sterilized a Whatman no.1. filter paper was used for spraying of required dose (Fiaz et al., 2012).

Methodology

Blanket application of all treatments except M. anisopliae was undertaken at 15 DAT, subsequently all treatments application was applied on 30, 50, 70 and 90 DAT. The knapsack sprayer was used for spraying operations. After every treatment, sprayer nozzles, pipes were washed twice thoroughly with clean water. In case of hoppers populations, number a hopper one day before (1DB) and 3 days after each application (3DAA) on ten random hills were recorded.

Effect of Different Treatments on the Population of Brown Plant Hopper on Paddy

Pooled analysis showed that the treatment of 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (2.42 nos./hill) was found significantly superior in reducing the population of brown plant hopper over other treatments and followed by 5 % garadi leaf extract (3.11 nos./hill), neem oil (3.23 nos./hill), *M. anisopliae* (3.62 nos./hill), 5 % custard apple leaf extract (3.69 nos./hill) , 5 % bitter gourd leaf extract (3.76 nos./hill) and 5 % NSKE (3.97 nos./hill). However, highest population of brown plant hopper was recorded in control (4.92 nos./hill).

Effect of Different Bio-Pesticide, Botanicals and Herbal Extracts on Population of Brown Plant Hoppers on Paddy

Tr. No.	Treatments	Brown plant hoppers (no./hill)											
		1st Spraying		2nd Spraying		3rd Spraying		4th Spraying		5th Spraying		Pooled	
		BT	AT	BT	AT	BT	AT	BT	AT	BT	AT	BT	AT
		14 DAT	18 DAT	29 DAT	33 DAT	49 DAT	53 DAT	69 DAT	73 DAT	89 DAT	93 DAT		
T_1	*Metarhizium anisopliae* (1x10^8 cfu/ml) @ 4 g /litre of water	0.00 (0.00)	0.00 (0.00)	0.10 a (0.32)	0.43 a (0.66)	0.20 a (0.45)	3.67 b (1.91)	4.30 (2.07)	4.67 c (2.16)	4.40 (2.10)	5.70 b (2.39)	2.25 (1.50)	3.62 c (1.90)
T_2	Neem oil @ 5 ml/litre of water	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.57 a (0.75)	1.27 b (1.13)	3.33 b (1.83)	3.13 (1.77)	4.93 c (2.22)	3.80 (1.95)	4.43 b (2.18)	2.09 (1.45)	3.32 b (1.82)
T_3	5 % NSKE	0.00 (0.00)	0.00 (0.00)	0.23 b (0.48)	0.73 b (0.86)	1.20 b (1.10)	4.23 b (2.06)	3.47 (1.86)	5.23 c (2.29)	3.77 (1.94)	5.67 b (2.38)	2.17 (2.00)	3.97 c (1.99)
T_4	5 % bitter gourd (*Momrdica charantia*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.13 a (0.37)	0.83 b (0.91)	1.20 b (1.10)	4.23 b (2.06)	3.20 (1.79)	4.63 c (2.15)	3.47 (1.86)	5.33 b (2.31)	2.00 (1.41)	3.76 c (1.94)
T_5	5 % custard apple (*Annona squamosa*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.20 a (0.45)	0.70 b (0.84)	1.53 b (1.24)	3.73 b (1.93)	5.13 (2.27)	5.03 c (2.24)	3.53 (1.88)	5.30 b (2.30)	2.60 (1.61)	3.69 c (1.92)
T_6	5 % garadi (*Cleistanthus collinus*) leaf extract	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.73 b (0.86)	1.57 b (1.25)	3.03 a (1.74)	5.00 (2.24)	3.80 b (1.95)	3.83 (1.96)	4.87 b (2.21)	2.64 (1.63)	3.11 b (1.76)
T_7	5 % bitter gourd leaf extract + 5 % garadi	0.00 (0.00)	0.00 (0.00)	0.17 a (0.41)	0.60 a (0.77)	1.63 b (1.28)	2.23 a (1.49)	4.37 (2.09)	3.17 a (1.78)	3.33 (1.83)	3.67 a (1.91)	2.38 (1.54)	2.42 a (1.55)

	leaf extract + 5 % custard apple leaf extract												
T_8	Control (water spray)	0.00 (0.00)	0.00 (0.00)	0.43 b (0.66)	1.00 c (1.00)	2.23 c (1.49)	5.37 c (2.32)	3.57 (1.89)	6.70 d (2.59)	3.87 (1.97)	6.60 c (2.57)	2.53 (1.59)	4.92 d (2.22)
	'f' test	NS	NS	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig	NS	Sig
	SE (±M)	-	-	0.05	0.04	0.12	0.10	-	0.05	-	0.07	-	0.04
	CD at 5%	-	-	0.14	0.13	0.37	0.30	-	0.16	-	0.21	-	0.13
	CV (%)	-	-	18.15	8.62	19.10	9.09	-	4.37	-	5.36	-	3.93

BT- one day before treatment, AT-3days after treatment
Sig – Significant, NS- Non-Significant
**Figures in parentheses are corresponding values of square root (n) transformation,
n= Brown plant hoppers (no./hill).

Conclusion

5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract was found effective in management of brown plant hopper.

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Organic Farming: To Mitigate Agricultural Pollutants

Article ID: 31340

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Introduction

At present-day, from corner to corner of the world, industrialized and industrializing countries are consuming the earth's resources at a distressing rate. Farmers used this method for agriculture that after the transitory of many generations soil would static be fertile as ever, while recent agricultural practices have started the process of agricultural pollution and this causes the degradation of land, environment, and ecosystem due to by-products of agriculture. No specific cause can be credited to the extensive agricultural pollution we face today. The International Federation of Organic Agriculture Movements standards advised that by using the minimal tillage, crop choice criteria, care of soil-plant cover, and other methods that decrease the soil erosion, organic farmers should reduce the loss of topsoil cover for superior production of crops. Conservation tillage should be adopted by organic farmers particularly if they are located in areas susceptible to erosion (IFOAM, 2000). "Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system." (FAO/WHO Codex Alimentarius Commission, 1999).

Reduction of Agricultural Pollutants

Improving of soil fertility and escaping the use of artificial agricultural inputs (together with fertilizers, pesticides and genetically-modified organisms) is common to all organic agriculture norms (e.g. EU Regulation 2092/91, USDA National Organic Programme, the WHO/FAO Codex Alimentarius Guidelines on Organically Produced Foods, IFOAM International Basic Standards).

Biological Control and Least-Toxic Approaches to Pest Management

The reduction or absence of artificial soil fumigants, insecticides, herbicides, fungicides, etc. helps to prevent coverage of agricultural and surrounding ecosystems to the toxic effects of pesticide pollution. Because pesticides have a direct suppressive effect on many organisms within the agro-ecosystem, the removal of pesticide use removes a major problem to the variation process of agro-ecosystems (Gliessman, 1999). In protected area landscapes, the avoidance of pesticide use by organic farmers is helpful to wildlife conservation.

The Use of Natural Soil Amendments

The use of naturally going on mineral soil amendments (e.g. rock phosphate, sulphate of potash) work to supply essential plant nutrients while decreasing nutrient leaching and/or runoff, Compost is used to develop and maintain soil organic matter levels and, when combined with an appropriate legume/grass cover crop and the incorporation of crop residues, it helps support larger and more diverse populations of soil organisms. Greater soil biodiversity has shown to increase the rate of nutrient cycling, improve soil aggregation and aggregate stability and improve the disease suppression of agricultural soils.

Table:1 Name and Application of Natural Soil Amendments

Name	Application
Alfalfa Meal	25-50 lbs./1,000 sq. ft.
Azomite	1-2 lbs./100 sq. ft.
Blood Meal	10-30 lbs./ 1,000 sq. ft.
Bone Meal	10-35 lbs./1,000 sq. ft.
Chicken Manure	1 cu. ft./200 sq. ft.
Coconut Coir	1 part coir to 2-3 parts soil.
Compost	Up to 20 lbs./ 100 sq. ft.
Greensand	50-100 lbs./ 1,000 sq. ft.
Gypsum	40-120 lbs./1,000 sq. ft.
Kelp Meal	5-20 lbs./ 1,000 sq. ft.
Dolomite Lime	25-50 lbs./1,000 sq. ft.
Rock Dust	50-150 lbs./1,000 sq. ft.
Rock Phosphate	50 lbs./1,000 sq. ft.
Shellfish Meal	30 lbs./1,000 sq. ft.
Sulfur	10 lbs./1,000 sq. ft.
Sul-Po-Mag	5-10 lbs./1,000 sq. ft.

Source: https://www.planetnatural.com/soil-amendments/

Polycultures (Intercropping and Strip-Cropping)

Polyculture is the intentional cropping of multiple species within a farm, in a planned spatial sequence. Strip cropping, where strips of one crop are planted next to strips of another is a less management intensive form of multi-cropping. When compared to monocultures, polycultures have regularly shown lesser populations of insect's pest and weeds.

Crop Rotation

Crop rotation helps to break the build-up phase in the cycles of weeds, insects and diseases, thus removing the need for pesticide application. Fallow periods, where ground is left uncultivated for a prolonged period of time (a few months to one and only year), allow a limited amount of secondary succession to advance and hence, the recovery of the diversity of both terrestrial and below-ground species.

Cover Cropping

Cereal and legume cover crop combinations can be a significant source of organic matter when incorporated into the soil. The use of perennial cover crops in orchards and vineyards is an effective means of improving the biodiversity and productive capacity of cropping systems and avoiding the labour and environmental risks related with herbicide use.

Minimum Tillage

The minimization of tillage will often lead to improved earthworm richness and activity, greater than before populations and diversity of decomposer organisms and a related increase in the organic matter content and aggregate stability of soils. Farming systems using no and low-till approaches are also less likely to incur soil erosion and need less inputs of energy.

Conclusion

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity when farmers used this method for agriculture that after the transitory of many generations soil would static be fertile as ever with reduction of soil erosion, runoff, improved earthworm richness, improving the biodiversity and productive capacity, increase the rate of nutrient cycling, improve soil aggregation and aggregate stability and improve the disease suppression thus removing the need for pesticide application. O.A lifetime supply nutrients cost effective for farmers and eco-friendly and reduces environmental, soil and water pollution.

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Quantitative Disease Resistance in Maize: Progress and Challenges

Article ID: 31341

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Introduction

Maize is third most important cereal crop after rice and wheat which is grown in all the three seasons. It provides food, feed and biofuel. It has been attacked by many pest and diseases. Although maize production has steadily increased over the past decades, the disease is still a worldwide concern that causes enormous yield losses. And reduces the grain quality. In maize, the diseases are controlled by adopting certain techniques like cultural practices, application of chemicals and most importantly development of disease resistant varieties. Eventhough chemical management is considered to be effective, we cannot recommend it to certain disease like post flowering stalk rot of maize. Among the six principles of disease management, the resistance is considered to be the most important principle as it is economical. (Clair, et. al., 2010).

Definition of Quantitative Disease Resistance (QDR)

QDR is the host plant resistance that leads to a reduction in disease rather than the absence of disease. QDR is controlled by multiple genes that can interact with the environment and with each other. QDR is considered to provide more durable resistance which remains effective over a long time over large area.

How Important is QDR?

The first reason, although effector triggered immunity (ETI) produces complete resistance, since this resistance is due primarily to one R protein, pathogen effector proteins can evolve to overcome the R protein and ETI mediated resistance (Jones, et. al., 2006). On the hand, because of multiple genes underlie QDR, the evolutionary pressure on pathogens is significantly decreased. QDR may, therefore, be a good source of long term / durable resistance. Indeed, several genes underlying QDR have been used in breeding programs for more than half a century with no signs of increased pathogen virulence.

The second reason is that ETI is most effective against biotrophic pathogens. ETI frequently results in a cell death known as the hypersensitive response (HR). The HR inhibits biotrophic pathogen growth and colonization and typically leads to full resistance against these pathogens. However, pathogens which feed on dead tissues (necrotrophic), exploit this cell death to increase their own virulence. In contrast to ETI, QDR gives an effective means of control for both biotrophic and necrotrophic pathogens. (French, et. al., 2016).

Finally, QDR is effective against a wide range of microbe classes – fungal, bacteria, viral and nematodes – and against pathogens that infect different developmental stages of the plant (Poland, et. al., 2009).

Quantitative Disease Resistance in Maize

Although maize is a major staple crop worldwide, only a few disease resistance genes controlling natural variation in resistance in maize have been identified. Mapping quantitative trait loci (QTLs) is a powerful tool for genetic dissection of QDR (Clair, et. al., 2010). The maize genome sequencing consortium has published the B73 reference sequence. The maize Hm1 gene was the first disease resistance gene identified at the molecular level in plants. Wisser et. al. (2006) summarized 437 dQTL and 17 major resistance genes identified in 50 publications on the genetic architecture of disease resistance in maize. The disease resistance QTLs cover 89% of the maize genome. and validated through transgenic or mutagenesis approaches. These include two qualitative resistance genes, Hm1 and Rp1-D, and four quantitative resistance genes with relatively large effects, ZmWAK, ZmHtn1, ZmTrx, and Rcg1 (Johal and Briggs, 1992). In addition, a few genes have been strongly implicated in resistance to different maize diseases, such as pan1 associated with resistance to northern corn leaf blight (NLB) and Stewart's wilt (Jamann, et. al., 2014), remorin (Jamann, et. al., 2016) for resistance to NLB, a glutathione S-transferase (GST) gene for resistance to southern leaf blight, NLB, and grey leaf spot and ZmLOX3, associated with resistance to

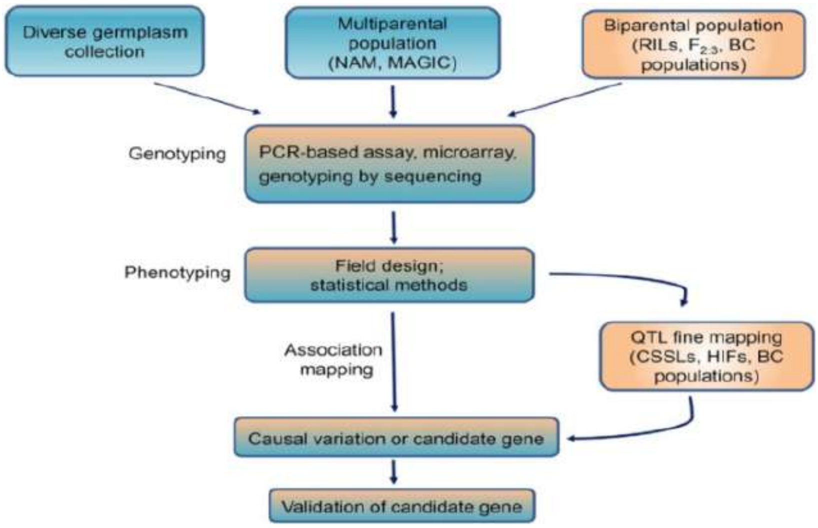
Aspergillusear rot (Gao, et. al., 2009). However, transferring of QDR is a challenge to the breeders. The transferred Quantitative Resistance Loci (QRL) may not act similarly in the new genetic background. Linkage drag can be an issue for transferring the QDR (Poland, et. al., 2009). But the information gained from mapping resistance can be used in marker-assisted selection program for development of new resistant varieties to various catastrophic diseases.

Reasons for Deployment of QDR in Maize

Two reasons for deployment of QDR are:

1. Maize is a naturally outcrossing species, the genetic architecture controlling quantitative traits more complex in maize.
2. Most economically important maize diseases are caused by necrotrophic pathogens. Resistance to necrotrophic diseases is almost exclusively quantitative rather than qualitative(Yang, et. al., 2017).

Strategies to Characterize QDR Genes in Maize



Abbreviations used.
MAGIC: Multiparent advanced generation intercross population.
NAM: nested association mapping population.
CSSL's: Chromosome segment substitution lines.

Maize Genome Sequencing Project

The maize genome sequencing project was carried out in Washington University genome centre. The scientist worked together to dissect the genome of maize using 16000 BAC clones. The maize genome sequencing consortium finally published the B73 reference sequence on 19 November 2009.

The following information was obtained by sequencing reference genome.

1. Genome size of maize was 2,300Mbp
2. Number of genes predicted were 39,656

The research was carried out for almost 4 years (Schnable et al., 2009).

Hm1: The first major gene identified

The maize Hm1 gene was the first disease resistance gene identified at the genetic level in plants. Hm1, a dominant resistance gene located on chromosome1. The Hm1 gene was identified via a transposon-tagging method (Marocco, et. al., 2005).

Progress of Work in Maize QDR (After Sequencing of Maize Genome)

Gene name	Disease	Predicted features	Gene identification method	dQTL	Note	References
Hm1	Maize leaf blight and ear mold	NADPH-dependent HC toxin reductase	Transposon tagging	No	Cloned	Johal and Briggs, 1992

Rp1-D	Common rust	NB-LRR	Transposon tagging	No	Cloned	Collins et al., 1999
ZmWAK	Head smut	Wall associated kinase	Sequential free – mapping,	Yes	Cloned	Zuo et al., 2015
Htn1	Northern corn leaf blight	Wall associated receptor like protien	Fine mapping followed by analysis of mtantants generated using TILLING	Yes	Cloned	Hurni et al., 2015
ZmTrxh	Sugarcane mosaic virus disease	Atypical h-type thioredoxin	Combined linkage and association mapping followed by transgenic complementation	Yes	Cloned	Tao et al., 2013
Rcg1	Anthracnose stalk rot	NB-LRR	Fine mapping followed by Transposon tagging	Yes	Cloned	Frey, 2005
pan1	Northern leaf blight and Stewart's wilt	Receptor-like kinase	Fine-mapping and mutant analysis	Yes	Implicated	Jamann et al., 2014
remorin	Northern leaf blight	Remorin_C domain (PFAM 03763)	Fine-mapping and mutant analysis	Yes	Implicated	Jamann et al., 2016
ZmLOX3	Aspergillus ear rot	Lipoxygenase	Mutant analysis	NA	Implicated	Gao et al., 2009

Challenges to Quantitative Disease Resistance in Maize

1. The B73 is not a resistant line and lacking information about the genes and QTLs controlling disease resistance.
2. Small genetic effects.
3. Lack of uniformity in the evaluation of disease symptoms.
4. Variations in disease severity across different geographical locations and years.
5. Linkage drag can be an issue for QTL alleles transferred from exotic or unadopted or wild species of germplasm.
6. The transferred QRL may not act similarly in the new genetic background.
7. Proper phenotype scoring is important.
8. Genotype vs environmental interaction hinder the activity of QTL's.

Conclusion

Quantitative disease resistances (QDRs) can be characterized with the genetic analysis method of quantitative trait locus (QTL) mapping. A QRL contains causal gene(s) and causal quantitative trait nucleotides (QTN) that are responsible for the phenotypic effect on QDR. Maize geneticists and pathologists need to work together to screen the most resistant varieties. Although a huge number of QTL's have been mapped only a few of the underlying genes have been identified to date. Study and discovery of QDR would help in better exploitation of host resistance.

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Emerging Diseases of Wheat and their Management in India

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Introduction

Wheat *(Triticum species)* is a crop of global significance. It is grown in diversified environments. It is a staple food of millions of people. Approximately one-sixth of the total arable land in the world is cultivated with wheat. India is the second largest producer of wheat after China. Wheat has a distinct place among the food grain crops. Carbohydrate and protein are two main constituents of wheat. On average wheat contains 11-12% protein.

One of the major constraints in boosting up the wheat production is the prevalence of number of diseases. In recent decade, among the fungal diseases Fusarium head blight (FHB), powdery mildew (PM) and blast of wheat causing severe damage to wheat crop.

Emerging Diseases

1. Powdery mildew:

a. Causal organism: *Blumeria graminis* f. sp. *tritici*

b. Symptoms: Powdery mildew produces white to grey cottony fungal growth on the upper leaf surface. This disease may occur on any above ground plant part, but it is usually most prevalent on the upper surface of the lower leaves. The white powdery patches or pustules produce large quantities of small asexual conidia in long chains, which are easily dislodged by wind or rain. When powdery mildew is severe, the entire leaf turns yellow and dies. Small, black fungal fruiting bodies (chasmothecia) may be seen immersed in the grey fungal tissue later in the season. Powdery mildew can cause severe blighting of the upper leaves and can attack the head of susceptible varieties.

		
PM on leaves	**PM on stem**	**PM on heads**

c. Epidemiology: The temperature range of 3-35°C with optimum of 15-20ºC has been found favourable for their germination of conidia whereas for the infection of the seedling's optimum temperature of 20°C coupled with RH between 24-75% is essential. Epidemics tend to occur when warm weather alternatives with dry and wet periods, accompanied by wind.

d. Management:

i. Burning of crop debris
ii. Application of recommended dose of nitrogen fertilizers
iii. Late sowing
iv. Spray triadimefon or tebuconazole @ 0.1 per cent
v. Use of resistant cultivars: MACS- 1967, DWR-162, DWR, HD-2667, HS-277, HW-89, NP-710, NP-718, K-53, CPAN-1922 (Highly resistant).

2. Fusarium head blight:

a. Causal organism: *Fusarium graminearum*

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b. Symptoms: A distinctive symptom of the scab is premature bleaching of one or more spikelet's or the entire immature wheat head. The bleaching can start anywhere on the head and spread until the entire head is bleached. Bleached spikelet is sterile or contain shrivelled and/or discoloured seed. During humid conditions, white or pink fungal growth with orange spore masses may be seen on bleached spikelet. Sexual blue-black fruiting structures also can form, giving the head a scabbed appearance, hence the name scab. During warm temperatures blight symptoms on heads appear within three days following infection. Scabby wheat grain often has a chalky white colour and/or is shrivelled. If this grain is used as seed for the following year's crop, severe seedling blight can result.

		
Bleaching of some or all the spikelets	**Pink to orange mass of spores visible on infected spikelets**	**Infected kernels are commonly called 'Tombstones'.**

c. Epidemiology:

i. Prolonged wet conditions
ii. Warm weather during anthesis
iii. Rainfall during 1-3-week period prior to anthesis
iv. Pathogen is predominant at 25 °C and grows well up to 30 °C.

d. Management:

i. Follow crop rotation: Corn – Wheat, Non cereals – Wheat, Soybean - Wheat
ii. Irrigation should be avoided from flowering to emergence of spikes.
iii. Application of recommended dose of nitrogen fertilizers
iv. Use of resistant variety UP 2825 and moderately resistant variety HP 1940.
v. Avoid cultivation of highly susceptible varieties like Sonalika, HD 29 and PBW 222.
vi. Spray tebuconazole @ 0.1 per cent.

3. Blast:

a. Causal organism: *Pyricularia oryzae*

b. Symptoms: Wheat blast infects all above ground parts of plant. The most conspicuous symptom is head/spike infection. Head infection can occur on the glumes, awns and rachis. Infected glumes support elliptical lesions with reddish brown to dark grey margins and white to light brown centre. Blackening of the rachis, lower nodes, shrivelling of grains, low test weight has also been observed. Since infection on spike blocks the translocation of photosynthates and nutrients to spike, therefore, results in partial or total spike sterility. On leaves lesions vary in shape and size depending on the stage of plants. Lesions with white centre and of reddish-brown margin on upper side, dark grey on the underside of the leaf can be observed on both young and old infected leaves.

c. Epidemiology:

i. Wet years.
ii. Continuous rains.
iii. Temperature 18-20°C during flowering.
iv. Sunny hot and humid days.

d. Management:

i. Use of disease-free seeds for sowing

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ii. Strict quarantine regulations
iii. Use of moderately resistant cultivars like BR18, IPR85, CD113 (Brazilian wheat cultivars), Postrock, JackPot, Overley, Jagalene, Jagger, and Santa Fe.
iv. Seed treatment with tricyclozole 75WP @ 2g/kg or carbendagzim 50WP @ 2g/kg of seeds.
v. Spray carbendazim 50Wp @ 1g/L or tricyclazole 75 WP @ 0.6 g/L or propiconazole 25EC @ 1ml/L and tebuconazole@ 1ml/L. Spraying at the flowering stage has found effective.

			
Complete bleaching of the spike	**Infection on leaf and stem**		**Infection on stalk**

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Farm Yard Manure

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Introduction

Farm yard manure is one of the oldest forms of manure in India and readily available to the farmers. The decomposition of mixture of cow dung, urine, leftover feed and litter material used in dairy farm is known as farm yard manure. The residual materials of dairy farm comprise of excreta of the shade is daily collected carefully and kept in trenches having dimensions 20-23 feet long, 5-6.5 feet broad and 3.5 feet deep. The residual materials kept in trench up to height of approximately 2 feet from the ground level. It will be taking 3-4 months for formation of farm yard manure. Well rotten farm yard manure is special type of manure and having 0.5 to 2.0 per cent nitrogen, 0.3-0.9 % P2O5 and 0.3-1.9% K2O. Biogas produced from waste product and excreta of animals and used for domestic purpose of human being.

Preparation

In India, farmer used the cow dung in the form of dung cake as fuel. Maximum portion of urine is soaked into the mud floor of dairy shed. The sunrays exposed to the mixture of cow urine, dung and other waste product soaked with water, so that the excreta of cow decomposed very rapidly into urea and ammonia.

$$\underset{NH_2}{\overset{NH_2}{CO}} + 2H_2O \xrightarrow[\text{Enzyme}]{\text{Urease}} (NH_4)_2CO_3 \rightarrow 2NH_3 + CO_2\uparrow + H_2O$$

On exposure of high temperatures or sun rays, on complex organic materials (cow dung) are converted to simple inorganic materials and it is washed by high rainfall.

Benefits

Farm Yard Manure is enhancing along with restore the original properties of soil and other benefits of FYM are mentioned below:
1. It increases the soil fertility and also helps in retention of water and nutrient.
2. It is rich of nitrogen and helps in breakdown of heavy soils.
3. Adds structure to light and sandy soils.
4. It is best for mulching and attracts earth worms to the soils.

What is the Difference Between Compost and Farm Yard Manure (FYM)?

1. Farm yard manure is the mixture of waste of farm animals or livestock and plants residues such as husk, leaves or hay whereas in case of compost prepared it includes of mixture of wastes of livestock as well as plants along with soil.
2. Farm yard manure is the semi- decomposed organic matter whereas in compost is the fully decomposed organic matter.

Use of Farm Yard Manure

It is potentiating the soil structure as well as increases release the nutrients and increase the growth of crops and forage. The use of this manure and fertilizers on immature plants and crops give better results. Manure contains trace amount of phosphorus and used along with single super phosphate as a basal dose and nitrogenous fertilizers should be used as a top dressing.

It is used for immediate benefits to the soil characteristics and also be used a mulch. Ensure the manure is properly mixed in with the soil to give maximum benefit to the plants along with equally distribution of nutrients. Manure is also suitable for mulching around the bases of well-established fruit trees and bushes.

To insulate the root base and feed the top soil apply to a depth of approximately 40 – 70mm. For more information on mulching, see our mulches page.

Better Quality Farmyard Manure Through Improved Decomposition

Farmyard manure a varying mixture of animal manure, urine, bedding material, fodder residues, and other components is the most common form of organic manure applied in the mid-hills of Nepal. Farmyard manure has a high proportion of organic material which nurtures soil organisms and is essential in maintaining an active soil life. Only about half of the nutrient content of farmyard manure becomes available for crop growth during the first year after it has been applied to the soil – the rest is channelled through soil biotic processes and the nutrients are released in the following years. The high organic matter content and the active soil life improve or maintain friable soil structures, increase the cation exchange capacity, water holding capacity, and infiltration rate, and reducing the risk of soil pests building up.

Conclusion

It is best way for the utilization of livestock wastes and used as manures. It is rich in nitrogen and phosphorus which enhances the crops production. It is cheaply available for the farmer. It also improves the soil texture.

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Organic Milk

Article ID: 31344

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Introduction

With changing scenario of person income and awareness towards the health the interest in organic farming has been increasing, particularly since sizeable opportunities to supply overseas markets with organic produce have become apparent. At the same time, domestic consumption of organic food has arisen dramatically. Whether producing for the domestic or international market. Milk and dairy products enjoy a thoroughly positive image as regards naturalness, originality, good taste and product safety, regardless of their method of production.

Nevertheless, according to a forecast, sales of organic milk as a whole are predicted to grow; there are claims saying it will triple until 2005. Therefore, the milk industry is really interested in investigating the modifications and risks induced by the conversion to organic farming. Studies have been undertaken to investigate the reasons behind consumer's purchases of organic products. Some points can be mentioned as major reasons for buying organic milk and milk products, it seems to be healthier, help to protects nature and less allergy with no chemical residue.

Definition

It is defined as the milk obtained from livestock which is reared under different organic practices. The certification is allowing under NPOP in India (National Program for Organic Production). Certification requires that livestock allowed to graze on fertilizer-free and pest-free pasture as well as be fed organic feed which is certified, and drug are not used in treatment of livestock but in some cases it can be given for specific purposes, like Aspirin may be given to reduce inflammations and Ethanol used as disinfectant/ sanitizers but not as feed additive.

Challenges

1. Conversion of conventional land into organic land is one of the most challenging aspects of the organic farming. It requires three years to convert farm land from conventional to organic.

2. Detecting organic input sources (feed), higher costs of production, and stabilizing animal health will be included in other challenges.

What is the Difference Between Compost and Farm Yard Manure (FYM)?

1. Farm yard manure is the mixture of waste of farm animals or livestock and plants residues such as husk, leaves or hay whereas in case of compost prepared it includes of mixture of wastes of livestock as well as plants along with soil.

2. Farm yard manure is the semi- decomposed organic matter whereas in compost is the fully decomposed organic matter.

Standards for Organic Milk Production

To produce organic milk, farm must be registered with an organic control body and production system adopted must meet the organic standards.

Five organic standards are important and have a worldwide acceptance are mentioned below:
1. European Union Regulation (1804/ 1999).
2. Organic Food Products Act (OFPA) of USA.
3. Draft Guidelines of Codex/WHO/FAO.
4. United Kingdom Register of Organic Food Standards (UKROFS) of UK.
5. The International Federation of Organic Agricultural Movements (IFOAM).

Steps Involved in Certification Includes

1. Registration of producers and the processing industries
2. Provision of fundamental information on the farm and crops
3. Inspection and verification of farm,
4. Processing unit, production methods and production practices by the inspector appointed by the various certifying agency.

The popular certifying agency are APEDA (Agricultural Products Export Development Agency), NSOP (National Standards for Organic Products), USOCA (Uttarakhand State Organic Certification Authority) appointed by Government of Uttarakhand, ECOCERT appointed by Ministry of Agriculture, Govt. of India etc. For the production of organic milk, the following recommendations should be considered:

1. Conversion to organic from conventional farming: Planning is foremost important step for conversion from conventional to organic production. Either the complete farm will be converted in one block or the conversion can be phased over a number of years. A minimum of 2-3 years are required to convert the land to organic stages. Organic milk can be produced from the day when land achieved complete organic stages. For achieving organic stages, herd must have started nine months and feeding six months prior to the intended organic milk production date.

2. Feeding: feed ingredients used in organic farm must be produced as well as certified to organic on the beginning of conversion. At least 60% feed should be obtained from the farm which is certified as organic and up to 30% may come from in-conversion sources. The balance of the ration should meet full organic standards. Compound rations must be 100 percent organic. Mineral supplementation is only permitted if required. Clover-based fodders are necessary for the success of organic dairy farms because they are the main source of nitrogen. Organic molasses should be used if required.

3. Soil fertility: Soil fertility will be maintained by rotations and grazing ground where possible and the careful usage of recycled manures and slurry. Synthetic fertilizers are prohibited in organic farming but the lime or some natural sources of nutrients is permitted.

4. Housing: Space requirements are very important for Cows to provide a comfortable, dry bedded lying area. Well bedded loose housing is preferred, 6m2 per dairy cow space to be required.

5. Animal health: Preventive management and homoeopathic remedies are always encouraged. For organic production veterinary medicines and antibiotics must not be used as a preventive medicine but may be used to prevent distress in the event of illness or injury with the withdrawal period at least twice the stated withdrawal period. Control of mastitis can be done by good management practices including teat dipping, and culling cows with high cell counts. Parasitic control might be achieved through careful grazing management practices to minimize exposure to infection. Vaccination is allowed in normal condition but it is permitted, under derogation, in cases where there is a known disease risk. Organic farming the vaccination, treatment for parasites and any compulsory eradication scheme should be prohibited.

6. Sources of stock: Purchased cattle must not come from herds which have had a case of Bovine Spongiform Encephalopathy in the previous six years. After the conversion of farm into organic, the animal cannot be treated as organic but their milk can be considered organic.

7. Selling of organic milk: To access premium prices for organic milk it is necessary to sell milk through an organically registered processing outlet. Considered marketing facilities should be before starting production.

The Health Benefits of Organic Milk Include the Following

1. More Omega 3: Organic milk have 71 % more omega 3 than conventional milk which is essential for optimum growth of body. Because organic cows, which are pasture grazed with fed a large quantity of red clover than the conventional cows. It is rich in Omega 3, which passes to the cow and finally to people through its milk intake. Daily intake of omega 3 fatty acids which protects from various diseases as well as to reduce the incidence of heart disease, inflammation (in skin diseases like eczema), cancer, and arthritis. The intake of diet rich in omega-3 fatty acids may also reduce or delay onset of Amyotrophic lateral sclerosis (ALS). It is also known as Lou Gehrig's disease; it is essential for heart health and cardiovascular conditions.

2. More Conjugated Linoleic Acid: Cows grazed on pastures produce 500% more CLA in their milk than cows that are fed fodder. The conjugated linoleic acid (CLA) can be beneficial in cancer treatment. Conjugated linoleic acid (CLA) increases the body's metabolic rate, immunity to disease, and muscle growth. It also reduces abdominal fat, cholesterol, and allergic reactions.

3. No chemical contamination: Organic cows are grown on grazed on pastures under organic condition. Therefore, organic milk is not contaminated with harmful or hazardous chemicals such as the residues of pesticides, fertilizers, and hormones. Furthermore, this nutrient-rich organic milk does not contain traces of antibiotics, GM feed, urea, or fertility hormones, as these are not fed to the cows to increase their milk production. By consuming organic milk, ensure that do not harm the environment. The pesticides used in non-organic farming are wiping out numerous species of beneficial insects, butterflies, and birds.

4. More Antioxidants: Organic milk has a two to three times higher of antioxidants like lutein and zeaxanthin than as compared to conventional milk. Lutein is extremely important for eye health and is effective in preventing numerous eye diseases such as macular degeneration and cataracts. Zeaxanthin is also important for good eye health. It protects the eye from UV damage and the impact of free radicals. It is very helpful in preventing cataracts, diabetic retinopathy, glaucoma and macular degeneration. Organic milk has a higher number of vitamins such as vitamin A and E than conventional milk. Since organic cow's graze on fresh grass and clover, organic milk having 50% more Vitamin E as well as 75% more beta carotene in comparison to conventional milk. Vitamin E is useful for protecting human body from free radicals and delays signs of aging. It also reduces the incidence of various chronic diseases including heart disease, diabetes and cataracts.

Beta Carotene is Converted by Our Body into Vitamin A

Vitamin A, also called retinol, is useful for guaranteeing strong eyesight, increasing resistance to infections, good skin, bone growth, tooth development, reproduction and gene expression.

Organic Certification

Certification Agency given a written documentation indicates a clearly identified production or Processing system has been methodically used and follows to the specified requirements. APEDA (Agriculture and Processed Food Products Export Development Authority) and NSOP (National Standards for Organic Products) are the important certifying agency. For Indian condition in case of small farmers, Group Certification is convenient as this step is investment intensive and there are 20 Accredited Certification Agencies (ISO-17011) in India.

Conclusion

Organic milk is changing the status or life style of human being; it is rich in omega 3 fatty acid, CLA and other vitamin / minerals as compared to conventional milk. Organic milk free from all chemical and pesticides. It is very useful against disorders such as cardiovascular disorder, arthritis, diabetes and allergic condition.

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Mango Ice-Cream: A New Product for Mango Lovers

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Introduction

With the change in the time the needs, interest as well as taste of the peoples are changing. The new product 'Mango Ice-cream' is attracting peoples of all age group. This is supposed to be the solution of the problem where mango was over produced and glut was disposed off. For this purpose, Dashehari, Amarapali, Malika and Totapari cultivars of mango is being utilized by the businesspersons. The pulp of cultivars rich in beta carotene Dashehari (3.11 mg/100g), Amarapali (3.51mg/100g) and Totapari (1.86 mg/100g).

The technology was popularized by the Central Institute of Sub-tropical Horticulture in 2018. By this, product may remain in the market for longer duration.

Steps for Preparation of Mango Ice-Cream

Take 1kg pulp of mango

↓

Add 200 g cream and 5 g stabilizer into pulp.

↓

Mix the pulp, cream and stabilizer and keep the total soluble solids to 28^0 Brix

↓

Heat the mixture for thorough mixing

↓

After the normalization of the temperature, place it in the cool chamber at a temperature of 4^{0}C for 6-8 hours.

↓

Homogenize the mixture with help of homogenizer

↓

Make the ice-cream bricks or put it in cups

↓

Store it to remain cool

Other product of mango includes candy, Am-Paper etc.

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Management Practices for Better Ratoon Sugarcane Crop

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Sugarcane productivity has shown the increasing trend, a wide gap exists between potential (competition crops) and existing (commercial plots) productivity levels. Ratooning constitutes around 50% of the total area under cane and ratoon productivity and early maturity that the plant crop. Ratoon productivity has been proved to increase with proper management involving timely Agricultural operations, proper nutrition management, and integrated pest management and maintenance of adequate plant population.

Selection of Suitable Varieties

1. Selection of suitable sugarcane varieties with good ratoonability.
2. It is observed that all sugarcane varieties perform better in plant can be use as ratoon crop or at least on par.
3. Cultivation practices:
    a. At the time of harvest of plant crop sharp knives for cutting the clump to the ground level need to be used.
    b. Cleaning of field and removal of dead canes, trash etc., where ever they are in the field.
    c. Breaking the clods by inter-cultivation between the furrows with the plough.
    d. Stubble shaving has to be done with sharp knives to the ground level. The advantage of stubble shaving includes the removal of generated old buds and rejuvenation of new buds. Care should be taken not to disturb the clump while stubble shaving.

Gap Filling

Normally while harvesting the plant crop due to the movement of labour, more gaps are found in the ratoon crop. Therefore, it is very essential to fill the gaps so as to have a greater number of millable canes in ratoon crop also. This can be done in the following ways:
1. With setts: Placement of either single/two/three budded setts in the gaps.
2. Pre-germinated settlings raised through "Polybag system"
3. Taking the clumps from thickly populated area and filling the gaps.

Poly Bag Seed Nursery

1. Single budded setts are to be cut carefully.
2. While planting in the bag proper care should be taken to keep the bud in upward direction.
3. A thin layer of soil medium should be on the bud of the sett.
4. Poly bags should be kept in rows.
5. Poly bags should be kept under shade preferably.
6. The buds start sprouting from 10th to 12th day onwards.
7. Normally the settlings aged between 35-40 days are to be used for planting.
8. While planting, care is to be taken not to disturb the soil of the poly bag.
9. With a blade give a gentle cut on one side of the bag along the length, remove bag carefully and put the setting in the furrows of the main field and press gently.

Trash Mulching

This should be done by applying 3 tonnes of trash per hectare and need to be spread on the field inbetween the furrows. The advantages include the following:
1. Forms as a cover to the soil.
2. Prevents evaporation of soil moisture.
3. Conserves the soil moisture.
4. Keep the root zone moist.

5. Helps in the production of more tillers.
6. Keeps the standing crop in lush green colour.
7. Aids the plant in absorbing more nutrients.

Integrated Nutrient Management

1. Inorganic Fertilizers: For ratoon crop, 3 bags of urea, 5 bags of super phosphate and 1.50 bag of muricate of potash are to be applied at the time of ratooning. The second dose of 3 bags of urea should be given at 45th day after rationing.

2. Organic fertilizers: Application of 2 bags of bio-compost, 4 kgs of Azospirillum and 4 kgs of phosphobactor per acre is recommended for getting higher yields and better sugar recovery.

Weed Management

In ratoon crops we should not apply any pre-emergence weedicide (Atrozin). The post emergence weedicides Gramoxone (4.50 liters) and Femoxone (2.50 Kg) per hectare are to be used for the control of weeds. If necessary one manual weedling may be done.

Water Management

Ratoon crops normally require 18-20 irrigations in their life span. Drip irrigation is also recommended in the places of water scarcity. In certain cases, alternate furrow method is recommended. However, wherever there is plenty of water, normal irrigations at regular intervals are recommended to get higher yields.

Harvesting of Ratoon Crop

It is an established fact that ratoons mature early (at least by one month) when compared to plant crop. Hence, all the care should be taken to get the cutting orders by respective sugar factories well in advance so that the cane may be used as an open mill cane at the time of starting of the crushing season.

Advantages

1. No preparatory cultivation is required.
2. Saving in the cost of seed material.
3. Saving of labour since many operations such as collection of seed cane, cutting of the setts and planting are not undertaken in rations.
4. The leftover in the field especially in the form of fallen leaves, trash, etc., in due course of time gets converted in to organic matter.
5. Ratoon crops generally come to maturity at least one month early.
6. The expenditure involved in growing ratoon crops is less as compared to plant crop.

Disadvantages

1. Cane yields are generally lower than plant crop yields.
2. Nitrogenous fertilizer requirement is more.
3. In almost all the places, the ratoon crops receive neglected attention. Neglected cultivation makes the ratoon crops more prone to pests and diseases.
4. Under some situations in certain varieties, flowering takes place and unusual delay in the harvest and particular conditions might result in the increase of fibre content that might ultimately affect the sugar recovery.

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CRISPR-Cas: Multiplex Genome Editing

Article ID: 31347

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Abstract

CRISPER/Cas9 enables high efficiency gene editing using multiplex gene knockout, deletion, duplication and over activation of gene fragments or chromosome. This technique can be successfully exploited in improvement of industrially important microbial cultures and crop plants. It has also been tested for therapeutic applications and clinical trials of various animal models making it a vigorous research implement for almost all the biological systems.

Keywords: CRISPER, Multiplex genome editing, crRNAs, SpCas9.

Introduction

The aptitude of engineering biological systems and organisms clutches gigantic potential for applications across basic science, medicine and biotechnology. The scientific community is always in a quest to alter the genetic machinery of microbial systems in order to attain some desirable traits in the microbial factories. The desire to alter the microbial machineries has led to the emergence of several genome editing technologies, including zinc-finger nucleases (ZFNs), transcription activator–like effector nucleases (TALENs) and the RNA-guided CRISPR-Cas nuclease system. The CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) system is an immune mechanism adapted by the majority of characterized Bacteria, Archaea and many other microbes. Briefly, CRISPR represents a family of DNA sequences present in the genome of prokaryotes. These fragments are originally derived from the DNA fragments of bacteriophages that have previously infected the prokaryote in order to detect and destroy DNA from similar bacteriophages during subsequent infections. When a bacteriophage invades, the DNA fragments are acquired by CRISPR-containing organisms and transcribed into CRISPR RNAs (crRNAs) which guides the cleavage of attacking RNA or DNA. The term Cas refers to an enzyme that uses CRISPR sequences as a guide to recognize and cleave specific strands of DNA that are complementary to the CRISPR sequence. The Cas enzymes together with CRISPR sequences form the basis of a technology known as CRISPR-Cas. This CRISPR immune system was originally employed to knock out target genes but modifications to work in association of many diverse Cas proteins have extended its ability for the specificity to activate/repress target genes in various cell types, purify certain regions of genome, DNA imagining in live cells and precise editing of DNA and RNA. The development of RNA-guided endonuclease, SpCas9 from *Streptococcus pyogenes* has marked it the most extensively used endonuclease for genome editing and transcription regulation.

Mechanism of Action

Based on differences in their mechanisms of action and components, CRISPR systems have been classified into two major classes, class 1 in which RNA-guided target cleavage requires a large complex of effector proteins, class 2 systems in which single RNA-guided endonuclease is required to enable the cleavage of invading genetic material1. In general, a CRISPR system functions in three stages to execute a full immune response against invading foreign DNA. In the first stage, mechanism starts with the incorporation of DNA fragments from invading bacteriophages or plasmids (termed as protospacers) into the host locus between CRSIPR RNA repeats. Second stage starts with the expression of Cas proteins, the transcription of CRISPR array containing acquired spacers leads to the cleavage of pre crRNA and further processing into mature crRNAs. The completely processed crRNA is a leader containing a spacer sequence which is a part of crRNA repeat sequence act as a target sequence to the invading genome. It allows the recognition of the crRNA by Cas proteins and other RNA components. In type II CRISPR systems, the processing of crRNA is dependent on the presence of a noncoding trans-activating CRISPR RNA (tracrRNA) which hybridizes with the crRNA repeat sequence. TracrRNA along with crRNA are also involved in Cas9 binding, and Cas9-mediated target cleavage. In the third stage, crRNA guides the Cas proteins for recognizing the suitable target and further mediates the cleavage of the invading genome, thus help in defending the host cells from infection. Any nucleotide sequence of ~20bp can be the target. The mechanism of action of most of the CRISPR systems are dependent on the presence of the unique sequence compared to the rest of the genome and sequence-specific PAM at the target site in the genome invaded by bacteriophage (Fig1). For Cas9 to bind, the PAM sequence performed as a binding signal but binding the exact sequence is Cas protein dependent. In type I and type II CRISPR systems, the absence of PAM sequence protects the CRISPR locus from self-cleavage in the host genome.

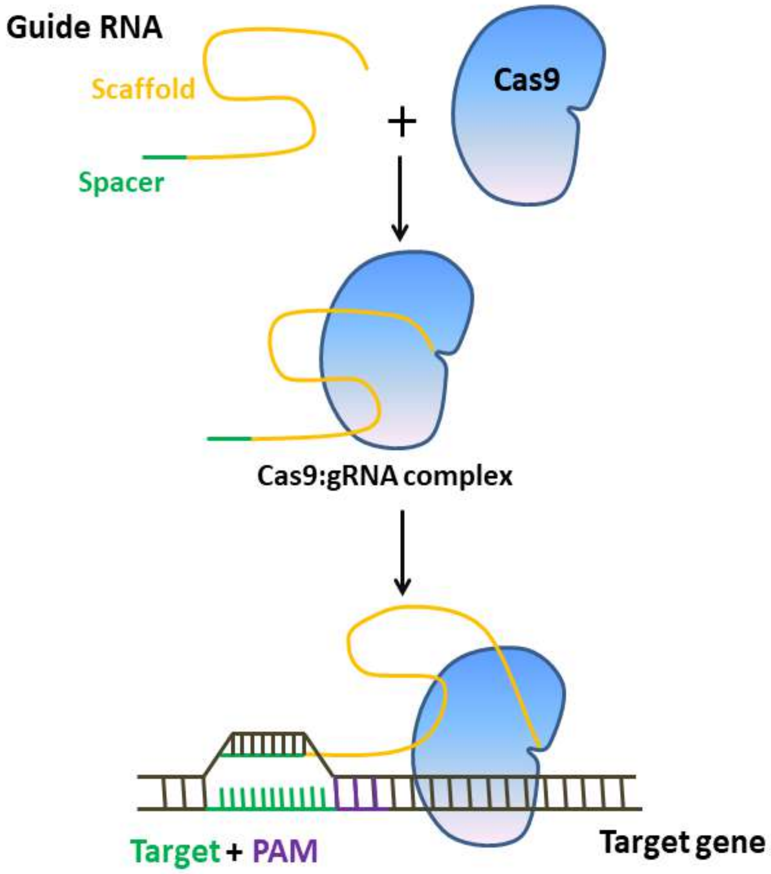

Fig.1 Mechanism of action and components of CRISPER system: Guide RNA, spacer and Cas9 form a complex which directs the molecular machinery to alter the target gene.

Applications of CRISPR-Cas Based Genome Editing Approach

The applications of CRISPR are not limited to the genome editing and gene regulation, it is also involved in fusing DNA-binding proteins (dCas9, ZFs, and TALEs) with fluorescent proteins (FPs) to allow straight imaging in living cells. Cas9 is made up of two nuclease domains: a RuvC-like nuclease domain (cleaves the non-target strand), an HNH nuclease domain (cleaves the target strand complementary to the guide RNA). Specificity of CRISPR is determined by the specificity of guide RNA with the particular genomic target compared to the rest of the genome. However, additional sites called as "off-targets" in the genome can serve as guide RNA targets where partial homology exists2. Mutating one domain creates a nickase Cas9 (nCas9) that cleaves only one strand of DNA due to the presence of single nuclease domain. dCas9 is formed when both nuclease domains are mutated, it lacks nuclease activity but withholds its DNA-binding activity guided by RNA. Site-specific genetic and epigenetic regulation, without cleaving the target DNA is mediated by fusion of dCas9 with other effectors. Among the various Cas proteins, Cas9 that cleaves the target DNA in the class 2 type II CRISPR system, is the most widely used RNA guided endonuclease for genomic editing and regulation. Thus, the CRISPR system provides the basis for a flexible genomic engineering toolkit.

Genome editing is of great interest in the treatment and prevention of many diseases. The CRISPR/Cas9 system has a remarkable therapeutic potential for treating various diseases. Genome editing therapy can help in the restoration of gene function or make up for the mutation in a gene. Single nucleotide polymorphism (SNP) editing has been proposed with different strategies, such as: introducing a defensive mutation, hitting out the gene that causes the disease, or adding a therapeutic transgene3. A pseudogene can be activated in a case where repairing of mutated gene is difficult due to genomic context. In such case mutated gene is replaced by pseudogene. However, when damage is caused by a protein to an organism by its abnormal structural and functional characteristics (accumulation of protein in a tissue and improper folding) e.g. in amyloidosis, regulation of the gene expression can be done in various ways at several points in the expression pathway.

Multiplex genome editing using CRISPR/Cas9 has opened doors for the plethora of exciting applications for performing genome editing with high efficiencies. It allows more robust approach for activation/repression of gene by recruiting several activators/repressors to the target gene. The present and future applications enabled by CRISPR/Cas9 multiplexing proficiency involves multiplex gene knockouts, gene activation and repression, deletion of chromosome and gene fragments, exon exchange, epigenome editing and Cas9-dimers to reduce off-targets4. The application of new methods will provide innovative approach to facilitate genome engineering which can have profound impacts on accelerating the multiplex genome editing with precision.

Conclusion

This technology has been applied in various microbial industries, for instance, to engineer probiotic microbial strains and to immunize the industrial microbial cultures against possible viral infections. Furthermore, it has also been successfully used to edit the genome of various monocots and dicots to obtain an improved yield. It has been tested successfully for therapeutic applications in various animal models like fish, rat, rabbits, dogs even monkeys. It is anticipated that CRISPR/Cas9 technology will soon be validated through ex-vivo clinical protocols to test against various types of cancer and other diseases. In the time being, it is completely suitable for therapeutic experiments using diverse strategies that have been developed for expression of gRNAs and editing multiple genomic targets and justified to be robustly developed as a research tool in varying range of biological systems.

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Impact of Conservation Tillage on Carbon Sequestration

Article ID: 31348

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Introduction

Conservation tillage, a common term which infers that all tillage approach that reduces outpouring and scrapping of soil surface in contrast with plow-based tillage, is known to enhance soil organic carbon (SOC) content. The chief mechanisms of carbon sequestration with conservation tillage are increased micro-aggregation and emplacement of SOC in the subsoil horizons. Adoption of suitable crop and soil management systems accentuate humification and increase the passive fraction of SOC. Soil organic carbon (SOC) sequestration is the predominant process to alleviate CO_2 emissions including contributions to ameliorate greenhouse gases. Tillage practices strongly influence carbon sequestration by physically mixing soil and by disturbing crop residues in soil.

Agricultural practices affect soil C reserve by influencing at least two processes:
1. Increasing rate of biomass decomposition and mineralization releasing CO_2 into the atmosphere.
2. Exposing SOC in the soil surface to the climatic elements thereby increasing mineralization of C. The rates of these processes are governed by several exogenous and endogenous factors including inherent soil properties, micro and meso-climate, and management practices (Lal et al. 1995).

Soil Carbon Sequestration

Soil carbon sequestration alludes to the way toward moving carbon-dioxide (CO_2) from the atmosphere into the soil through crop residues and other organic solids and in a form that is not promptly reemitted. This exchange or "sequestering" of carbon helps balance emanations from non-renewable energy source burning and other carbon-emitting activities while upgrading soil quality and long-term agronomic productivity. Soil carbon sequestration can be accomplished by management systems that add high amounts of biomass to the soil, cause minimal soil disturbance, conserve soil and water, improve soil structure and enhance soil fauna activity.

Carbon sequestration refers to the expulsion of carbon dioxide from the atmosphere into a seemingly perpetual stable structure that does not affect atmospheric chemistry. The Carbon sequestration process may be naturally or anthropogenic. The natural process includes terrestrial sequestration in soil (humification and formation of secondary carbonates) and trees (biomass production and storage in above ground and below ground components).

These natural processes can be managed, and their rate and magnitude can be enhanced in some ecosystems. Carbon is considered sequestered if it ends up in a stable form, such as wood or soil organic matter. Soil carbon sequestration is a significant and quick sink for expelling climatic carbon dioxide and easing back an unnatural weather change (Miller et al. 2004). Carbon sequestration in humus is strongly related to soil management practices and especially to soil-conserving practices. Practices that increase SOM (soil organic matter) include: leaving crop residues in the field, choosing crop rotations that include high-residue plants, utilizing ideal supplement and water the executives practices to develop solid plants with a lot of roots and residues, growing cover crops, applying manure or compost, using low or no-till systems and mulching to help conserve the soil. Addition of manure enhances SOC pool and improves soil physical fertility (Blair et al. 2006).

Conclusion

Soil carbon sequestration can be significant cost-effective approach for mitigating unfavourable effect of climate change. Conservation tillage practices such as reduced tillage, minimum tillage, zero tillage are techniques through which atmospheric carbon can be sequestered into soil. Agriculture practices with or without residue incorporation have positive impact on soil carbon sequestration and crop productivity.

Selection of the right combination of tillage implements is necessary to create a soil environment conducive for optimum germination and maximum yield.

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Integrated Management of the Fall Armyworm on Maize

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Abstract

Fall armyworm is a notorious pestiferous insect with high dispersal ability, wide host range and high fecundity that make it one of the most severe economic pests. India predominantly being a tropical country favors high rate of multiplication round the year and its high pestiferous nature poses a formidable challenge to India agriculture warranting immediate action before it assumes a serious proportion.

Introduction

Spodoptera frugiperda belongs to family Noctudae is commonly known as Fall armyworm (FAW). It is a highly polyphagous migratory lepidopteron pest species that refers the invasive behaviour of larvae native to tropical and subtropical region of America causing significant damage to crop. It was detected in Central and Western Africa in early 2016. FAW is migratory in nature and moths fly for over 100km per night and high fecundity with adult female laying 1000 egg producing 10 batch average of their 10-20 days lifespan. The pest can persist in an area throughout the year where there is availability of alternative hosts and favourable temperatures. In addition, it is reported to causes major damage to economically important cultivated crops like maize, rice, sugarcane, cotton, soybean, millets, peanuts as well as horticultural crops like cabbage, tomato, potato, beet and onion.

In India, incidence of this pest was first observed in Shivamogga district, Karnataka on 18th May 2018 and subsequently reported in Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh, Odisha, Bihar, West Bengal, Gujarat, Rajasthan, Kerala, and Uttar Pradesh at mild to alarming levels in farmer's fields. By January 2019, Chhattisgarh was the last state to report the pest. In northeast India, this invasive pest was reported for the first time during late March 2019 in Lunglei district of Mizoram and West Tripura district of Tripura. Subsequently, it has detected causing massive outbreaks during April in Mizoram and Nagaland. Later, it was detected causing damage to maize crop during early May in Meghalaya, Manipur, Sikkim and Arunachal Pradesh of northeast India. FAW was first detected in Manipur on 7th May, 2019 in Chandanpokpi village of Chandel district and subsequently reported from all the districts of Manipur. The pest is suspected to have arrived from Myanmar via Chandel district of Manipur, which borders Myanmar.

Identification and Life Cycle of FAW

FAW has four black spots arrange in square shape in 8th abdominal segment and in trapezoid manner in 9th abdominal segment and marked with a white inverted 'Y' shaped on its head. The adult male moths have grayish-brown molted forewing light and dark splotches and female adult having noticeable spot near the extreme end of each forewing, the hind wing is iridescent silver white with narrow dark border. FAW can't tolerate prolonged freezing temperature and this species doesn't enter diapauses stage. Fall armyworm life cycle includes egg, six instars caterpillar stage, pupae and adult. Duration of life cycle varies with climatic and other conditions such as life cycle completed within 30 days during summer, 60 days in spring, autumn and up to 80-90 days during winter season.

		
Eggs are pale green or white at the beginning, get covered in scales, and turn clear brown to brown before	**Neonate larvae.**	**There are 6 larvae stages. Young larvae are pale colored. They become brown to pale green, then turn**

hatching. They hatch within 2-3 days.		darker at the latest stages. The larvae stages last 12 to 20 days (depending on ambient temperature and other environmental conditions).
		
Half-grown or fully grown caterpillars are the easiest to identify. The larvae are generally characterized by 3 yellow stripes on the back, followed by a black, then a yellow stripe on the side. Look out for four dark spots forming a square on the second to last segment (photo). Each spot has a short bristle (hair). The headis dark; it shows a typical upside down Y-shaped pale marking on the front.	The pupa is dark brown and hides in the soil, more rarely in the stalk. Pupa lives 12-14 days before an adult emerges.	The moth is 3 to 4 cm wide. Its front wings are dark brown while the rear wings are grey white. It will live 2 to 3 weeks before dying

Initial Sign of Infestation

First instar caterpillar. Gregarious larvae feed superficially on one side of leaf (or inside whorls) and spread to new host plant through ballooning mechanism.	
Second instar caterpillars. Feed gregariously in initial phase and make small leaf holes/papery windows.	
Third, Fourth and Fifth instar caterpillars. Often feed solitarily inside the whorls and because large holes accompanied by larval droppings (excreta).	 

Integrated Pest Management (IPM) for Fall Armyworm

1. Monitoring: Installation of FAW pheromone traps @ 5 acre-1 on or before germination of the crop to monitor pest and population build-up.

2. Scouting: Start scouting in **"W"** pattern in the field after leaving 3-4 outer rows as soon as maize seedlings emerge

3. Cultural Measures:

a. Deep ploughing is recommended before sowing. This will expose FAW pupae to predators.

b. Timely sowing is advised. Avoid staggered sowings.

c. Intercropping of maize with suitable pulse crops of particular region. (eg. Maize + pigeon pea/black gram /green gram).

d. Erection of bird perches @ 10 /acre during early stage of the crop (up to 30 days)

e. Sowing of 3-4 rows of trap crops (eg. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows symptom of FAW damage.

f. Clean cultivation and balanced use of fertilizers.

g. Cultivation of maize hybrids with tight husk cover will reduce ear damage by FAW.

4. Mechanical control:

a. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosine water.

b. Soil application inside the whorls.

c. Mass trapping of male moths using pheromone traps @15/acre.

5. Biological Control strategies:

a. *In situ* protection of natural enemies by habitat management. Increase the plant diversity by intercropping with pulses and ornamental flowering plants which help in build-up of natural enemies.

b. Augmentative release of *Trichogramma pretiosum* or *Telenomus remus* @ 50,000 acre-1 at weekly intervals or based on trap catch of 3 moths trap-1.

6. Microbial Biopesticides:

a. Application of *Metarhizium anisopliae* talc formulation (1 × 108 cfu g-1) @ 5 g l-1 whorl application at 15-25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage.

b. Application of *Nomuraea rileyi* rice grain formulation (1 × 108 cfu g-1) @ 3 g l-1 whorl application at 15-25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage.

c. Application of *Bacillus thuringiensis* v. *kurstaki* formulations @ 2 g l-1 (or) 400 g acre-1.

Stage Wise Options Including Chemical Control

1. First Window (seedling to early whorl stage): To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE OR Azadirachtin 1500 ppm @ 5ml/ litre of water.

2. Second window (mid whorl to late whorl stage): To manage 2nd and 3rd instars larvae at 10-20% damage spray Spinetoram 11.7% SC @ 0.5 ml/litre of water OR Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 0.25 ml/l of water OR Chlorantraniliprole18.5% SC @ 0.4 ml/litre of water.

3. Poison baiting: Poison baiting is recommended for late instar larvae of second window. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 litres of water for 24 hours to ferment. Add 100g thiodicarb just half an hour before application in the field. The bait should be applied into the whorl of the plants.

4. Third Window (8 weeks after emergence to tasseling and post tasseling): Insecticide management is not cost effective at this stage. Hand picking of the larvae is advisable.



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Sugar Beet Seed Pelleting: An Augmentation Technique for Quality Seed Production

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Seed pelleting is the process where inert materials like clay or limestone are added to seeds for altering their size and shape so as to improve the plantability. The technique of pelleting has been developed commercially in past 40 to 50 years in which techniques from pharmaceuticals industries were applied. Germans were the first inventors in creating a seed pellet of sugar beet plant. Pelleting commonly implies for singling seeds in field. Seed pelleting can be combined with other important technologies such as priming and seed health maintenance technology which contributes in attaining high crop yield. Pelleting of seeds is known to be preferred in irregular shape of seeds such as of sugar beet. There are various types of seed pelleting, in general. These are inoculants pelleting, protective coating, herbicide coating, nutrient coating, hydrophilic coating and oxygen supplier coating. In sugar beet plant, protective coating is preferred.

Process of Seed Pelleting in Sugar Beet

In seed pelleting process, the seeds are rolled in rotating drums and powdered material and water are added for adhering to the seed so as to provide strength during transportation and drilling, besides protection to insect's pests and fungal pathogens. Seed pelleting in sugar beet occurs in four different layers (Fig. 1).

The first layer is a thin one for fungicide containing active Thiram which prevents fungal damage to seeds by disinfecting action. The second layer is for formation of hard coat pellet, formed by components of solid and liquid shell mass which contains materials possessing germination and emergence promoting properties. Furthermore, this layer needs precision as it imparts proper weight and shape to pellet.

Moreover, this second layer acts as a spatial separator (between the treatment applied and the seed) to the third layer. The third layer is of additional coating for prevention of insects and seed borne diseases such as Aphanomyces and Pythium damping off. The fourth layer is of pigmented coating applied on to the third layer. This layer helps in prevention of abrasion of seed treatment that generally occurs during drilling of seeds. Furthermore, it protects direct contact to seed treatment agents by farmers.

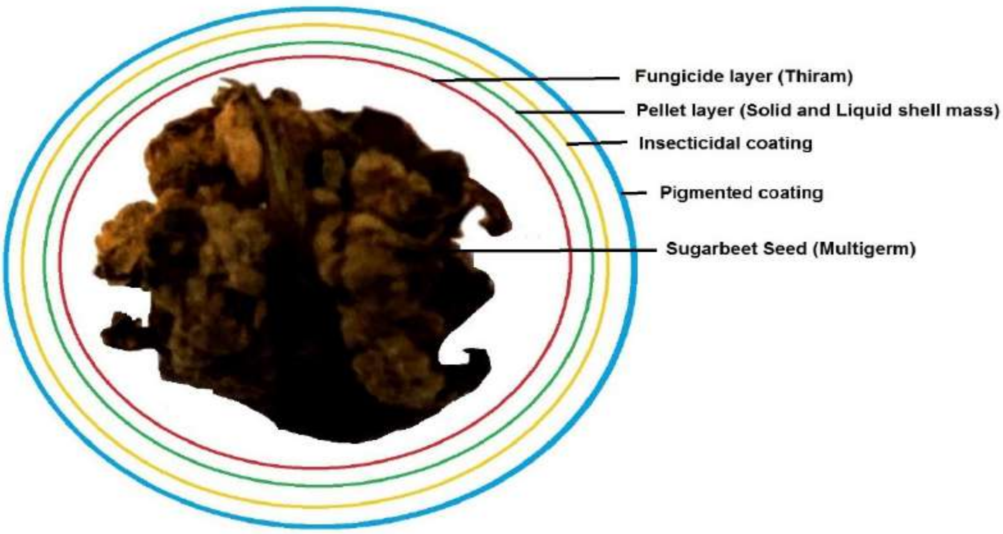

Fig. 1: Sugar beet seed pelleting

Insecticides Used in Coating of Seeds in Sugar Beet

There are some insecticides like Neonicotinoids and Pyrethroids, etc., which have been used in coating/pelleting of sugar beet seeds so as to prevent the seeds from damage caused by insect's pests. Their properties have been mentioned in the table below:

Insecticides	Properties
Neonicotinoids	Protection of complete plant from sucking and bitting pests. Its active ingredient is disseminated through sap of plant.
Pyrethroids	It kills the pests that penetrate inside the treated seed. Its active ingredient causes prevention on being eaten up by animals. Protects from hypocotyls. Acts only in soil.

Pelleting Materials Used in Seed Pelleting and How to Select them?

Seed pelleting requires pelleting material, adhesives as well as chemicals for proper production of seed pellet. The pelleting materials used are as Gypsum, Calcium carbonate (chalk powder), Wood ash, Charcoal, Leaf powder (Albizia, Pongamia, Prosopis), Flyash while for adhesives Maida, Gum Arabic, Revive, Starch, Rice gruel, Sago gruel are used whereas for chemicals Macronutrient, Pesticides, Micronutrient, Vitamins, Growth regulators are used.

For right selection of pelleting material following points should be kept in mind:
1. The material should be porous in nature so as to allow movement of air.
2. Coating should be easily breakable on contact with soil moisture. This helps in preventing physical impedance in germination of seeds.
3. No toxicity in the material used for pelleting.
4. The material used as pelleting should have commercial importance.

Advantages of Seed Pelleting in Sugar Beet Plant

Seed pelleting in sugar beet offers several advantages. These are:
1. Occurrence of uniform seed emergence in field so that gap filing process is prevented.
2. Seed rate in planting gets reduced as precision sowing involved.
3. Proper plant to plant distance is maintained.
4. Yield gets increased.
5. Application of chemicals or fertilizers is saved from being applied on to soil for good production.
6. Handling of seeds gets easier as without pelleted seeds are small and irregular in shape.
7. Improve ballistic property.
8. Damage from insect pest at seedling stage is prevented.
9. Provides protection from eating up/damage of seeds by birds, animals and insects.
10. Enhancement in oxygen availability in seeds.
11. Maintains the moisture content in seeds.

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The Weapon of an Airborne Hunter: Dragon Fly

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Introduction

Dragonflies are one of the fastest and efficient predators during nymphal as well as adult stage. The adult preys on tiny flies, leafhoppers, mosquitoes and even insects larger than their body size such as robust moths and butterflies, with the help of their acute tracking vision, maneuvering skills during flight and spiny femora and tibia of legs. Dragonflies have a success catch rate of 97% (Olberg et al., 2000) which was recorded with high speed filming in green house experiments and the result was obtained after proper statistical analysis. Every predator uses different prey capturing kinametics and behavioral strategy (Combes et al., 2013). Dragonfly uses ambush method to attack their prey from back while chasing them to their death. Dragonfly wings move independent of each other that provides them with a unique ability not only to fly forward but also to fly backwards, upwards, downwards, taking sharp turn and hover in air. About 3012 species of dragonfly exists, which are classified in 348 genera in 11 families.

Strategy for Seizing the Prey

DF usually hunt with greater efficiency during day time, at brighter light and warmer temperature. The hawk strategy of hunting in DF is primarily dependent on the vision, direction perception and tracking its prey pursuit pathway, for this purpose they have “fovea” which is responsible for sharp vision but they lack rods so are insensitive to dim light, hence DF requires light for hunting. The prey do not usually fly in a straight path but they do maneuver and take sharp turns, thus make large angle between the pursuer and the prey, so the DF constantly gaze the prey by locking its vision on it and by continuous rotation of the mobile head to track the different angular positions of its hunt, and feeds the image of the path to “fobea”. Researchers have put forward some hypothesis regarding interception steering maneuvers in DF. The hypothesis is:

1. DF use fast sensory reflexes to measure the flight pathway of the prey along with the motion of their own body (Michael. H. Dickinson, 2015) and based on the sensory information shifts their body and moves their head. When DF flies to capture the prey there is relative movement between the two, so to measure the image drift of the prey and to distinguish it from the drift caused by its own motion requires a efficient sensory reflexes, to finally catch the prey at the end of pursuit otherwise end up in a failure to track the true position of the catch.

2. Apart from the fast-sensory reflexes DF also receives information from 2 internal signals/models to undertake the devouring process which is too fast to be captured by human eye, and needs high speed action camera to see through details (Mischiati et al., 2014). The researchers believe that there are 3 types of internal modes to regulate the sensiomotor control, physical model, inverse model and forward models that lets a predator to predict the properties of world, to generate the motor command needed to attain desired sensory state and to predict the sensory consequence of the self-movement respectively.

3. Some scientists believe that DF use “parallel navigation” With parallel navigation the predator constantly steers its body axis, to decrease the length of the range vector (direction to prey) from predator to prey. When angular velocity of the prey disturbs the range vector, the predator immediately shows a pursuit response to balance the range vector direction.

4. DF uses motion parallax to predict the distance of the prey from its position (Olberg et al.,2005).

Pursuit Pathway

The pathway is discussed in steps (Fig. 1).
Step 1: The sitting DF and the approaching prey- after motion detection, the DF saccades to orient the fovea, and lock the position of the prey, same as in the weapon locking system in jet fighter planes. While the prey reaches the zenith of the DF, it sits tight and through foveation, monitors the overhead positioning, angular speed and angular size of the prey.

Step 2: DF take-off- as soon as the prey reaches the zenith of the DF, it takes off, tracking the range vector of the prey.

Step 3: Maneuver- after reaching to the close proximity of the prey the DF orients its body to model its legs in the form of basket, and traps the prey.

Step 4: Returns- after the perch the DF flies back to the position and masticate the prey while sitting.

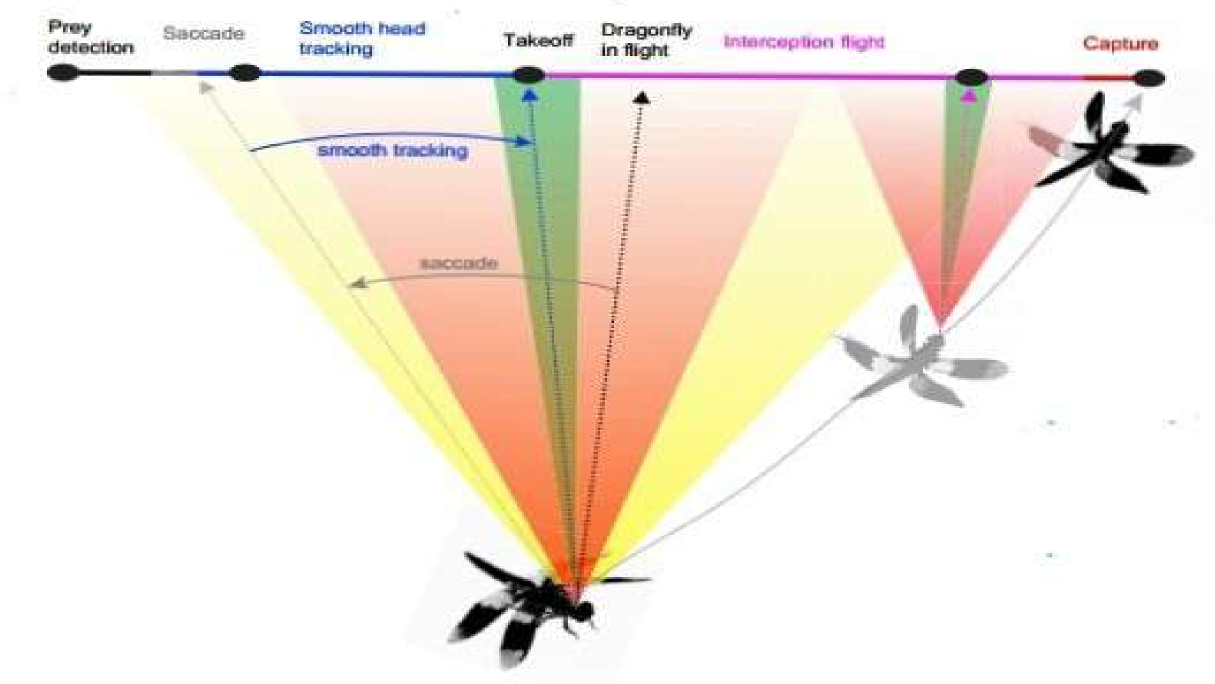
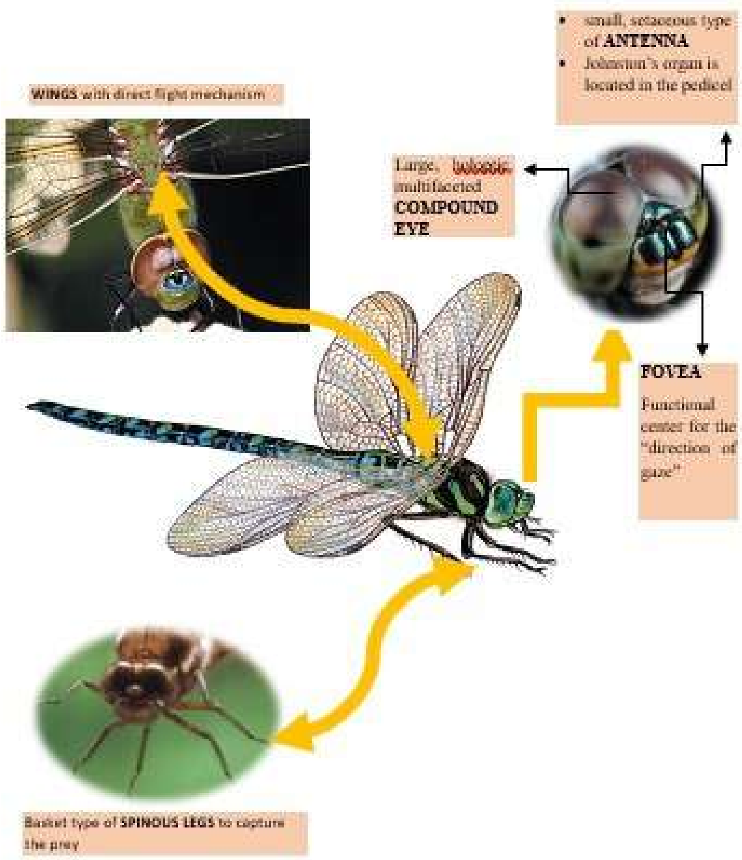


Figure 1: Steps of prey capture in dragon fly. Modified diagram from Lin and Leonardo (2017)

Description of the Airborne Hunter: Dragonfly



Larva: Dragonfly larva, similar to the adults is ferroceous predators but unlike the adults they live underwater. The larva of dragonfly is called naiad. Owing to hemimetabolous nature of development the naiads look different than their parents. They mostly predate on the small fishes, tadpoles and the underwater insects. They are ambush hunters but also sometimes chase their prey. They have phenomenal eyesight and spinous hair like structures on its legs which are packed up with sensitive mechanoreceptors to identify the moving prey. When prey approaches, it engages its labium, a specialized prehensile organ which is retracted under its head at rest by a locking mechanism. Internal hydraulic pressure created by contraction of the abdominal muscles and closure of the anal valve releases this mechanism and allows the labium to fire. The toothed labia then capture the prey very efficiently in milliseconds.

Summary

The body part that is used as a weapon to catch the prey:

1. In adult: 3 pair of spinous legs. The leg in DF is rarely used for walking. When DF takes off after calculating the velocity, angular position and the trajectory pathway of the prey, through the above said strategy it becomes easy to stabilize its range vector and balance the body steers to attack the prey from bottom and capture them in the basket formation of the 6 legs.

2. In naiads: the prehensile toothed labium provided with hook which is movable and is called mask.

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Cactus Farming for Green Fodder

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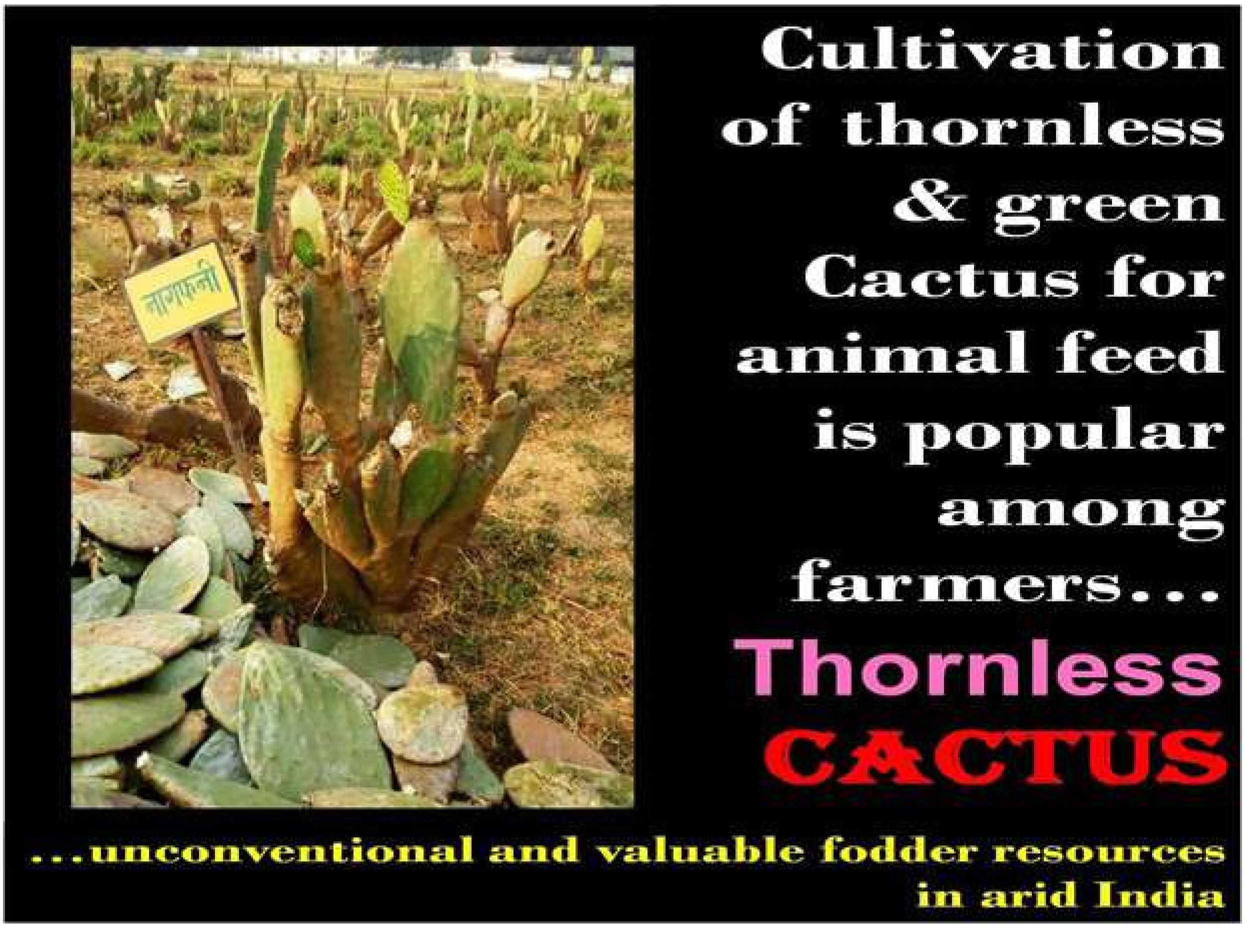
It is well known that the livestock and animal husbandry sector is critical for rural economy as it contributes towards more than 25.75 per cent of value of the outturnas compared to agricultural and allied sector. This sector plays an important role in Indian economy and about 20.5 million people depend upon livestock for their livelihood as it contributes 16% to the income of small farm households as against an average of 14% for all rural households. The forage resources are shrinking due to the need of various crops, as well as climate change. Rural poor and small land holders were badly affected due to prolonged drought and desertification especially in Africa and Asia. If people are to live in such inexorable conditions, it is essential that the crops grown there are able to withstand drought, high temperature, unfertile poor soils and water exertion etc. Thornless Cactus (*Opuntia ficus indicus*) commonly known as fodder cactus or prickly pear is acquiring interest across the globe as a fodder crop because of its distinct nature to be able to grow on the land where normally no other crop is able to survive.



Cactus pear farming is popular in Mexico, Morocco, Ethiopia, Kenya, Brazil, South Africa, Pakistan and India as fodder in drought-prone area or arid to semi-arid climatic conditions, because farmer does not require huge quantity of water for its cultivation and the cost of cultivation is low. It has higher water use efficiency as well as rain water use efficiency as compared to any lineal fodder crop because it is a Crassulacean acid metabolic (CAM) plant as explicated by nocturnal stomatal opening permitting net CO2 uptake and less water loss appeared during cooler part of day and night hours cycle, leading to high water use efficiency, which is the most common feature of this xerophytic plant that has ability to surmount in severe water deficit condition up to 5-7 meters in height. The cactus crowns beget 3 meters in width and the diameter may go up to more than 1 meter. The edible part as fruit and young cladodes are consumed by human beings as appetizers, soups, salads, beverage, candy, jelly with bread and various flavour of cactus drink. Its young stem known as no pales is used like a vegetable having tremendous nutritional value with greatest agronomic importance.

Thornless cactus is a good forage crop for farmers of drought prone areas and acts as a good nutritional fodder for cattle like buffaloes (milch livestock), sheep, horses etc. where farmers cannot grow traditional fodder crops like Napier grass, wheat paddy and maize, and legumes in bulk quantity due to absence of irrigation vantage. It is rich in crude protein, fibre, various kind of minerals (Calcium, Phosphorus, Magnesium, Potassium, Sodium, Zink, Manganese, Copper, Iron and others), Carotenoid (Vitamin A) with water soluble carbohydrates. It is highly digestible with 70 percent dry matter digestibility because of its high content of mucilage so that consumption of cladode will not cause acidosis in ruminants. Farmers may do cactus farming as:

1. It is relatively drought-resistant; survives long drought spell.
2. It produces large quantities of fodder.
3. It supplies succulent fodder to live stocks during drought.
4. The plant tolerates a wide range of soil and climate.
5. Plant is smarter than grasses and legumes in converting water to dry matter due to its specialized photosynthetic mechanism.
5. It is 3-fold more productive than C-4 plants (sugarcane, maize) and 5-fold better than C-3 plants (paddy, wheat) under similar environmental conditions.

In India, the cactus pears were first introduced for scientific cultivation as a fodder in 1970s by ICAR-Central Arid Zone Research Institute (CAZRI), Jodhpur where rainfall is up to 700 mm. Various agricultural research institutes such as ICAR-CSSRI, Karnal, ICAR-CIAH, Bikaner, ICAR-IGFRI, Jhansi and others are promoting thornless cacti. On account of its global importance, the International Cactus Pear Network (CactusNet) was established in Santiago in 1992 for dedicated support to the food and agricultural importance.

Cactus farming can be successfully practiced by vegetative propagation using cladodes or paddles planting in rainy or post rainy seasons (June to March and July to November) in India. Traditionally it is propagated through cutting of cladodes, but it is also suitable for saline soils and to check soil erosion and combat deforestation. For planting in large areas, cactus saplings are established through tissue culture. Well drained heavy sandy, sandy-loam soil, gravely and stony lands especially at the foot hill slopes are suitable for cactus farming. The first harvest is done when plant attains one meter, height followed by regular harvests at the interval of 5 to6 months and green fodder yield may vary from 40 to 50 metric ton per hectare in a crop year. Cactus should not be allowed to be grazed directly by the animals as it decreases their longevity. Cut and carry method is best for harvesting. Small cactus pieces should be mixed with some dry fodder such as wheat and paddy straw in 1:3 ratio supplementing 72% for protein, 62% for dry matter, 43 % for crude fibre and 67% organic matter.

For enhancing the productivity per unit land area, these cacti play an important role for integration of fodder crops in existing cropping system. With the use of modern technology such as precision farming, Cactus may grow with other crops under intercropping system and agro-forestry. There is need and great scope for use of post-harvest processing and value addition for rural entrepreneurial capacity should be build up to farmer to earn at least four to five time the present income to overcome the impecuniosity and prosperity. In this connection mass propagation for field planting, systemic field evaluation for developing location specific technologies and feeding trails on ruminants are significant to establish thornless cactus as unconventional and valuable fodder resource in arid India.

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Role of Probiotics in Aquaculture

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Introduction

Aquaculture sector has shown a promising increase in the recent years, the progressive exploitation of the wild stock and increase in the world`s population and protein demand have further lay more emphasis on aquaculture. Aquaculture have certain restraining factors such as diseases and mortality which decreases the productivity .The excessive usage of antibiotics in shrimp culture have resulted in the development and modification of the pathogen genome, which enable them to resist and infest on a large scale .

Parker (1974) has been attributed for his pioneering work on probiotics. In English literature probiotic is define as bacteria which improve the quality of water or inhibit pathogens. In general probiotics are being defined as one or more than one culture of certain bacteria which have been found to be of beneficial effects .According to Fuller (1986) probiotic is live beneficial microbial feed supplement which would help in their colonisation as well as proliferation in the gut of the host ,thus prevent the colonisation of harmful microbes. They do so by secreting some inhibiting substance like hydrogen peroxide. . probiotics are of two types: Feed probiotics; which is mixed with feed and improve the gut micro-flora of the cultured species. water probiotic; which is added to the cultured water, they are used for bioremediation of various chemical parameters in the pond (Nitrogen, phosphorus, Hydrogen sulphide). Control of; BOD, turbidity, pollution at the pond Bottom, reduces pH, reduces Incidence of Obnoxious gases, algal Blooms, eliminates pathogens, removes foul odour.

Probiotics Over Antibiotics and Chlorine

The used of antibiotic especially in different culture system of shrimp during different stages of their life cycle, have led to development of antibiotic resistant gene in the genome of the pathogen, which is later transfer to the consumers and resulting in many new spectrum of diseases which are difficult to tread and finally leads to death.

Chlorine have been used extensively in various culturing unit i,e hatcheries, on growing pond etc to disinfect the incoming water , but its usage stimulates and arouse the development of wide varieties of antibiotic resistance genes in bacterial genome. It have been reported by some of the farmer in Thailand that chlorine is used for disinfecting their different culture units to eliminate varieties of copepods and other crustaceans which prey on the shrimp before stocking shrimp, after the chlorine is removed by treatment with sodium thiosulphate a rapid augmentation in *Vibrio harveyi* have been reported .This is attributed to the chlorine resistant gene present in the genome of vibrio coupled with fast growth rate of vibrio ,which makes them able to pass through the chlorine disinfecting stage and infest the culture system

Probiotic are Mainly of Two Types

1. Feed probiotic: Feed probiotics are those probiotics which are mixed or added along with feed and taken orally by fish eg *Lactobacillus acidophilus, Bacillus subtilis* etc, they are mixed during palletisation of feed and are encapsulated .Benefits of feed probiotics are as follows:

a. To stimulate nonspecific defence mechanism in the host to protect it against pathogens.
b. To produce specific compounds like bacteriocins that inhibit pathogen.
c. To exhibit anti-cancer effects.
d. Effect on growth , survival and immune status.
e. Increase of the food conversion rate and weight gain.

2. Water probiotic: probiotic which are added to the water to rectify the physical, chemical characters and the productivity of the water, it is also one of the major means of bioremediation. It helps in control of; BOD, Turbidity, Pollution at the Pond Bottom, reduces pH, Reduces Incidence of Obnoxious gases, Algal Blooms, Eliminates Pathogens, Removes foul odour.

a. Rectification / Bioremediation of Nitrogen: Fish are known to excrete ammonia which have a detrimental effect on the fish. Excess and left-over feed that is not consumed by the fish were also the source of ammonia in water. Ammonia at pH below 7 is present as ammonium ion which is less toxic. The presence of certain beneficial microbes such as *Nitrosomonas* which convert ammonia to Nitrite and *Nitrobacter* converts nitrite to Nitrate i,e Nitrification. Nitrification is a process which alter the pH below 7 on the pH scale (acidic) i,e besides converting ammonia to nitrate it also convert the toxic ammonia to ammonium. Therefore, supplementation of these microbes i,e *Nitrosomonas, Nitrobacter* helps to reduce the problems related to ammonia.

b. Rectification/Bioremediation of Phosphorus: Phosphorus after Nitrogen have been known to play a crucial role in the productivity of aquatic system. Phosphorus also plays an important role in the formation of cell membrane of living organisms i,e phospholipids and form a main part of the gentic materials i,e nucleotides (sugar+nitrogenous base+Phosphate) i,e DNA and RNA. Certain beneficial bacteria have been known to secrete enzymes such as phytases and phosphatase, which contribute to the phosphorus cycle in aquatic system. The solubility of the phosphate in aquatic ecosystem depends on the pH level of the water and certain bacteria like the nitrifying bacteria makes the water acidic, which inturn helps to convert ammonia to less toxic ammonium and also convert to nitrate. This acidic medium also helps in promoting the solubility of inorganic phosphate and therefore uptake of phosphate by the living biota.

c. Rectification/ Bioremediation of Hydrogen sulphide: H_2S which is a gas resulting from the decomposition process and have a pungent smell like a rotten egg have been known to cause many harmful effects on shrimps and fishes. Certain strains of bacteria belonging to the family chlorobiaceae and chromatiaceae have been known to utilise H_2S and sunlight as they possessed bactero-Chlorophyll and able to carry out photosynthesis under the anaerobic condition of the bottom mud. Therefore to eliminate H_2S from the culture system one must do bottom racking to improve water circulation and reduce the anaerobic condition of the pond bottom, besides this mechanical method one can also add the bacteria belonging to the chromatiaceae and chlorobiaceae as soil probiotic or water probiotic and help to eliminate H_2S from the aquaculture system.

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Fangy Roots: Morphological Root Deviation in Sugar Beet

Article ID: 31354

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Sugar beet is a plant whose root is the most important part as it is grown as raw material of sucrose and nowadays as ethanol potential crop. Sugar beet possesses tap root (white in color in particular for roots having sucrose content) system that can reach up to a depth of 1 to 2 meters. Root of sugar beet contains 20 % sugar, 5% pulp, 2.6% non-sugars and rest 75% water. These roots are known to be processed not only for white sugars but also for ethanol production. Furthermore, other parts such as pulp and molasses are used for food and feed.

Sometimes morphological deviation in common root has been observed which is known as fangy roots. These roots are also referred as forked roots or overdeveloped secondary roots along the side of tap root (Fig. 1).

Fig. 1: Fangy roots of sugar beet

The fangy roots are caused by occurrence of diseases, soil condition or weather alterations. Sugar beets grown in poor soil leads to formation of sprangled / forked roots. Furthermore, shallow soils also cause such distortion in roots. Soil plough or acidity also leads to fangy roots. Nematodes such as stubby root nematodes (Trichodorus spp. and Paratrichodorus spp.), etc., also is one of the reasons for formation of fangy roots as it damages the tap roots at early stage. The lateral roots take up the function of main tap root which causes fangy or furcated storage roots to form. Besides, it is known that any damage to main tap root system such as Rhizoctonia infection, mechanical damage, chemical damage, water logging condition, etc., can cause roots to be forked or fangy.

Difference Between Fangy and Normal Beet Roots

Fangy root	Normal sugar beet root
Forms when main tap root system is damaged	Tap root system
Low sugar content	High sugar content
High purity content	Low purity content
Difficulty during lifting of roots by harvester	Not so
Loss in sucrose content from broken fangy part	Sucrose content maintained all through
Difficulty in cleaning of beets as soil gets stucked	Easy to clean

Problems of Fangy Roots

1. Difficulty in lifting and have high dirt tare.

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2. Increase in harvester losses at the time of lifting.
3. Lower sugar content.
4. Higher impurity than the body of the beet.
5. Difficulty in cleaning of roots prior to processing.
6. Causes problems in processing such as diffusion.
7. Higher breakage of the beets prior to diffusion. This results in sugar loss from broken portions/surfaces.
8. Causes loss of material as reduction in fine pulp.
9. Indirectly increases tare due to the amount of soil lodged between roots.

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Disease Resistance Genes in Plants: A Bird's Eye View

Article ID: 31355

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The United Nation (UN) has announced year 2020 as International Year of Plant Health (IYPH). A study reports that worldwide 20 to 40% yield losses are due to pest and pathogen in five major staple crops (wheat, rice, maize, potato and soybean). Plants provide 80% of food source for human feed. Plant resistance through disease resistance gene is one of the most cost-effective and ecologically sound approach to manage the diseases. Disease resistance genes encode defense related proteins which take part in resistance pathway. According to a UN report, there will be a need of more food in future with more nutritive value and food security to feed the population as world population is expected to increase up to 9.8 billion in 2050. Disease resistance genes can play an important role by facilitating information about disease resistance mechanism and interaction plant-pathogen-environment for maintaining of sound plant health as a healthy plant is a source of healthy food with increased productivity. Each year the estimated economic constraint for diseases and insects is around 220 billion dollar and 70 billion dollars respectively.

Disease Resistance Genes

Disease resistance genes initiate defence responses against pathogen via interaction of R-protein and pathogenic (Avr) protein (Fig1). It can be generally categorized into two groups. The first group is for those genes which are involved in the recognition of pest or pathogen, the resistance (R) genes. The other group comprises of the genes which participate in defence responses. Over the last 25 years, various R genes have been cloned from many plant species: potato, tomato, wheat, sugarcane, barley, maize, soybean, lettuce and coconut etc. The R- genes are playing a remarkable role in plant immune system or disease resistance system. They have vital utility in crop improvement from conventional plant breeding approaches to genome editing modifications.

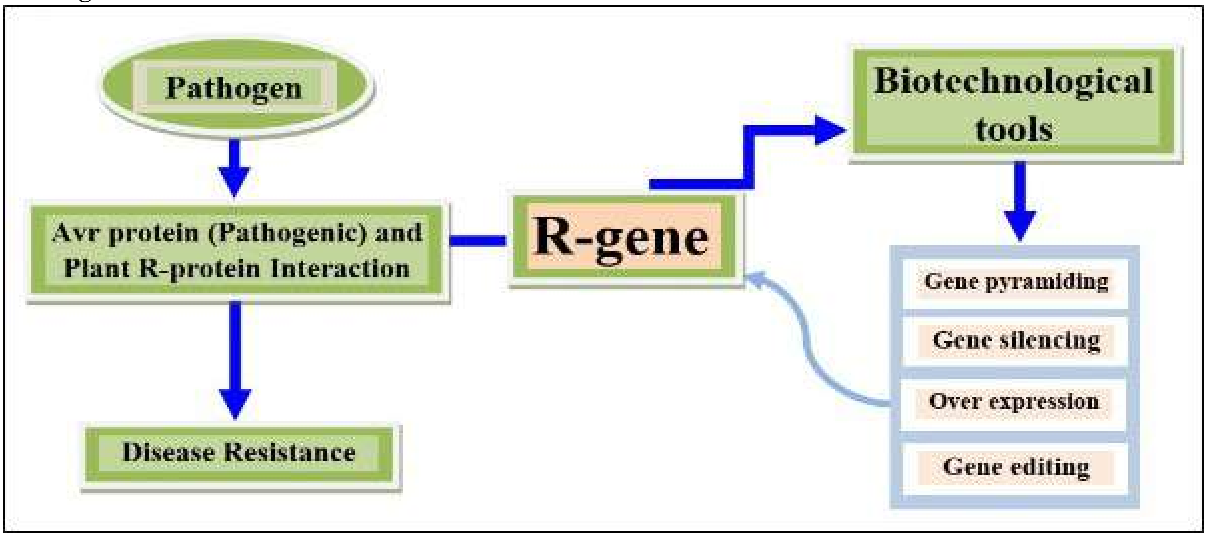

Fig 1: Common mechanism of plant disease resistance with biotechnological applications

Application of Disease Resistance Gene in Crop Improvement with the Advent of New Technologies

Conventional breeding approaches are being widely used in crop improvement from many years. Disease resistance genes along with the application of biotechnological approaches (genetic engineering, gene pyramiding, gene silencing and genome editing) have greatly revolutionized the development cultivars of with desired traits in more specific way as compared to the conventional breeding approaches. In last two 20 years, numerous disease resistant transgenic crops have been developed and many are under trial. Using R- gene transformation, a number of resistant crops have been developed (Table1). A range of genes such as: chitinase, glucanase, osmotin, defensin and pathogenesis-related genes are transferred in different crops for providing resistance against bacterial and fungal diseases throughout the world. A number of genes have been used together with natural and synthetic Cry genes, protease inhibitors, trypsin inhibitors and cystatin genes to provide insect and nematode resistance. The Zinc finger nucleases, TALENs and CRISPR/Cas9 are some of the genome editing tools that provide newer and faster avenues for plant biologists to generate precisely engineered disease resistant crops against insects and pathogen such as bacteria, fungi and virus. Genome editing technology offers a new way for gene modification of the endogenous plant DNA via deletions, insertions, and replacements of DNA at designated targets.

Table 1. List of fewR-genes With Resistant Species

S.No.	R- gene	Resistant species	Strategy
1	*Pto*	Tomato	Transgeny
2	*N*	Tomato	Transgeny
3	*Rpg1*	Barley	Transgeny
4	*Cf-9*	Tobacco and potato	Transgeny
5	*Bs2*	Tomato	Transgeny
6	*Mi-1*	*Lactucasativa*	Transgeny
7	*Cry*	Rice	Pyramiding
8	*Prf*	Tomato	Cisgeny
9	*Cp*	Tobacco	RNAi
10	*npr1*	Cotton	Transgeny
11	*Ch*	Rice	Pyramiding

Conclusion and Future Perspective

The improvement of crop productivity by developing disease resistant crop plants or healthy plants is the most important concern to feed the burgeoning global population. Therefore, various approaches are being used to identify disease resistance genes from crop plants. Many reforms have been used to develop disease resistant varieties via applying various technologies from conventional breeding to gene editing approaches. The development of disease resistant cultivars is being done using gene manipulation under lab conditions and there is a need to make it eco-friendly for field practices. Obviously, the success of these approaches depends on the acceptance by the society because each approach has its own ethical policy.

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Popular Article on Different Castes in Social Insects

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Introduction

The group of individuals that performs the same function is called 'castes'. As like as in our ancient texts mentioned caste system like Brahmins, kshatriyas, vyshayas and shudras , like as in insects especially some social insects like termites, ants and honeybees there is presence of different cast system, they performs theirs particular function in the colony of these insects.(Gordon,2002)We say these three insects like termites, ants and honeybees are called social insects, because the individuals in the colony cooperates with each other and they have well defined caste system with specific work.(Wilson and Kinne,1990).

Sociality has different types, like as Solitary: It exhibits no social behaviour most arthropods, Subsocial: In this adults care for their own off springs, ex Aphids, Communal: It means without cooperative with each other, Quasisocial: Members are cooperate with each other, Semisocial: In this workers are usually sisters of the queen, Eusociality: In this, insects cooperative with brood care, have well distinct labour system and presence of overlap of generations. Ants, Honeybees ants are belonging to this eusociality group. (Yan et al., 2014).

Significance

Caste is a subset of individuals within a colony of insects, that they are having specialized or particular work in the insect colony (Parker,2010).

Caste System in Termites

Termites are belonging to the order Isoptera and also thy are called as 'white ants' , because the majority of them are white and small and live in large colonies like as ants, termites have well defined caste system, termites have four distinct castes. Namely King, queen, worker and soldier. And also based on the reproductive ability they are divided as reproductive and non-reproductive (Roisin, 2006).

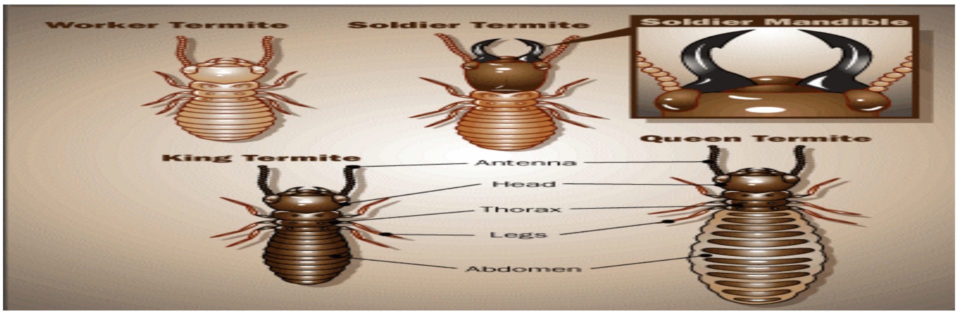
Reproductive - King and Queen

These are also divided as primary and secondary reproductive.
1. Primary reproductive: In these termites' body is dark, well sclerotised with well-developed compound eyes and wings. They are fertile and they are the original founders of the colony.

2. Secondary reproductive: These termites are pale in colour and both compound eyes and wings are not well developed. They replace the primary reproductive when they die; these secondary reproductive are also called as 'supplementary reproductive or replacement reproductive.

3. Non reproductive- workers and soldiers: Many larvae differentiate into workers and others develop into soldiers. They sterile and they are usually blind and apterous. Normally the soldier's strength less than 5% of the total colony strength (Pervez, 2018).

Termite Castes



(Source:Google)

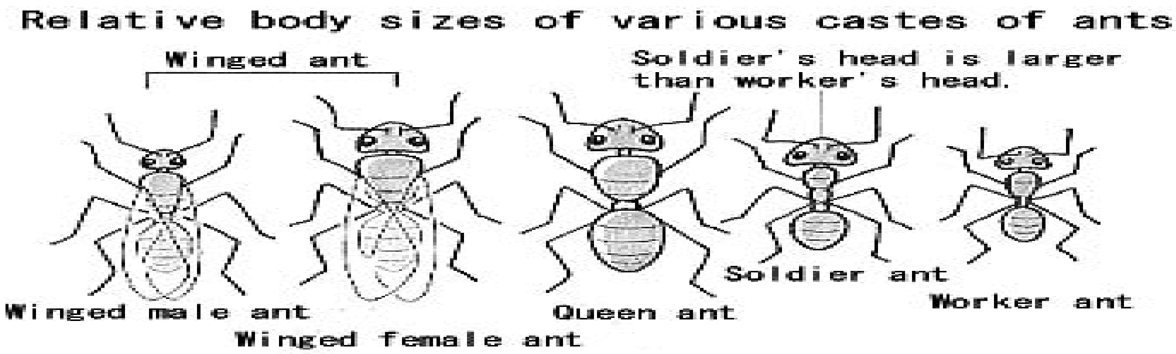
King: The only work of king termite is fertilizing the queen and also help the queen termite in raring the first brood.
Queen: There is only one queen is present in termite colony, after fertilization the queen's abdomen Is seen as enlarged condition, this obesity condition of termite queen is called as 'physogastry'.
Workers: These are the main caste in the termite colony. The body is soft and unpigmented Mandibular and salivary glands are well developed, they build the fungal garden called as 'termitoria'.They go out for foraging. They mainly responsible for the damage caused to timber crops.

Soldiers

Two types of soldiers are present in termite colony.
Mandibulate: mandibles are well developed in these termites.
Nasute termites: in these termite's head is modified as snout like structure and also, they have frontal gland in this snout, this gland secretes defensive sticky fluid in these termites When they are engaged with enemies. Soldier termites defend the termite colony.(Pervez,2018).

Different Castes of Ants

Ants belong to the order 'hymenoptera' and family 'formicidae'.Ants have three distinct castes namely queens, males and workers.
Queens: These are the reproductive females, most of all the queens are winged but some are short winged and wingless, they have life span up to 25 years.
Workers: These are the non-reproductive sterile females; these are always wing less and these are the dominant in the colony.
Males: These are fertile males, mostly winged and some are short winged or wingless, the only work of males is to fertilize the queen and after some time they will die.(Trible and Kronauer 2017).



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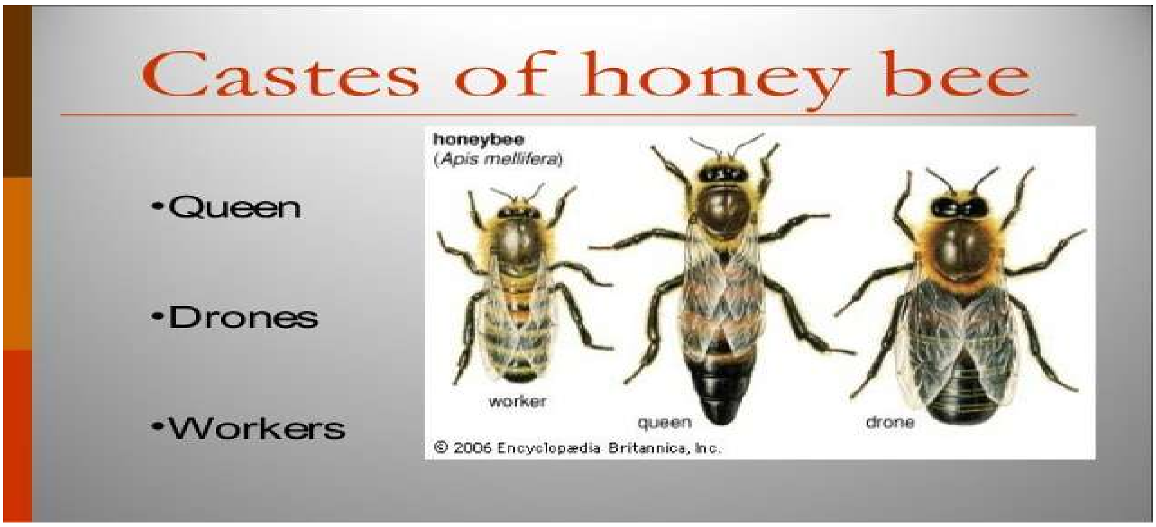
Different Caste of Honeybees



(Source Google)

Honeybees are belonging to the order; hymenoptera' and the family 'apidae', these are one of the best economically important insects. Every colony of honeybee consists of a single queen, a few hundred drones and several thousand workers. Queen is fertile female worker is a sterile female Drone is a fertile male.

Honeybee Castes

Queen: There is presence of only one queen in a honeybee colony. It is larger than other castes. She lives for three years. There is secretion from Mandibular gland of the queen honeybee called as 'queens' substance'. This substance helps to prevent absconding and swarming of colonies. After five to ten days of emergence queen honeybee mates with drones, in one or more nuptial flights, when her sperm theca is filled with sperms, she will start laying eggs and will mate any more.

Drones: These are the fertile males. These are stingless bee's life span of drones is normally 57 days Drones are produced by the unfertilized eggs of the queen. The only function of the drones is in honeybee colony is to fertilize the queen. It also helps to maintain hive temperature.

Workers: These are the sterile female These are dominant in the honeybee colony Life span of worker honeybee is four weeks normally Royal jelly produced from worker honeybees by the 'hypo pharyngeal' glands. Life span of worker honeybees divided into two phases as first three weeks for house hold duties-nurse bees and rest of the life for outdoor duties – scout bees. (Plettner et al., 1997).

Conclusion

Social insects have well distinct castes, these different castes have specialized and performs particular function, these each different castes of social insects strongly cooperate with each other, because of this nature social insects inspires human beings to do work on the of 'work is worship' principle. And also, they inspire human that we can get the success only by doing the work with collective manner with team work and also with strong cooperation among the population.

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Ill Effects of Environmental Pollution on Human Health

Article ID: 31357

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Introduction

Environmental pollution is a world-wide problem. With growing population and industrialization, the concern about human health, hygiene and ecological balance has developed among natural as well as ecological scientists. Pollution not only effect deterioration of environment and creates health hazards but also effects loss to the national economy.

With increases in population pressure, urbanization, industrialization, mining and quarrying and other development activities various pollutants are contaminating the natural environment. Now-a-days industrialization is considered to be a barometer of economic development of any country. The prosperity and position enjoyed by advanced countries is mainly due to industrialization. But unfortunately, it also brings some undesirable effects at local, national and global environment.

Environment pollution in India arises from poor socio- economic living conditions as well as urbanization, industrial growth and modernization of agricultural practices, mining and quarrying which have gained momentum during, the last 25 years of planned modern economic era. There is a need to create an awakening on the problems arising due to faulty agricultural practices, and other related consequences and to suggest means to reduce the stress on environment in the rural areas as well as in urban areas which had always been considered pollution free and safe for living. Increase in awareness and knowledge can go a long way in minimizing the cause of environmental pollution to reduce harmful effect of environment in general and health in particular. This is the only way to ensure a pollution free environment for our generations to come.

Concept of Environment

Environment (from the French environner: to encircle or surround) can be defined as:
1. The circumstances or condition that surround an organism or group of organisms.
2. The complex social or cultural conditions that affect an individual or community.

Since humans inhabit the natural world as well as built or technological, social and cultural world, all constitute important parts of our environment (Purohit et al 2018).

Concept of Pollution

Human's increasing interference with nature beyond a certain limit creates environmental damage which is harmful for all the organisms. Due to human induced environmental changes sometimes, harmful products originate which creates unwanted contamination through toxic substances in the natural environment, which often give rise to problems of pollution.

Pollution defines as a contamination of the environment by man-made substances or energy that have adverse effects on living and non-living matter. This contamination of air, water or soil materials interferes with human health, the quality of life or the natural functioning of ecosystems.

Kinds of Pollution

Environment pollution may broadly be classified into: (1) Natural pollution; (2) Man-made pollution.
1. Natural Pollution: Environment is polluted often by natural phenomenon, such as earthquakes, floods, drought, cyclones etc.
2. Man-made pollution: Human activities.

The environmental pollution can also be classified further as, Air pollution, water pollution and soil pollution etc.

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Environment Pollution

Environment pollution is an important problem faces mankind in the modern era. This problem emerged since the industry era started, as the environment pollution concept means: Qualitative and Quantitative changes in the components of the living and non-living environment. According to Environmental Management (2017) Environmental pollution is defined as “the contamination of the physical and biological components of the earth or atmosphere system to such an extent that normal environmental processes are adversely affected.

Major Issues

Major environmental issues are forests and agricultural degradation of land, resource depletion (such as water, mineral, forest, sand, and rocks), environmental degradation, public health, loss of biodiversity, loss of resilience in ecosystems, livelihood security for the poor.

The major sources of pollution in India include the rapid burning of fuelwood and biomass such as dried waste from livestock as the primary source of energy, lack of organized garbage and waste removal services, lack of sewage treatment operations, lack of flood control and monsoon water drainage system, diversion of consumer waste into rivers, cremation practices near major rivers, government mandated protection of highly polluting old public transport, continued operation by Indian government of government-owned and high emission plants built between 1950 and 1980.

India's population growth adds pressure to environmental issues and its resources. Rapid urbanization has caused a build-up of heavy metals in the soil of the city of Ghaziabad, and these metals are being ingested through contaminated vegetables. Heavy metals are hazardous to people's health and were known as carcinogens.

Effects on Human Health

Pollution causes many deaths and illness among people- particularly in developing countries, indoor air pollution is also widespread not only in rural areas of many developing countries but also in urban area (Taofeek et al, 2014). Include all the pollution air pollution have major effect on human health. According to World Health Organization, 2018 air pollution is a major health problem because worldwide almost three billion people rely on biomass fuels which are mostly stubble burning by farmers, wood charcoal and animal dung for household cooking and heating.

Air pollution can cause death, impairment of health, reduce visibility, bring about vast economic losses and contribute to the general deterioration. It can also cause intangible losses to historical monuments. Minor symptoms include headaches, mucosal irritation (eye, nose, throat or respiratory discomfort). Severe reaction can include nausea or asphyxiation and prolong exposure can lead to various system effects of toxic poisoning or to cancer of the lungs or other organs.

Suggestion

For a happy, progressive and purposive living, the earth and its environment must not only be kept pollution-free but also be protected from the hazards of pollution. It is the need of the hour to make people aware of the effects of environmental pollution on health and provide them solution to combat the ill effects of the same. Scientists are working on different adaptation strategies but its reach to the end users and its adoption by them needs immediate action. The proposed research work is an attempt in this direction.

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Real-Time N Management

Article ID: 31358

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Introduction

In developing countries, fertilizers have been used in adequate amount and in imbalanced manner. Also, fertilizers are becoming a major constraint in agricultural production due to energy crisis particularly in developing countries. General recommendation of NPK fertilizers has resulted in soil fatigue, proving their decreased efficiency and thus requires upward refinement and proper balance among the macro and micro nutrients. Balanced and efficient fertilizer application is essential to compensate for the increase yields and hence greater removal of soil nutrients. Nitrogen is the key element in crop production, improper use of nitrogenous fertilizer, instead of giving yield advantage, it reduces the yield. There are different opportunities to improve nitrogen use efficiency out of which use of site-specific precision agriculture technology is the most efficient one to be followed. Site specific nutrient management (SSNM) relies on principles of "5R", the right time, the amount, the right place, the right source, and the right manner. The site-specific nutrient management (SSNM) is an approach for "feeding" crop with nutrients as and when needed. The SSNM approach does not specifically aim to reduce or increase fertilizer use. Instead, it aims to apply nutrients at optimal rates and times in order to achieve high yield and high efficiency of nutrient use by the crop, leading to high cash value of the harvest per unit of fertilizer invested.

It provides two equally effective option:

1. Fixed time nutrient management
2. Real time nutrient management

Real Time Nutrient Management

Improving the synchronization between crop N demand and the available N supply is an important key to improve N-use efficiency. Since crop N requirements are closely related to yield levels, which in turn are sensitive to climate, particularly solar radiation and the supply of nutrients and crop management practices, dynamics N adjustment of real time has significance. Based on colour of leaf, SPAD meter and leaf colour chart (LCC) have been successfully used to know when the crop needs N application. These technologies provide instantaneous results and have been demonstrated as effective tool to schedule N fertilization to crops like rice, wheat and maize with ensured high yields and economic benefits to the farmers.

The most commonly used gadgets like SPAD meter, LCC and Green seeker are being discussed.

1. Chlorophyll meter (SPAD meter).
2. Leaf colour chart.
3. Optical sensor-based N Management (Green seeker).
4. Based on GIS.

Chlorophyll Meter (SPAD- Soil Plant Analysis and Development)

It is a simple, quick and non-destructive in situ tool for measuring relative content of chlorophyll in leaf that is directly proportional to leaf N content. The meter works by emitting two frequencies of light, one at a wavelength of 660 nm (red) and one at 940 nm (infrared). Leaf chlorophyll absorbs red light but not infrared, the difference in absorption is measured by the meter and termed "Optical Density Difference," ODD. Therefore, the unit of measurement is ODD, a ratio that is provided by the meter. The value does not give an actual chlorophyll or nitrate count rather than saying, "there is this number of chlorophylls," the meter value can be interpreted as, "this is a ratio of reflection vs. absorption." It instantly provides an estimate of leaf N status in un-plucked leafy tissue. Leaf N status corresponds to leaf chlorophyll content, which is displayed in arbitrary units (0-99.9). Since SPAD meter reading are unit less, it needs to be calibrated with chlorophyll or N content and leaf greenness. It has been used successfully for synchronizing N application with N needs of rice, maize, wheat and cotton crops.

Fig1: SPAD Meter

Leaf Colour Chart

The Leaf Colour Chart (LCC) is jointly developed by IRRI and Philippines rice institute from a Japanese prototype for the purpose of measuring required quantity of N to be applied in rice field to obtain maximum productivity. The LCC is also suitable for maize & wheat providing farmers with a good diagnostic tool for detecting N deficiency. The LCCs relevant to use for sugarcane, potato, cotton, cassava, vegetables, mustard, oil palm etc. are under Research and Development in order to maximize the yield of these crops. It is a easy, quick, cost effective and non-destructive method for estimating the N status of a leaf. This is a strip made of plastic material. It consists of 6 colour shades ranging from light yellowish green (No. 1) to dark green (No. 6) colour strips consisting of leaf-like veins. The LCC's essential or threshold values are specified as the green colour intensity to be retained in the uppermost completely opened leaf, and the N fertilizer recommendations are provided if the leaf greenness is below the critical LCC. Leaf greenness or leaf N content is closely related to photosynthesis rate and biomass production and is a sensitive indicator of changes in crop N demand during the growing season. Thus, maintaining the leaf greenness just above the LCC critical value ensures high yields with need-based N application thereby leading to high fertilizer N use efficiency.

Fig2: Leaf colour chart

a. Select plants for testing: Randomly select at least 10 disease-free rice plants or hills in a field, where plant population is uniform.
b. Match the leaf to the chart: Select the topmost, youngest, fully expanded leaf from each hill or plant. This part best reflects the N status of the plants. Place the middle part of the leaf on the LCC and compare its colour with the colour panels. Do not detach or destroy the leaf.
c. Measure the leaf colour: Measure the leaf colour under the shade of your body. Direct sunlight affects leaf colour readings. If possible, the same person should read the LCC at the same time of the day, every time. If the colour of a rice leaf is in between two shades, take the average of the two values as the reading. For example, if the colour is in between 3 and 4, the reading should be 3.5.
d. Determine the average LCC: Take the reading of the 10 leaves, and determine the average. If the colour is more or less than 3, N fertilizer top dressing is needed.

Optical Sensor-Based N Management (Green Seeker)

The Green seeker is a crop research and consulting tool that provides useful data to determine normalized difference vegetative index (NDVI) and Red to near infrared ratios.

NDVI = (NIRref - REDref) / (NIRref + REDref)

These data can be used in conjunction with other agronomic references to index basic nutrient response, crop condition, yield potential, stress and pest and disease impact in a quantitative manner. The unit can be used to monitor changing field (crop, plant) conditions during growing season and the effects of different level of an input compared to a local standard. Recent advances in optical sensing allow the collection of information on crop growth and physiological parameters temporally and spatially as affected by environmental stresses. Green seeker hand held optical sensor senses 0.6m×0.01m area when held at a distance approximately 67 cm from the illuminated surface. The sensor unit has self-contained illumination in both red (671+6 nm) and near infrared (NIR) (780+6 nm) bands. The device measures the fraction of emitted light in the sensed area that was reflected back to the sensor (reflectance). Chlorophyll contained in the palisade layer of the leaf controls much of the visible light (400-720 nm) reflectance. The amount of light reflected in the visible region is defined by the chlorophyll content in the cell and the amount of light reflected in the near infra-red (NIR) region is defined by living vegetation or biomass. The amount of blue and red light absorbed by the leaf is proportional to the chlorophyll density of the leaf. Reflectance of the near infra-red portion of the electromagnetic spectrum (720-13,00 nm) is predominantly influenced by mesophyll cells.

Fig 3: Green seeker

Based on GIS

Remote sensing and GIS are important in site specific nutrient management and thereby can reduce the cost of cultivation as well as increase the fertilizer use efficiency. Geographic Information Systems (GIS) consist of data and software designed for spatial analysis of GPS-referenced data. Various databases in an agricultural GIS system might include soil survey data, soil test information, pest infestations, yield data, remote sensing imagery and other types of observations and records that can be collected and referenced with their geographic position (by GPS). These data sets can then be converted to maps to illustrate their spatial variability within the field and become additional layers in the field database. Soil fertility investigations are necessary to confirm fertility status, which is also works as a guide for fertility management practice to adopt. Out of several soil fertility investigation methods, application of geospatial technology with involvement of GPS and GIS has improved the work process compared to other old techniques. GIS technologies can simplify and assist in dealing with soil variability. While it may not necessarily have a great impact on absolute amounts of inputs such as fertilizer applied it has the potential to increase the efficiency and effectiveness of the same and potentially increase yields and reduce adverse impacts on soils.

Conclusion

Nitrogen fertilizer is an important nutrient for plant growth and unfortunately it is highly prone to different kind of losses. The loss here is in terms of yield, soil health and economy. Higher yield, nutrient use efficiency and net returns can be secured through real time application of Nitrogen. The above tools can be used to schedule the N fertilization to provide a need and time-based balanced nutrition.

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[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.

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