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Mango Ginger

Article ID: 10400

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Introduction

Mango ginger botanically known as *Curcuma amda*, of the family Zingiberaceae is a less known spice. It is commonly called “Amrardraka” and “Karpooraharidra” in Sanskrit, “Ama-haldi” in Hindi and “Maavu shunti” in Kannada. The underground rhizome is the major economic part of this plant. It is a native crop of China and various other parts of Asia and the Asiatic Islands. The crop is cultivated to a limited extent in certain parts of West Bengal, Assam, Western Ghats, Konkan coast, Andhra Pradesh, Tamil Nadu, Orissa and Kerala.

Chemical Composition

The dry rhizomes on steam distillation yield a volatile oil of about 0.8-0.11 per cent, a pale-yellow fluid with a camphoraceous ginger aroma and contain fiber of 2-3.5 per cent.

The essential oil contains α-pinene, α and β-curcumene, Camphor, Mystic acid and Turmerione, which contribute to the characteristic mango odour of the rhizome. The coloring matter is Curcumin.

Proximate and nutrient analysis of edible rhizome plays a crucial role in assessing their nutritional significance and nutraceutical quality. The mango ginger rhizome was found to be a rich source of fibers and starch.

Uses

1. The fresh rhizomes find use in many culinary preparations like pickles, salads, chutneys, preserve, candy, sauces and in meat and other products.
2. Mango ginger finds extensive use in the indigenous system of medicine.
3. The rhizome is bitter, sweet-sour and aromatic; it is useful in biliousness, itching, skin diseases, bronchitis, asthma and hiccoughs.
4. The crushed pulp is applied over contusions, sprains and bruises for rapid healing.
5. It is a good appetizer and has antipyretic properties and helps to clear the bowels.
6. Used to increase the secretion of gastric juices and prevents formation and helps in the expulsion of gases from the stomach and intestine.
7. Roots also have many medicinal uses; they are reported to increase the flow of urine, produce smoothening and softening influences on the applied part.
8. The oil is found to have antifungal properties as well.

Description of the Plant

Mango ginger is not botanically related to mango or ginger, but to turmeric. Though a perennial herb, it is cultivated as an annual for its underground rhizomes.

Morphologically, the mango ginger plant is similar to turmeric, but has only short crop duration of six months. The rhizomes more or less resemble those of true ginger at first sight and have a sweet smell of unripe mango, but lack the pungency of ginger. The rhizomes are pale yellow or green outside with a lighter colour inside.

		
Fig. a) Plant	**Fig. b) Fresh rhizome**	**Fig. c) Dried rhizome**

Cultivation Aspects

Soil and Climate: The crop prefers fertile soil with good drainage. It also grows well in sandy loam soils. Since, it is a shade-tolerant crop, it can be grown in partially shaded situation or as a crop component in homesteads where multi-species crops are grown.

The crop is situated for humid tropical climate with a high rainfall of more than 1500 mm is essential.

Varieties: Mostly, local varieties are used for cultivation. But recently, a variety called 'Amba' has been released for cultivation from High Altitude Research Station, Orissa University of Agricultural and Technology, Pottangi.

Propagation: The crop is propagated through the underground rhizomes. The whole or split rhizomes or well developed, healthy and disease-free rhizomes are suitable for propagation.

The micro propagation in mango ginger has been standardized. The rhizome explants are reported to produce both the shoot and root simultaneously when cultured on B5 medium containing NAA (0.5 mg/l) and BA (4mg/l). The field establishment of the invitro produced plants may range from 60-70%

Land preparation: The field should be prepared by ploughing and thoroughly breaking up the clods, followed by levelling during February-March. After the first pre-monsoon showers in April. Beds of 1.2m width, 25cm height and of convenient length are laid out with a spacing of 40 cm between them. Cattle manure or compost at the rate of 30-40 t/ha is spread over the beds and mixed well in the soil.

Planting: The whole or split mother rhizomes or finger rhizomes, weighing 15-20 g, are suitable for planting during April or May-June. For local and Amba varieties, small pits are made in the beds at a spacing of 25 x 30 cm and at a depth of 4-5cm. About 1500 kg of seed rhizomes are required to cover a one-hectare area.

Manures and Fertilizers: In order to obtain the maximum yield, inorganic fertilizers should be supplied at the arte of 30 kg N, 30 kg P and 60 kg of K per hectare. The full dose of P and half dose of K may be applied as a basal dose. Two third of N can be applied 30 days after planting and one third nitrogen and the remaining potash may be applied 60 days after planting.

Irrigation: Mango ginger is a rain fed crop, but supplementary irrigation may be necessary during dry weather and also at the time of harvest.

Weeding and Mulching: The rhizomes will sprout within 3-4 weeks after planting. After the complete emergence of the sprouts, weeding is done after 45 days of planting and is repeated if necessary. The crop should be mulched with green leaves at the rate of 15t/ha, immediately after planting. Repeat the mulching after 50 days with 7.5 t/ha of green leaves, if it is necessary. The crop is earthed-up 60 days after planting.

Pest and Diseases: Compared to the related crops, ginger and turmeric, this crop is relatively free from pest and diseases. But when large-scale cultivation is taken up, the shoot borer (*Dichocrosis punctiferalis*) causes damage to the crop. The affected plants with the appearance of dead-heart with the larvae inside have to be uprooted and burnt. If the infestation is severe Dimethoate could be sprayed.

Harvesting and Yield: The drying up of the leaves is the indication of harvesting time. From the six months onwards, harvesting can be done by lifting the entire plant with a spade and then cutting away the top portion. If a few mango ginger plants are grown in homesteads or home gardens, if may serve as an immediate remedy for some of the common stomach disorders, besides being used in food.

Partial harvesting that means removing a portion of the rhizome from the plant is also practiced in homesteads in Kerala and Karnataka to suit the family requirements. After the harvest, roots and soil particles are removed from the rhizomes by washing with water and it is advisable to dry the rhizomes in the shade for one or two days before storage or transplanting.

The yield of fresh rhizomes will be around 30-40 t/ha. A plant can yield up to 1-1.5kg of rhizome.

Conclusion

The wide variety of uses of mango ginger as vegetable, spice, condiment and medicine make the crop a promising one for commercial exploitation. The shade tolerance capacity of mango ginger is an added advantage which has to be exploited. Therefore, it can be safely included as one of the crop components for intercropping situations or in homesteads where many species of crops are grown.

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Bioenergy Crops: The Potential Carbon Sequestrator and Ultimate Energy Source

Article ID: 10401

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Introduction

The major concern for sustainable industrial development is the conversion from fossil-based feedstocks to renewable feedstocks for energy fuel, chemical production by the consequences of many factors like depletion of fossil feedstock, diversification to renewable sources, abundance of renewable resources and environmental threats. In this regard, global attention among researchers and academicians towards both energy and materials leading to search new green and renewable technologies for safer future environment overcoming much dependence on petroleum products can be focused. In the fast-changing world emission of greenhouse gases is an emerging issue. In the fast-changing world emission of greenhouse gases and fossil fuel crisis is a major emerging concern. To secure and safe our future minimization of carbon dioxide and other greenhouse gases should be done along with sustainable alternative fuel source. Carbon sequestration has created a trend towards growing of bioenergy crops which solves both the problem. Various scope in this field includes mitigation of upcoming fossil fuel crisis, maintaining Sustainable environment and reducing overwhelming production of greenhouse gases.

Bioenergy Crops

1. Herbaceous Energy Crops:

a. Elephant grass *(Pennisetum purpureum).*
b. Klein grass (*Panicum coloratum* L.).
c. Buffalo grass (*Buchloe dactyloides* Nutt.).
d. Switch grass (*Panicum virgatum* L.).
e. Miscanthus (*Miscanthus* spp.).
f. Eastern gama grass *(Tripsacum dactyloides).*
g. Big bluestem *(Andropogon gerardii).*

2. Short-Rotation Woody Energy Crops:

a. Poplar (*Populus* spp.).
b. Willow (*Salix* spp.).
c. Cottonwood (*Populus fremontii* L.).
d. Sweetgum *(Liquidambar styraciflua).*
e. Sycamore *(Platanus occidentalis).*
f. Black locust *(Robinia pseudoacacia).*
g. Silver maple (*Acer saccharinum* L.).

Carbon Sequestration

Bioenergy crops are the link between sink (biomass and soil organic carbon) and the source (fossil fuel combustion). Bioenergy crops can be used as a good option to sequester atmospheric CO2 by increasing biomass productivity which can be incorporated into existing energy alternatives to improve energy use efficiency.

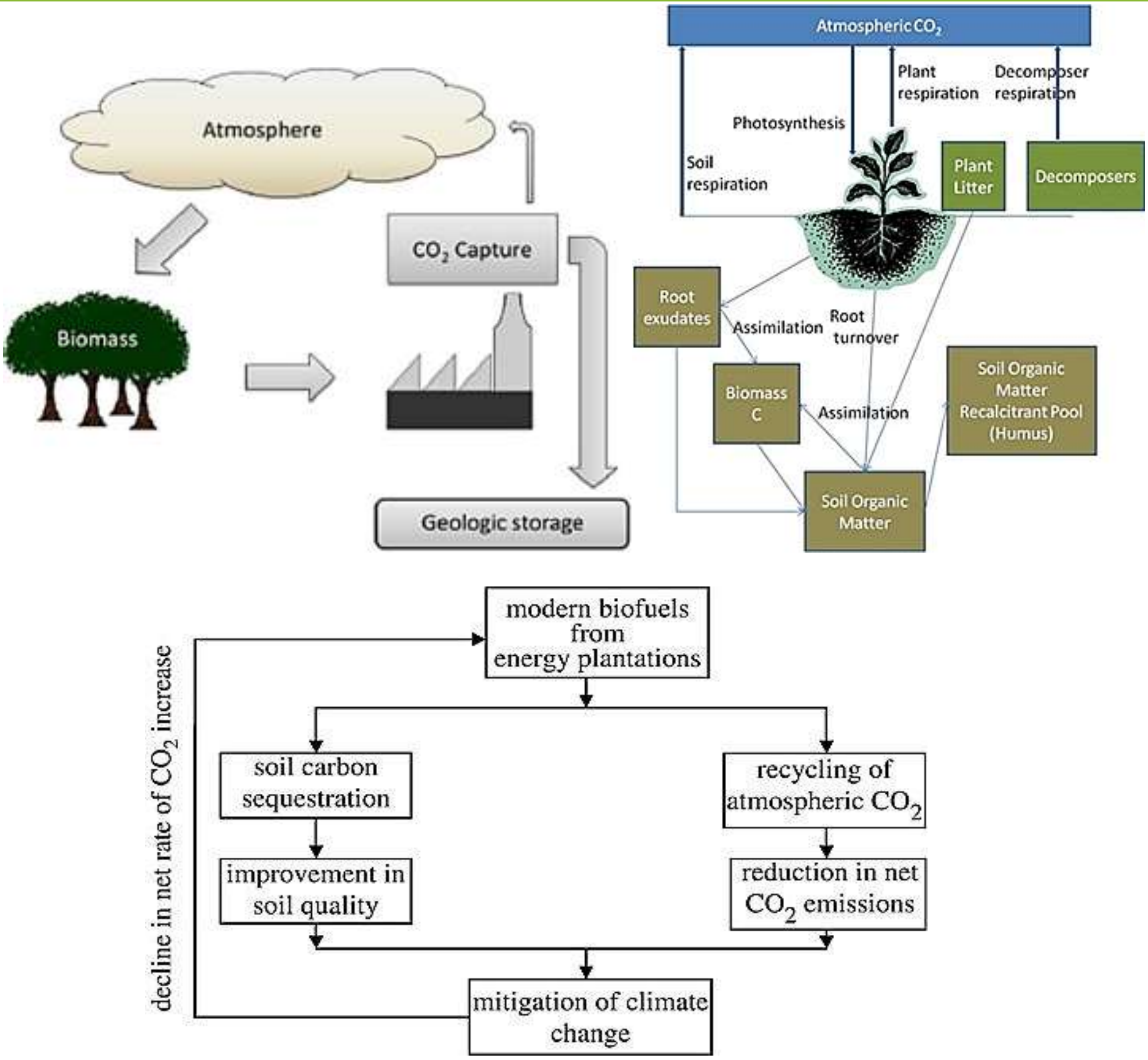

Fig.1 Interactive effects of modern biofuels produced from energy plantations on terrestrial/biotic carbon sequestration.

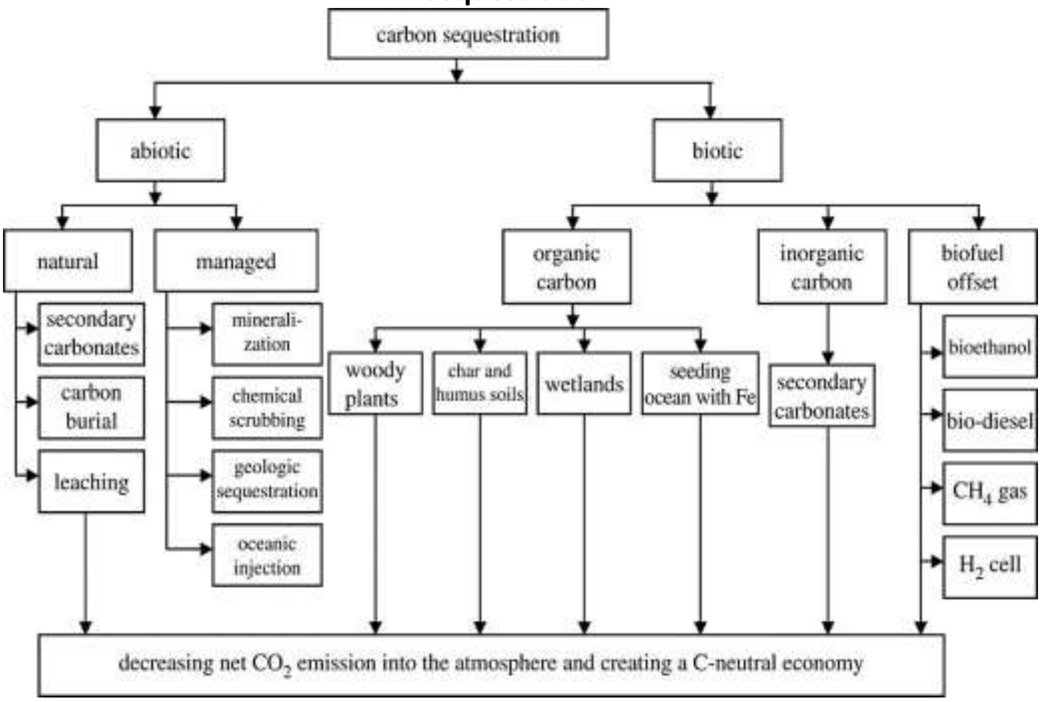

Fig.2 A wide range of processes and technological options for C sequestration in agricultural, industrial and natural ecosystems.

Conclusion

Carbon sequestration implies a transfer of atmospheric CO_2 into other long-lived global pools including oceanic, pedologic, biotic and geological strata to reduce the net rate of increase in atmospheric CO_2. Both herbaceous and woody perennial bioenergy crops can provide several environmental benefits such as SOC sequestration due to minimal soil disturbance by tillage operations and the continuous plant C input into the soil. Further global research may be focused towards mitigation of climate change through Carbon sequestration implementing novel technologies on bioenergy crops by academicians and researchers.

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Garlic *(Allium sativum)* as a Botanical for Insect and Disease Management

Article ID: 10402

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Introduction

Garlic *(Allium sativum)*, has natural fungicidal and pesticide properties that work effectively to control pests, makes an excellent economical, non-toxic biological pesticide for use in agriculture. The natural pesticide (garlic) has a strong aroma that can provide an olfactory camouflage against insects, masking their normal host-finding or feeding cues (Perrin and Phillips, 1978). Aphids, ants, termites, whiteflies, beetles, borers, caterpillars, slugs, and armyworms are some of the pests that can be suitably controlled using garlic (Kaluwa and Kruger, 2012).

Plant Parts Used

The whole plant, bulbs, leaves, and flowers.

Mode of Action

Repellent, insecticidal, nematicidal, fungicidal, antibiotic effects.

	Materials	Preparation methods	How to use	Target pests
1.	**Garlic bulb extract (Method 1)**			
	85 grams of chopped garlic. 50 ml of mineral oil (Kerosene or vegetable oil). 10 ml of soap. 950 ml of water. Strainer. Bottle container.	Add garlic to vegetable oil. Allow mixture to stand for 24 hours. Add water and stir in the soap. Store in a bottle container.	Dilute 1 part of the emulsion with 19 parts of water (ex. 50 ml of emulsion to 950 ml of water. Shake well before spraying. Spray thoroughly on the infested plant, preferably early in the morning.	American bollworm Armyworm Cotton Stainer Onion thrips Potato tuber moth Root-knot nematode Bacterial diseases Anthracnose Downey mildew Rice blast
2.	**Garlic bulb extract (Method 2)**			
	2 garlic bulbs. Few drops of soap. Grinder. Strainer. Bottle container.	Grind garlic. Allow mixture to stand for 24 hours. Store in a bottle container. Strain before use.	Dilute 1 part of the emulsion with 9 parts of water. Shake well before spraying. Spray thoroughly on the infested plant, preferably early morning.	Black spots Blight Fruit rots Mildew Rusts
3.	**Garlic oil spray**			

	100 grams of garlic. 2tbsp mineral oil. 10.5 liters of water. 10 ml of soap. Covered container.	Chop garlic finely. Soak garlic in mineral oil for a day. Add half a liter of water and soap. Blend well by stirring thoroughly. Strain.	Dilute the filtrate with 10 liters of water. Fill the sprayer. Shake sprayer from time to time to avoid oil from floating.	Leafhoppers Squash bugs Whitefly
4.	**Garlic oil emulsion**			
	50 ml of garlic oil. 950 ml of water. 1ml of soap.	Add soap to oil. Blend well by stirring thoroughly. Add water and stir.	To prevent oil from floating, immediately spray extract on infested plants and shake the sprayer from time to time. Spray early in the morning or late afternoon.	American bollworm Potato tuber moth Rice blast Rice brown leaf spot Root-knot nematode

Standard Procedure for the Preparation and Application of the Plant Extracts

1. Select plant parts that are free from diseases.
2. Do not have direct contact with the crude extract while the preparation and during the application.
3. Harvest all the mature and ripe fruits before plant extract application.
4. Always test the plant extract formulation on a few infested plants first before going into large scale spraying.
5. Make sure to place the plant extract out of reach of children and house pets while leaving it overnight.
6. Wear protective clothing while applying the extract.

Conclusion

Garlic oil spray has a broad-spectrum effect. This is not recommended for aphid control since it kills the natural enemies of aphids. It should be limited to home and garden applications where natural controls are rarely present.

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Role of Organic Farming in Sustainable Agriculture

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Summary

India is mainly an agricultural country. Nearly three-fourth of its population is dependent directly on agriculture for a living. Indian agriculture continues to face serious challenges from ever increasing population. Cultivation of high yielding crop varieties responsive to fertilizers and irrigation and the intensive cropping systems pose the problem of weeds, insects and pests causing tremendous losses to crop and their produce.

Organic farming is the practice that relies more on using sustainable methods to cultivate crops and it avoids chemical inputs that do not belong to the natural ecosystem. This form of agriculture conserves our soil and water resources, protects our climate, improves agro-diversity, ensures biodiversity, meets the demand for food and safeguards livelihoods.

Organic farming is one of the several approaches found to meet the objectives of sustainable agriculture. In India, there is ample scope for pure organic farming in the rainfed areas, where there is little or no use of fertilisers and other agro-chemicals.

Introduction and Background

Organic farming is the practice that relies more on using sustainable methods to cultivate crops and it avoids chemical inputs that do not belong to the natural ecosystem. Organic agriculture can contribute to meaningful socio-economic and ecologically sustainable development, especially in developing countries.

This is due to the application of organic principles, which advocates the application of local resources viz., indigenous seed varieties, manure, etc. and therefore cost effectiveness. Organic farming is one of the several approaches found to meet the objectives of sustainable agriculture. Sustainable Agriculture is more a philosophy or way of life. Sustainable agriculture is the practice of farming using principles of safeguarding ecology.

Unlike organic agriculture, sustainable agriculture concentrates on the ability of providing food on the long-term. As such, besides artificial fertilizers and pesticides, it also does not allow the use of agricultural machines running on non-renewable resources. Besides this, it focuses on finding the most energy-efficient and cost-effective method of utilizing agricultural machines and non-renewable natural resources. For this reason, it also implements natural biological cycles and controls where ever it is possible.

Sustainable agriculture is able to feed the world without destructive the environment or fear-provoking human health. It is a way of growing food in an ecologically and ethically responsible approach and it results in higher returns over time, with less need for high-priced and environmentally harmful inputs such as chemical fertilizers, pesticides and weedicides. Hence, Organic farming is a very native concept to India and it brings agricultural sustainability.

Concept of Organic Farming

According to FAO "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs".

Organic farming is based on understanding the ways of nature. It does not mine the soil of its nutrients nor does it humiliate the soil for fulfilling the needs of the common man. The living inhabitants of the soil are protected and nurtures. Thus, organic farming is a system of farming that aims at maintenance the soil breathing, maintaining its good health, cultivating the land and then raising the crops. This must be done to sustain a pollution-free environment and in an ecological way.

Principles of Organic Farming

The organic farming is based on the following principles.

1. Principle of health: Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems -healthy soils produce healthy crops that foster the health of animals and people.

2. Principle of ecology: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. It states that production is to be based on ecological processes, and recycling.

3. Principle of fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties - farmers, workers, processors, distributors, traders and consumers.

4. Principle of care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions.

The Potential of Organic Farming to Endorse Sustainable Agriculture in India

The concept of Sustainable agriculture integrates three main goals- environmental health, economic profitability, and social and economic equity. The concept of Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. The conservation of natural resources is critical for the agricultural sector which ensures long-term sustainability. The rigorous reliance on chemical fertilizers and pesticides always questions the concept of sustainability in its all aspect. It harms environment and the food chain. The use of chemicals in farming has serious long-term effects on the environment. These chemicals contaminating soil and water sources, thereby it enters in to the food chain.

In addition to this, when cattle consume foliage that contains these chemicals become highly concentrated in the flesh and milk of dairy cows. Ultimately, it creates serious health problems to people who consume dairy products. Organic agriculture avoids all kinds of practices which damages agro ecosystem. It provides healthy food while establishing an ecological balance to prevent soil fertility or pest problems. In order to alleviate all environmental and social problems arising from chemical based farming, the promotion of organic farming is indispensable.

Other than environmental problems, chemical fertilizers and pesticides-based farming creating so many economic destitutions to the farmers. The unsustainable farm practices have negative impact on farmer’s health and long term returns of farmers. The increase in use of pesticides and fertilizer leads to the increase in cost of production.

The only group which gets benefited by this is the corporate who manufacture these pesticides. The continuous application of chemical fertilizers reduces the fertility of soli which causes continuous decline in farm produce. It leads to the increasing cost of production and declining productivity which makes the farming economically unsustainable. Agriculture can be sustainable only if it has a long-term economic viability. Organic farming ensures long term economic sustainability than modern chemical fertilizers and pesticides-based farming.

Moreover, organic products carry a premium price in the market which makes organic farming more profitable. An effective agricultural sector strategy can contribute to a broader development of agricultural productivity, food security, generation of rural employment and poverty reduction while promoting the conservation of the natural resource base.

This new strategy should be adopted with sound infrastructure, governance, the private public participation and effective implementation seeking to contribute to poverty reduction, enhance regional integration, accelerate human development, and improve productivity in agriculture.

It is thus clear that agriculture needs to undergo a drastic revamp to become more sustainable. This is important to take care of the environment and to improve the productivity of the agro ecosystem. The policy measures are important to support agriculture which reflects the long-term social and environmental sustainability.

The organic farming stress on use of local resources which contributes to the empowerment of farmers and rural community. It is defined as a process or framework that promotes the wellbeing of members of an organization while supporting the ability of future generations to maintain a healthy community.

Social sustainability can be improved by enabling rural poor to get benefit from agricultural development, giving respect to indigenous knowledge and practices along with modern technologies, promoting gender equality in labor, full participation of vibrant rural communities to enhance their confidence and mental health, and thus decreasing suicidal rates among the farmers. Organic farming appears to generate 30% more employment in rural areas and labor achieves higher returns per unit of labor input.

The following possibilities are identified regarding potential of organic farming to promote sustainable agriculture in India:

1. As India now in the initial stage of organic farming, the quantity produced not enough to feed the large Indian population. Under this situation, concentrating on the export aspect of organic farming is more suitable opportunity for India.

2. Optimization of the potential trade in organic products is one of the good opportunities for improving the conditions of agricultural sector of India. Through the export of organic agricultural products, India can improve the conditions of Indian farmers as well as the entire agricultural sector.

3. Organic farming can be adopted as one of the strategies for sustainable agriculture promotion with a long-term perspective to foster community institutions that meet employment, environmental and health needs of the society.

4. Institutional barriers to the development of the organic sector are needed to be resolved with proper strategy and execution.

5. The traditional and indigenous farming knowledge should be conserved, while introducing selected modern technologies to manage and enhance diversity into farming systems.

Conclusion

The increasing awareness about the safety and quality of foods, long term sustainability of the present farming system persuades sustainable agriculture practices. The organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensure profitable livelihood option for rural community of India.

Organic farming is one of the most well-known modes of sustainable agricultural production by the consumer. It is presented as the "miracle solution" that helps produce healthy food for consumers, recovers soils that have been damaged with chemical fertilizers, and eventually save the planet.

Taking into account the economic, environmental and social functions that must be fulfilled by any mode of healthy agricultural production, organic farming is extremely efficient. Sustainable Agricultural development in India is essential to support the farmers who are struggling to sustain in this sector.

As an initial step to promote Sustainable Farming, the Governmental inventiveness to assist the unorganized frames through various means are essential to overcome the present problems faced by Organic farmers and enable them to achieve social and economic development thorough successful sustainable agricultural practices.

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Moringa: A Most Nutritious and Multi-Purpose Tree

Article ID: 10404

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Summary of Article

Moringa oleifera also referred to as the horseradish tree, drumstick tree, Ben oil tree, miracle tree, and Mother's Best Friend, is known for its multi-purpose characteristics, wide adaptability, and ease of establishment. Any part of the tree, with its high nutritional values, is ideal for both dietary and marketable purposes. The leaves are rich with essential minerals, vitamins and other plant chemicals. The leaves are rich in minerals, vitamins and other plant chemicals that are important. Leaf extracts are used to treat undernourishment and to get better breast milk in lactating mothers. It is used as an antioxidant, anticancer, anti-inflammatory, antidiabetic and antimicrobial agent. *M. Oleifera* seeds, a natural coagulant, are commonly used in the treatment of water.

Introduction

Moringa oleifera Lam. Commercially, a medium-sized tree is grown mainly for its pods, leaves and seeds. The tree is often referred to as a "wonder tree" due to its many uses and is sometimes referred to as the "Drumstick-tree and Horseradish tree." The tree is regarded as the best friend of a mother in Africa. It is recognized in India, for instance, by different names in different languages: Soanjna (Hindi) Shigru (Sanskrit), Sohanjna (Punjabi), Murungai (Tamil), Sajna (Bengali) Murinna, (Malyalam).

For human and animal consumption, the leaves, seeds, roots, flowers and pods of all parts of the Moringa are acceptable (Leone *et al.,* 2016). Since ancient times, it has been a daily portion of typical eatables in India. It is a multipurpose herbal plant for medicinal purposes and a global option (Abdull Razis *et al*., 2014).

It is used as a potential anti-oxidant, anti-cancer, anti-inflammatory, anti-hyperglycemic, anti-diabetic and anti-microbial agent (Abdull Razis *et al*., 2014; Arora *et al.,* 2013). It is used in conventional and functional foods and also has a beneficial effect on digestion and is capable of preserving foods. Moringa is grown as a semi-arid crop all over the world.

Each part of the Moringa tree has been used as a medicine and food product, which has gained tremendous attention as the 'tropical natural nutrition'. Moringa trees have been used in many developing countries to combat malnutrition, particularly among infants and breastfeeding women, especially in India, Pakistan, the Philippines, Hawaii and many parts of Africa. Elkhalif, *et.al* (2007) explores the nutritional qualities of M leaves.

The Sudanese Oleifera tree (Rawag) and the results showed that the moisture content was 74.42 percent, 16.7 percent protein, 3.5 percent fiber, 8 percent ash and 1.7 percent oil. Furthermore, the mineral content was measured and the calcium content was found to be 0.20 mg/100g, 0.13mg/100g magnesium, 0.075mg/100g potassium and phosphorus. 0.031 mg/100g.

The Pod, Seed and Oil

The shells are usually cooked and eaten like green beans. All seeds were also pink, roasted or powdered, and steamed in tea and curry (Fahey, 2005). The peels and seeds have a taste that varies from sweet to bitter and are most often eaten after frying to get a peanut-like taste, often referred to as Moringa grains. In general, the spokes are prepared similar to green beans and have a slight taste of asparagus. Essential amino acids and are extremely nutritious while mainly from Asia, Africa, the American population is used as a vegetable Worldwide; the use of other peoples is increasing.

Leaves

Moringa leaf is a health food source and is an organic health supplement that has been used in many therapeutic ways (McBurney et al, 2004 and Fahey, 2005). Leaves that contain vitamins A, C and E are a very rich source of nutrients.

Leaves that are rich in biologically active carotenoids, tocopherols and vitamin C promote the potential for a healthy diet and avoid free-radical damage which causes many diseases. Fine leaves are harvested daily for soups, sauces or salads. According to reports, fresh leaves can be frozen, reddened, or stored as a dry powder for several months without significant loss of nutritional value. Dried in the shade, ground to a powder, and then stored for later as a food scent or added.

In foods such as soups and stews, dried or fresh leaves are used (Lockett et al, 2000). Commonly used as pastry in pasta, rice or wheat. In order to maintain a stable livestock, farmers have given their leaves to livestock (Fahey, 2005) includes newer applications as well. In addition, the use of Moringa powder in aquatic culture systems such as fish feed and Moringa leaves is a protein substitute for animals.

Moringa's feed value has been reported to be comparable to soybeans and rapeseed meal. Pregnant women and lactating mothers use powdered leaves to stimulate the nutrition of their babies or children. In particular, mothers suffering from malnutrition are underdeveloped countries (McBurney et al, 2004; Lockett et al, 2000) suggested that Moringa oleifera leaves were healthy for human consumption because people they did not observe any significant side effects.

However, it was found that the toxicity of biologically active agents depending on the dosage and acute toxicity profile of Moringa oleifera leaves was studied. They concluded that Moringa oleifera ether, ethanol and water extracts contain phytochemicals that are relatively non-toxic when administered orally within 24 hours as a single dose to mice.

The Stem and Bark

Moringa oleifera, planted as a hedge in the yards, provides climbing garden plants with wind cover, shade and support. The household / garden part can be easily understood. Moringa wood is relatively soft. Therefore, n, t is used in heavy construction. The wood is soft, but it provides good fuel for cooking. It gives 4600 kcal / kg or more. The fiber is used to make ropes from the bark.

Flowers

The flowers are pleasantly fragrant, yellowish-white in colour. Fresh or dried flowers are used for making teas (Ponnuswami, 2012) with hypecholesterolemic properties (Gopalakrishnan et al., 2016) and also contain Ca, Kandamino acids. The flowers are said to taste like mushroom when fried. The flowers act as hypecholesterolemic, and theanti-arthritic agents can cure urinary problems and cold (Sutalangka et al., 2013). Flowers contain 9 amino acids, sucrose, D-glucose, traces of alkaloids, wax, quercetin and kaempferat; the ash is rich in K and Ca. They have also been reported to contain some flavonoid pigments such as alkaloids, kaempherol, rhamnetin, isoquercitrin and kaempferitrin.

Root

The taste of the root is like radish and it is common in East African food.

Plant Growth Enhancer

Laboratory studies show that Moringa spray has a variety of beneficial effects on plant growth. The rapid growth of young plants has been proven by the effectiveness of the spray. Plants were more robust, more resistant to pests and diseases, longer life, and heavier roots and stems. And leaves, more fruit production, bigger fruit, 20-35% yield increase f Even some of these discoveries could be replicated in the industry and could be of great help in increasing the food supply for millions of hungry people (Fahey 2005).

Conclusion

Together, these findings make Moringa an excellent versatile plant used to improve community health and nutrition and appear to be the most promising candidates for producing unique bioactive neutraceutical contributes to growing economically beneficial crops and poverty in India. Moringa, with emerging awareness regarding its Moringa: A Multipurpose Potential Crop – A review 597 multiple uses, appears to be a potential crop, as found from various studies in the past years. Moringa oleifera consists of antioxidant, anticancer, antinflammatory, antiulcer, anti-hyperglycemic, antidiabetic and antimicrobial properties. Besides, its role in agriculture, as animal feed, forage crop, natural plant growth enhancer and bio-pesticide has also been established. High nutrient content, neutraceutical nature and other medicinal uses makes it to be a potential crop. As discussed in the light of scientific findings, Moringa can be a potential multipurpose crop to utilize marginal and degraded lands and also to use the unused space in perennial plantations. However, concerted efforts are needed to harness its potential completely.

Table 1: Nutrients composition of leaf, seed and root (Igwilo et al., 2017)

S. No.	Nutrient	Leaf	Seed	Root
1.	Energy values (Kcal/100 g)	426.12	426.12	384.05
2.	Crude proteins (%)	27.60	28.02	5.02
3.	Crude lipids (%)	20.00	33.78	6.33
4.	Carbohydrates (%)	33.93	28.77	76.75
5.	Ash (%)	11.60	3.03	4.97
6.	Thiamine B1 (mg/100 g)	18.47	-	-
7.	Riboflavin B2 (mg/100 g)	14.82	-	-
8.	Pyridoxine B6 (mg/100 g)	57.29	-	-
9.	Ascorbic acid (mg/100 g)	773.30	94.74	48.13
10.	Niacin B3 (mg/100 g)	50.35	-	-
11.	Calcium (mg/100 g)	13.45	2.84	3.99
12.	Sodium (mg/100 g)	104.06	129.03	514.80
13.	Potassium (mg/100 g)	20.81	-	15.4

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Participatory Research and Development for Natural Resource Management

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Introduction

Natural Resources are sine qua non for a nation's progress, whose stocks are plummeting due to their non-judicious exploitation. India is no exception to this. Natural resources do possess a mollycoddling effect on agriculture, which make it inevitable to facilitate and formulate plans for Natural Resource Management. The dwindling phase of natural resources should be dealt seriously. India being an agrarian economy, it is plausible to evolve methods incorporating agricultural development with Natural Resource Management (NRM). Nonetheless development cannot be side-lined, so the discourse and research on NRM should effusively welcome participation of common people. Participatory Research in NRM has been gaining significance due to changing agricultural agenda.

Genesis of Participatory Research & Development for NRM

1. 1960's a new discipline on farm management evolved with Farm Economics, Engineering, Planning as its core constituents.
2. 1970's Crop Ecology domain emerged to address more issues of Agricultural Research with Physiology, Pathology , Entomology, Genetics, Agronomy etc as major subject domains.
3. 1980's Farming System Research gained ground as more concern on farm as an individual unit was envisaged.
4. 1990's world nations reached a consensus that sustainability should be given priority, sustainability at stake can be global threat, thus Natural Resource Management has been chalked out as part of Sustainable development concerns.

Understanding Participatory Research in Context of NRM

In the field of natural resource management (NRM), which emerged as a new integration domain in the agricultural sciences, participatory research is conceptually and operationally still in its infancy and a range of activities are labelled 'participatory research'.

By the early 1960s farm management was a very important domain. It included farm economics, engineering, planning, and home economics. By the early 1970s crop ecology became an important integration domain, including disciplines such as physiology, pathology, entomology, genetics, and agronomy. From the mid-1970s to the mid-1980s farming systems research was a prominent integration domain. By 1985 sustainable production had become a major integration domain. It has now been redefined as sustainable natural ecosystem management with a larger role for disciplines such as geography, meteorology, ecology, hydrology, and sociology, (Janssen and Goldsworthy, 1996).

Janssen and Goldsworthy (1996) argue that the emergence of new domains depends on two critical factors: (1) an understanding of the inter relations between problems and the ability to deal with these interactions in the research methodology, and (2) public concern about major issues. Indeed, the emergence of 'natural resource/ecosystem management' (NRM) as a domain in international agricultural research is paralleled by the appearance of new tools and instruments for data storage and processing such as geographic information systems and modelling. At the same time, worries about food production and global hunger have been modified by increased public concern about the rapid deterioration of the Earth's ecosystems (particularly since the 1992 Earth Summit in Rio) and increasing levels of poverty. The term INRM first entered the CGIAR's vocabulary through a study on priorities for soil and water research (TAC, 1997), which called for an 'integrated' approach to natural resource management. Human activity is the major destructive force in nature, improving natural resource management primarily requires changing human behaviour at 'grassroots' level (Röling,1994, 1996, 2000). Today it is widely agreed that local peoples' perspectives need to be at the centre of research efforts for development and that innovations need to be 'owned' by the local land users, if changes in decision-making and behaviour leading to impact are to be achieved. Such ownership can be created effectively through development and implementation of innovations by local people themselves in cooperation with outsiders (Hagmann and Chuma, 2002).

Five Principles of Good Practice in Participatory Research for Natural Resource Management (Vernooy and McDougall, 2003).

1. The research reflects a clear and coherent common agenda (or set of priorities) among stakeholders and it contributes to partnership building.
2. The research addresses and integrates the complexities and dynamics of change in human and natural resource systems and processes, including local understanding of these.
3. The research applies the 'triangulation principle' (i.e., multiple sources of information and methods), and links together various knowledge worlds.
4. The research contributes to concerted planning for the future and social change.
5. The research process is based in iterative learning and feedback loops and there is a two-way sharing of information.

NRM Research Practice Addresses Four Major Issues

1. Impact orientation: What kind of impact do NRM research projects strive for?
2. Research focus: What is their research focus and who are the intended beneficiaries?
3. Pathway/strategy to impact: What is their pathway or strategy to achieve an impact at the local level?
4. Role of Participatory Research: What is the role of PR in the project strategy?

Impact Orientation

International agricultural research centres face an apparently paradoxical situation with regard to impact. Some donors want to see impact at the level of resource-poor farmers, while others emphasise that the mandate and comparative advantage of the IARCs is to conduct '*strategic*' research and produce '*international public goods*' that can be extrapolated to other locations at the regional and global level. Though most IARC projects show a stronger impact orientation, the goals and objectives leading to the desired impact remain rather diffuse with no clarification of what research can realistically contribute. This is a general pattern observed in many research projects – participatory or non-participatory.

'Hard 'impacts related to physical, natural and financial capital and 'soft' impacts related to social/human capital are not clearly separated, even though they would require different strategies. This often results in a diffuse and unclear strategic orientation. Since a clear strategy is needed to connect research outcomes and development impacts it is difficult to imagine how tangible effects can 'fall in place' when the impact strategy is diffuse. Participatory NRM research particularly requires a strong impact orientation to guide a flexible and dynamic process of socio-technical development. The research products need to be derived clearly from the strategic orientation.

Research Focus

While covering a broad range of topics, the analysis of NRM research projects revealed three major research foci:

1. The development and assessment of technologies: E.g., to develop and promote productive and profitable alternative land use systems to slash and burn agriculture.

2. The generation of new theoretical insights into complex NRM systems to contribute to policy or management recommendations (policy research): E.g., to identify and assess NRM problems within major land-use systems in eco -regions, to identify the driving forces behind key processes occurring within these land use systems at different spatial scales.

3. Developing approaches for organizational/ institutional innovation: E.g., to develop or identify a set of models, institutional arrangements, methods, tools and strategies to enable local communities to achieve a more sustainable and equitable management of forest resources.

Pathway/ Strategy to Impact

To promote the dissemination of their research products, most IARCs seek collaboration with 'adaptive research and dissemination partners', such as NARS, extension services, NGOs, development agencies and farmers' groups. These partners form the focal mechanism through which IARCs attempt to reach out to farmers in pilot development projects.

Role of Participatory Research

Participatory approaches in international agricultural research are mostly utilized at the level of applied and adaptive research or even technology transfer, i.e., 'downstream' applications (Becker, 2000). Those who advocate participatory research as a means of empowerment, equity, and local capacity building are looked upon as 'muddying the waters' by mixing development-driven agendas with research driven ones (Humphries et al., 2000). The same study revealed that women and marginalized groups in particular are brought into the research process at a relatively late stage, when technologies have already been identified and are ready for dissemination (Johnson et al., 2000).

An Agro-Ecological Basis for Natural Resource Management

A new Natural Resource Management (NRM) approach must be developed to directly and simultaneously tackle the following objectives:

1. Poverty alleviation.
2. Food security and self-reliance.
3. Ecological management of productive resources.
4. Empowerment of rural communities.
5. Establishment of supportive policies.

For the effusive welcoming of any government programmed by the people "Understanding and Getting the Most from peoples' Local Knowledge" should be the moto. To buttress the moto an evolving concept is Ethnoscience.

Ethnoscience and Rapport Building

The gist of ethnoscience is learning local categories for things (insects, plants, diseases, people, etc.) and the meanings of those categories. By understanding how people use their language, we get insights into how they see the world. Hence, folk categories of knowledge are formed by mental concepts attached to word labels.

This is may be rather complex, with different people (women, elders, ritual specialists) knowing certain things. Games and drawings can be used to elicit some of these differences (Nazarea-Sandoval, 1995). However, much of folk knowledge is shared by the entire group of people (Hays, 1983). Eventually leading to rapport building. This rapport building is nothing but dialogue building.

Indigenous Ecological Knowledge

IEK can be represented as emerging from a complex system composed of three subsystems: context, practice and belief (CPB).

Contextual knowledge portrays learning due to history, demographic factors and biophysical features of place. Knowledge as practice portrays meaningful action, through physical interaction and experiential learning. Knowledge as belief portrays the influence that spirituality and values have on how people act within their ecosystem.

Role of Development Communication

1. Problem Identification.
2. Planning.
3. Intervention.
4. Developing a Research Relationship.

Property Rights and Technologies for Natural Resource Management

Degradation of natural resources has become a global problem that threatens the livelihood of millions of poor people. Many promising technologies for natural resource management are available to address these problems, but farmers and others often fail to adopt them. Although many factors can be identified, lack of secure property rights and collective action deserve greater attention from policymakers and technology developers.

How Property Rights Affect Technology Adoption

Unlike conventional agricultural technologies, many natural resource managements (NRM) technologies take years to give results. If farmers do not have secure rights to the natural resources, there is no incentive for them to adopt these technologies.

Property Rights

Property rights include not only ownership of resources as defined by laws, but also a variety of rights from customary law and local practice.

For tenure security, the rights should provide:
Excludability, to allow those with rights to exclude others from using a particular resource.
Duration, to provide a sufficient time horizon to reap the benefits of investments.
Assurance, from institutions that can enforce an individual's rights.

Participatory Research and Development in Natural Resource Management: Towards Social and Gender Equity

The management of agriculture and natural resources involves interactive roles of diverse social actors. These actors usually include a diversity of stakeholders including small and large farmers, business entrepreneurs, local government authorities, resource-based user groups, community-based organizations and others. Different individuals and groups of individuals are bringing different perspectives, experiences, knowledge and interests to the management of resources, and to any associated research and development initiatives. They have different and often changing access to and control over, decision-making, and specific knowledge about natural resource management processes. These stakeholders are not homogenous or fixed groups, but differentiated by social categories of gender, class, caste, ethnicity and age.

Participatory GIS

Participatory GIS is the integration of local knowledge and stakeholders’ perspectives in the GIS. Stakeholders should also have access to GIS databases and products and be able to apply GIS and GIS products to development planning, resource management and advocacy.

1. stakeholder and beneficiary participation in the data collection process.

2. participation in the planning process: assessment of planning and management options, conflicts and development scenarios.
3. integration of social and natural science information using spatial databases in natural resources research and development.

Monitoring and Evaluation in NRM

1. Efficiency refers to the amount of time and resources put into the project relative to the outputs and outcomes. A project evaluation may be designed to find out if there was a less expensive, more appropriate, less time-consuming approach for reaching the same objectives.
2. Effectiveness describes whether or not the research process was useful in reaching project goals and objectives, or resulted in positive outcomes.
3. Relevance or appropriateness describes the usefulness, ethics, and flexibility of participatory research within the particular context and for the particular research question.

Impediments

1. Archaic research and development approach.
2. Lack of indigenous knowledge.
3. Gender inequity.
4. Unprecedented approach.
5. Tech- unsavvy researcher.
6. Non-cooperation by the people.
7. Culture Lag.
8. Skepticism on research personnel.
9. Illiteracy of the community people.

Conclusion

The burgeoning population is posing a threat to food security, which leads to unbridled exploitation of natural resources. Hence a mechanism to curtail the same is the need of the hour. There is a growing concern on sustainability for which NRM is one of the pragmatic solutions. In the near future there will be a shift from Millennium Development Goals to Sustainable Development Goals. The dogged progress of any nation is possible only through people or via collaborative research.

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Major Diseases of Mustard and their Management: A Brief Review

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In India Rapeseed-Mustard is most important and predominant source of edible oil and raw material for industrial products. It belongs to family Brassicaceae (Cruciferae) and genus Brassica. The estimated area, production and yield of rapeseed-mustard in the world was 36.68 million hectares (mha), 72.42 million tonnes (mt) and 1974 kg / ha, respectively, during 2017-18. Globally, India account for 19.8 % and 9.8% of the total acreage and production. During the last seven years, there has been a considerable increase in productivity from 1840 kg/ha in 2010-11 to 1974 kg/ ha in 2017-18 and production has also increased from 61.64 mt in 2010-11 to 72.42 mt in 2017-18 (https:// www.drmr.res.in/). Rajasthan alone contributes 43% of the total mustard production in India. Rapeseed and mustard are crops of temperate climates, but these can also be cultivated at higher elevations in the tropics. Numerous biotic and abiotic factors are responsible for lowering the productivity of mustard. Major abiotic constraints are drought, salt, heat, frost and heavy metal stress. Besides these abiotic stresses, biotic stresses like Alternaria blight, white rust, downy mildew, powdery mildew and Sclerotinia stem rot are considered to be most devastating. Fungal diseases play an important role in yield loss and are present at different stages of the plant growth from seedling to fruit stage.

Alternaria Leaf Spot/ Blight

It is caused by two species of Alternaria (*Alternaria brassicae* and *Alternaria brassicola*). Disease symptoms start with formation of spots on leaves, stem and siliquae. The spots produced by *A. brassicae* are usually appear as light grey coloured and smaller in size while *Alternaria brassicola* produces black sooty velvety spots and big in size. Both the pathogens develop symptoms in concentric rings i.e., called target effect. These lesions rapidly multiply and spread to other plant parts like stems and siliques etc. The black or brown spot contains visible circular, concentric rings. The circular spots often merge to form large patches causing the leaf blight. In severe attacks plant shows damping off of seedling, wilting and rotting at foot and root like symptoms also. Infection not only turns down the fresh produce but also affects the stability of stored products. Infected seeds containing spores or mycelium on or under the seed coat are the main source of transport of these pathogens. Water, wind, animals and infected tools also causes spread of spores. Most of the infections occur due to the infected left over on the ground after harvest. This phytopathogen can also lie dormant on perennial plants, vulnerable weeds and crop debris.

For management of this disease, a combination of agricultural management practices and chemical protection should be applied. Agricultural practices include timely sowing of clean, healthy and certified seed, maintaining a balanced nutrition, destruction of infected weed and left-over debris, proper field sanitation, eluding irrigation at flowering and pod formation stages and crop rotation with no cruciferous crops. Deep summer sowing and adoption of early sowing is also helpful to manage. Seeds should be treated with Mancozeb @2.5g/kg seed and spray with mancozeb or zineb @ 2.5 g/liter of water at 15 days interval.

White Rust

It is caused by obligate pathogen *Albugo candida* and also known as white blister or staghead disease. Both local and systemic infection is observed in this disease. In case of local infection isolated white or creamy yellow raised pustules appear on under surface of leaves which later coalesce to form large patches. Systemic infection causes hypertrophy and hyperplasia resulting in malformation and distortion of floral parts. Entire inflorescence is replaced by swollen sterile structure which is called stag head. Contaminated seeds and soil are the major source of infection of the pathogen. Cool and wet weather (12-14°C temperature & 60-80% RH) proves to be favourable for the development of this disease. Primary infection occurs through the oospores present in soil or seeds. Use of healthy, clean & certified seeds and collection and destroy infected plant debris, follow long crop rotation with non-host crops and early sowing are management practices to combat this disease. Seed dressing with Metalaxyl (Apron 35SD)@6g/kg seed followed by a single spray Metalaxyl 8% + mancozeb 64% WP @1000 g in 400 l of water/acre also helpful.

Downy Mildew

It is caused by the pathogen *Peronospora parasitica* and It can damage plant at any phase of development from seedling, cotyledons to the harvest stage. Symptoms appear on all aerial parts but predominantly on leaves and inflorescence. Greyish white irregular necrotic patches develop on the lower surface of the leaves. The most obvious and pronounced symptom is the stag head formation which is infection of inflorescence causing hypertrophy of the peduncle or inflorescence. The infected inflorescence does not produce any siliqua or seed. This fungus is an obligate parasite and survives through oospores formed in affected host tissues and on weed hosts. The secondary spread occurs through wind borne sporangia. Management practices like collection and destroy infected plant debris, crop rotation with nonhost crops and early sowing are helpful to manage this disease to some extent. Chemically this disease can be managed by seed treatment with Metalaxyl (Apron 35SD) @6g/kg seed followed by a single spray with Metalaxyl (Ridomyl MZ) @0.2%.

Powdery Mildew

This disease is caused by *Erysiphe cruciferarum*. It infects all aboveground parts of the plant. The pathogen produces white powdery fungal growth on both side of leaf surface as a result of which leaves fall prematurely and become pale in color. Under favorable environmental conditions whole leaves, stems and siliques are affected. The affected siliques produce small and shriveled seeds. The fungus is ectophytic, spreading on the surface of the leaf, sending haustoria into the epidermal cells.

The fungus over-summers through cleistothecia as ascospores or as mycelium on volunteer host plants. The disease spreads through wind borne conidia. The disease is supported by dry climate and gets extreme under inundated conditions. Management options like collection and destroying of infected plant debris and spraying the crop with wettable sulphur@0.2% or Dinocap@0.1% or tridemorph@0.1%.

Sclerotinia Stem Rot

Sclerotinia stem rot is also known as white blight, stem disease or watery soft rot. It is caused by pathogen *Sclerotinia sclerotiorum.* It is a necrotrophic pathogen and cosmopolitan in distribution. Air-borne spores or sclerotia are the source of infection. Sclerotia act as dormant survival spores in the soil and it can survive for many years in the soil. Wet humid conditions enhance germination of the spores and infection. Germination of sclerotia in soil gives rise to mycelium which infects the susceptible plant. Symptoms of the disease appear two to three weeks post infection. The pathogen produces light brown faded patches on branches, stems and pods and later these patches expand and become greyish-white in colour. When these infected stems split open, hard black bodies called sclerotia are present which is the resting stage of the fungus. For management of this disease, good agricultural practices should be used like sowing certified disease-free seed along with crop rotations. Infected left-over debris should be removed before sowing seeds.

Insect Resistance: Snag in Insecticidal Approach

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Introduction

Insecticides are organized into classes- organophosphates, carbamates, pyrethroids, neonicotinoids, etc.-that share a common chemical structure and mode of action (MOA). MOA is the specific process by which an insecticide kills an insect, or inhibits its growth. Target site of action is the exact location of inhibition, such as interfering with the activity of an enzyme within a metabolic pathway. Genetics and intensive application of insecticides are two factors of several responsible for the development of insecticide resistance. Insects with genes that confer resistance to a particular insecticide or class of insecticides survive treatment and are thereby “selected” to pass on this resistance to later generations. Among all the different categories of pests, insects are known to exhibit resistance at alarming rates. Worldwide, more than 500 species of insects and related arthropods are resistant to insecticides.

Resistance may develop to only a single insecticide. However, it is more common for insects that exhibit resistance to one insecticide to be resistant (or develop resistance more rapidly) to other insecticides with the same MOA. A classic example is the house fly. Populations of this insect that became resistant to DDT in the 1950’s, also exhibited resistance, with no previous exposure, to pyrethroid insecticides used decades later. DDT and pyrethroids have the same MOA. This phenomenon is known as cross-resistance. A closely related phenomenon, multiple resistance, occurs in insect populations that resist two or more insecticide classes with unlike modes of action. Insects develop this type of resistance by expressing multiple resistance mechanisms. This can happen if one insecticide is used until insects display a resistance and then another is used and the insect population becomes resistant to that one, and so on. Localized populations of Colorado potato beetle are notorious for multiple resistance to more than 50 insecticides with various modes of action. Multiple resistance is less common than cross resistance but is potentially of greater concern because it drastically reduces the number of insecticides that can be used to control the insect in question.

In contrast to resistance, insecticide tolerance is a natural tendency and is not a result of selection pressure. Mature caterpillars are more tolerant to many insecticides than younger ones of the same species due to differences in body size, exoskeleton thickness, and the ability to metabolize a poison. These differences are identified as tolerance or natural resistance rather than true insecticide resistance.

Insecticide Resistance Mechanisms

There are several ways that insect populations can become resistant to insecticides, and pests may exhibit more than one of these mechanisms at the same time.

Metabolic resistance: Resistant insects may detoxify or destroy the toxin faster than susceptible insects, or prevent the toxin from reaching target sites by binding it to proteins in their bodies. Metabolic resistance is the most common mechanism and often presents the greatest challenge. Resistant insects may possess higher levels or more efficient forms of the enzyme(s) that break down insecticides to nontoxic compounds.

Altered target-site resistance: The site where the toxin usually binds in the insect becomes modified to reduce the insecticide’s effects.

Behavioural resistance: Resistant insects may avoid the toxin by a change from their normal activity. Insects may simply stop feeding or move to the underside of a sprayed leaf. Some malaria-transmitting mosquitoes in Africa developed a preference for resting outside that prevented them from coming in contact with pesticide sprayed on interior walls.

Penetration resistance: Resistant insects may absorb the toxin more slowly than susceptible insects. Penetration resistance occurs when the insect's outer cuticle develops barriers which can slow absorption of the chemicals into their bodies. This mechanism is frequently present along with other types.

Most insect control failures are not due to resistance. Before assuming insects surviving an insecticide application are resistant, eliminate other possible causes of poor control such as:
1. The pest was not identified correctly and the wrong pesticide was used.
2. An incorrect dosage of pesticide was used or the pesticide was applied in an improper manner.
3. The pesticide was not applied at the appropriate time (i.e., pest target was not in the area at the time of treatment or was in a life stage not susceptible to the pesticide).
4. Pests re-infested the area following the pesticide application.

Other reasons for failures include:
1. Pest resurgence–the natural enemies (i.e., predators and parasites) of the pest as well as the pest are eliminated by a pesticide application, the natural enemy populations can take longer to rebound than the pest population, therefore pest populations increase rapidly as the pesticide residues decrease.
2. Secondary pests–certain pests that usually do not occur at significant levels can reach damaging levels after a pesticide application because their natural enemies are eliminated by the pesticide. With the number of natural enemies reduced by pesticides, the pest population can rebound quickly.

Take Steps to Avoid Insecticide Resistance

The following integrated pest management (IPM) and pesticide management tactics will help delay the onset of insecticide resistance:
1. Monitor pests: Use research-based sampling procedures to determine if pesticides are necessary (based on action/economic thresholds) and the best application timing (when pests are most susceptible).

2. Employ appropriate control measures: Effective IPM-based programs will include insecticides, cultural practices, biological control (predators and parasites), mechanical control and sanitation. A healthy plant or crop is often less susceptible to insect attack.

3. Tank-Mix: Applying two or more pesticides with different modes of action in a tank-mix or pre-pack may delay the onset of, or mitigate, existing pest resistance. Tank-mixing allows for adjusting of the ratio of pesticides to fit local pest and environmental conditions.

4. Insecticide Spraying by the Numbers: To make it easy to recognize different classes or modes of action, the Insecticide Resistance Action Committee (IRAC) has created a classification scheme that distinguishes modes of action by group numbers. IRAC is an industry-organized group of pest management specialists that develops resistance management guidelines for global implementation. The U.S. Environmental Protection Agency requested agricultural chemical companies to voluntarily include the IRAC MOA group number in a standard format on the insecticide label (example below). Products sharing the same group number have the same MOA. When a premix label displays the group number(s), the user can easily determine the modes of action included in the premix.

5. Select and use insecticides wisely:

a. If repeated applications of pesticides are necessary, alternate insecticides with different modes of action against the pest so that no more than two consecutive applications are made with the same MOA.
b. For some cropping systems, insecticide applications are often arranged into mode of action spray windows or blocks that are defined by the stage of crop development and the biology of the target pest(s).

c. Follow label directions for the proper application method and rate.
d. Minimize the use of long-residual insecticides.
e. When feasible, spot treat (e.g., field edges or other hot spots) or leave unsprayed areas within treated fields or adjacent "refuge" fields.
f. Keep good records of insecticide use to aid in planning for future years.

What can you Do About Resistant Insects?

If insecticide resistance is confirmed by diagnostic testing or by eliminating other potential reasons for pesticide failure (see Is Resistance to Blame), manage insecticide resistance with the approaches listed below:
1. Immediately stop using the insecticide in question and other insecticides with the same mode of action.
2. Manage insect pests as outlined in Take Steps to Avoid Insecticide Resistance. Adhering to these resistance avoidance principles will help prevent resistance from recurring and prove beneficial in managing resistance in the long term.
3. Use preventive control, as appropriate, for pests that are known to be resistant.
4. Seek advice from your local county Extension Educator, Land-grant university insect management specialist, or log onto the Insecticide Resistance Action Committee website at: http://www.irac-online.org/for assistance with the long-term planning of insect control in subsequent crops.

Conclusion

Reversal of resistance can occur in some pest populations by allowing time between applications of a class of pesticide to permit resistant populations to become diluted by pesticide-susceptible individuals. However, no one can predict if or when resistant pests will change back to a susceptible population.

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Sweet Basil - Miracles Plant

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Scientific name: *Ocimum basilicum*
Family: Lamiaceae / Labiatae
Chromosome number: 2n=48

Ocimums are important groups of aromatic and medicinal plants which yield many essential oils and aroma chemicals and find diverse uses in perfumery and cosmetic industries as well as in indigenous system of medicine. Among various Ocimum species, *O. basilicum* is commercially and extensively cultivated for essential oil production. The essential oil contains methyl chavicol, linalool, 1,8-cineole and methyl cinnamate as the major components. Its oil is employed for flavoring of food stuffs, confectionery, condiments, perfumery industry, and in toiletry products.

Botany

O. basilicum Linn. is a large, herbaceous, erect, strongly aromatic annual herb growing to a height of 30-90 cm. Leaves opposite, ovate-lanceolate, 3.75-5 cm long; petioles very slender usually slightly hairy; flowers 0.72-1.25 cm long, born in racemose inflorescences, corolla 0.72 - 1.25 cm long, white, pink or pale-purplish, bracts are petiolated, flowers are conspicuous, seeds black and ellipsoid which become mucilaginous on wetting:

		
Basil plant	**Inflorescence**	**Seeds**

Major Production Areas

The genus Ocimum is well represented in the warmer parts up to 1800 m altitude from sea level. The main centers of diversity in this genus are in Africa, South America (Brazil) and Asia and grow mainly in France, Italy, Bulgaria, Egypt, Hungary, South America, Comoro Islands, Thailand, India, Haiti and Guatemala. In India the cultivation of French basil is mainly concentrated in Uttar Pradesh.

Cultivation Methods

Propagation: The plant is propagated through seeds, but direct sowing of seeds in the field is not advisable. Seedlings are first raised in the nursery and then transplanted to the field. About 125 g seeds are required for raising seedlings in one hectare.

Soil condition: Basil can be cultivated on a wide range of soils, from moderately fertile, well drained loamy to sandy loam soils with a pH ranging from 4.3-9.1.

Climate: Crop comes up well in warm and humid climate up to an altitude of 1800 m. long day, high temperature and high humidity have been found favorable for plant growth and high oil production.

Planting time: The crop can be grown from the middle of February to the end of September and also during Kharif in plains of North or South India. In the hilly areas of north India, the crop can be grown during kharif.

Nursery Rising of Seeds

Raised seed beds of 10 - 15 cm height should be thoroughly prepared by the addition of well rotten farmyard manure and leaf mould each at the rate of 1 kg/ sq m and mixed well into the soil. Beds of 1 m × 4 m, with irrigation channels are laid out and seeds (10-15 g per bed) are mixed with fine sand or wood ash and sown in lines of 6 cm apart or broadcast over the beds.

The seeds are then covered with a thin layer of fine soil or farm yard manure. The nursery beds are watered immediately after sowing and regularly thereafter. In the plains of North India, the seeds may be sown in the nursery in the months of April-May or August-September and in the hilly region's seeds are sown in April. The seeds start germinating 3 days after sowing and the germination will be complete in about 8-12 days. The seedlings will be ready for transplanting in about 6 weeks after attaining a height of 10-15 cm. A spray of 2% urea solution to the nursery plants at 15-20 days before transplanting helps in getting healthy and vigorous seedlings.

Planting

Land preparation: The land is well prepared with 2 to 3 ploughings until a fine tilth of soil is obtained. Farmyard manure / compost 10-15 t/ha is to be applied before the 2nd and 3rd ploughing.

Transplanting: The seedlings of six weeks old which are having a height of 10-15 cm are transplanted in the main field. Transplanting should be done preferably in the evening hours to avoid transplantation shock. Spacing of 40-60 cm is ideal for basil cultivation.

Crop nutrition: Farm yard manure/ compost are to be applied at 10 t/ha before planting. A medium fertilizer dose of 40:40:40 kg/ha of N, P2 O5 and K2 O is recommended (Dzida 2011).

Irrigation: In total, 12-15 irrigations are required during a year. Apply mulch to conserve soil moisture.

Intercultural operation: Normally the seedlings get well established in the field one month after transplanting. First weeding is done at this stage and second, 4 weeks after the first. No further weeding is required thereafter as the plants become bushy and thereby suppress the weeds.

Harvesting: Care should be taken while harvesting the basil to avoid any type of contamination at this stage. Clean all surfaces that come in to contact with the plants during and after harvest. Time of harvest plays an important role in qualitative and quantitative oil production. Harvesting is usually done in bright sunny days for good oil yield and quality. The crop is harvested at 90-95 days after planting in a stage when the plant is in full bloom and the lower leaves start turning yellowish. Harvesting is done with the help of sickles. Corresponding to the part harvested, two grades of oil can be obtained i.e., herb oil and flower oil. The flower oil has a superior note. For getting the high-quality oil only the flowering tops are harvested. Normally 3-4 floral harvests are obtained in this crop. The first harvest is taken when the plants are in full bloom and the subsequent harvests at 65-75 days interval. The whole plant is harvested after leaving about 15 cm from the ground level for regeneration of the crop. The harvested produce will be allowed to wilt in the field for 4-5 hours so as to reduce the moisture and also the bulkiness.

Yield: An average yield of 3-4 tons of flowers and 13-14 tons of herbage can be obtained per hectare.

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Bioremediation: An Eco-Friendly and Sustainable Strategy Against Environment Pollution

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Introduction

Modern civilization is developing pretty quickly where the environmental pollution is a simultaneous emerging issue. It's becoming severe day by day. The concentration of some non-biodegradable pollutants or toxins is also increasing spectacularly and creating enormous problems. Hydrocarbon contamination which occurs due to the activities related to the petroleum refineries, accidental release of petroleum products and some natural phenomenon is an alarming threat.

Considerable management strategies have been taking place to mitigate the pollutant hazards which are expensive, non-eco-friendly, less effective. Bioremediation is one of the most popular, effective and sustainable concepts to deal with the issue of cleaning contaminants from the environment and water with help of different microorganisms.

The digestion of the toxin materials is being done by some specific microbes. Biotechnology plays a significant role in the process of bioremediation because it provides natural mechanisms for the removal of contaminants from the environment, soil and water. Biotechnology mechanisms are applied to bioremediation when the contaminants are composed of industrial wastes.

Nowadays researchers are giving more effort to enhance the efficacy of the microbes regarding toxin metabolism. This is one of the most successful and eco-friendly tools to clean the environment where the human cannot reach.

Occurrence and Nature of Heavy Metals

Approximately 53 out of the 90 naturally occurring elements are called "Heavy metals". Copper (Cu), Manganese (Mn), Iron (Fe) and Zinc (Zn) are essential micronutrients for plant growth. They will be toxic at concentrations higher than the amount required for normal growth.

Metals such as Cadmium (Cd), Mercury (Hg), and Lead (Pb) are toxic even at very low concentrations. Oxidative stress: redox-active transition metals (e.g., Fe^{2+}, Cu^{2+}) produce free radicals. They replace other essential metals in pigments and enzymes. Some metal ions (Hg^{2+}, Cu^{2+}) react to thiol groups to interfere with protein structure and functions. Some metals occur as radioactive isotopes (238U, 137Cs, etc.) to pose health risks.

Problems to Human and Animal Health

Different heavy metals have different effects after toxicity like Selenium toxicity (9 mg/day), which can cause deformed fingernails in humans and alkali diseases in animals. Cadmium Toxicity (200µg kg-1 fresh wt), disrupts the normal functions of Zn and Ca. *"itai-itai"* disease is a multi-system disorder by cadmium toxicity characterized by; Severe osteoporosis and bone fragility.

Similarly, in mercury Toxicity (>0.1µg/Kg BW), can cause "Minamata" disease (Japan 1953-60). Mercury-contaminated fish caused the loss of lives. Contamination by methyl mercury (27-102 ppm) causes tissue abnormalities primarily in CNS, foetus and red blood cells. Arsenic toxicity (3mg/day), can cause Skin cancer, Hyperkeratosis, Hyper-pigmentation, Black foot and Cancer of internal organs Heavy metals prevailing in soils and their regulatory limits.

Elements	Conc. Range (mg/kg)	Regulatory limit (mg/kg)
Lead	1-6900	600
Cadmium	0.1-345	100
Arsenic	0.1-102	20
Chromium	0.005-3950	100
Mercury	0.001-1800	270
Copper	0.03-1550	600
Zinc	0.15-5000	1500

(Salt et al.,1998)

Conventional Approaches for Amelioration

Landfilling, thermal treatment, Excavation and burial, Ion exchange, land farming, chemical extraction, soil washing, groundwater extraction and treatment are the most common and conventional approaches for the amelioration of heavy metals. These conventional approaches are unattractive because of cost intensiveness, intrusive in nature, often not feasible, destroy soil structure and CEC, destabilize natural ecosystem, Aesthetically unacceptable, and Low metal concentration.

Phytoremediation

An emerging technology that uses plants and their associated rhizospheric microorganisms to remove, degrade, or contain chemical contaminants located in the soil, sediments, groundwater, surface water, and even the atmosphere.

A natural way to decontaminate polluted soil and water by the *"Use of green plants to remove pollutants from the environment or render them harmless*" (Salt *et al.,*1998). Besides plants, *soil microorganisms* are also used for the amelioration of organic and inorganic contaminants. Besides plants, soil microorganisms are also used for the amelioration of organic and inorganic contaminants.

The main objectives of phytoremediation to lower contamination levels of various pollutants in soil and water, to accumulate contaminants in harvested portions of plants that can be removed from the site and to maintain or improve the physical, chemical and biological condition of the soil.

Different Approaches of Phytoremediation

Phytoextraction: Accumulation of metals in shoot tissues followed by harvesting.
Phytodegradation: Use of Plants and associated microbes to degrade organic pollutants.
Rhizofiltration: Use of plant roots to absorb and adsorb metals from the aqueous waste stream.
Phytostabilization: Reduction in leaching, runoff, soil erosion and bioavailability of toxic metals.
Phytovolatilization: Use of plants to volatile pollutants.

Pros and Cons

Bioremediation costs less than other methods of remediation, more accepted because its visually appealing, in situ, a variety of organic and inorganic compounds can be remediated and Produces less waste are the Pros side whereas toxicity of pollutants to the plants, limited plants usage, time-consuming, season dependent and dependent on the root system of remediating plant.

Conclusion

Heavy metals cause serious health problems to animals and human beings. Anthropogenic sources are the major cause of heavy metal pollution and conventional approaches to ameliorate them are costly and unattractive. Phytoremediation is an emerging "Green Cure Technology" based on the broader "philosophy" of Bioremediation.

Transgenic plants are more efficient in absorption and tolerance of heavy metals than non-transgenic plants. Selection and screening of promising species, varieties/clones and use of heavy metal tolerant & plant growth-promoting bacteria boost the phytoremediation process. Correction of pH, dilution of effluents and use of fertilizers are required for efficient phytoremediation. Safe disposal and use of harvested plant material should be done.

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Identification of Pegion Pea Insect / Pests and their Management

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Introduction

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) and chickpea (*Cicer arietinum* L.) are important grain legumes in Asia. These crops are generally heavy damage by insect pests. Farmers in many regions apply insecticides in a pursuit to manage these pests. This article hand over confession of the most common species, their biology, nature of damage and damage symptoms and management practices.

More details given below:

1. Borers:

a. Gram pod borer.
b. Spotted pod borer.
c. Plume moth.
d. Spiny pod borer.
e. Blue butterflies.
f. Pod fly.

2. Sucking Pests:

a. Pod bugs.
b. Green leaf hopper.
c. Blister beetle.
d. Flower webber.

3. Bud & Flower Feeder

a. Blister beetle.
b. Flower webber.

4. Defoliators:

a. Bihar hairy caterpillar.
b. Leaf cutter bee.
c. Flea beetle.
d. Weevils.

5. Leaf Webber:

a. Leaf Webber.

6. Non-Insect Pests:

a. Eriyophid mite

Red Gram Pod Borer, *Helicoverpa armigera* (Lepidoptera: Noctuidae)

Life cycle:

			
Adult (3-5 days)	**Egg (15-20 days)**	**Larva (8-10days)**	**Pupa**

Damage symptoms:

a. 'Circular holes' on the pods.
b. Skeletinization of leaves – feeding chlorophyll only leaving veins by young larvae Defoliation.
c. Feeds flower and green pods.
d. In green pods – make circular holes and feed the grains and make empty. ETL: 5 adults / trap or 2 eggs / plant or 1 larva/plant.

Management

a. Monitoring: Set-up sex pheromone traps @ 5 traps / acre.
b. Preventive measures:

i. Deep summer ploughing.
ii. At the time of sowing, mix 100gm of jowar seeds along with red gram seeds or
iii. Install pegs at the time of flowering @ 20-25pegs / ha, which serves as bird perch.
iv. Take-up the sowing before July 15th.
v. Grow sorghum as a intercrop.
vi. Collection & destruction of grown-up larvae from the plant.
vi. Spray HaNPV@250LE/ha, add 0.5kg jaggery and 1ml boric acid.
vii. Spray Nomuraea rileyi @2-5g/l (based on 2X108 CFU/g).
viii. Spray azadarachtin 1EC @ 2ml/l.

c. Foliar application of any one chemical:

Insecticide	Formulation	Dosage
Chlorantraniliprole	18.5 SC	0.3ml/l
Flubendiamide	480 SC	0.075 ml/l
Emamectin benzoate	0.5 SG	0.2 g/l
Spinosad	45 SC	0.1 ml/l
Novaluran	10 EC	0.75 ml/l
Indoxacarb	14.5 SC	0.5 ml/l

Spotted Pod Borer, *Maruca vitrata* (Lepidoptera: Crambidae)

Adult identification:

a. Larva - Greenish white with brown head. It has two pairs of dark spots on the back of each segment.
b. Adult - Forewings - light brown color with white markings; Hindwings – white color with brown markings at the lateral edge.

Nature of damage: Spotted pod borer is one of the key insect pests of tropical food legumes damaging tender leaf axils, flower buds, flowers and pods by webbing and boring clusters of flowers or pods during cooler parts of the year on about 39 hosts. Larvae are photonegative and larval period lasted from 8 to 21 days on different hosts. Larva feeds on 'flower buds & flowers by webbing', & also feeds on 'seeds in the pod.'

Damage symptoms:

a. Bore holes on the buds, flower or pods.
b. Infested pods and flowers are webbed together.

	
‘Webbed flower buds & flowers’	**‘Damaged seeds’ in the pod**

Management:

a. ETL: 5/plant.
b. Collection & destruction of webbed flowers along with larvae & pupae.
c. Bird perches 50/ha.
d. Mechanical collection of grown-up larva and blister beetle.
e. Ha NPV 3 x1012 POB/ha in 0.1% teepol.

Apply any one of the following insectcides:

a. NSKE 5% twice followed by triazophos 0.05%.
b. Neem oil 2%.
c. Phosalone 0.07% (Spray fluid 625 ml/ha) Note: Insecticide / Ha NPV spray.

Insecticide	Formulation	Dosage
Bacillus thuringiensis serovar kurstaki (3a,3b,3c)	5%WP	1000-1250 g/ha
Azadirachtin	0.03 % WSP	2500-5000 g/ha
Chlorantraniliprole	18.5 SC	0.3ml/l
Profenophos	50 EC	2 ml/l
Spinosad	45%SC	125-162 ml/ha
Chlorantraniliprole	18.5 SC	150ml/ha
Indoxacarb	15.8% SC	333 ml/ha
Emamectin benzoate	5% SG	220 g/ha
Dimethoate	30% EC	1237 ml/ha

Pod Fly, *Melanagromyza obtusa* (Diptera: Agromyzidae)

Adult identification:

a. Eggs: Eggs are laid by them singly or in cluster inside the pod wall by piercing through the ovipositor. The fly lays about 60-80 eggs. Incubation period is 2-4 days.
b. Larva: Larval period is about 5-18 days.
c. Pupa: Pupal period varies from 7-10 days. A number of overlapping generations are found in a year.

Life cycle:

			
Eggs (3 days)	**Maggots (9-10 days)**	**Pupa (8-9days)**	**Adult TLC: 20-22 days**

Symptoms of damage:

a. Dark brown encrustation on the pod wall.
b. Dry pods showing pin head size hole.
c. Seeds shrivelled, striped and partially eaten.
d. Maggots cause damage by boring into the soft seeds and feed on grains.
e. The damaged seeds are unfit for consumption as well as for germination.
f. The extent of damage may be even up to 60-70% during severe infestation.

Management:

a. Preventive measures: Early sowing may result in lower incidence of the pest.
b. Biological: Conserve natural enemies like *Euderus lividus, Eurytoma* sp., *Euderus agromyzae.*
c. Curative measures: Foliar application of any one chemical.

Insecticide	Formulation	Dosage
Thiamethoxam	75 SG	0.2gm/l
Imidacloprid	17.8 SL	0.2ml/l
Carbaryl	50 WP	1.5 kg700 L water/ha
lambda cyhalothrin	5 EC	400 -500 ml700 L water/ha
Lufenuron	5.4 EC	2.5 L with 700 L water/ha

Note: Add jaggery to the insecticides

Leaf Webber, *Grapholita critica* (Lepidoptera: Tortricidae)

Identification of pest:

a. Egg: laid in groups under surface of leaves.
b. Larva: green colored.
c. Pupa: pupation takes place within the webbed-up leaves.
d. Adult: Forewings having distinct wavy lines and prominent wavy spots. Hind wings are semi hyaline color.

Nature of damage & damage symptoms: Larva webs the 'tender shoots & leaves' and feeds within.

	
Feeds on leaves	**Leaves Webs**

Symptoms of damage:

a. Young larva feeds gregariously on leaves.
b. Later webs together the leaves feed within.

Management:

a. Remove and destroy the webbed leaves with caterpillars within.
b. Set up light traps@1/ha.
c. Encourage the activity of parasitoid: *Cotesia crocidolomiae*.
d. Collection & destruction of webbed leaves along with larvae & pupae.
e. Foliar application of any one chemical.

Pod Bugs, (Hemiptera)

1. *Riptortus pedestris* (Hemiptera: Alydidae).

2. *Clavigrella gibbosa* (Hemiptera: Coreidae).

Identification of the pest: *Riptortus pedestris*

a. Brownish black and hemispherical.
b. Nymphs – resemble dark brown ants.

Nature of damage: Nymphs & adults suck the sap from 'seeds through pods.'

Damage symptoms:

a. Pods dry up & 'seeds become shriveled'.
b. Pods with black spots.
c. Shedding of green pods.
d. Poorly filled pods with shriveled grains inside.

Eriyophid Mite, *Aceria cajani* (Acari: Eriophidae)

Adult identification:

a. Eggs: Milky white eggs are found on vegetative terminals.

b. Adult: The mites are difficult to see with the naked eye. They are 0.2 mm long, light pink, spindle shaped, and are normally found feeding on the underside of leaf lets. Many nymphs are found on young folded leaflets. Plant - to-plant infestation occurs by the wind dispersal of infective mites. It acts as a 'Vector' for 'Sterility Mosaic Virus'.

Damage symptoms:

a. Leaves become soft & lose shape.
b. Mosaic appearance.
c. Without production of flowers.
d. Intermodal length elongated.
e. Bushy appearance of the plant.

Blue Butterfly: *Euchrysops cnejus*

Symptoms of damage:

a. Buds, flowers and young pods with boreholes and presence of slug like caterpillar.
b. Larval entry hole on the pod is plugged with excreta.

Identification of the pest:

a. Larva - pale green or yellow with a red line and short black hairs on the body.
b. Adult - butterfly is blue, medium sized with 5 black spots in the hind wings and two black spots in the inner margin.

Life cycle: The adult moth is greyish blue with prominent black spots in the hind wings and a long tail. It lays eggs singly or in group of 2-3 on flower buds, green pods, shoots and leaves. The egg period is 4-7 days. The larva is pale green with a rough skin and measures 1mm in length. The larval period is 9-27 days. It pupates in leaf, twig or pod. The pupal period lasts for 17-19 days

Management:

a. Discourage dense or close planting.
b. Dig soil regularly during the period of infestation to kill larvae and pupae.
c. Pick and destroy the larvae, pupae & adults.
d. Avoid early or late sowing.
e. Release egg parasitoid *Trichogramma* sp.
f. Conserve larval parasitoids Aploymia sp., *Hyperencyrtus lycaenephila, Listrodromus crassipes*.
g. Chemical control measures are the same as redgram pod borer.

Blister Beetle: *Mylabris pustulata* (Meloidae: Coleoptera)

Damage symptoms:

a. The adult feeds voraciously on buds and flowers.
b. A single beetle can destroy as many as 20-30 flowers/day.

Life cycle: The eggs are laid by female beetle in clusters of 60-80 eggs at 2-3 cm depth in soil. Eggs are light yellowish in color and cylindrical in shape. Incubation period is about three weeks. Young grubs are white in color. It pupates inside the soil tunnel.

Flower Webber: *Eublemma hemirrhoda* (Noctuidae: Lepidoptera)

1. Larva webs together the flowers and feeds on them.
2. Adult has yellow forewings with purple patches and white hind wings.
3. Larva is green with a black head.

Plume Moth: *Exelastis atomosa* (Pterophoridae: Lepidoptera)

Damage symptoms: The tiny larva bores into unopened buds, flowers and tender parts. 5-20% pods are damaged.

Life cycle: Adult is delicate, brown colored small moth with plumed wings. Eggs are laid on flower buds and tender pods. Egg period is 4 days. Larva is greenish brown, 10 mm in length densely packed with short hairs and spines. Larval period is 14-30 days. It pupates on the pods itself. Pupal period is 4-8 days.

Management:

a. Conserve Larval parasitoids, *Apanteles paludicolae*, *Diadegma* sp.
b. Chemical control measures are the same as redgram pod borer.

Spiny Pod Borer: *Etiella zinckenella* (Phycitidae: Lepidoptera)

Damage symptoms: The larva feeds inside green pods and then on pod surface, webbing together 2-4 pods.

Life cycle: Eggs are laid singly (or) in groups preferably at the junction of the calyx and pod or on the pod surface. A female lays 47-178 eggs, which hatch in 5-6 days. The larva bores within the green pods and feeds on seeds. Larval period lasts for 10-13 days.When fully grown the larva drops to ground and forms a cocoon about 2.5 cm or so below ground or under dry leaves. Pupal duration lasts for 9-20 days depending on the climate. The moth's pair 24-30 hour after emergence.

Management:

a. Conserve natural enemies like *Tetrastichus* sp., *Bracon hebetor*, *Phanerotoma* sp. and *P. hendecasisella.*
b. Chemical control measures are the same as redgram pod borer.

Conclusion

Use of high yielding, disease resistant varieties. Avoid contaminated seed. Be often in the survey of pests and natural enemies by the farmers. Cultural practices that minimize pest outbreak or increase natural enemy activity. Use of environmentally friendly insecticide when applicable. Minimal, "emergency-only" use of synthetic pyrethroids.

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Biological Control and its Importance in Agriculture

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In considering the contributions of biological pest control to a sustainable agriculture, it may be useful first to examine briefly some of the advantages and disadvantages of each of the major methods by which pests can be controlled. The major methods of pest control can be grouped into three categories of:

1. Physical Control.
2. Chemical Control.
3. Biological Control.

These broad categories, in turn, can be combined into integrated pest management (IPM), integrated crop and pest management (ICPM). Biological control is the control of one organism by another. This control may be expressed as either a longer population of the pest or as a restriction or prevention of the severity or incidence of pest damage without regard to the pest population . Biological control depends on knowledge of biological interactions at the ecosystem, organism, cellular, and molecular levers and often is more complicated to manage compared with physical and chemical methods. Biological control is also likely to be less spectacular than most physical or chemical controls but is usually also more stable and longer lasting. In spite of biological controls having been used in agriculture for centuries, as an industry biological control is still in its infancy. Biological control is now being considered for an increasing number of crops and managed ecosystems as the primary method of pest control. One reason for its growing popularity is its record of safety during the past 100 years considered as the era of modem biological control . No microorganism or beneficial insect deliberately introduced or manipulated for biological control purposes has, itself, become a pest so far as can be determined, and there is no evidence so far of measurable or even negligible negative effects of biocontrol agents on the environment. The new tools of recombinant DNA technology, mathematical modelling, and computer technology combined with a continuation of the more classical approaches such as importation and release of natural enemies and improved germplasm, breeding, and field testing should quickly move bio-control research and technology into a new era.

Biological Control

Biological control was discovered by trial and error and then practiced in agriculture long before the term itself came into use. One example is the ancient practice of not growing the same crop species in the same field more frequently than every second or third year or even longer. Such crop rotation allows Biological Control and its Important in Agriculture 177 time for the pest or pathogen population in soil to decrease below some economic threshold because of the predatory, competitive, and other antagonistic effects imposed by the associated microflora and fauna. In other words, crop rotation allows time for the natural soil microbiota to sanitize the soil, especially with regard to the more specialized plant parasites and insect pests that are highly dependent on their host crop to maintain their populations. The era of modern biological control, involving the deliberate transfer and introduction of natural enemies of insect pests, was launched 100 years ago with the highly successful introduction of the vadalia beetle from Australia to California in 1888 to control the cottony cushion scale of citrus. In 1914, the German plant pathologist C. F. von Tubuef wrote a somewhat speculative article entitled "Biologische Bekampfung von Pilzkrankheiten der Pflanzen." This is apparently the first reference in the scientific literature to the term "Biologische Bekampfung" or "biological control" (Baker, 1987). DeBach (1964) defined biological control as "the action of parasites, predators, or pathogens in maintaining another organism's population density at a longer average than would occur in their absence." This definition covers some highly successful biological controls of insect pests with natural enemies, but it does not accommodate some other highly successful controls accepted in other disciplines as examples of biological control.

Need for Biological Control in India

The production of food grain should increase to 250 million tones by the year 2020 in order to meet the needs of the growing population. Beyond good agronomic and horticultural practices, growers often rely heavily on chemical fertilizers and pesticides. However, the environmental pollution caused by excessive use and misuse of agrochemicals, as well as fear mongering by some opponents of pesticides, has led to considerable changes in people's attitudes towards the use of pesticides in agriculture. A concomitant increase in the proportion of pests and diseases resulted in the increased use of toxic chemical for their management. The number of species resistant to pesticides and fungicides is increased. In recent years after signing of the general agreement of trade and tariff of world trade organization more emphasis is given to the use of ecofriendly pesticide for crop production in view of their least toxic nature, low levels of disease resistance and low residue problems. However, Biological controls should be integrated with other control measures because different methods are effective at different times and locations under varying conditions.

Merits of Biocontrol Agents

1. Biological control is less costly and cheaper than any other methods.
2. Biocontrol agents give protection to the crop throughout the crop period.
3. They do not cause toxicity to the plants.
4. Application of biocontrol agents is safer to the environment.
5. They multiply easily in the soil and leave no residual problem.
6. Biocontrol agents not only control the disease but also enhance the root and plant growth by way of encouraging the beneficial soil micro flora. It increases the crop yield also.
7. Biocontrol agents are very easy to handle and apply to the target.
8. Biocontrol agent can be combined with bio-fertilizers.
9. They are easy to manufacture.
10. It is harmless to human beings and animals (Environmentally safe.).

Mode of Action of Biocontrol Agents Competition

Microorganism competes for space, minerals and organic nutrients to proliferate and survive in their natural habitats. This has been reported in both rhizosphere as well as phyllosphere. Competition has been suggested to a play a role in the biocontrol of species of Fusarium and Pythium by some strains of fluorescent pseudomonas. Competition for substrates is the most important factor for heterotrophic soil fungi. Success in saprophytic ability (CSA) and inoculums potential of that species. Those fungi with highest number of propagules or the greatest mass of mycelia growth have the greatest competitive advantage. Competitive saprophytic ability is the summation of physiological characteristics that make for success in competitive colonization of dead organic substrates. Antibiosis plays an important role in biological control. Antibiosis is a situation where the metabolites are secreted by underground parts of plants, soil microorganism, plant residues etc. It occurs when the pathogen is inhibited or killed by metabolic products of the antagonists. The products include the lyric agents, enzymes, volatile compounds and other toxic substances. Mycoparasitism / Hyperparasitism: Mycoparasitism or hyperparasitism occurs when the antagonist invades the pathogens by secreting enzymes such as chitinases, celluloses, glucanases and other lytic enzymes. Mycoparasitism is the phenomenon of one fungus being parasitic on another fungus. The parasiting fungus is called hyperparasite and the parasitized fungus as hypoparasite. In mycoparasitism, two mechanisms operate among involved species of fungi. This may be hyphal of interfungus interaction i.e., fungus-fungus interaction, several events take place which lead to predation viz., coiling, penetration, branching and sporulation, resting body production, barrier formation and lyses.

Induced Systemic Resistance (ISR): ISR is the ability of an agent (a fungus, bacteria, virus, chemical etc.) to induce plant defense mechanisms that lead to systemic resistance to a number of pathogens. Inoculation of plants with weak pathogens or non- pathogens leads to induced systemic plant resistance against subsequent challenge by pathogens. The mechanisms remain largely unknown but typically the induced resistance operates against a wide range of pathogens and can persist for 3-6 weeks. The biocontrol agents bring about induced systemic resistance (ISR) through fortifying the physical and mechanical strength of cell wall as well as changing physiological and biochemical reaction of host leading to the synthesis of defense chemicals against challenge inoculation of pathogens. Defense reaction occurs due to accumulation of PR proteins (chitinase, B-1, 3 glucanse), chalcone synthase, phenylalanine ammonia lyase, peroxidase, phenolics, callose, lignin and phytoalexins. Plant growth promotion: Biocontrol agents also produce growth hormones like, Auxins, Cytokinin, Gibberellins etc. These hormones suppress the deleterious pathogens and promote the growth of plants and simultaneously increase the yield. May increase plant growth by producing gibberellins- like substances, mineralizing phosphates.

Conclusion

For growth of agricultural production has led several new challenges, making further growth possible only if these challenges are met appropriately and timely. Increase in crop production from the modern farming techniques reaching a plateau is the most of the countries including India and the environmental problems due to excessive use of chemical fertilizers and pesticides becoming a matter of concern. So, the biological control can be alternate system, which may play an important role in achieving the goal of agriculture.

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Tospoviruses in Vegetable Crops: Epidemiology and Management

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India is the second largest producer of vegetables in the world, with an annual production of 183.17 million tonnes from 10.05 million hectares with 14.4 per cent to the world production. A variety of vegetables are grown under field conditions in the diverse agroclimatic zones of the country making it possible to grow almost all fresh vegetables year-round to meet the increased demand for dietary requirements of vegetables. Among, tomato, chilli, okra, potato and onion are economically important and occupy nearly 50 per cent of the total area under production. Diseases caused by tospoviruses are emerging as a significant limiting factor for the sustainable production of these vegetables (Suresh et al., 2016).

Taxonomy and Importance

The "spotted wilt" disease of tomato was first described in Australia in 1915 and viral etiology was confirmed in 1930. The tomato spotted wilt virus (genus *Tospovirus*; family *Bunyaviridae*) (TSWV) was thought to be the sole member of tomato spotted wilt virus group until 1989 when *Impatiens necrotic spot virus* was characterized (Sherwood *et al.,* 2009). The genus tospovirus now contains TSWV as type member and more than a dozen other distinct viruses whose identification has been facilitated by the use of serological and molecular techniques. These are enveloped isometric RNA viruses with a tripartite genome containing small (S), medium (M) and large (L) segments of ssRNA.

Pappu *et al.* (2009) reported more than twenty-nine tospoviruses in different parts of the world. To date, there are five tospoviruses *viz., Capsicum chlorosis virus* (CaCV), *Groundnut bud necrosis virus* (GBNV), *Peanut yellow spot virus* (PYSV), *Watermelon bud necrosis virus* (WBNV) and *Irish yellow spot virus* (IYSV), are present in India. Order of importance is given to GBNV which causes 70 to 90 per cent loss on groundnut in India.

Thrips as Vectors of Tospoviruses

In nature thrips (*Thysonaptera*) transmits GBNV and other Tospoviruses in persistent circulative and propagative manner (Jones, 2005). Movement of virus in thrips body via midgut and salivary epithelial membrane is barrier to salivary glands or by ligaments connecting midgut and salivary glands. Eleven thrips species reported as vectors of tospoviruses all over the world. Out of eleven, five species *viz., Ceratothripoides claratris, Thrips palmi, Frankliniella schultzi, Scirtothrips dorsalis* and *T. tabaci* were found to be reported in India (Mandal *et al.,* 2012).

Symptoms of Tospoviruses

1. Tospovirus infection is known to induce several symptoms on its host plants including leaf speckling, mottling, chlorotic and necrotic lesions of various shapes, sunken spots, etches, ring spots, stunting, yellowing, and wilting (David et al., 2011).

2. These symptoms are known to vary with the host plant species, cultivars, plant age, virus isolate and/or strain, and environmental conditions.

3. In addition to transmitting tospoviruses, thrips can also injure host plants by direct feeding. Thrips are known to feed by using their piercing and sucking mouth parts and consuming plant sap.

4. Such type of feeding often results in silvering and curling of leaves, followed by necrosis of plant tissue.

5. Thrips feeding and oviposition can also result in injury to fruit. Some thrips species (e.g., FL flower thrips, *Frankliniella bispinosa* (Morgan), primarily feed on the floral parts such as petals and pollen, which results in spotting, deformation of flower buds, and reduced fruit set.

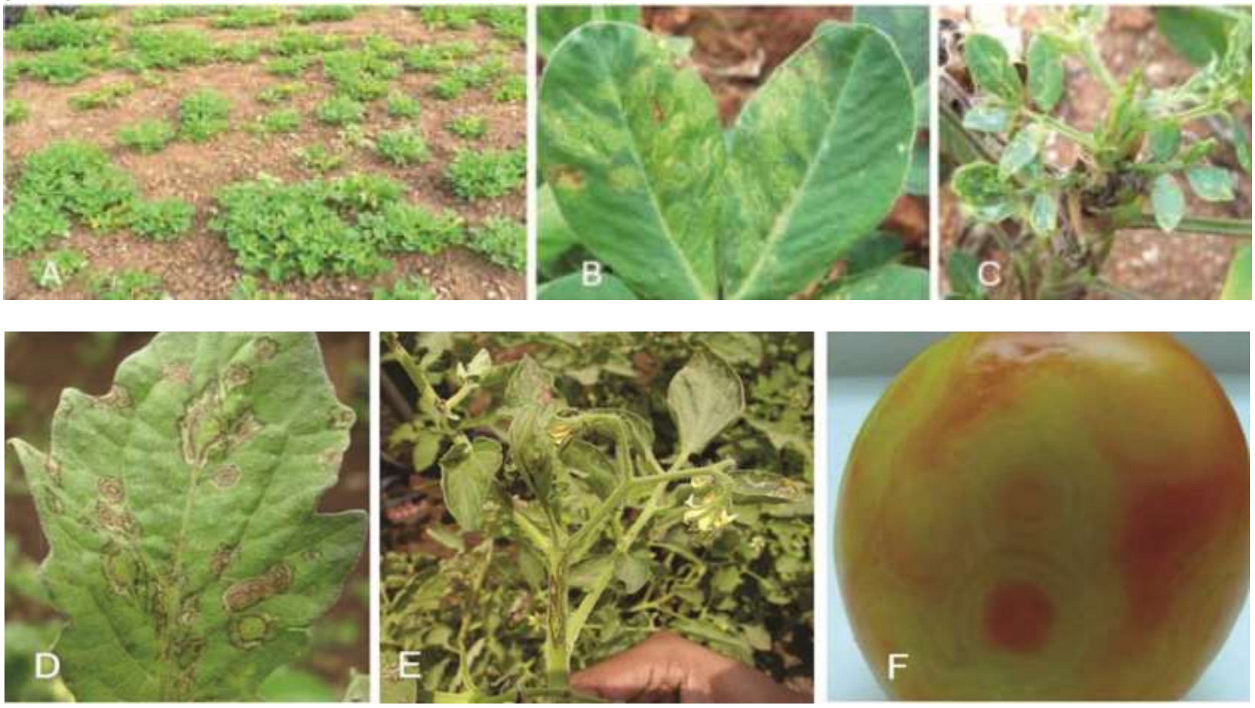

Plate 1. Groundnut bud necrosis virus on groundnut (A to C) and tomato (D to F). A, Field outbreak of bud necrosis disease, B, chlorotic rings on leaves, C, stunting of plant with mosaic mottling and bud necrosis symptoms on groundnut. D, Necrotic rings on leaf, E, stem necrosis, F, concentric rings and patchy color on fruit of tomato.

Epidemiology of Tospoviruses

Since tospoviruses are not seed-borne, it is assumed that the primary spread of tospoviruses is by thrips coming from other crops or weeds, whereas secondary spread takes place from infected plants within a field. The primary sources of GBNV include a range of solanaceous and fabaceous hosts such as black gram, cowpea, eggplant, groundnut, mung bean, pepper, potato, soybean, and tomato, which can sustain virus infection and support thrips vector multiplication. Bud necrosis disease of groundnut is mostly monocyclic type, and disease incidence depends on infection by viruliferous thrips that acquire the virus from other crops or alternate hosts. *Ageratum conyzoides* has been shown to support GBNV and vector multiplication.

Management of Tospoviruses

Management of tospoviruses is difficult because of their wide host range, thrips resistance to insecticides, and lack of durable resistance in crop hosts. Control measures for tospoviruses, which include phytosanitary, cultural resistance, host plant resistance, and chemical and biocontrol measures, need to be based on sound epidemiological principles such as internal and external sources of inoculum, early or late phases of virus spread, and vulnerable stages in the virus/vector/crop cycle.

1. Grow tolerant varieties and uproot and destroy severely infected plants.
2. Setting up of blue sticky traps @ 12 per hectare in the field will check the thrips population.

3. Conserve bio agents like flower bugs (anthocorids), lady bird beetles (coccinellids), praying mantis, green lace wing (chrysopids), long horned grass hoppers, dragon flies and spiders.
4. Inter crop with agathi (*Sesbania grandiflora)* to provide shade which regulate the thrips population.
5. Do not grow chilli after sorghum.
6. Do not follow chilli and onion mixed crop.
7. Sprinkle water over the seedlings to check the multiplication of thrips.
8. Treat seeds with imidacloprid 70% WS @ 12 g/kg of seed.
9. Spray insecticides dimethoate @ 0.06% or profenofos @ 0.05%.

Sources of Resistance to TSWV

1. Among the resistant sources, recessive (sw2, sw3, and sw4) and dominant genes (Sw1a and Sw1b) have been reported; however, their resistance was quickly overcome upon challenge with TSWV.

2. Sw-5 gene cluster originates from *Solanum peruvianum* and has been the most widely deployed resistance source against TSWV because of its durability and the ability to provide stable resistance against tospovirus species (Turina et al., 2016).

Conclusion

Management of tospoviruses and other similar viruses vectored by insects will continue to be serious threats to Indian agriculture since both the viruses and the thrips vectors are endemic. Both traditional breeding programs and transgenic breeding programs (if accepted) will provide the best input into management programs for tospoviruses. Understanding the biology of both the virus and its thrips vector, and their relationship to environmental conditions favorable for epidemics, continues to be a priority in research programs.

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Measuring Risk in Agriculture - A Few Methodological Approaches

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Introduction

Agricultural production is subject to many risk and uncertainties. Any farm production decision plan is typically associated with multiple potential outcomes with different probabilities. The agricultural risks are exacerbated by a variety of factors, ranging from weather variability, frequent natural disasters, uncertainties in yields and prices, weak rural infrastructure, imperfect markets and inadequate and sub-optimal financial services, which he cannot control. These factors endanger the livelihood and incomes of the farmers by adversely affecting farm production and returns. Farm manager need foresee the possible risks in farming for optimum farm plan preparation. Hazards and unforeseen events occur in all economic and business activities (Anonymous, 2009).

Many risks directly affect farmers´ production decisions and welfare. In response to the potential impact of these uncertain events, farmers adopt diverse risk management strategies in their production plans. These risk management strategies may include decisions on use of market instruments, government programs, insurance and diversification.

Methods of Risk Estimation

There are various whole-farm programming models that incorporate risk. They include MOTAD, Target-MOTAD, safety first and Game theoretic approaches. These methods provide the farmers with alternative farm plans and suggest the farmers with the farm plan with minimum variance from the expected returns.

Game Theory

Game theory is the formal study of decision-making where several players must make choices that potentially affect the interests of the other players. It is the formal study of conflict and cooperation. These concepts apply whenever the actions of several agents are interdependent. These agents may be individuals, groups, firms, or any combination of these (Bairwa et al., 2012). When weather risk is predominant, game theory models are apt devices to provide realistic solution. In this model, nature is considered as opponent of farmer and component of risk and uncertainty faced by farmers.

MOTAD

The mean-absolute deviation analysis or otherwise known as MOTAD is a linear technique designed to approximate this quadratic result and can be solved using linear programming with risk as a component (Hazell, 1971). Hazell developed MOTAD model as linear alternative to quadratic and semi-variance program for farm planning under risk. This model uses linear decision criterion with expected return and mean absolute deviation. He demonstrated that optimal plans generated by MOTAD and Quadratic Risk Programming models were nearly the same. MOTAD works in order to find an optimal point where the total absolute deviations from the expected returns are reduced to a minimum. The Total Absolute Deviations (TAD) are considered as an alternative way of measuring risk thus, using MOTAD, it is possible to identify the minimum value of Total Absolute Deviations which the farmer has to face. However, what the model offers is a set of options for minimizing risk, where, as a result, high values of expected total gross margin corresponds to high values of Total Absolute Deviations. The farmer has then to decide, according to his risk averse/risk neutral nature, which solution to implement. Target-MOTAD is the further extension of MOTAD.

Safety-First Model

Safety first approach guides the manager to ensure that he attains the minimum income necessary to meet his fixed cost and meet his family living cost each year. These models are appropriate where the risk of catastrophe is large either because of inherently risky environment or family is poor and has minimal reserves to fall back on bad year (Hazell and Norton, 1986).

Conclusion

Agriculture is a risky occupation, where we cannot completely avoid risk. But it can be minimized with the above said approaches which would help the farmers to make better decisions by choosing the optimum farm plan (Higher returns) among the alternatives even by saving the resources used in the existed farm plan with idealized (normative) decision-making, which would undoubtedly be of great value for the farmers in increasing the farm income on sustainable manner.

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Small-Scale Mushroom Cultivation for Additional Income Generation

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Summary

In India, mostly farmers are with small and marginal holding. To improve their agricultural productivity and income generation, crop diversification is required. Mushroom cultivation as an enterprise has the potentiality to generate additional income. Sri Hariom Prasad Jaiswal, a farmer of Begusarai district started small scale mushroom cultivation along with his traditional agricultural practice. He generated an additional income of Rs. 19,000.00/- in a season from mushroom production along with his regular income from traditional farming. Considering limited land with farmers, mushroom cultivation could be a promising option for supplementary income generation for small-holding farmers.

Introduction

The development of rural areas depends on the rural economy which mostly is agriculture-based. Agriculture is seasonal and depends upon weather conditions. There is hardly any land left for further cultivation of more crops. Most farmers are small-holding farmers and they have to generate more income from available resources with them for their economic growth. For the development of the rural economy, improvement in agricultural productivity through diversification will be crucial. To generate more income, the transformation of farming from a subsistence approach to an innovative and commercial approach is required.

Proposed Solution

Mushroom is a popular food due to its special flavour, nutritional value and medicinal properties. Mushrooms are a rich source of protein, vitamins, and minerals (Qumio et al., 1990). Mushroom cultivation can directly improve livelihood through economic, nutritional and medicinal contributions (Marshall and Nair, 2009). Mushroom cultivation can help reduce vulnerability to poverty and strengthens livelihoods through the generation of a fast yielding and nutritious source of food and a reliable source of income (Rachna et al., 2013).

Mushrooms can be grown in a room by racking vertically on locally available substrate material without any requirement of extra land. In a short time with low technology and little investment mushroom cultivation can be done (Easin et al., 2017). Mushroom cultivation will improve the socio-economic condition of farmers and solve the employment problems of rural areas. Promotion of mushroom cultivation can relieve pressure on land, increase food and nutritional security and uplift the status of the farmer through earning additional income (Shahi et al., 2018).

The total production of mushrooms in Bihar is more than 2000 tonnes and it is increasing at a very fast rate. Oyster, as well as Button mushroom, offers good potential for its cultivation in Bihar because of its sub-tropical nature (Shahi et al., 2018). The technology involved in mushroom cultivation is very simple and can be acquired by any person after a short training. Many farmers of the Begusarai district got training on the Mushroom production technique from Krishi Vigyan Kendra, Khodawandpur, Begusarai and started its production.

Case Study

Sri Hariom Prasad Jaiswal, a resident of Muzaffara village in Birpur block of Begusarai district, is a small-holding farmer with a 0.32-acre area of arable land. Agriculture is his main occupation; he and his family solely depend upon agricultural produce for livelihood. Sri Hariom is practicing agriculture for 15 years. He mainly grows maize, wheat and vegetable crops. His annual income from traditional cultivation was around Rs. 27,000.00/- only. He started small scale mushroom cultivation after the training from KVK, Begusarai in the year 2019. He started with oyster mushroom in which he has to invest less capital and little management was needed. He used his two storage rooms of dimension 10*10*5 feet each, which were unutilized. He kept 60 bags of mushrooms in these two rooms after properly cleaning and sanitizing the rooms (Figure, 1 and 2). His total expenditure to install the setup was around Rupees 2500/- only. This expenditure cost includes the cost of spawn, straw, bags, rubber, chemicals and miscellaneous expenditure to produce in one season. He harvested the mushrooms in three flushes, which gave him production of around 2 Kg per bag. For selling of these mushrooms, he made packets of 250 gm and fixed the price Rs. 40/- for 250 gm. In the local market, he started selling the mushrooms by describing its benefits as food. Villagers also had shown interest in buying the mushrooms because of its taste and benefits over several other vegetables. A farmer with a small-holding of land has generated an additional income of around Rs. 19,000.00/- only from small scale mushroom cultivation in one season. Income from mushroom production was an additional income for Sri Hariom Prasad Jaiswal along with income from other crops which has allowed him to rise from subsistence level (Table, 1).

Conclusion

Mushroom cultivation can help reduce vulnerability to poverty and strengthens livelihood. For small-holding farmers with limited land, crop diversification and small rural enterprises can be a promising solution for additional income generation. Small-scale mushroom cultivation as a rural enterprise can be adopted by farmers to generate additional income with limited resources and less capital.

Recommendation

Regardless of age and gender, mushroom cultivation can be done by any individual. It is a woman-friendly profession. Women can utilize their spare time for mushroom cultivation without sacrificing their household responsibilities. Awareness about the nutritional value of mushroom as a substitute for vegetables and a source of income generation will help rural people to adopt mushroom cultivation as a rural enterprise.

Table 1: Income generated from different components taken by Sri Hariom Prasad Jaiswal:

Sl. No.	Component	Expenditure (Rs.)	Income (Rs.)
1	Maize	5000	9500
2	Wheat	4000	9000
3	Vegetables	3500	8000
4	Mushroom	2500	19000

Figure 1: Farmer Sri Hariom Prasad Jaiswal along with his small-scale mushroom unit

Figure 2: Oyster mushroom grown by farmer Sri Hariom Prasad Jaiswal.

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CRISPR/Cas9 Modification

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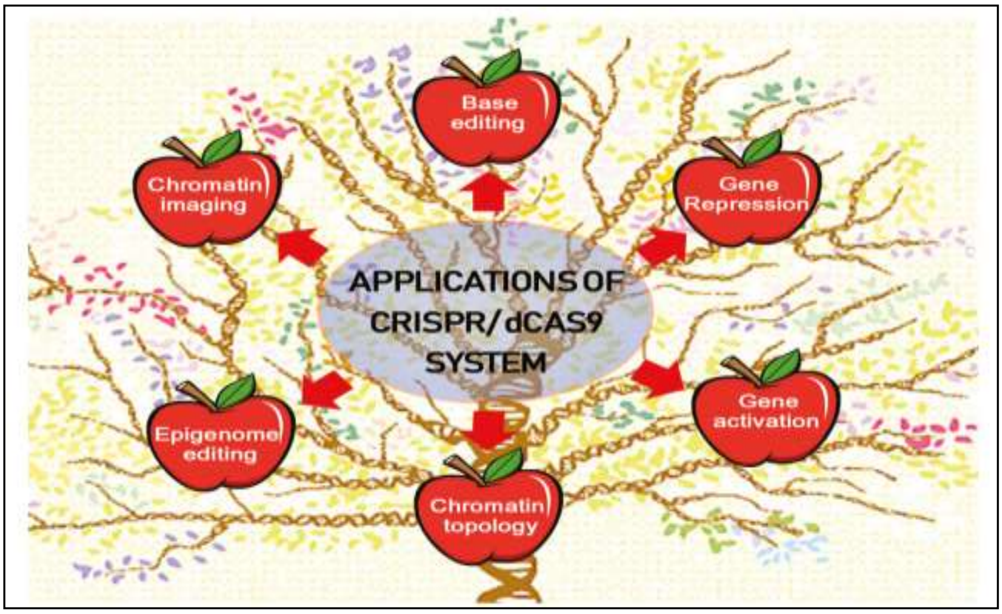
Introduction

CRISPR is becoming an indispensable tool in biological research. Once known as the bacterial immune system against invading viruses, the programmable capacity of the Cas9 enzyme is now revolutionizing diverse fields of medical research, biotechnology, and agriculture. CRISPR-Cas9 is no longer just a gene editing tool; the application areas of catalytically impaired inactive Cas9, including gene regulation, epigenetic editing, chromatin engineering, and imaging, now exceed the gene-editing functionality of WT Cas9.

Modifications of Cas9 Based on its Functional Domains

1. Normal Cas9.
2. Cas9 nickase (D10A).
3. Cas9 nickase (H847A).
4. Dead Cas9.
5. dCas9 fused effector domain.
6. Double nicking.
7. Light-activated Cas9.



Development in CRISPR-Cas9 Modifications

CRISPR-Mediated Gene Expression Regulation

Li et al. (2018) developed a new potent dCas9-TAD named dCas9-TV through plant cell-based screens, which confers far stronger transcriptional activation of a single or multiple target gene than the routinely used dCas9-VP64 activator in both plant and mammalian cells.

Piatek et al. (2015) generated a transcriptional repressor, by fuse the dCas9 C-terminus with the SRDX repression domain and repressed of an endogenous gene.

dCas9 as a Re-Engineering Platform for Base Editing

Shouwei et al. (2018) selected watermelon acetolactate synthase (ALS) gene as the target for base-editing. Single point mutations at several conserved positions of ALS genes are known to confer high level of herbicide resistance in watermelon.

Fang et al. (2018) developed a fluorescence tracking adenine base editor using the Cas9n-guided TadA: TadA7.10 heterodimer, which can efficiently and cleanly introduced A to G conversion in rice.

dCas9 as a Re-Engineering Platform for Epigenome Editing

Kwon et al. (2017) used Cas9-based histone deacetylase (HDAC) and design principles required to achieve locus-specific histone deacetylation. They assessed its range of activity and specificity, and analysed target gene expression in two different cell types to investigated cellular context-dependent effects.

Kearns et al. (2015) used a nuclease-deficient (d)Cas9 histone demethylase fusion to functionally characterized previously described and novel enhancer elements for their roles in the embryonic stem cell state. Further, they distinguish the mechanism of action of dCas9-LSD1 at enhancers from previous dCas9-effectors.

dCas9 as a Re-Engineering Platform for Chromatin Topology

Morgan et al. (2017) engineered a method for chromatin loop reorganization using CRISPR-dCas9 (CLOuD9) to selectively and reversibly establish chromatin loops. They demonstrated the power of this technology to selectively modulate gene expression at targeted loci.

dCas9 as a Re-Engineering Platform for Live-Cell Chromatin Imaging in Plants

Steven *et al.* (2017) demonstrated imaging technique based on two orthologues of the bacterial CRISPR associated protein Cas9. By fusing eGFP/mRuby2 to catalytically inactive versions of *Streptococcus pyogenes* and *Staphylococcus aureus* Cas9, they showed robust visualization of telomere repeats in live leaf cells of *Nicotiana benthamiana*.

Tobias *et al*. (2015) constructed a catalytically inactive version of the Cas9 endonuclease, fused it with eGFP (dCas9-eGFP) and co-expressed small guide RNAs (gRNAs) to target pericentric, centric, and telomeric repeats, which are enriched in distinct nuclear structures.

Conclusions

The CRISPR/Cas9 genome editing system, with its accelerated development and expanded applications, is an indispensable tool for precise and efficient genome editing, but some related problems need more attention. The natural variation in Cas9 proteins isolated from different species might provide new Cas9 proteins with higher efficiency and thereby broaden the choices available for precise genome editing. Finally, CRISPR technology will play an essential role in crop improvement and sustainable agriculture.

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Trans Fatty Acids: Possible Health Implications and Policies Regulating the Consumption of Dietary Trans Fats

Article ID: 10416

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Summary

With countries around the globe recognizing the deleterious effects of trans fatty acids in the diet and its apparent links with cardiovascular diseases and other morbidities, it is of paramount importance to know the possible health impact of dietary TFAs and how statutory bodies of states and countries can take measures to eliminate them from the food supply. It is also significant to shed light on the performance of previous relevant policies in achieving the coveted target.

Introduction

As the announcement of the latest amendment concerning the curtailment in the legally permissible amount of Trans Fatty Acids (TFA) in edible oils and fats from the current limit of 5% to 3% in 2021 and subsequently, to 2% in 2022 by the Food Safety and Standards Authority of India (FSSAI) emanated on the 29th of December, 2020, it becomes imperative to elucidate the fundamentals of dietary Trans Fats and its possible health implications along with the impetus that led to this decision by the statutory body.

As detailed by Wilczek et.al., (2017), Trans Fatty Acids are a form of unsaturated fatty acids, which contain at least one double bond in the trans configuration. There are several naturally produced TFAs by the bacteria that dwell in the rumen of animals and these TFAs are consequently found in the dairy and meat products sourced from these ruminants. (MacGibbon and Taylor, 2006). However, the matter of concern is partially hydrogenated vegetable oil (PHOs), which are manufactured at the industrial level. These are the substantial source of dietary TFAs in humans. Partial hydrogenation is carried out to furnish certain desirable properties to the cooking fats such as increased stability and improved shelf life (Zupanic et.al., 2018). Industrially processed TFAs can constitute up to 60% of the fat content in Margarine (Dawczynski and Lorkowski, 2016). Literature has laid out the probable association of dietary TFAs with an increased risk of non-communicable health conditions. On the contrary, in recent times research has been implemented to show the role of ruminant Trans fats in protecting cardiovascular health.

Health Implications of Dietary Trans Fatty Acids

According to the World Health Organization, Cardiovascular Diseases (CVDs) are reported to be the primary cause of mortality around the world with an estimated death toll of 17.9 million a year, which is 31% of all deaths. A profusion of literature has repeatedly demonstrated strong links between the consumption of TFAs and increased risk of cardiovascular diseases (De souza et.al., 2015). Multiple concepts have been proposed by scientists and researchers regarding the possible mechanisms linking TFAs and cardiovascular health with the most notable ones being serum lipid alterations, increased systemic inflammation, and impaired endothelial function (Wilczek et.al., 2017).

Mozaffarian et.al., (2007) in his paper published in the European Journal of Clinical Nutrition, communicated that replacing TFAs with cis-unsaturated fats in places where PHOs are extensively consumed in the diet, could contain the prevalence of coronary heart diseases (CHD) by 9%. A meta-analysis notified that there exists a strong correlation between trans-fat intake and CHD mortality but no linkages were reported with the incidents of diabetes and ischemic stroke (De Souza et.al., 2015). Michas et.al., (2014) reported the well-established detrimental effects of Trans Fatty Acids and advocated their complete elimination from the diet and substituting them with PUFA and MUFA for health benefits. Similar recommendations have been put forward by the American Heart Association based on a thorough review of clinical trials.

TFAs from different sources has also been studied for their possible effects on cerebrovascular health. TFAs sourced from partially hydrogenated vegetable oils were ranked the highest as a risk factor followed by TFAs from partially hydrogenated fish oils and ruminant TFAs in women. Ruminant TFAs have not shown any significant cerebrovascular disease risk among men. However, the authors concluded that TFAs in general increase the risk of CVDs (Laake et.al., 2012).

Though the predominantly documented health impact of TFAs is associated with cardiovascular diseases, Dhaka et.al., (2011) in his exhaustive review, further delivered information interrelating the dietary TFAs and the risk of cancer, diabetes, obesity and complications during pregnancy and an array of cognitive disorders. An association was put forth by Barnard et.al., (2014) between TFA consumption and dementia. The authors reviewed several studies exhibiting ambiguous results only to conclude a concomitance of dietary trans-fat consumption with a range of cognitive disorders. Additionally, in postmenopausal women, TFAs have also been associated with an increased risk of breast cancer (Anjom-Shoae et.al., 2020). A significantly high risk of ovarian cancer has been correlated with the consumption of saturated and trans fats.

Policies Regulating the Consumption of Trans Fatty Acids

It is not a conundrum anymore that industrially produced TFAs are identified with a deluge of non-communicable health conditions. All things considered, countries around the world have launched legislation steered to cut back its production and consumption. The first country to introduce a legal limitation on the TFA content in food was Denmark. This monumental decision led to a subsequent reduction in the rate of CVD mortality in the country (Wilczek et.al., 2017). Thereupon, numerous other European countries also pursued the same intending to reduce the CVD mortality rate in their judiciaries.

The World Health Organization in collaboration with Resolve to Save Lives proposed the REPLACE initiative in 2018. It is an action package that doubles up as a roadmap to escort the food industries and statutory bodies to eliminate industrially-produced Trans fats from the national food supplies by 2023. The REPLACE initiative provides a catalog of tools and practices to be followed at present to accomplish the goal in near future (Ghebreyesus and Frieden, 2018).

Hyseni et.al., (2017) judged numerous studies on the interventions to reduce TFA intake from 1986 to 2017. As detailed earlier in this paper, Denmark accomplished a cutback of 3 grams per day from 1976 to 1995. In other communities, a decrement of 2.4 grams per day was documented after the implementation of regulations to curtail TFA content in industrially manufactured food items. An intriguing aspect of the review revealed that food labelling and dietary counselling at the individual level was also a successful tool in reducing TFA consumption. An analogous review conceded that all the studies advocated that there was a diminution in trans-fat production and consumption after enforcement of all sorts of policies. However, banning trans fats had a preeminent impact compared to other policy measures such as voluntary reduction and labelling. Other studies divulged that the umbrella impact of the TFA ban would not just aid in reducing CVD mortality but also is a cost-effective measure compared to other policy measures (Downs et.al., 2017).

Conclusions

The recent landmark ruling of the FSSAI can be considered as an advantageous move keeping in mind the literature that backs the claim that such policy measures are effective in eliminating trans fats from the diet and the food supply chain and conclusively pave the way for an improved health situation in the country.

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Climatic Change Impact on Agriculture

Article ID: 10417

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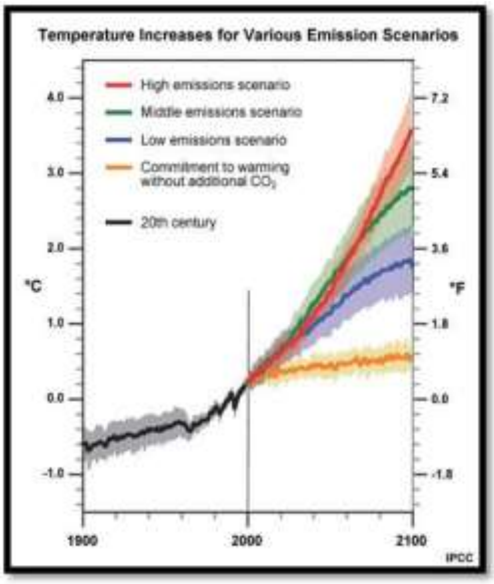
Introduction

Climate change is any significant long-term change in the patterns of the region's average climate (or total land area) over a significant period of time. It's about unusual variations in the atmosphere and the effects of these variations on other parts of the earth. These changes can take tens, hundreds or maybe millions of years. An increase in anthropogenic activities such as industrialization, deforestation, urbanization, agriculture, and change in land use patterns will lead to greenhouse gas emissions, which will accelerate the rate of climate change. Climate change scenarios include high temperatures, high atmospheric CO_2 concentrations and changes in precipitation. There are three ways in which the greenhouse effect is important to agriculture. First, increased atmospheric CO_2 concentrations have a direct effect on the growth rate of crop plants and weeds. Second, changes in the CO_2 -induced climate can change the temperature, rainfall, and sunlight levels that affect plant and animal productivity. Finally, rising sea levels could cause farmland to lose groundwater levels and salinity along the coast.

Description

The greenhouse effect is a natural process that plays a major role in shaping the Earth's atmosphere. It produces a relatively warm and hospitable environment near the surface of the earth, where humans and other forms of life can thrive and thrive. However, increased greenhouse gases (GHGs) (carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), per fluorocarbons (PFCs) and sulfur hexafluoride SF_6) etc.) Anthropogenic activity contributed to the overall increase in the Earth's temperature, which led to global warming. The average global surface temperature has risen by 0.74°C since the end of the 19th century and is expected to increase by 1.4°C - 5.8°C by 2100 AD with significant regional variations (IPCC, 2007). Atmospheric CO2 increased from 280 ppm to 395 ppm, CH_4 from 715 ppb to 1882 ppb and N_2O from 1750 and from 227 ppb to 323 ppb in 2012. The global warming potential (GWP) of these gases is CO_2, CH_4 and N_2O 1, 25 and 310, respectively.



Global Scenario of Climate Change (Source: IPCC, 2007)

Estimates of global warming suggest that by 2100 the global average surface temperature is likely to rise from 1.4 - 5.8°C. The rate of warming is unprecedented in the last 10,000 years.

All climate patterns indicate an increasing trend in temperature. Precipitation pattern changed as rainfall decreased in South and Southeast Asia. More severe and prolonged droughts have occurred since the 1970s. Permanent snow cover is reduced on both the area and depth of the snow cover. Global Mean Sea level is expected to rise from 0.18 to 0.59 m by the end of the century.

Six of the 10 countries most affected by climate change are in Asia-Pacific. India, Nepal, Philippines, Afghanistan and Myanmar top the list. In Bangladesh, for example, one-fifth of the country's population is displaced as a result of damage to farmland, which is expected to rise 1.5 meters above sea level. The Maldives Islands in the Indian Ocean are submerged in half of their territory with a rise of 2 meters above sea level.

Agricultural Productivity and Food Security

Food security is directly and indirectly linked to climate change. Any change in climatic parameters such as temperature and humidity that control crop growth will have a direct impact on the quantity of food produced. Indirect connection is related to catastrophic events such as floods and droughts, which are likely to increase as a result of climate change, leading to massive crop damage and making large patches of arable land unsuitable for cultivation and therefore a threat to food security. The net impact of food security depends on global vulnerability to climate change and the ability to cope and recover from global climate change. Globally, rising unpredictable weather patterns will lead to a drop in agricultural production and higher food prices, leading to food insecurity.

Food insecurity can be an indicator for predicting the risk of extreme events and slow-moving changes. This effect of global warming has significant implications for agricultural production and trade in developing countries, as well as the risk of increasing hunger. The number of people suffering from chronic hunger has risen from less than 800 million in 1996 to more than 1 billion recently. The United Nations Population Data and Projections (UN 2009) estimates that the world population will reach 9.1 billion by 2050, an increase of 32 percent from 2010. The world population is projected to grow to 2.2 billion in the next 40 years from 2050, and a significant portion of the additional population will be in countries struggling to sustain themselves. Preliminary estimates for 2080 indicate a 15-30 percent decline in agricultural productivity in most climate-change-exposed developing countries - Africa and South Asia.

The IPCC also seldom warns that a rise in winter temperature of 0.5oC will reduce wheat yield in India by 0.45 tons per hectare. Rice and wheat account for the bulk of total food grain production in India. Any change in rice and wheat yields will have a significant impact on the country’s food security. 2.56 lakh farmers have committed suicide since 1995 when Indian agriculture was already plunged into crisis.

According to AK Singh, Deputy Director General (Natural Resource Management) of the Indian Council of Agricultural Research (ICAR), forecasts for medium-term climate change are expected to reduce crop yields by 4.5 to 9 per cent due to climate change. By 2039. Long-term forecasts paint a grim picture with crop yields expected to fall by 25 or more by 2099. As 27.5% of the population is still below the poverty line, mitigation of the effects of climate change is essential. Indian food production needs to grow by 5 million metric tons per year to keep pace with population growth and ensure food security. Resources such as soil, water and biodiversity need to be carefully managed to combat the impact of climate change on agriculture. To combat the effects of climate change on agriculture and food production, India needs to work at the global, regional, national and local levels.

Conclusions

Climate change, the result of "global warming" is now beginning to show its effects around the world. The primary determinant of agricultural productivity is the climate, which has a direct impact on food production worldwide. Agriculture is the most sensitive sector to climate change because the climate of an area / country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are very sensitive to climate change such as temperature and precipitation, which can lead to the spread of pests and diseases, thus reducing crop yields and ultimately affecting the country's food security. The net impact of food security depends on global vulnerability to climate change and the ability to cope and recover from global climate change.

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Association Mapping: An Innovative Breeding Approach for Crop Improvement

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Introduction

Association mapping (AM), also known as linkage disequilibrium (LD) mapping, has been proposed as an alternative approach to overcome limitations of pedigree-based QTL mapping. In AM, genotype and phenotype correlations are investigated in unrelated individuals. Unlike QTL mapping, AM takes advantage of LD as well as historical recombination present within the gene pool of an organism, thus utilizing a broader reference population. If two alleles from separate loci occur together more often than otherwise predicted, on the basis of their individual frequencies, i.e., non-random association of alleles at separate loci, they are deemed to be in LD.

Only those molecular markers that are tightly linked to the trait and located within the extent of LD decay will demonstrate significant marker-trait association. If markers are not tightly linked to a trait, they will be separated by recombination during meiosis throughout the evolutionary history of the crop. Accumulating meiotic events in a population will increase the statistical power and mapping resolution for detecting associations. However, it should be noted that the rate of LD decay should be sufficient enough to statistically identify associations, but not too high as it will make it difficult to narrow down the target genomic region. AM requires availability of large numbers of polymorphic markers and is more complex than QTL mapping, as historical factors such as population admixture, selection, and genetic drift can bias the detected association. Moreover, the population genetic structure as well as effects due to non-random mating (relatedness) must be accounted for in the analysis to avoid false positive (spurious) associations. Population structure influences both the power and precision of detecting associations. However, it can be overcome with good sampling and by using appropriate algorithms to detect groupings in a population and accounting for these in an association mapping analysis. Early on, LD mapping had been used in human studies to understand the genetic control of disease. Nowadays, it has rapidly gained interest among plant scientists for studying biomass traits, yield, and disease resistance, among others.

Procedure

1. AM population: A large random sample from a natural population, a germplasm core collection, a collection of breeding line including cultivars, or a population from multiparent crosses of the concerned spp are used for AM. The sample should include as much genetic diversity present in the population/ germplasm collection.

2. Phenotyping: The selected sample is evaluated for the various traits of interest. It should be based on the replicated trails conducted over locations and years to minimize environmental effects.

3. Genotyping for population structure analysis: The sample is then genotyped, i.e., tested with a set of molecular markers (preferably SSR markers)that are evenly distributed over the entire genome of the spp. These markers should be unlinked, i.e., 40cM apart in the genome (Pritchard et al., 2000)

4. Structure and kinship analysis: The markers data are analysed to detect and estimate the population structure of the samples using the STRUCTURE program and the extent of kinship among the individuals of the sample using TASSEL program.

5. Genotyping for LD analysis: The sample is also sample is also genotyped with a sufficiently large number of molecular markers that cover the entire genome as densely as is feasible. So that LD between markers and the loci of interest can be detected. The pattern of LD in the concerned genomic regions of the species and the extent of LD observed among different populations of the species would determine the number of markers required for adequate coverage of the whole genome.

6. AM and LD analysis: A model-based analysis of relatedness between the phenotype and the genotype data is done to detect and quantify LD between the markers and the genes/QTL governing the traits of interest. The estimates of population structure and kinship are used as covariates in the model to minimize false association between the markers and the genes/QTLs of interest.

Approaches

1. Genome-Wide Association Mapping (GWAS): The markers used for genotyping are distributed preferably evenly and densely, over the whole genome. All the loci involved in the control of all the traits showing variation in the sample can be evaluated in one go. When a large number of markers are used, thousands of independent comparisons among markers loci have to be made.

2. Candidate Gene Approach: Another way around the above problems is to restrict the analysis to the genomic regions having the candidate genes/QTLs for the traits of interest. A candidate gene is a gene that is expected, on the basis of previous knowledge (e.g., comparative genomics, genome sequence annotation, QTL analysis etc. The total number markers used and sample size will also be reduced.

Advantages of Association Mapping

1. High resolution of mapping (<10cM).
2. Time requirement is less.
3. Exploitation of genetic diversity- allele mining.
4. Development of mapping population is not required.
5. Historic mutations and recombination's are considered.
6. More than two alleles per locus can be studied simultaneously.

Lacuna

The structure in the large-scale population can produce spurious marker-trait associations without physical linkage information (Pritchard et al., 2000, Buckler and Thornsberry 2002).

Applications of Association Mapping

1. High resolution mapping.
2. Marker trait associations.
3. Genetic diversity studies and understanding evolution.
4. More Precise QTL mapping.
5. Marker Assisted Selection.
6. Cost effective powerful gene tagging method.
7. Best approach in perennial horticultural crops.
8. Map based cloning of genes for difficult traits.

Few Landmarks in Association Mapping in Crops

Liu et al. (2019)	Molecular Mapping of the Cf-10 gene by Combining SNP/ InDel-Index and Linkage Analysis in Tomato *(Solanum lycopersicum)*
Rahman et al. (2018)	Molecular Mapping of QTL Alleles of Brassica Oleracea affecting days to Flowering and Photosensitivity in spring *Brassica napus.*
Thorwarth et al. (2018)	Genomic Prediction and Association Mapping of Curd-related traits in gene bank accessions of Cauliflower
Mallikarjuna et al. (2017)	Molecular Mapping of Flowering Time Major Genes and QTLs in Chickpea

Tian et al. (2017)	Molecular Mapping of Reduced Plant Height Gene Rht24 in Bread Wheat
Jianbing et al. (2016)	Association Mapping of leaf traits in Spinach *(Spinacia oleracea).*
Matschegewski et al. (2015)	Genetic Variation of Temperature-regulated Curd Induction in Cauliflower: Elucidation of floral transition by Genome-Wide Association Mapping and Gene Expression Analysis
Portis et al. (2015)	Association Mapping for Fruit, Plant and Morphology Traits in Eggplant
Xu et al. (2012)	Genome Wide Linkage Disequilibrium in Chinese Asparagus Bean (*Vigna unguiculate* spp. *Sesquipeialis)* germplasm
Arif et al. (2012)	Genetic Studies of Seed Longevity in Hexaploid Wheat Using Segregation and Association Mapping Approaches
Zou et al. (2012)	Molecular Cloning, Expression and Mapping Analysis of a Novel Cytosolic Ascorbate Peroxidase Gene from Tomato
Neumann et al. (2011)	Genome-Wide Association Mapping; A Case Study in Bread Wheat *(Triticum Aestivum).*
Nimmakayala et al. (2010)	Population Structure and Association Mapping in Watermelon.
Nagao et al., (2004)	Molecular Mapping of a Gene Responsible for Al- Activated Secretion of Citrate in Barley.

Conclusions

Recently, increasing numbers of genomic resources have become available for various crops. Whole genome sequences of many crops have recently become available. Although many of these are merely draft sequences, high-throughput sequencing integrated with barcoded multiplexing of samples can drastically reduce sequencing and genotyping costs. All of these recent developments will aid not only in expanding genetic and genomic resources, but also in refining genome sequences of these fruit species. Ultimately, these genomes can be used as references to identify SNPs and CNVs, and will significantly limit flaws of SNP- and CNV-based genome-wide and candidate gene-based AM studies, especially in economically important perennial species. Presence of considerable levels of synteny among many species suggest that even for those plant species with fewer genomic resources, candidate-gene AM coupled with QTL mapping studies and comparative mapping would be feasible and highly valuable. Knowledge acquired in one species can then be extended to others. For example, establishing tomato as a model by increasing and refining its genome sequence and identifying regions associated with important traits could even be used for other related species of solanaceae by conducting comparative genomics. This can lead to a better understanding of genome structure and polymorphism, and will also provide large resources of molecular markers for germplasm evaluation, breeding, and pursuing positional cloning efforts.

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Application of Nanotechnology: A New Horizon Towards Sustainability in Agriculture

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Introduction

Nanotechnology has the potential to revolutionize the agricultural and food industry with novel tools for the molecular management of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients, among others. On the other hand, nano bio-technology can improve our understanding of the biology of various crops and thus can potentially enhance yields or nutritional values, as well as developing improved systems for monitoring environmental conditions and enhancing the ability of plants to absorb nutrients or pesticides. Agricultural and food systems security, disease management delivery systems, new techniques for molecular and cellular biology, new materials for pathogen detection and protection of the environment. Nano biotechnology operates at the same level with virus or disease infecting particle, and thus holds the potential for primordial detection and eradication. It also holds out the possibility that smart sensors and delivery systems will help the agricultural industry combat viruses and other crop pathogens. In the near future, nano-structured catalysts will be available which will increase the efficiency of pesticides and herbicides, allowing lower doses to be used. Nanotechnology will also protect the environment indirectly through the use of alternative (renewable) energy supplies, and filters or catalysts to reduce pollution and clean-up existing pollutants in soil and water. In the agricultural sector, nanotech research and development is likely to aid and frame the next level of expansion of genetically modified crops, animal production inputs, chemical pesticides and precision farming techniques.

Nanotechnology and Agricultural Production Developments

In the near future, nanostructured catalysts will be available which will increase the efficiency of pesticides and herbicides thus allowing lower doses to be used. An agricultural system widely used in the USA, Europe and Japan, which efficiently utilises modern technology for crop management is called Controlled Environment Agriculture (CEA). CEA is an advanced and intensive form of hydroponically based agriculture. Controlled-environment agriculture (CEA) is any agricultural technology that enables the grower to manipulate a crop's environment to the desired conditions. CEA technologies include greenhouse, hydroponics, aquaculture, and aquaponics. Controlled variables include temperature, humidity, pH, and nutrient analysis. Plants are grown within a controlled environment so that agricultural practices can be optimized. The computerized system monitors and regulates localised environments such as fields of crops and irrigated water. CEA technology provides an excellent platform for the introduction of nanotechnology to agriculture. Nanotechnological devices for CEA that provide “scouting” capabilities which could tremendously improve the grower’s ability which will help in determining the best time to harvest the crop and the vitality of crop along with food security issues, such as microbial or chemical contamination.

Nano-Sensors for Monitoring Soil Conditions and Plant Growth Hormone

The proficient use of agricultural natural assets like water, nutrients and chemicals during farming as nano sensors is user friendly. It makes use of nanomaterials and global positioning systems with satellite imaging of fields and might make farmers to detect crop pests or facts of stress such as drought. Nano sensors disseminated in the field are able to sense the existence of plant viruses and the level of soil nutrients. They also minimize fertilizer consumption and environmental pollution. Nano-encapsulated slow- release fertilizers have been widely used. To check the quality of agricultural manufacture, nano barcodes and nano processing could be used the idea of grocery barcodes for economical, proficient, rapid effortless decoding and recognition of diseases. Nanotechnocrates are capable of studying plant's regulation of hormones such as auxin, which is accountable for root growth and seedling organization. Nano sensors that react with auxin have been developed. This is a step forward in auxin research, as it helps scientists to know how plant roots acclimatize to their environment, particularly to marginal soils. For the improvement of soil retention of water or liquid by Nanomaterials, e.g., zeolites and nano-clays, for retention of water or liquid agrochemicals in the soil for their slow release to the plants.

Nanocapsules for Efficient Delivery of Pesticides, Fertilizers and Other Agrochemicals

Nanoencapsulation is a process through which chemicals like insecticides are slowly but efficiently released to a particular host plant for insect pest control. Nanoencapsulation with nanoparticles in the form of pesticides allows for proper absorption of the chemicals into the plants. This process can also deliver DNA and other desired chemicals into plant tissues for protection of host plants against insect pests. Nanoencapsulation is currently the most promising technology for protection of host plants against insect pests. Fertilizer plays a pivotal role in agriculture production (35 to 40%). To enhance nutrient use efficiency and overcome the chronic problem of eutrophication, nano-fertilizer might be a best alternative. Nanofertilizers could be used to reduce nitrogen loss due to leaching, emissions, and long-term incorporation by soil microorganisms. Technologies such as encapsulation and controlled release methods have revolutionised the use of pesticides and herbicides. Pesticides inside nanoparticles are being developed that can be timely released or have release linked to an environmental trigger. Many companies make formulations which contain nanoparticles within the size ranges of 100-250 nm; they are able to dissolve in water more effectively than existing ones (thus increasing their activity). Syngenta, world's largest agrochemical corporation, is using nanoemulsions in its pesticide products. One of its successful growth regulating products is the Primo MAXX® plant growth regulator, which if applied prior to the onset of stress such as heat, drought, disease or traffic can strengthen the physical structure of turf grass and allow it to withstand ongoing stresses throughout the growing season. Another encapsulated product from Syngenta delivers a broad control spectrum on primary and secondary insect pests of cotton, rice, peanuts and soybeans. Marketed under the name Karate® ZEON this is a quick release microencapsulated product containing the active compound lambda-cyhalothrin (a synthetic insecticide based on the structure of natural pyrethrins) which breaks open on contact with leaves. In contrast, the encapsulated product "gutbuster" only breaks open to release its contents when it comes into contact with alkaline environments, such as the stomach of certain insects.

Nanotechnology in Organic Farming

Organic farming makes use of computers, GPS systems, and remote sensing devices to measure highly localized environmental conditions, thus determining whether crops are growing at maximum efficiency or precisely identifying the nature and location of problems. Precision farming can also help to reduce agricultural waste and thus keep environmental pollution to a minimum. The product for plant production with Nano capsules, nano particles, nano emulsions and viral capsids acts as smart delivery systems of active ingredients for disease and pest control in plants. The carbon nanotubes play a beneficial role in mustard plant growth and the TiO_2 treatment by Nitrogen.

Nano Herbicides

Weeds survive and spread through underground structures such as tubers and deep roots. Ploughing infected fields while removing weeds by hand can make these unwanted plants spread to uninfected areas. Being very small, nano herbicides will be able to blend with the soil, eradicate weeds in an eco-friendly way without leaving any toxic residues, and prevent the growth of weed species that have become resistant to conventional herbicides. Whether the nano application is due to a nanosized active ingredient or the creation of a nanosized formulation through the use of an adjuvant, the use of nano application is same. If the active ingredient is combined with a smart delivery system, herbicide will be applied only when necessary according to the conditions of the agriculture field. Improvements in the efficacy of herbicides through the use of nanotechnology could result in more crop production without causing any harmful effects to agricultural workers who are supposed to physically remove weeds if no application of herbicides is practiced.

Nanoparticles and Plant Disease Control

Some of the nano particles that have entered into the arena of controlling plant diseases are nanoforms of carbon, silver, silica and alumino-silicates. At such a situation, nanotechnology has astonished scientific community because at nano level, material shows different properties. The use of nano size silver particles as antimicrobial agents has become more common as technology advances, making their production more economical. Silver is known to affect many biochemical processes in the microorganisms including the changes in routine functions and plasma membrane, prevent the expression of ATP production associated proteins, etc. Production of nanomaterials through the use of engineered plants or microbes and through the processing of waste agricultural products. Thus, use of nanoparticles has been considered an alternate and effective approach which is eco-friendly and cost effective for the control of pathogenic microbes. Properly functionalized nano capsules provide better penetration through cuticle and allow slow and controlled release of active ingredients on reaching the target weed. Fungicidal properties of nano-size silver colloidal solution are used as an agent for antifungal treatment of various plant pathogens; the most significant inhibition of plant pathogenic fungi was observed on potato dextrose agar (PDA) and 100 ppm of AgNPs.

Nanoparticles as Pesticides

Nanoparticles are also effective against insects and pests. Nanoparticles can be used in the preparation of new formulations like pesticides, insecticides and insect repellents. Porous hollow silica nanoparticles (PHSNs) loaded with validamycin (pesticide) can be used as efficient delivery system of water-soluble pesticide for its controlled release. Such controlled release behaviour of PHSNs makes it a promising carrier in agriculture, especially for pesticide-controlled delivery whose immediate as well as prolonged release is needed for plants. Nanosilica, a silica product, can be effectively used as a nanopesticide. The mechanism of control of insect pest using nano-silica is based on the fact that insect pests used a variety of cuticular lipids for protecting their water barrier and thereby prevent death from desiccation. Modified surface charged hydrophobic nano-silica (∼3-5 nm) could be successfully implemented to manage a variety of ectoparasites of animals and agricultural insect pests. The insecticidal activity of poly-ethylene glycol-coated nanoparticles loaded with garlic essential oil against adult *Tribolium castaneum* insect was found in stored products. It has been observed that the control efficacy against adult *T. castaneum* was about 80%; presumably due to the slow and persistent release of the active components from the nanoparticles. The applications of diverse kind of nanoparticles viz. silver nanoparticles, aluminium oxide, zinc oxide and titanium dioxide in the management of rice weevil and grasserie disease in silk worm (*B. mori*) are caused by *Sitophilus oryzae* and baculovirus BmNPV (*B. mori* nuclear polyhedrosis virus, respectively reflect the insecticidal activity of nanostructured alumina against two insect pests viz. *S. oryzae* L. and *Rhyzopertha dominica* (F.), which are major insect pests in stored food supplies throughout the world.

Nanotechnology for Crop Biotechnology

Nano capsules can facilitate successful incursion of herbicides through cuticles and tissues, allowing slow and regular discharge of the active substances. This can act as 'magic bullets', containing herbicides, chemicals origins which target exacting plant parts to liberate their substance exploited a 3 nm mesoporous silica nanoparticle in delivering DNA and chemicals into isolated plant cells. Mesoporous silica nanoparticles are chemically coated and act as containers for the genes delivered into the plants; they trigger the plant to take the particles through the cell walls, where the genes are put in and activated in a clear-cut and controlled way, without any toxic side effects. This technique firstly has been applied to establish DNA fruitfully to tobacco and corn plants. For breeding of Plant and genetic modification by Nanoparticles carrying DNA or RNA to be delivered to plant cells for their genetic transformation or to trigger defense responses, activated by pathogens.

Conclusion and Perspectives

Nanotechnology has great potential as it can enhance the quality of life through its applications in various fields like agriculture and the food system. The future of nanotechnology is uncertain due to many reasons, such as negative reaction of the public towards genetically modified crops, lack of many of the requisite skills in public agricultural research organizations for this type of research and ill-equipped and somewhat hesitant regulatory structures to deal with these new technologies. There is a need to tear down the sharp boundary present between the social and natural sciences and if we succeed in discarding this boundary, we may be able to develop a more desirable and more democratic sociotechnical future.

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Impact of COVID 19 Pandemic on Adoption of Digital Technologies by the Indian Farmers

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The COVID 19 pandemic has affected almost all sectors of the global economy. Agriculture sector being the backbone of Indian economy is greatly suffered during the global pandemic. Farmers have faced huge challenges to meet the food requirements of the country during the crisis. The COVID 19 has forced all sectors to adopt the digital technologies, now is the time to ensure that the farmers also utilize the digital technologies to address their concerns.

The situation arose due to pandemic has catalysed the need to strengthen the digital agriculture by adopting latest digital innovation in the farms. Digital technologies in the field of agriculture include use of mobile, internet, artificial intelligence, data analytics etc. The farmers needed timely and accurate information related to weather or use of pesticides during the pandemic. With use of digital platforms, the farmers now remotely connect with agricultural experts and take their advice on the use of high yield variety seeds and pesticides in the farms. Many agricultural universities and organizations have arranged expert talks using digital platforms on various topics of farming to aid the farmers during the pandemic.

COVID 19 pandemic has caused disruptions in supply chain of fertilizers and pesticides used in agriculture. Any slowdown in the production of any ingredient has caused ripple effect on the supply of fertilizers, pesticides etc. With the help of technology and analytics, it is now possible for the farmers to optimize the use of pesticide with the limited supply. Many of the start-ups are coming to provide the data driven assistance to the farmers. They use technologies to provide data on crop health monitoring, crop scouting, yield forecasting, detection of diseases, weather, irrigation techniques and soil sampling to assist the farmers in taking decisions related to the crops and shortages in the supply of seeds or pesticides. These start-ups are providing a common platform for the agronomists, entomologists, seed experts, soil and farm machinery experts to counsel the farmers based on the collected data of the farms during the COVID 19 crisis.

Automation in the farm machinery and irrigation mechanism has always been seen as a solution for the shortage of labours in the farms. There was acute shortage of farm workers due to restriction in movement of workers across the country due to COVID 19. The recent pandemic has forced the farmers to adopt the technologies in the farm machinery to address the issue of labour shortage and productivity. These technologies involve use of in-situ sensors, microcontroller, variable rate technology and robotics to cultivate and harvest the crops. The technologies have facilitated in precision planting where seed spacing and depth can be controlled for better yield.

The global pandemic has disrupted the agricultural supply chain, due to which farmers have faced logistic issues. Digital and GPS technology are being used by the farmers in their machinery to monitor the vehicle movement and fuel consumption. Many logistic aggregators are coming forward to provide digital platforms where they can collect the logistic related demands of the farmers and provide hassle free movements of their farm goods. Start-ups are using Farming as a Service (FaaS) model, utilizing the digital technology to provide the innovative farm-to-fork solution to farmers and agri-business. Digital logistic service has benefitted the farmers in terms of saving freight cost during the pandemic situation where there was restriction on movement of vehicles.

The government has embraced this pandemic situation to strength the digital platform in all the sectors of the economy. Surely the poorest of our country must also get benefitted from these technologies so that they can reap the benefits of digitization. The post COVID-19 challenge would be to implement the technologies like robotics, big data, machine learning and artificial intelligence in the field of agriculture and make them a viable option of large sections of the farmers. The most innovative work of digital technologies is to predict the results based on large amount of data collected from the farms with the help of machine learning. Machine learning can predict the yield based on the genes, climatic conditions, soil type etc.

Digital technology is not the panacea but a way to accelerate the agricultural development. The pandemic has positive impact on the adoption of digital technology across the globe. Digital technologies have potential to upscale the farm productivity with innovations in agriculture. The time has now come when we have to make collective efforts for implementation of these technologies in the farming sector.

Food Fortification - Creating Value to Society by Addressing Essential Micronutrient Deficiencies

Article ID: 10421

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Around two billion people almost one third of the global population suffer from micronutrient deficiencies, or 'hidden hunger'. Women of reproductive age and children less than two years specifically need iron, folic acid, vitamin A and zinc. Micronutrient deficiencies affect the individuals, families and entire countries. These can contribute to increased morbidity and mortality rate among mothers and children. Hence, an adequate supply of micronutrients is very important factor to contribute child's development.

In India malnutrition contributes to more than one third of deaths in children below the age of five years. About 42% of Indian children are underweight and 58% have stunted growth by two years of age. It is thus, essential to pay more attention to correlate between children nutritional status and capability to achieve the required physical growth and mental development. Our country has the highest number of children under malnourished condition in the world. More than half of population of tribal children under the age of five years are stunted and fail to meet their nutrition potential for growth and development. Proper nutrition plays an important role in human development, as it makes the children less susceptible to infections, lowers morbidity, disease disability and mortality and hence, increasing learning ability and adult productivity.

Fortification of Staple Foods

Food fortification is the process of adding micronutrients (essential trace elements and vitamins) to food for improve the nutritional quality of the food and provide a public health benefit with minimal risk to health. It can be carried out by food manufacturer, or by governments as a public health policy which aims to reduce the number of people with dietary deficiencies within a population. The predominant diet within a region can lack particular nutrients due to the local soil or from inherent deficiencies within the staple foods; addition of micronutrients to staples and condiments can prevent large-scale deficiency diseases in these cases.

Fortification commonly uses staple foods as vehicles to deliver micronutrients generally lacking or not contained in sufficient concentration in the diet. Fortifying staple foods is an effective and sustainable solution to improve the nutritional status particularly among low-income population groups. Food fortification itself is the practice of deliberately increasing the content of an essential micronutrient in a food. In order to achieve this, staple food producers add selected essential micronutrients such as vitamin A to staple foods such as flour or oil. Food fortification is a proven, sustainable, cost-effective and high-impact solution to address micronutrient deficiencies. Staple foods such as wheat flour, maize flour, rice, oil, pulses and salt, are consumed by most of the global population consistently throughout the year. They can be fortified with micronutrients, including iron, folic acid, vitamin A, iodine and others, without affecting taste, texture, or color and with a negligible cost to the consumer. This inclusive solution reaches nearly the entire population.

Examples of Food Fortification

1. Wheat flour, maize flour and rice with micronutrients, including iron, folic acid, zinc, vitamin B12, and others.
2. Universal salt iodization and double-fortified salt with iodine and iron.
3. Edible oils with vitamins A and D.
4. Pulses with iron.

Insects: The Insightful Pharmacists

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Introduction

When animals feel sick, they can't hinge on any clinical facility by themselves as we humans do. At certain times we might have noticed our pets like cats or dogs eating grass. This behavior is believed as an attempt to wipe out worms from their stomach by retching i.e., animals deliberately ingest some substances to fight off illness and parasites which is known to be a practice of self-medication. The ever-growing world of scientific evidence shows that this captivating behavior is not only restricted to animals but also in birds and insects too. Insects encounter an unceasingly intense irregular or unpremeditated fight against pathogens and parasites with a variety of defense mechanisms. If none of these defenses are effective, insects practice self-medication by ingesting certain natural substances as medicines. Many organisms from mammals like chimpanzees to less neurologically complex insects engage in self- medication.

Self-medication is therefore defined as the ability to consume or otherwise contact biologically active natural compounds specifically for the purpose of curing an infection (parasitic) or to reduce its symptoms (Singer et al., 2009). The substances for self-medication include those that nature proffers viz., plant secondary metabolites, sources of fungi, microbes, nutrients, etc. to heal their aches and pains specifically for the purpose of helping to clear a (parasitic) infection or reduce its symptoms.

Self-Medication and Zoo Pharmacognosy

The science of animal self-medication is called zoo-pharmacognosy, derived from the roots "zoo" (animal), "pharma" (drug), and "gnosy" (knowing). The word "zoo-pharmacognosy" was coined by Dr Eloy Rodriguez, a biochemist at Cornell University. Pharmacophagy is a term that was coined by another group of scientists who studied on insect self-medication.

Self-Medication as Final Defence

When attacked by parasites, insects rely on a range of alternate defense mechanisms like behavioral avoidance, morphological barriers, innate immune responses etc. Initially, an insect's cuticle and peritrophic matrix acts as first line of defense as barriers to keep pathogens out. Once the cuticle gets ruptured by pathogen/parasites, then innate immune system comes to play by means of melanization, encapsulation and production of antimicrobial peptides. Melanization is immediate localized blocking reaction caused by enzyme phenoloxidase serine protease around parasite eggs. Encapsulation is the formation of haemocytic capsule around pathogens and macroscopic parasite. Different antimicrobial peptides for defense are defensins, cecropins, proline rich peptides etc. Self-medication is activated only when innate immune response has shown itself insufficient to clear the infection (Smilanich et al., 2009).

How Insects Self-Medicate?

Insects adopt different ways of self-medication by adjusting behavior according to the situation persists which can be called as a form of adaptive plasticity to compensate for the detrimental effects of parasitism (Singer et al., 2009). Adaptive plasticity is the ability of an individual to change the expression of a trait in a predictable way relative to an environmental factor (Pigliucci, 2005). Thus, self-medication is an innate behavior rather than learned responses.

Different ways of self-medication include:

1. Ingesting antiparasitic toxins.
2. Altering the nutritional intake to fight parasites.
3. Changing ovipositional sites.
4. Actively changing the diet composition.
5. Collection and storage of antimicrobial substances.

Methods of Self-Medication

Self-medication is classified into four categories based on the mode of contact. They include topical application, absorption, ingestion, proximity. The first two methods are restricted to higher vertebrates whereas insects adopt ingestion and proximity. Proximity is the medication by distance without any direct contact with the medicine. Example for proximity medication is seen in gall wasps. Gall wasps developing in galls near tannin rich leaves have lower rate of fungal attack and high emergence rate than those emerging in tannin poor leaves even in a single plant.

Criteria for Establishing Self-Medication by Insects

There are some rigorous criteria for establishing that behavior is a form of self-medication. A classic list of three criteria that must be met to establish self-medication comes from Clayton and Wolf (1993):

1. The substance in question must be deliberately contacted.

2. The substance must be detrimental to one or more parasites.

3. The detrimental effect on parasites must lead to increased host fitness. The problem with these criteria is that they do not include any information about the effect of the medicinal substance on the infected individual. A substance that is universally beneficial should be consumed whenever encountered, and is questionable whether it is possible here to make any difference between self-medication and diet choice. Singer et al., (2009) therefore argued that existence of trade-off is essential for establishing self-medication, and added a fourth criterion.

4. The substance must have a detrimental effect on the host in the absence of parasites when ingested at the level ingested by infected individuals.

Types of Self-Medication

Based on the time of consumption, self-medication is categorized into prophylactic and therapeutic medication. Substances that are ingested to prevent infection before getting infected at time of high infection risk (prophylaxis medication) may differ from those that are used to treat an existing infection or consumed after infection in response to active infection (therapeutic medication).

Recent Cases of Self-Medication

The most convincing cases of therapeutic self-medication have been reported in woolly bear caterpillar, *Grammia incorrupta* (Lepidoptera: Erebidae) which ingests plant toxins called pyrrolizidine alkaloids (PAs) as a medicating substance when parasitized by the tachinid fly, *Exorista mella.* Parasitized caterpillars showed a 17 per cent increase in survival when fed a diet containing PAs compared to diet without PAs. Increased consumption of PAs also had detrimental effects on growth and survival in unparasitized caterpillar consistent with a fitness cost of consuming the medicinal substance (Singer *et al*., 2009).

Povey *et al*., (2013) reported that army worm, *Spodoptera exempta* (Lepidoptera: Noctuidae) when infected with baculovirus, selectively increased their intake of protein to survive the virus challenge. Also, the level of protein that maximized performance in infected caterpillars exhibited a slight decline in performance in uninfected caterpillars consistent with costs of increased protein consumption.

The bumble bees, *Bombus terrestris* (Hymenoptera: Apidae) when infected by gut parasite, *Crithidia bombi* exhibited preferential ingestion of natural nectar alkaloids such as anabasine, gelsemine and nicotine which helped to reduce the load of parasite (Baracchi *et al.*, 2015). Ants, *Formica fusca* (Hymenoptera: Formicidae) consume reactive oxygen species, a harmful substance, upon exposure to a fungal pathogen, *Beauveria bassiana* (Bos *et al.*, 2015).

Interestingly, insects also medicate their kin including offspring (trans-generational medication) and other genetic relatives (social medication) (de Roode and Hunter, 2019). Fruit fly, *Drosophila melanogaster* (Diptera: Drosophilidae) has been found to practice both therapeutic and prophylactic kin medication. Kacsoh *et al.*, (2013) reported that parasitized fruit flies exhibited an active preference for food containing ethanol for self-protection and alcohol-containing media for oviposition to protect their offspring. In yet another instance of trans-generational medication, the monarch butterflies, *Danaus plexippus* (Lepidoptera: Nymphalidae) cannot cure themselves when infected by the protozoan parasite, *Ophryocystis elektroscirrha* but shows preference for oviposition on antiparasitic milkweed, *Asclepias* spp. containing higher concentrations of cardenolides (Lefevre *et al*., 2010).

Conclusion

The ability of animals, including small insects, to know and differentiate which substances are medicinal is one of their many unexplained intelligent behaviors. Thus, self-medication showed that insects can self-medicate even without learning. After all, from an evolutionary stand point, staying healthy is a basic principle of survival. Those species which are alive at present can be expected to have evolved a variety of ways of protecting themselves from predators and parasites. In addition, understanding and recognizing the alternatives insects make to self-medicate may help in discovering therapeutic compounds against many parasitic diseases in higher animals including humans.

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Crop Stubble Burning Challenge in Punjab

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Introduction

Rice-wheat cropping system is a major cropping system in the state of Punjab. A major concern of this cropping system remains the management of rice straw. With the cultivation of rice and wheat crops, about more than million tonnes of straw is produced, respectively. Wheat straw is used as fodder for cattle. However, rice straw is still the cause of grief for farmers.

According to PAU report given by Department of soil science about 220 lakh tonnes of straw is resulted only from paddy fields every year, out of which 90 per cent is burnt in the fields. The reason for this is the general perception among farmers about short time period between harvesting of rice and sowing of wheat that is not enough for decomposition of rice straw. So, most of the farmers adopt the easiest way to manage the rice residue by burning it in the field, which results in environmental degradation.

What is Stubble Burning?

Stubble burning is the act of setting fire crop residue to remove them from the field to sow the next crop. It is practiced in areas which use 'combine harvesting method'. Combines are machines that harvest, thresh i.e., separate the grain, and also clean the separated grain, all at once. The problem is that the machine doesn't cut close enough to the ground, leaving stubble behind which is of no use for farmers. There is pressure on farmers to sow the next crop in time for it to achieve a full yield. So, the quickest and cheapest solution is to clear the field by burning the stubble.

Self-Medication as Final Defence

When attacked by parasites, insects rely on a range of alternate defense mechanisms like behavioral avoidance, morphological barriers, innate immune responses etc. Initially, an insect’s cuticle and peritrophic matrix acts as first line of defense as barriers to keep pathogens out. Once the cuticle gets ruptured by pathogen/parasites, then innate immune system comes to play by means of melanization, encapsulation and production of antimicrobial peptides. Melanization is immediate localized blocking reaction caused by enzyme phenoloxidase serine protease around parasite eggs. Encapsulation is the formation of haemocytic capsule around pathogens and macroscopic parasite. Different antimicrobial peptides for defense are defensins, cecropins, proline rich peptides etc. Self-medication is activated only when innate immune response has shown itself insufficient to clear the infection (Smilanich et al., 2009).

Why do Farmers Practice Stubble Burning?

Even after being discouraged by the government, farmers prefer stubble burning because it’s very cheap. Lack of financial and technological means to opt for alternatives to stubble burning, such as ploughing the stubble or investing it for other purposes, also plays a role in the continuation of this practice. Uprooting the stubble, cutting, burying and watering it take two days. It then takes 45 days to turn into manure. The element of time is crucial for farmer as the plantation for the next crop (Rabi crop) is due in November-end. Also, this process costs a farmer Rs 500-700 per acre per day while setting fire to the stubble barely costs them anything.

Effects of Stubble Burning

Effects of Stubble Burning Stubble burning in Punjab, Rajasthan and Haryana is blamed for causing a thick blanket of smog in Delhi during winter, which is a serious health hazard. Open stubble burning emits large number of toxic pollutants in the atmosphere which contain harmful gases.

After release in the atmosphere, these pollutants disperse in the surroundings, may undergo physical and chemical transformation and eventually adversely affect the human health. Burning husk on ground destroys the nutrients in the soil, making it less fertile. Heat generated by stubble burning penetrates into the soil, leading to the loss of the moisture and useful microbes. It kills natural nutrients and bacteria that help rejuvenate soil.

Loss of soil nutrients and useful microbes: Straw burning causes the loss of many soil nutrients. On an average, burning of one tonnes of rice straw results in the loss of 400 kg organic carbon, 5.5 kg nitrogen, 2.3 kg phosphorus, 25 kg potash and 1.2 kg sulphur. Besides, heat generated by paddy straw burning leads to loss of useful microbes in soil. Thus, straw burning adversely affects the soil health and soil fertility.

Environment pollution: The burning results in the emission of many gases such as carbon dioxide (70%), methane (0.66%), carbon monoxide (7%), nitrous oxide (2.09%) and ash which cause the environment pollution and climate change. This pollution has many adverse effects on humans as well as animals' health.

Transportation problems and road accidents: The smoke screen that results after burning causes the transportation problems. These days, several accidents happen every day resulting in the loss of invaluable lives and wealth.

Loss to biodiversity: Straw burning causes the burning of trees and plants around the fields and on roadsides which results in the loss of biodiversity.

Alternatives of Burning Stubble

In-situ management of paddy straw: Many machines have been developed by the university, which are used for in-situ management of paddy straw.

Happy seeder: Happy seeder is used to sow wheat in combine harvested paddy field without removal of straw from the fields. For the proper working of happy seeder, the loose straw needs to be spread uniformly in the field. For this, it is recommended to harvest the paddy by combine harvester fitted with PAU super straw management system (SMS).

Benefits

1. The Happy Seeder removes the need to burn rice stubble before planting wheat, therefore reducing air pollution.
2. Controls wind erosion.
3. Reduces water erosion.
4. Increases intake of water
5. Tends to check the decline of organic matter.
6. Direct sowing also reduces soil disturbance, enabling it to retain more nutrients and organic content.
7. The Happy Seeder also saves money because less time is needed on carrying out field operations, which in turn reduces fuel and labor costs.

Drawbacks

1. There are barriers in case of adoption of Happy Seeder.
2. These barriers include cost, risk aversion and existing subsidies for using herbicides and electricity.
3. In the paddy fields, the remaining stubble temporarily ties up nitrogen. So, protein content of wheat may be slightly lower.
4. To overcome these barriers, subsidies are being offered for the purchase of Happy Seeders.

Straw Chopper / Mulcher

For chopping and spreading of rice straw and stubble in the field, the PAU has developed a machine named Paddy Straw Chopper-cum-Spreader. The chopped straw can be mixed in to the soil with rotary tillers after applying a light irrigation.

Benefits

1. Controls wind erosion.
2. Reduces water erosion.
3. Increases intake of water.
4. Tends to check the decline of organic matter.
5. It is very suitable for chopping all types of crop residue in straw such as wheat, Paddy, maize, Sorghum, Sunflower etc.
6. Thus offering high versatility and making it ideal solution for customers working under contract.
7. The machine in a single operation, chop the left stubbles and spread it on the ground.
8. The chopped and spreader stubbles are then easily buried in the soil by the use of single operation of rotavator or disc harrow and decayed after irrigation.

Drawbacks

1. It is expensive for small and marginal farmers.
2. Difficulties with seeding a following crop and controlling seed depth.
3. Temporarily ties up nitrogen. So, protein content of wheat may be slightly lower.
4. Weeds especially cheat grass and volunteer wheat become difficult to control in wet seasons.
5. Soil stays warm longer in the fall of the year and cold later in the spring of the year than where land is plowed.

Management After Removal of Paddy Straw

To utilize rice straw after removing from the field, straw can be collected either manually by labor or with the help of straw baler. For proper utilization of collected straw, the university has developed many techniques. These techniques not only reduce the incidence of straw burning, but its proper utilization also helps in generating many other income sources.

Preparation of pralichar: Pralichar is a type of coal which is obtained after thermo-chemical conversion of rice straw at low temperature in the presence of little or no oxygen.

Preparation of phospho-compost: To prepare the phosphor-compost from rice straw, straw bundles of convenient size (about 10-15 kg) are made. These bundles are dipped one by one into the soaking solution (one kg cow dung for every 1,000 liter of water) for 2-3 minutes and excess water is drained.

Preparation of biogas: The university has developed paddy straw-based biogas plant.

Animal bedding and fodder: Rice straw, after chopping, can be used as animal bedding. This bedding material also helps in preparation of good farm yard manure as the straw absorb the cattle’s urine which enrich it with the nutrients and also hasten the decomposition process. Moreover, rice straw can be used as fodder for cattle.

Power generation: Rice straw can be used to generate electricity when straw bales are used as fuel in power plants.

Paddy straw geyser: For the proper use of rice residue, a model of paddy straw geyser has been developed by the university in which straw bales are used as fuel for heating water.

Mulching material: Rice straw gives so many benefits when used as mulch in the fields. Mulching helps to maintain soil moisture, control of weeds and also to stabilize the soil temperature which facilitate vigorous crop growth. For growing mushroom.

Other uses: Besides, rice straw can be used as raw material in cardboard and paper industries. Nowadays, rice straw is being used as packing material which is the best alternative to the non-decomposable packing material.

Government Initiatives to Control

Government Initiatives in November 2015, the National Green Tribunal directed authorities in Delhi and its neighboring states to stop this practice. But the directive had little effect. The Centre had, in March, approved a Rs 1,151-crore scheme to promote in-situ management of crop residue by providing subsidized THS machines. Under the scheme, the users are supposed to deposit the subsidized price amount with the agriculture department once their applications are cleared. Punjab has planned 30 paddy stubble-based power plants, mostly in paddy-growing areas of the state. These plants will consume 44 lakh tonnes of paddy stubble; seven such plants are operational with a total generation capacity of 62.5 megawatt.

Challenges Punjab government has set the target of delivering 25000 THS machines but only about 500 machines were actually delivered to end-users who have paid the applicable subsidised rates on these. The deliveries are happening at a slow place because the buyers, especially farmers, are not depositing even subsidised price money. With manufacturers not getting their monies whether the upfront share from buyers or government subsidy, delivering the machines even by September 30 (the earlier deadline was August 31) is looking to be a herculean task.

Conclusion

Environmental pollution is the contamination and undesirable modification of the physical, chemical and biological quality of environment. Stubble burning is the act of setting fire crop residue to remove them from the field to sow the next crop.. Burning husk on ground destroys the nutrients in the soil, making it less fertile. Heat generated by stubble burning penetrates into the soil, leading to the loss of the moisture and useful microbes. Many machines have been developed by the university, which are used for in-situ management of paddy straw. Besides, Government initiatives to control stubble burning. It is concluded that it is the need of the hour to make people aware of the causes, effects, mitigations, technologies and government initiatives for environmental pollution on health and provide them solution to combat the ill effects of the same.

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Contract Farming in India: Transforming Lives of Small & Marginal Farmers

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Introduction

Debates on privatization of lands and its commodification have been going round the table for a while now. The projects related to agricultural improvement are making headlines focusing on the eradication of traditional farming methods and adopting new techniques and programmers. These decisions coming from the government supremo have stirred the current status of agricultural reforms relating to recent farm bills in India. This article demonstrates how the farmers can improve their income while also “retaining their land” and entering into contracts with private companies.

Contract Farming

As per FAO, Contract farming can be defined as an agreement between farmers and processing and/or marketing firms for the production and supply of agricultural products under forward agreements, frequently at predetermined prices. The arrangement also invariably involves the purchaser in providing a degree of production support through, for example, the supply of inputs and the provision of technical advice. The basis of such arrangements is a commitment on the part of the farmer to provide a specific commodity in quantities and at quality standards determined by the purchaser and a commitment on the part of the company to support the farmer's production and to purchase the commodity.

Conceptual Points

It is to be noticed that the company which is entering into the contract with the farmers WILL have to ensure better control on the quality of the end-product with both stakeholders having an equal interest in its success. Directly contracting with the buyers will increase competition leading to higher prices of farm produce for farmers ensuring higher income for them.

Various survey results show that the average revenue of a contract farm is about 11 percent higher than an average non-contract farm. The per hectare cost of production in a contract farm is about 13 percent lower and thus, as a result, the average profit margin under contract farming is more than 50 percent above those without any contract. Contract farming reduces the risk of production, price and marketing costs. It will also open up new markets which would otherwise be unavailable to the small and marginal farmers of the nation.

Problematic Areas

1. Small land holdings: Small and marginal holdings (less than 2 Ha) constitute 86.21 per cent of the total land holdings in the country. This doesn’t allow farmers to have sufficient income and good overall productivity, since lesser capital available. In this situation, contract farming can prove to be a boon. Big businesses entering the system and investing on such small and marginal farmer’s land will help in eradicating the issue with capital investment. A single firm will thus be able to contract with tens of thousands of farmers and consolidate their farms in one go.

2. Low productivity: Next challenge is low productivity. Contract farming can prove to be revolutionary step here by providing the know-how to innovate in any area of production. The lack of private investment in agriculture has led to the gap in this sector as compared to others.

3. Low post harvest value addition: Set up of cold storage chains, warehouses, food processing units etc. require private intervention in our country since several government after government has failed at it. This is where contract farming will help the farmers improve their income.

How Contract Farming Can Help?

The first issue is of disguised employment in Indian agriculture which will be solved by contract farming. More than half of the Indian people are involved in agriculture still its contribution is only around 17%. These people can get jobs in agriculture-related activities that contract farming will help create. Secondly, companies will provide capital investment in the field of farmers rendering them with good quality fertilizers, manures, seeds etc. which otherwise wouldn't have been available to them at such attractive prices. The contract farming will also break the monopoly of APMCs where farmers of states like Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh, Madhya Pradesh have been exploited since decades. Contract farming will help in large pooling in lands of thousands of farmers where technology replaces most labor work, thus reducing the cost of production of farmer and thereby increasing his net profit after selling the crop. Subsequently, the transportation facilities will be facilitated by those companies in contract with and the farmer wouldn't need to add on to his production cost that includes the transportation too.

Conclusion

The full potential of Indian agriculture can be harnessed only through major reforms. Contract farming in India can prove to be one such reform by making a contractual agreement between farmers and businesses. The socialist impulses need to be taken care of by the people and a minimum floor price should rather be discussed with the authorities. The contract farming will facilitate guaranteed market for farmers, which will increase their produce. It will also reduce unemployment in the rural areas and the lifestyle will be changed in a positive manner. This will only improve the economic value of our country among the world. Contract farming can prove to be a first step in harmonizing economic gains and sustainability in reference to the continuum of agrarian environment in reforms. An understanding needs to be developed for the rapid advancements in the field of agriculture in India- mainly focusing on the upliftment of the small and marginal farmer.

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Crop Yield Monitoring: Remote Sensing Based Forecasting

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Introduction

Recent developments in aerospace survey technology, digital image processing, modeling of crop production process, and geographic information systems has created promising opportunities for upgrading the agriculture statistical systems. Timely and in advance information of crop growth season and their response helps government and other stakeholders about the upcoming crop, their success and failures so that farmers as well as government can make itself prepared for the coming situation. It also gives a rough estimate of the crop demand, its prices, hikes that can be observed for the coming season or with the excess production it can also go in loss. Such delivery of rice growth and yield information is made possible by regular earth observation using space-born Synthetic Aperture Radar (SAR) technology combined with crop modeling approach to estimate and forecast yield, Radar-based remote sensing is capable of observing rice vegetation growth irrespective of cloud coverage. In this system, crop area estimates are generated through area frame sampling and processing of satellite data, and yields are derived through the application of crop growth simulation model and statistical techniques.

Background of Yield Modelling

Fundamentally, it is a basic tool of remote sensing and having observed success in rice crop production, it is common now-a-days. Climatic events such as flood and drought are major threats to food security, especially in developing countries and countries with emerging economies.it was derived to find out the reliable, cost-effective, timely, and repeatable information on agricultural production of the major commodities such as (wheat, rice, barley and potato) at regional level.

Approach for Yield Modelling

The approach for yield modelling is to make operational crop forecasting method easier based on existing technology and capacity of the involved organizations, the basic concept of this work was to develop a yield estimation method that is based (in operational phase) only on satellite RS data. Crop yield modelling can be done basically on two principles Firstly, calibration of the method followed by operational application. This idea was based on our earlier experiences and results (Hamar et al. 1996). Development of these models involves extensive development, realization, experimentation and evaluation activities which can only be controlled when it is concentrated on a smaller area. Based on the need and demand the basic objectives of crop yield modelling are:

Working of crop yield modelling: The crop yield forecasting system works on 3 systems as quoted by Sharifi et al.

1. Area estimation (Crop inventory): This process makes use of different techniques and data which are coming from variety of sources such as remote sensing, field observation and historical data to derive area estimates of the major agricultural commodities.

2. Yield forecast: This process makes use of crop growth simulation models and detailed data on soil, weather, crop physiology, crop management, and historical production data to derive periodical estimates on yield of various agricultural commodities.

3. Production forecasting: This process makes use of area and yield estimates derived from processes 1 and 2 and calculates the periodical production forecasts for the lowest administration units. This unit is then aggregated to the higher levels of administration. In the following each of these processes are considered as one subsystem and further detailed.

Yield Forecasting

By viewing all these factors, weather and climatic conditions, based on the meteorological recommendations and other biotic and abiotic factors yield modelling or we can say yield forecasting can be done to have an estimate in advance of what quantity of crop yield is to be obtained. The yield estimate is making use of crop growth simulation models which make use of an extensive data sets on crop phonology, physiology, soil, weather and management practices. In the absence of the real data for many of the required parameters a reasonable estimate as a default value is applied in the simulation procedures, it will also set a framework for new data collection, research, and development. Thus, Timely and cost-effective estimates on crop area and yield expected, net return, gross income. All these factors can be calculated in advance to ensure a fixed and more income and to avoid last moment inflation in prices.

Conclusion

Thus, with the above facts and the spatial resolution of existing spaceborne remote sensing systems and the wise integration of different remote sensing sources enable to achieve a high level of detail and accuracy, whenever the data are understood, processed and used in the right way. Doubtless, the proposed solution is attractive, less time consuming and less expensive compared to area regression estimators exclusively based on field survey. National partner involvement is crucial, operational crop monitoring. In RIICE, national partners lead the terrestrial data collection and validation, but also contribute to product generation, where the knowledge on the rice types and practices is essential as the only way to sustain, promote and validate the need for in-count, National partner involvement is crucial as the only way to sustain, promote and validate the need for in-country, operational crop monitoring. In RIICE, national partners lead the terrestrial data collection and validation, but also contribute to product generation, where the knowledge on the rice types and practices is essential.

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Effect of Coronavirus on the Food Crops

Article ID: 10426

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Introduction

Out of the different pandemics that the humanity has experienced, such as Ebola and Swine Flu, the current one is a well-known virus called the Novel Coronavirus (COVID-19) and it is majorly implicating our lives and the activities. It has brought sufferings to many people and the urgency of this situation cannot be downplayed at any cost. This situation has brought an attention to the practices pertaining to the post-harvest management of various agricultural produce in India.

Agriculture is one of the most important sectors in human development and is related to food security. Therefore, it becomes important to analyze the relationships between agricultural supplies and the impact of COVID-19 on it. According to The Food and Agriculture Organization (FAO) the virus is affecting agriculture in-the supply and demand for food to meet the needs of people. The interlinked factors should be properly studied and mentioned in public domain, viz.

Food Supply

The food and feed come among the essential goods forming a complex network of their supply, making agricultural sector one of the fundamental components of any country. Due to the coronavirus crisis, growers, retail market owners and farmers come at a high risk of catching this disease because of their exposure to people in order to meet the supply. This raises serious concerns about how the agricultural produce should reach from farm-to-fork?

The food supply chain is more of a network connecting the farmer's field produce with the consumer's table. In the process, various steps are carried out such as manufacturing, packaging, distribution and storage.

During the initial nationwide lockdown, people panicked and went to the shops and supply centers generating huge stocking of cereals and necessary food supply, thus creating shortage of food. However, it is a role of FAO to promote that food value chains are not interrupted and continue to operate. Therefore, after the intervention, the food supplies and other basic necessities were then restored.

As a part of food supply system, the various facilitating ways are as follows:

1. Delivery of food rations of basic necessities
2. Economic allocation equivalent to the cost of food rations of basic necessity.

Feeding millions of families and children with the limited food supplies might pose to be a big challenge for the government. Though depending from country to country, the conditions may vary.

Food Demand

Demand refers to the willingness and ability of consumers to pay money for a particular good or service. The demand for food decreased during pandemic times due to uncertainty and reduction in people's paying capacity. Even though it is a slight decrease, the condition may worsen if it continues for long time due to loss of employment. (FAO. 2020b).

However, there has been an increase in the online demand for commodities as it is mostly contactless affair. Coming to food, there is a fall in food prices since February'20, with about 1% decrease as compared to January (According to FAO, Food Price Index). Reports say, that exempting the retail prices, wholesale prices of vegetables decreased by about 15% due to this outbreak. The lockdown led to an alarming rise in demand of crops which are perishable in nature, there will be a limited supply after about a month. The transportation and distribution of crops is severely affected, curbing its natural capacity. Losses also increase because there is a prominent delay in handling of produce. A high uncertainty in market has led to panic among the farmers who are ready with their mature fruits and vegetables to sell but no transportation is available to them due to complete lockdown. This status doesn't seem to be improving in the coming days and economical losses suffered by the farmers need immediate relief from the government. It also poses a threat on the vulnerable groups of the society- who are already suffering from hunger and living below poverty line. This also might lead to a major food crisis at the global level.

Food Security

By this term, we understand that it focuses on unrestricted access to food that allows people to satisfy their basic needs. (Rosales and Mercado, 2020). Not taking a quick action would lead to a food crisis globally. Some major action needs to be taken by the authorities for keeping global food supply chains active and to mitigate the impacts of the pandemic across the food and food supply system. Various programmers are run by authorities at a global level to minimize the effect of this short-term crises. Out of the majorly affected and vulnerable groups- the first one is chronically hungry group who are unable to meet their caloric requirements for a normal life. Second being small farmers who might be prevented from working on their land and access necessary inputs. The third group- children from low-income families, whose source of nourishment is mainly food provided by social programs (mid-day meals etc.). Thus, necessary precautions and wide reached programs is the need of the hour since this pandemic will affect the actions and activities of humanity, agriculture is not outside this impact.

Conclusion

The food supply chain is a major factor in the post-harvest handling of the produce, and thus, its phases: production –processing – transport – storage – retail and goods services need to be regulated smoothly. There is a lot that can be done to protect the produce as well as the farmer's interests- hike in the Minimum Support Price (MSP), assistance through CHC, ensuring direct delivery from field-farms and the local markets, good transport facilities etc. The government has taken few decisions but considering the losses to farmers, it's a paltry amount. An immediate measure to ensure the continued farm practices and their reach to nearest "mandis" has to be taken, right now.

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Medicinal Plants as Effective Immunity Modulators

Article ID: 10427

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Introduction

Medicinal plants have great potential for use as alternative medicines and are the basis for the discovery of natural compounds for the development of therapeutic agents in pharmacology. Flavonoids of medicinal plants are considered to be powerful immunomodulatory agents. Traditionally, ginger and ginger volatile oils, curcumin, Panax L. *(Araliaceae)* and garlic are recommended and used to strengthen immunity and reduce the likelihood of inflammatory respiratory diseases.

Types of Modulators

1. Ginger: Recent research has rejuvenated the centuries old traditional herbs to cure various ailments by using the modern tools like diet-based therapy or regimen. Ginger (*Zingiber officinale*) is one of the classic examples used for not only culinary preparations but also holds unique therapeutic significance.

The bioactive molecules present in ginger include α-zingiberene, α-farnesene, β-bisabolene, α-curcumene, [6]-gingerol and [6]-shogaol, paradol, zingerones, and allied derivatives. Owing to the rich phytochemistry, it has been used in Chinese, Ayurvedic medicines.

2. Potential as immunity booster: Ginger is consumed in many cultures as immune boosters, and its anti-inflammatory potential has been highlighted in number of scientific investigations. The mechanisms for its anti-inflammatory properties include inhibition of arachidonic acid-induced platelet aggregation and formation of thromboxane B, upregulation of histone H3 acetylation, and suppressed histone deacetylase (HDAC)1 expression, inhibition of IL-1, TNF-α and IL-8, downregulation of inflammatory inducible NO synthase (iNOS) and cyclooxygenase 2 (COX-2) gene expression through inactivation of Nuclear Factor Kappa B (NF-kB). phosphorylation, Nuclear factor-jB (NF-jB), gene activation of proinflammatory enzymes, COX-2, nuclear activation, and protein kinase C (PKC)-a translocation. The anti-inflammatory potential of ginger is helpful for the management of disorders like respiratory infections, arthritis, allergic diseases, and gout. In the nutshell, it can be observed that ginger and its components hold anti-inflammatory activities. They are effective in reducing the extent of chemical toxicity and are of significance importance in treating the inflammatory disorders.

3. Garlic: Garlic (*Allium sativum L.*) was originated from Central Asia over 6000 years ago and holds potential to be employed as medicinal agent. The health benefits of garlic appear to be true today as diet-based therapy and its use as a dietary supplement is recommended in many countries. Most of its biological effects are attributed to organosulfur compounds including, diallyl sulfide (DAS), diallyl disulfide (DADS), δ-glutamyl-S-allyl-L-cysteines, S-allylmercaptocysteine (SAMC), S-allyl-L-cysteine sulfoxides, and nonstarch polysaccharides. Various garlic preparations such as aged garlic extract (AGE) and aqueous extract, garlic oil is being sold in the market with distinct health claims.

Potential as Immunity Booster

The role of garlic in immuonutrition is multifarious both as immunostimulant and immunosuppressant. The consumption of garlic results in improvement in hematological attributes, e.g., total white blood cell (WBC) counts as well as homeostasis characteristics. Consumption of garlic may increase the production and release of nitric oxide (NO) that is further responsible for enhanced release of IFN-alpha in humans, beneficial against viral, or proliferative diseases.

Inhibiting growth of cancerous cells is perhaps the most remarkable beneficial action of garlic. Certainly, it does not appear that a single mechanism could account for the observed protection based on the variety of carcinogens. Organosulfur compounds of garlic inhibit carcinogen activation/formation, boost phase-II detoxifying processes, cause cell cycle arrest mostly in G2/M phase, stimulate the mitochondrial apoptotic pathway, increase acetylation of histones, and suppression of tumor proliferation provided evidence using multivariate odd ratios that garlic is inversely associated with the risk of several common cancers. Some of its preparations like aged garlic extract and fresh garlic juice hold potential to inhibit cell proliferation and induce apoptosis. Recently, it has been suggested that the DAS, diallyl trisulfide (DADS) and DATS can initiate a cascade of molecular events characteristic of apoptosis of cancerous cells. The mechanism through which garlic and its functional ingredients imparts anticancer effects needs further elaborations.

Conclusion

Use of herbals/botanicals has been gaining wide popularity in recent years, but the mechanism of action of most of these herbals/botanicals has not been subjected to thorough scientific investigations. Plants and botanicals hold therapeutic potential in clinical therapy to prevent or cure certain health risks with additional benefit of reduction in prevention cost. Indeed, findings suggested that these plants and their bioactive metabolites are effective in balancing and proper functionality of immune system through various modules of immune modification like stimulation and suppression. Thus, current scenario demands form scientific research to explore the mode of actions of the selected botanicals/herbs. Nutritionists, physicians, and other health professionals can use such information effectively for the treatment of various ailments in the vulnerable segments. Overall, certain plants and botanicals can be utilized as an additional tool for disease prevention and risk management.

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Data Collection Tools

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Introduction

Data collection is the process of gathering and measuring information on targeted variables in an established system, which then enables one to answer relevant questions and evaluate outcomes. The main emphasis on ensuring accurate and honest collection remains the same.

The goal for all data collection is to capture quality evidence that allows analysis to lead to the formulation of convincing and credible answers to the questions that have been posed. Data collection tools refers to the device being used to collect data.

Many different methodologies can be used for data collection and analysis. Most are based around a core set of basic tools. We have to consider are as follows.

Interview Method

Interviewing is a commonly used method of collecting information from people. Any person-to-person interaction, either face to face or otherwise, between two or more individuals with a specific purpose in mind is called an interview.

Definition of Interview

According to Monette et al. 'an interview involves an interviewer reading questions to respondents and recording their answers'.

According to Burns 'an interview is a verbal interchange, often face to face, though the telephone may be used, in which an interviewer tries to elicit information, beliefs or opinions from another person'.

Types of Interview

Interviews are classified into different categories according to this degree of flexibility:

1. Structured Interview.
2. Unstructured Interview.

Unstructured Interviews

These are prevalent in both quantitative and qualitative research.

1. Flexible Interview structure.
2. Flexible questions.
3. Flexible contents.

These are being used in both qualitative as well as quantitative research. In quantitative research you develop response categorizations from responses which are then coded and quantified.

As unstructured interviews are dominantly used in qualitative research, they are described in greater detail under 'Methods of data collection in qualitative research.

Structured Interviews

In a structured interview the researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule. An interview schedule is a written list of questions, open ended or closed, prepared for use by an interviewer in a person-to-person interaction structured interview the researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule.

Advantages

1. The interview is more appropriate for complex situations.
2. It is useful for collecting in-depth information.
3. Information can be supplemented.
4. Questions can be explained.
5. Interviewing has a wider application.

Disadvantages

1. It is time consuming and expensive.
2. The quality of data depends upon the quality of the interaction.
3. The quality of data depends upon the quality of the interviewer.
4. The researcher may introduce his/her bias.

Questionnaire

A questionnaire is a written list of questions, the answers to which are recorded by respondents. In a questionnaire respondent read the questions, interpret what is expected and then write down the answers.

The only difference between an interview schedule and a questionnaire is that in the former it is the interviewer who asks the questions (and if necessary, explains them) and records the respondent's replies on an interview schedule and in the latter replies are recorded by the respondents themselves.

Ways of Administering a Questionnaire

1. The mailed questionnaire: The most common approach to collecting information is to send the questionnaire to prospective respondents by mail. Usually, it is a good idea to send a prepaid, self-addressed envelope with the questionnaire as this might increase the response rate. One of the major problems with this method is the low response rate. In the case of an extremely low response rate, the findings have very limited applicability to the population studied.

2. Collective administration: One of the best ways of administering a questionnaire is to obtain a captive audience such as students in a classroom, people attending a function, participants in a program or people assembled in one place. This ensures a very high response rate as you will find few people refuse to participate in your study.

3. Administration in a public place: Of course, this depends upon the type of study population you are looking for and where it is likely to be found. Usually, the purpose of the study is explained to potential respondents as they approach and their participation in the study is requested. Apart from being slightly more time consuming, this method has all the advantages of administering a questionnaire collectively.

Type of Questions in a Questionnaire

Questions are of two types being consider in the questionnaire are as follows:

1. Open-Ended Question: In this, the respondent writes down the answers in his/her words, but in the case of an interview schedule the investigator records the answers either verbatim or in a summary.

2. Close-Ended Question: In this, possible answers are set out in the questionnaire or schedule and the respondent or the investigator ticks the category that best describes the respondent's answer.

Advantages

1. It is less expensive.
2. It offers greater anonymity.

Disadvantages

1. Application is limited.
2. Response rate is low.
3. There is a self-selecting bias.
4. Opportunity to clarify issues is lacking.
5. Spontaneous responses are not allowed for.

Conclusion

It is concluded that data collection tools refer to the device being used to collect data such as interview, questionnaire and vice versa. These tools are also sub divided in to structured, unstructured Interview, mailed questionnaire and also less expensive and provide in-depth information. The only difference between an interview schedule and a questionnaire is that in the former it is the interviewer who asks the questions (and if necessary, explains them) and records the respondent's replies on an interview schedule, and in the latter replies are recorded by the respondents themselves. It is showed in the article that there is need to work in the responses of the participants or active participation which enhance through interviewer create trust in interviewee.

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Distance Education – Concept, Meaning, Definition and Characteristics

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Introduction

Distance education may be defined as mode of education in which instruction is provided without any contact between teachers and students. Its origin goes back to the use of correspondence course as means to convey instruction.

Today, distance education employs an integrated combination of means such as television, radio, audio cassettes, computers and printed materials. Many countries throughout the world, including U.S.A, France, Japan, and India etc. have developed distance procedures for higher education.

More recently new institutes have been created that combine distance education with the principle of open education like Indira Gandhi National Open University of India etc.

Distance education is known by a variety of names like correspondence education, independent study, home study, open learning, e- learning etc.

Definitions

According to Holmberg (1981): Distance education as "the various forms of study at all level which are not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises, but which, nevertheless, benefit from the planning, guidance and tuition of tutorial organization".

According to Ochoa (1981): Distance education is a system based on the selective use of instructional media- both traditional and innovative that promotes the self- teaching learning process to achieve educational objectives, with a potentially greater geographic coverage than the traditional face to face system of education.

According to Moore (1973): Distance is a function of dialogue and structure. Dialogue is the extent to which interaction between learner and the teacher is possible. Structure is the extent to which the objectives, procedures and evaluation of teaching can be adopted to a particular students' learning programme.

History of Distance Education in India

The history of distance education in India is not very old. It's a post- independence phenomenon. Seeing the development of distance education in eastern countries, immediately after independence, the government realized that the traditional full-time education had turned out to be restrictive and inaccessible to the masses.

The knowledge explosion was demanding acquirable new skills and knowledge. The Board of Secondary Education, Madhya Pradesh was the first to start correspondence courses in 1965. This is now referred to as the M.P. Open School. The first open school was established in New Delhi in 1979 in order to provide distance education to school drop outs.

Characteristics of Distance Education

Keegan (1986) however, states the following principal characteristics of distance education:

1. The separation of teacher and student: The separation of teacher and student here implies that learning activities take place in the physical absence of the teacher. This means that the student carries on his/her learning according to the space and time available to him/her in the absence of the teacher.

2. The influence of an educational organization: Distance education is not only different from conventional system of education but also from private study at home. Large portion of the learning activities are carried on through self-directed learning. However, there is an educational organization that deliberately imparts education to its learners.

3. The use of technical media: The use of modern communication media to provide basic teaching elements to the learners is another important characteristic of distance education. Students who are unable to attend formal education because of physical, social and economic problems benefit a lot through the communication media, like print, broadcast, telecommunication etc.

4. The provision of two -way media: Two-way communication between an individual learner and his tutor is considered as an essential element of distance education. Theoretical considerations and empirical studies reveal that students communicate with their tutors in writing and by computer, on the telephone as well as of supplementary face to face meetings.

5. The absence of group learning: Keegan (1986) states that 'most distance education systems treat the student basically as an individual. He holds that 'the separation of the learner from the learning group throughout the length of the learning process is a characteristic feature of this form of education which distinguishes it from conventional, oral and group-based education' However, he concludes that distance education is characterized by the quasi-permanent absence of the learning group throughout the length of the learning process so that people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactic and socialization purposes.

6. Privatization of learning: 'A distance education takes the student from the learning group and place him/her in a more private situation' (Keegan, 1986).

Aims of Distance Education

1. To meet the increase demand for higher education.
2. To allow learners to learn according to their own time, place and pace of learning.
3. To provide freedom and autonomy to the learners to carry on self-directing learning.
4. To provide opportunity to pursue higher education to all qualified and willing persons who had fail to join regular university courses due to personal, social and economic reasons.
5. To eradicate mass illiteracy.

Concept

The concept of "closure" and "openness" in distance education.

Closure

1. Rigid entry requirement.
2. Rigid Instructional procedure.
3. Restriction on the mode of didactic communication.
4. Rigid attendance requirements.
5. Fixed time schedule for the completion of a particular course.
6. Fixed examination schedule.
7. Dichotomy between education and work.

Openness

The term openness is therefore, associated with the freedom of the learners starting from objective formation to evaluation. In addition, the more the number of characteristics of closure is absent, the higher the degree of openness. Specifically, the term 'open' is generally associated with four aspects.

1. Learners.
2. Place.
3. Method.
4. No age restriction.

Types of Distance Education

Synchronous: The participants in the same space at the same time in order to attend to the material of teaching. All the students should assemble before the TV or Broadcast to receive instructional material (for example, live, interactive television or on-line computer chats).

Asynchronous: The instruction is delivered at different points of time usually recorded videos, print materials etc. Learners have freedom to receive the instruction at their own time, space and pace (for example, independent study modules, videotapes, MOOCs).

Distance Education in India

Presently there are 45 institutes of correspondence/distance education in India attached to the formal universities. There are 6 open universities including IGNOU. Karnataka and Gujarat are in the process of establishing Open Universities. Though the emphasis on distance education in India came rather late in comparison to several developing countries, including Pakistan and Sri Lanka, the interest in Distance Education is growing very rapidly in India and is expected to double up in the next decade.

Mode of Distance Education

1. Indira Gandhi National Open University (IGNOU): It was established in 1985 to democratize higher education. The aim was to provide cost-effective, quality education to large section of our population including those living in remote areas. Today, it serves the educational aspiration of over 2.6 million students in India and offers 350 certificate, diploma, degree and doctoral programmed. The main two function of IGNOU is actively involved in research, training and extension education activities. Its co- ordinates and maintain distance education throughout the country.

2. Study Webs of Active Learning for Young Aspiring Minds (SWAYAM): SWAYAM is a programmed initiated by Ministry of Human Resource development, Government of India. It was started in 9th July 2017 and design to generally achieve the three cardinal principles of education policy viz., access, equity and quality pretty contrary to popular belief. At present about more than 1550 MOOCs courses are listed on SWAYAM of which more than 800 courses are already delivered. About 34 Lakhs students have enrolled in these courses. The objectives of this effort are to mostly take the best teaching learning resources to all, including to most disadvantage.

The courses hosted on SWAYAM mostly are in four quadrants:

a. Video lecture
b. Specially prepared reading fairly material that can definitely be downloaded.
c. Self- assessment tests through test and quizzes.
d. An on- line discussion forum for clearing the doubts.

3. Massive open on- line course (MOOCs): MOOC was first introduced in 2006. MOOCs can satisfy this particular need of the society by giving appropriate information to the huge amount of population. Basically, it is an online platform that provides free access to numerous high qualities basic as well as the advanced courses in that particular domain. So, it is an educational platform, it is a learning platform for all and number of people can be part of this particular system and generally the courses are being offered by the renowned faculty from the premier institutions of the country.

MOOCs Means

1. Massive: Allows access to a large number of learners.
2. Open: Open to everyone and without any prerequisites.
3. Online: Offered via internet and No need of physical attendance at a classroom can access anytime-anywhere.
4. Course: It has learning objectives to be achieved by learners after certain activities within in a given period of time.

Conclusion

Distance learning is a convenient method of learning for many students. It is concluded that distance education is good for those people who are doing job or already left their education in middle way so if they want to peruse their study again, they need to go for distance education. It is also helpful for them who somehow are not able to get regular degree due to some circumstances but they have the potential and qualities. Distance education the syllabus is almost same as regular education and presently there are 45 institutes of correspondence/distance education in India attached to the formal universities. In India we the people taking distance very lightly and we thought that only dull people are taking distance education but this is not true needy people who can't afford regular education, also takes distance education. So, all education is same whether that is regular or distance.

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Impact of National Literacy Mission on Adult Education: An Overview

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Introduction

National literacy mission was started in 5 May 1988 by government of India with the aim of attaining a sustainable threshold level of 75 percent literacy by 2007. It aims to educate 80 million adults in the age group of 15-35 years over a period of 8 years. By literacy NLM means not only how to read, write, count but also helping people understand why they are deprived and helping them move towards change. Beside predetermined capabilities level of reading, writing and numeracy with comprehension, functional literacy includes imbibing value of national integration, conservation of environment, women's equality, observance of small family norms etc.

History

National Literacy Mission works under National Literacy Mission authority, an independent wing of Ministry of Human Resource and Development. The central directorate of adult education provides academic and technical resource support to national literacy mission authority. It initially has two flagship programmes:

1. Total literacy.
2. Post literacy.

The initiative was revitalized on 30 September 1999, when they were combined as a single program LITERACY CAMPAIGNS AND OPERATION RESTORATION. National Literacy Mission initiated its first successful campaign in kottayam city of Kerala followed by Ernakulam district. In 1999 UNESCO conferred upon it their NORMA LITERACY PRIZE. It receives jury appreciation for the teaching material it had produced and for raising the awareness of quality primary education in school.

Total Literacy Campaign

The principal strategy of National Literacy Mission is to spread the literacy. These are area and time period specific, participative, cost-effective, outcome-oriented and objective oriented. The campaign is implemented by Zila Saksharta Samities district level committees which are registered under the society’s registration act as autonomous body. The campaign is characterized by large scale mobilization through mass-based communication strategy. Apart from importing functional literacy, campaign also disseminate other social important message like enrolment and retention of children in school, immunization, propagation of small family norms, women empowerment, communal harmony and vice versa.

Post Literacy Programme

It attempts to give interested learner an opportunity to harness and develop their learning potential after completion of a course in basic literacy. These are open to neo-literates in the age group of 9 -35 who have completed their basic literacy course under the total literacy campaign, drop out from primary school and pass outs from non-formal education system.

Continuing Education Programme

The continuing education scheme provides a learning continuum to the efforts of total literacy and post literacy programmes. The main thrust is on providing further learning opportunities to neo literates through continuing education centers which provide area specific, need based opportunities for basic literacy, up gradation of literacy skills, alternative educational programmes, and vocational skills and also promote social and occupational development. It also undertakes no. of important programmes such as:

1. Equivalency programs.
2. Income generating programs.
3. Quality of life improvement programs.
4. Individual interest promotion programs.

Management Structure

Source: www.nlm.nic.in (national literacy mission govt. of India portal)

Funding and Qualitative Term Functional Literacy Implies

National Literacy Mission release funds for each district. While the ratio between centre and state is 2:1. It is 4:1 for tribal sub plan districts. Becoming aware of the cause of deprivation and moving towards amelioration of their conditions by participating in the process of development. Skill improvement to improve economic status and general well-being. Imbibing values of national integration, conservation of environment, women's equality and observance of small family norms etc.

Support to Non-Government Organizations and Women Empowerment

National Literacy Mission also provide assistance to Non- government organization (NGO) in the field of adult education. It provides monetary grant to NGOs for undertaking projects of basic literacy, post literacy continuing education and other projects, including evaluation of adult education programmed and for establishing resource center. National Literacy Mission has played a significant role in creating an environment where women themselves demand knowledge and study to empower themselves. As a result of these literacy programmers, the female literacy rate during the period 1991-2001 increased by 14.7 per cent. This was 3.15 percent more as compared to male literacy rate that is 11.72 percent in 1991-2001.therefore NLM leads to women empowerment.

Conclusion

National literacy mission was started in 5 May 1988 by government of India with the aim of attaining a sustainable threshold level of 75 percent literacy by 2007. It is an independent wing of Ministry of Human Resource and Development. The principal strategy of National Literacy Mission is to spread the literacy. National Literacy Mission provide assistance to Non- government organization (NGO) in the field of adult education and played a significant role in creating an environment where women themselves demand knowledge and study to empower themselves. It is concluding that National Literacy Mission gives learner an opportunity to harness and develop their learning potential after completion of a course in basic literacy in the age group of 15-35 and also promote social and occupational development which helps to improve their livelihood and make them self-reliant.

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ITC'S E-Choupal: A Tribune for Farmer Transformation in India

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Introduction

Agriculture is vital to India. It produces 23% of GDP, feeds a billion people, and employs 66% of the workforce. The e-Choupal system has catalyzed rural transformation that is helping to alleviate rural isolation, create more transparency for farmers, and improve their productivity and incomes. Indian Tobacco Corporation is one of India's leading private companies. Its International Business Division was created in 1990 as an agricultural trading company; it now generates US$150 million in revenues annually. The company has initiated an e-Choupal effort that places computers with Internet access in rural farming villages; the e-Choupals serve as both a social gathering place for exchange of information (Choupal means gathering place in Hindi) and an e-commerce hub. It fulfilled the mandate of corporate social responsibility without needing massive investment of company's resources and provide opportunity for the company to tap rural markets.

Efforts of ITC'S E-Choupal

E-Choupal as an effort to re-engineer the procurement process for soy, tobacco, wheat, shrimp, and other cropping systems in rural India has also created a highly profitable distribution and product design channel for the company—an e-commerce platform that is also a low-cost fulfilment system focused on the needs of rural India.

Soyabean Marketed Prior to e-Choupal

Soybeans are an important oilseed crop that has been exempted from India's Small-Scale Industries Act to allow for processing in large, modern facilities. Yet 90% of the soybean crop is sold by farmers with small holdings to traders, who act as purchasing agents for buyers at a local, government-mandated marketplace, called a mandi. Here were 3 channels: traders, mandi and cooperatives which were involved in market because mandi is vital as plays a central role in marketing and delivery of oilseed by farmers to traders and mandi trading is done by adatiya. Based on word-of-mouth information, farmers take the crop to a particular mandi. Bids are placed by adatiya after physical inspection.

Major Problems Facing Agriculture Sector in India

Because of the Green Revolution, India's agricultural productivity has improved to the point that it is both self-sufficient and a net exporter of a variety of food grains. Yet most Indian farmers have remained quite poor. The causes include remnants of scarcity-era regulation and an agricultural system based on small, inefficient landholdings. The agricultural system has traditionally been unfair to primary producers such as:

1. Shrinking share in national GDP.
2. Low adoption of modern technologies leading to low productivity.
3. Heavy control by the government.
4. Mismanagement of produce due to poor supply chain.
5. Poor primary producers.
6. Large number of small holdings.

E-Choupal System

The e-Choupal system gives farmers more control over their choices, a higher profit margin on their crops, and access to information that improves their productivity. By providing a more transparent process and empowering local people as key nodes in the system, ITC increases trust and fairness. The increased efficiencies and potential for improving crop quality contribute to making Indian agriculture more competitive. Despite difficulties from undependable phone and electric power infrastructure that sometimes limit hours of use, the system also links farmers and their families to the world. Some sanchalaks track futures prices on the Chicago Board of Trade as well as local mandi prices, and village children have used the computers for schoolwork, games, and to obtain and print out their academic test results.

The Business Model

The e-Choupal model, in contrast, has required that ITC make significant investments to create and maintain its own IT network in rural India and to identify and train a local farmer to manage each e-Choupal. The computer, typically housed in the farmer's house, is linked to the Internet via phone lines or, increasingly, by a VSAT connection, and serves an average of 600 farmers in 10 surrounding villages within about a five-kilometer radius.

Using the system costs farmers nothing, but the host farmer, called a sanchalak, incurs some operating costs and is obligated by a public oath to serve the entire community; the sanchalak benefits from increased prestige and a commission paid him for all e-Choupal transactions. The farmers can use the computer to access daily closing prices on local mandis, as well as to track global price trends or find information about new farming techniques-either directly or, because many farmers are illiterate, via the sanchalak.

Key Players of E-Choupal

E- Choupal consist two key players which plays very important roles throughout the procedures such as Sanchalak and Samyojak.

Sanchalak: Local farmer who provides infrastructure for keeping the computer. Facilitates inward and outward flow of information. Average economic status, literate, belong to large family and familiar to the villagers. Given training in use of computers, quality control and running the centre. Earns money on commission basis. Access to computer and greater social status are the main motivators.

Samyojak: Person (cooperating) who had earlier acted as commission agent. Mainly provides logistical support (transport, cash, bagging, paperwork, etc.) also provide information and market signals (crops grown) to ITC. Help in setting up e-choupals by identifying farmers, locations and local issues and the commission is paid by ITC.

ITC'S E-Choupal Benefit

Farmers benefit from more accurate weighing, faster processing time, and prompt payment, and from access to a wide range of information, including accurate market price knowledge, and market trends, which help them decide when, where, and at what price to sell. Farmers selling directly to ITC through an e-Choupal typically receive a higher price for their crops than they would receive through the mandi system, on average about 2.5% higher (about US$6 per ton). The total benefit to farmers includes lower prices for inputs and other goods, higher yields, and a sense of empowerment.

Conclusion

ITC's e-Choupal initiative began by deploying technology to re-engineer procurement of soya and other crops from rural India. It has catalyzed rural transformation that is helping to alleviate rural isolation, create more transparency for farmers, and improve their productivity and incomes also many critical factors in the apparent success of the venture are ITC's E- Choupal such as maintenance of local partners, the company's commitment to transparency, and the respect and fairness with which both farmers and local partners are treated. It is concluded that e-Choupal model shows that a large corporation can combine a social mission and an ambitious commercial venture; that it can play a major role in rationalizing markets and increasing the efficiency of an agricultural system, and do so in ways that benefit farmers and rural communities as well as company shareholders.

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BAEL: Nutrition Facts and Health Benefits

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Introduction

Bael, *Aegle marmelos* (Linn.) Correa ex Roxb., a plant of Indian origin having tremendous therapeutic potential is not fully utilized. It belongs to family Rutaceae, the family of citrus fruits. It is known with different names in different languages (Purohit and Vyas,2004). Bel, Beli, Belgiri (Hindi); Bilva, Shivadruma, Shivaphala, Vilva (Sanskrit); Bael, Bengal quince, Golden apple (English); Bel, Bel Kham (Urdu); Bel (Assamese and Marathi); Bilivaphal (Gujrati); Marredy (Malyalam); Belo (Oriya); Vilvama, Vilva marum (Tamil); and Bilva, Bilva pandu (Telugu). Bael is known in India from pre-historic time and has been mentioned in the ancient system of medicine (Bose, 1985). It has a great mythological significance also. Every part of plant such as fruit, seed, bark, leaf and root are important ingredients of several traditional formulations. Due to its curative properties, it is one of the most useful medicinal plants of India. It is utilized in day-to-day life in various forms. The products obtained from bael, being highly nutritive and therapeutic are getting popularized in Indian as well as in international market. The foundation for revitalization of local health traditions (FRLHT), Bangalore, India listed bael (Aegle marmelos) as RET (Rare, Endangered and Threatened) species specifically endangered species. This underutilized tree is generally propagated through seeds.

Distribution

Bael is indigenous to dry forests on hills and plains of central and southern India, southern Nepal, Sri Lanka, Myanmar, Pakistan, Bangladesh, Nepal, Vietnam, Laos, Cambodia and Thailand. It is cultivated throughout India, as well as in Sri Lanka, northern Malay Peninsula, Java in the Philippines and Fiji Islands.

Cultivars

In India, the plant is widely cultivated particularly in Uttar Pradesh and Bihar. So, for around twelve distinct cultivars, viz. Basti No.1, Kagzi Gonda, Gonda No.1, Gonda No.2, Gonda No.3, Kagzi Etawah, Sewan Large, Narendra Bael 7, Mirzapuri, Deoria Large, Chakaiya, Baghel and Lamba have been reported. Out of these four cultivars Kagzi Etawah, Sewan Large, Mirzapuri and Deoria Large have been found to be superior and excellent in taste and other qualities.

Chemical Composition

Various chemical constituents were found in bael like alkaloids, coumarins, steroids, polysaccharides, tannins, carotenoids have been isolated and identified from different parts of tree, such as leaves, fruits, wood, root and bark.

1. Alkaloids: Agelin, aegelenine, marmeline, dictamine, fragrine, O-methylhalfordinine, O-isopentanylhalford iniol, N-4-methoxy styryl cinnamide.

2. Coumarins: Marmelosin, marmesin, imperatorin, marmin, alloimperatorin, methylether, xanthotoxol, scoparone, scopoletin, umbelliferone, psoralen and marmelide.

3. Polysaccharides: Galactose, arabinose, uronic acid and L-rhamnose was obtained on hydrolysis.

4. Tannin: Tannin was also present in leaves and fruit as skimmianine. Carotenoids were also reported, which import pale colour to fruit.

5. Seed oil: Composed of palmitic, stearic, oleic, linoleic and linolenic acid.

Medicinal Importance

The different parts of Bael are used for various therapeutic purposes, such as for treatment of Asthma, Anaemia, Fractures, Healing of Wounds, Swollen Joints, High Blood Pressure, Jaundice, Diarrhoea, Healthy Mind and Brain Typhoid Troubles during Pregnancy. Aegle marmelos has been used as an herbal medicine for the management of diabetes mellitus in Ayurvedic, Unani and Siddha systems of medicine in India, Bangladesh and Sri Lanka. The main usage of the parts of this tree is for medicinal purposes. The unripe dried fruit is astringent, digestive, stomachic and used to cure diarrhea and dysentery. Sweet drink prepared from the pulp of fruits produce a soothing effect on the patients who have just recovered from bacillary dysentery.

Cultivation

1. Climate: A subtropical condition with hot dry summer and mild winter the tree would be ideal cultivation of bael. It can be grown up to an altitude of 1200M MSL and it is not damaged by temperature even as low as -70C.

2. Soil: The bale fruit is said to do best on rich, well-drained soil, but it has grown well and fruited on the oolitic limestone of southern Florida. It grown luxuriantly in the soils having pH range from 5 to 8. In India it has the reputation of thriving where other fruit trees cannot survive.

3. Cultivars and propagation: There are lot of variation seen among the progenies raised from seeds for size and shape of fruits, bearing habit, pulp quality, color, texture, sugar percentage etc., Cultivars like 'Mirzapuri', 'Kaghli', 'Gonda' and a few selections from Faizabad like KB 11, KB 1, Dhar Road and Ayodhya are found to be better. Root stocks are raised from seeds. On 6 months old seedlings, patch budding is done during June-July.

4. Seed Germination: Among the various treatment given to seed of Bael (Aegle marmelos), water soaking result in highest percentage of germination (80%) which was closely followed by concentrated sulfuric acid treatment for 20 min. (76%) and least percent of germination occurred with concentrated sulfuric acid (10min) or thiourea 1 percent (20%). Although water soaking resulted in highest percentage of germination, it took longer time for initiation and completion of germination as compared to concentrated sulfuric acid, which resulted in quicker germination.

5. Nursery management and planting: The bale fruit is commonly grown from seed in nurseries and transplanted into the field. Seedlings show great variation in form size texture of rind quantity and quality of pulp and number of seeds. The flavor ranges from disagreeable to pleasant. Therefore, superior types must be multiplied vegetative. Sowing is done in June or July. The development of seedlings is very slow. They require at least a year in the nursery to be fit for transplanting. They should be transplanted in rainy season; the stem is ordinarily 5-7 cm tall with 3-5 leaves, and the taproot, 20-25 cm long. It is also propagated by root cuttings and stem cuttings treating with IBA (4000 ppm) using quick dip method. Seedlings or budded plants are transplanted in the field at a spacing of 10-12 m. Budded plants start bearing fruits at the age of 4-5 years, whereas seedling trees require 7-8 years.

6. Inter cultural operation: The tree has no exacting cultural requirements, doing well with a minimum of fertilizer and irrigation. The spacing in orchards is 25 to 30 ft (6-9 m) between trees. Seedlings begin to bear in 6 to 7 years, vegetative propagated trees in 5 years. Full production is reached in 15 years. In India flowering occurs in April and May soon after the new leaves appear and the fruit ripens in 10 to 11 months from bloom March to June of the following year.

7. Harvesting: Normally, the fruit is harvested when yellowish-green and kept for 8 days while it loses its green tint. Then the stem readily separates from the fruit. The fruits can be harvested in January (2 to 3 months before full maturity) and ripened artificially in 18 to 24 days by treatment with 1,000 5to 1,500 ppm ethrel (2-chloroethane phosphonic acid) and storage at 86om F (30oC). Care is needed in harvesting and handling to avoid causing cracks in the rind.

8. Yield: The average yield is 300-400 fruits per tree. The quality of fruits is greatly associated with the weight and size of the seed-sacs. The larger and heavier the seed sacs, the greater is the amount of mucilage and poorer the quality. A tree may yield as many as 800 fruits in a season but an average crop is 150 to 200, or, in the better cultivars, up to 400.

Key Players of E-Choupal

E- Choupal consist two key players which plays very important roles throughout the procedures such as Sanchalak and Samyojak.

Sanchalak: Local farmer who provides infrastructure for keeping the computer. Facilitates inward and outward flow of information. Average economic status, literate, belong to large family and familiar to the villagers. Given training in use of computers, quality control and running the centre. Earns money on commission basis. Access to computer and greater social status are the main motivators.

Samyojak: Person (cooperating) who had earlier acted as commission agent. Mainly provides logistical support (transport, cash, bagging, paperwork, etc.) also provide information and market signals (crops grown) to ITC. Help in setting up e-choupals by identifying farmers, locations and local issues and the commission is paid by ITC.

Conclusion

The bael is an important and high value medicinal fruit unfortunately it is coming under RET list especially endangered and underutilized species, before we go for conservation some of the basic information about tree morphology, chemical composition, medicinal importance and cultivation aspects are must. This is eye opener for conservation of bael tree through scientific methods.

Importance of Bio-Regulators in Horticulture

Article ID: 10433

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There are various synthetic organic compounds which are applied to plants to give some positive responses. These compounds are artificial plant hormones which help in a deficient concentration (< 0.001 M) in maintaining of growth and development of the plants. These are now widely used to get a better result in the field of agriculture and horticulture. Some of the uses of natural and synthetic hormones in the above areas are given below:

Effect on Vegetative Plant Structures

Role in the Rooting of Cuttings: There are some plants like China rose (Hibiscus), rose (Rosa), etc., generally reproduce vegetatively. They are usually propagated by cutting pieces of stem. When the cut stem piece is placed in the moist stand, then adventitious roots come out from the cut end.

The rooting of cutting now a day can be hastened by pre-treating the cuttings with powders or solution containing synthetic hormones like Indole acetic acid (IAA), Indole butyric acid (IBA), Naphthalene acetic acid (NAA), etc. By the help of such cuttings, a large number of identical plants may be raised from a single individual plant for the preservation of desired genetic pattern, generation after generation.

Role in Controlling Cambial Activity: The secondary growth in thickness of stems and roots in woody plants take place due to the activity of cambium. The primary cambium (fascicular cambium) and secondary cambium (interfascicular cambium) together form the cambium ring. The activity of this is higher in spring month; then it gradually declines and become the lowest in summer. As a consequence, the formation of annual rings occurs.

This rhythmic activity of cambium is closely linked with the hormone Indole acetic acid (IAA) which stimulates meristematic activity in the cambial tissue.

Role in Callus Formation and Healing of Wounds: Cambium performs another important function by forming callus or wound tissues for the healing of wounds. There is a possibility of infection by some pathogenic organisms in any types of injuries, especially during pruning of plants.

For protection against wounds in the exposed area, some substances come out of the wounded cells causing uninjured cells to become meristematic resulting in the formation of callus or wound tissue, whereby healing of wounds takes place. For the formation of callus, hormones like auxin (Indole acetic acid) are found to be very effective.

Role in weed Control: Unwanted plants are called weeds which can be effectively controlled by the application of synthetic hormones. Weed killing hormones are known as herbicides. One of the ideal weed killers is the herbicide 2, 4-dichlorophernoxy acetic acid (2,4-D).

Other herbicides sometimes used are 2-methyl,4-chlorophenoxy acetic acid (MCPA) and 2,4,5-trichlorophemnoxy acetic acid(2,4,5-T). The most effective way of this herbicide is used in an aqueous spray on the foliage. In this case, 1% concentration for 5 gallons per 1000 sq feet is used.

Role in the Prevention of Sprouting of Potato Tubers: The modified, underground stem is the potato tuber which breaks dormancy at an early period causing quick loss of weight and decrease in the starch content. This creates a great problem for the agriculturists.

For overcome this difficulty now a day, synthetic hormones are applied. In this case, potato tubers are dipping in indole acetic acid solution, sprouting, i.e., bud formation of potatoes can be inhibited. Another synthetic hormone, such as methyl a-naphthalene acetate, is also effective in preventing but formation.

Effect on the Reproductive Structures of Plants

Control of Floral Initiation: Control of floral initiation is a process which is controlled by the hormone. In many cases, naphthalene acetic acid (NAA) is used to enhance the vegetative bud of pineapple, causing the induction of flower bud. 2, 4-D also can induce flowering. Gibberellins have also been shown to initiate flower formation in some plants like Hyoscyamus and Samolus (Lang, 1956).

Control of Fruit Development (*Parthenocarpic* Fruit Formation): The formation of parthenocarpic fruits such as seedless fruits can be induced by the application of IAA and IBA (Gustafson, 1936) in plants like squash, tomato, pepper, Petunia, etc. Naphthalene acetic acid has also been found suitable for the development of seedless fruits in strawberry.

Role in the Control of Abscission Layer: In most species of plants a time comes when the shedding of leaves and flowers and dropping of fruits take place from the stem. The process of their removal from the plant is called abscission which generally takes place by the formation of abscission layer,

The abscission layer in the form of a thin plate of cells is formed at the base of the leaf petiole or fruit stall. The cells of this layer become softened and so weaker than they readily break from the plants by wind or by any other mechanical means.

Abscission can be controlled by means of the hormone. It has been observed that when auxin production diminishes then the abscission layer forms. It has been shown that by application of auxin, abscission layer formation is delayed. Pre-harvest drop of fruits (apple, orange, peaches, plums, etc.) causes a severe reduction in the yield of fruits.

Synthetic hormones like 2,4-D, NAA or naphthalene acetamide is used to prevent premature drop of fruits before they are ready for picking from the plants. It is an economically important aspect of horticulture.

Role in Thinning of Blossom and Control of Fruit Production: Plant hormones are used effectively in thinning of blossom and control of fruit production. In this case, hormones reduce fruit set by removing some of the flowers.

Role in the Fruit Growth and Maturation: Plant hormones like Indole butyric acid (IBA) can be effectively applied in the control of fruit size and their maturation, for example, tomato.

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Care and Maintenance of Drip Irrigation Systems

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Drip irrigation systems are becoming more widely used for horticultural crop production, especially vegetable crops. The system must function efficiently during the entire growing season. Failure at a critical point in the crop production cycle can cause loss of the entire crop. System failures are often due to inadequate maintenance of the system especially if fertigation is being utilized to supply nutrients to the plant's root zone. Maintenance of the drip irrigation system does take time and understanding; however, maintenance is critical for the successful use of drip irrigation systems. This article should help one understand how to maintain drip irrigation systems.

Water Quality

Water for drip irrigation can come from wells, ponds, rivers, lakes, municipal water systems, or plastic-lined pits. Water from these various sources will have large differences in quality. Well water and municipal water is generally clean and may require only a screen or disc filter to remove particles. However, no matter how clean the water looks, a water analysis/quality test prior to considering the installation of a drip irrigation system should be completed to determine if precipitates or other contaminants are in the water. This water quality analysis should identify inorganic solids such as sand and silt; organic solids such as algae, bacteria, and slime; dissolved solids such as iron, sulphur, and calcium; and pH of the water. Water testing can be done by a number of laboratories in the state. Your local Cooperative Extension Service (CES) County Agent can supply a list of laboratories or suggest a local lab that can do water quality analysis. Check with the lab first to obtain a sample kit containing a sampling bottle that is clean and uncontaminated.

Table 1: Criteria for Plugging Potential of Drip Irrigation System Water Sources:

Plugging Hazard			
Factor	**Slight**	**Moderate**	**Severe**
[in parts per million (ppm)* except pH]			
Physical			
Suspended Solids (filterable)	<50	50-100	>100

Chemical			
pH	>7.0	7.0-7.5	>7.5
Manganese	<0.1	0.1-1.5	>1.5
Iron	<0.1	0.1-1.5	>1.5
Hardness	<150	150-300	>300
Hydrogen sulphide	<0.5	0.5-2.0	>2.0

In addition to these factors, it is desirable to ask for any additional tests that might be necessary. If the water is also to be used as a household supply or might be used as a drinking water source, the analysis should also include the basic drinking water analysis which includes bacterial counts, nitrates, or other suggested tests. Also salts, Chlorides, Sodium, Calcium (for general irrigated water quality).

Maintaining Drip Irrigation Systems Continued

Hydrogen sulfide can often be detected by a bad "rotten egg" smell. If a review of your water test indicates factors that may cause potential plugging (Table 1), then special care in drip system maintenance needs to be practiced. High levels of a factor might not render a well unsuitable for drip irrigation but will make appropriate water treatment a requirement before successful use in a drip irrigation system. Any surface water such as streams, ponds, lakes, rivers, or pits will contain bacteria, algae or other aquatic life. Sand media filters are absolute necessities. Even though sand media filters will be more expensive than screen or grooved disk filters, they are highly recommended for water sources that have high levels of suspended organic and inorganic materials.

Maintenance of the System

Filters: Both screen and sand media filters in a drip irrigation system should be checked during or after each operating period and cleaned if necessary. A clogged screen or grooved-disk filter can be cleaned with a stiff bristle brush or by soaking in water. A sand media filter should be backflushed when pressure gauges located at the inlet and outlet sides indicate a five-psi difference. Check drip irrigation lines for excessive leaking, and look for large wet areas in the planting area indicating a leaking tube or defective emitter. It is also a good practice to flush submains and laterals periodically to remove sediments that could clog emitters. Systems can be designed with automatic backflushing devices and automatic end line flushing devices, but still require manual checks.

Chemical Control Measures: Unfortunately, filtration alone is not always adequate to solve all water quality problems. Chemicals are necessary to control algae, iron and sulfur bacteria, and disease organisms. Chemicals can cause some materials to settle out or precipitate out of the water while causing other materials to maintain solubility or stay dissolved in the water. Chlorine is a primary chemical used to kill microbial activity, to decompose organic materials, and to oxidize soluble minerals, which causes them to precipitate out of solution. Acid treatments are used to lower the water pH to either maintain solubility or to dissolve manganese, iron, and calcium precipitates that clog emitters or orifices. Potassium permanganate also is used to oxidize iron under some conditions. It is recommended to place the filtration system after the chemical treatment to remove any particles formed. Chemigation protection and injection equipment requirements vary with toxicity class of the injected chemicals.

Bacterial Slimes/Precipitates: Bacteria can grow in the absence of light within the system or in a contaminated well. The bacteria can live on iron or sulfur and produce a mass of slime that quickly clogs emitters and filters. This slime can also act as an adhesive to bind other solids together to cause clogging. They also can cause soluble iron and sulfur to precipitate out of the water. Bacteria cause iron precipitation by oxidizing soluble ferrous oxide to form insoluble ferric oxide. Iron concentrations as low as 0.1 ppm can be troublesome, whereas levels of 0.4 ppm can be severe. The iron precipitate forms as a red filamentous sludge, which can attach to PVC and polyethylene tubing and completely block emitters. Sulfur in amounts over 0.1 ppm of total sulfides can be troublesome in irrigation water. Bacteria that live on sulfur can produce white stringy masses of slime, which can completely block the emitting devices. Interactions of soluble iron and sulfur can lead to a chemical reaction forming insoluble iron sulfide. Stainless steel filter screens used in high sulfide water can cause iron sulfide precipitation. Chlorination is the usual treatment to kill bacteria or inhibit their activity. A continuous residual rate of 1 to 2 ppm of free available chlorine at the distant end of the irrigation system or an intermittent rate of 10 to 20 ppm for 30 to 60 per treatment cycle should be effective. The initial injection rate may need to be higher to achieve the desired residual level in the system. Treatment cycles may be required at the end of each irrigation cycle for severe water sources or after every 10-20 hours of irrigation for cleaner water sources.

Maintaining Drip Irrigation Systems Continued

Sometimes, wells are contaminated with bacteria and shock chlorination is necessary to reduce or solve the problem. This is done by injecting chlorine at a rate of 200 to 500 ppm into the well. The volume of water to be treated must be estimated from the diameter and depth of the well. Consult a local well driller for exact procedures and regulations prior to attempting this activity.

Algae and Aquatic Plants: Algae and aquatic plants in surface waters can be great nuisances' because they reproduce rapidly during summertime blooms. They have a tendency to become entangled in screen meshes and clog the surface of sand media filters, resulting in frequent filter backflushing. Algae can be controlled in surface waters by adding copper sulfate or other chemicals in an approved manner. Care must be taken to avoid harming fish. Green algae can grow only in the presence of light, so they do not cause a problem in buried pipelines or black polyethylene. However, algae can grow in the white PVC pipe or fittings used to assemble aboveground pipelines and then be washed into laterals and emitters to cause clogging.

Chlorine is used to kill algae within the irrigation system. A chlorine concentration of 10 to 20 ppm for between 30 and 60 minutes is suggested. It is advisable to work section-by-section through the pipeline and flush the dead algae out of the pipes immediately after treatment, to prevent emitters clogging. If significant emitter clogging occurs, a higher concentration may be needed to decompose the organic matter in the emitter.

Chemical Precipitation of Iron

Water with over 0.1 ppm of iron is quite likely to cause a problem in irrigation systems. The problem can be solved by either removing the iron from the water or by retaining the iron in solution. Several techniques are available:

1. Aeration and Settling: A reliable way of removing iron from irrigation water is to pump the water from the well and to spray it in the air over a pond or tank. During aeration of the water, iron is oxidized into its insoluble form, which can be settled out in the pond. The disadvantage is that the water must be double-pumped, requiring a second pump after the settling basin to re-pressurize the water. Energy costs are not increased, but two pumps must be purchased.

2. Chlorine Precipitation: Free chlorine will instantly oxidize ferrous iron to ferric iron and take it out of solution as a solid. The iron concentration must be determined, and chlorine must be injected at a rate of 1 ppm for each 0.7 ppm of iron. Some additional chlorine may be needed for other contaminants, such as iron bacteria and bacterial slime. Complete mixing of the chlorine and water is necessary and can be accomplished by creating turbulence in the system before the filter. A sand media filter is the most appropriate choice and should be backwashed frequently, preferably automatically.

If manganese is present in the water source, caution must be exercised, because oxidation of manganese by chlorine occurs at a much lower rate. Care must be taken to precipitate the manganese before the filter, or clogging problems could occur.

3. pH Control: Iron is more soluble at lower pH values. Acid can be continuously injected to keep the pH low in the irrigation system or can be used periodically to dissolve iron deposits. To dissolve the iron, the pH must be reduced to approximately 2.0 or less for a period of 30 to 60 minutes. The system must be flushed to remove the iron after treatment.

Iron precipitation can be caused by raising the pH. A solution to increase the pH can be prepared by mixing 3 pounds of soda ash (58 percent light grade) with 4 gallons of water. This neutralizing solution can be injected into the water system and can be mixed with chlorine solutions.

4. Iron Sulfide Precipitation: Sulfur-bearing minerals are common in most sedimentary rocks. A soluble form of sulfate is carried by water. Sulfates are difficult to precipitate and generally remain in solution. Sulfate can be used as a food source by bacteria which produces hydrogen sulfide gas as a by-product. If sufficient iron is present under moderate reducing conditions, iron sulfides can be precipitated, and a sand media filter is suggested to remove the precipitate.

Maintaining Drip Irrigation Systems Continued

Precipitation of Calcium Salts: Calcium salts, particularly calcium carbonates, precipitate out as a white film or plating in the system. The salts are soluble at low pH. Acid can be used to maintain a pH of 4.0 or lower for 30 to 60 minutes which dissolves calcium deposits to clean emitters and pipelines. Hydrochloric (muriatic) acid is recommended for treating calcium blockages although sulfuric and phosphoric acid can also be used. Temperature, pH, and calcium concentration are all factors influencing calcium solubility, so conditions can vary throughout the irrigation system. Water sources differ in the amount of hardness and/or pH requiring different amounts of acid to lower the pH. The most common acid that growers will find available is muriatic acid (20% hydrochloric acid) at hardware and farm supply stores. It will require about 0.5 to 1 gallon in 100 gallons of water of this strength muriatic acid material to lower the pH to approximate 3.5 for several well and tap waters tested. Make sure that you flush and clean the injector after acid application since the acid may be corrosive to internal parts. Allow the acid treated water to remain in your lines for 30-minute t to 1 hour, then flush with water. Use extreme care in handling acids and always add acid to water.

If the water hardness is excessive water softening equipment can be used to remove calcium and magnesium. Zeolite water conditioners soften hard water by removing dissolved calcium and magnesium by ion exchange in a tank, where they are placed in a deep bed. As hard water flows downward through the bed, the calcium and magnesium ions are withheld by the mineral and replaced by sodium ions. When the sodium ions are exhausted, the system must be regenerated by a flow of salt water through the exchange material. A backwash procedure is used to remove the calcium and magnesium ions. If the water contains iron, an iron-removal filter should precede the water softener.

Chlorination: The common practice of chlorination is the addition of chlorine to purify drinking water supplies. Chlorine acts as a powerful oxidizing agent in water and vigorously attacks organic materials. Free available chlorine also reacts strongly with readily oxidizable substances such as iron, manganese, and hydrogen sulfide.

To be effective, a residual of active chlorine in parts per million of available chlorine should be measurable near the end of the lateral lines of the irrigation system. The amount of chlorine added to the system will be the residual desired plus the amount needed by the water to oxidize the materials present. This amount can vary considerably over a season. Contact time between chlorine and the water should be maximized to get the most benefit.

Table 2: Common chlorine compounds used in micro-irrigation:

Compound	Form	Precent available
calcium hypochlorite	Dry	65-70
sodium hypochlorite	Liquid	5.26 – 15
chlorine gas	Gas	100

The gas and liquid forms of chlorine are more commonly used (Table 2). Common household bleach, 5.25% sodium hypochlorite, is used in many small operations. Chlorine gas is more dangerous (very poisonous and very corrosive). A commercial dealer should install the gas metering device called a chlorinator and train the operators. Chlorine gas is heavier than air, so adequate ventilation is recommended.

The pH of the water greatly affects the effectiveness of chlorination. Acidic water causes greater availability of hypochlorous acid (HOC), which has an efficiency for killing microorganisms that is 40 to 80 times greater than that of hypochlorite (OC-). When chlorine is dissolved in water, HOC and OC-, which together are referred to as "free available chlorine", co-exist in an equilibrium relationship influenced by temperature and pH.

Maintaining Drip Irrigation Systems Continued

Commercial Drip Maintenance: Treatment Solutions Several commercial solutions are available, which contain a mixture of ingredients to deal with pH, iron, and hardness water problems. These commercial products come with instructions on dilution concentrations for daily maintenance or “shock” treatment to unclog plugged lines. For small producers getting started with drip irrigation, these commercial products should be considered as a water treatment.

Summary

Drip irrigation is an extremely efficient method of controlling processes, such as availability and uptake of water and minerals. The correct use of a drip irrigation system requires different approaches or methodology than those used in conventional irrigation systems. This involves thinking in terms of frequent irrigation intervals, correct emitter selection and spacing for soil type and topography, control of irrigation depth, and more exacting maintenance of the system. It is important to consult an irrigation specialist in designing a drip irrigation system, so that the system will indeed perform as expected. Correct use of a drip irrigation system can save water, reduce potential for groundwater pollution, improve water use efficiency, reduced disease pressure and any allow prescription nutrient applications.

High Tech Nursery

Article ID: 10435

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Introduction

Plug tray nursery raising technology for off-season vegetables is highly suitable and can be established as a small-scale industry in major vegetable growing areas of our country by progressive farmers especially in peri urban areas. Growing seedlings in plug trays in artificial medium without soil or compost is healthier as it prevents contact with soil-borne diseases. Drainage also can be easily varied in artificial media. Coco peat, Perlite, vermiculite is a cheaper and effective alternative base for an artificial growing medium, but it is important to get the pH right and avoid any salt contamination.

Types of Containers or Plug Trays Used for Vegetable Nursery Raising

1. Plastic trays of the same size with same size of cells are fixed in Styrofoam are mostly preferred because they encourage more uniform root zone temperature and moisture.

2. Cell size to use for raising vegetable seedlings will vary with the crop. Generally, smaller cells (8-10 cc in volume) are required for optimum growth of winter vegetable crops.

Ingredients Used as Root Medium for Nursery Raising in Pro-Trays

Mostly artificial soil-less media is used for raising healthy and vigorous seedlings of vegetable in plastic protrays. Mainly three ingredients viz., coco peat, vermiculite and partite, are used as root medium for raising the nursery. These ingredients are mixed in 3:1:1 or 2:1:1 ratio before filling in the required plug trays plastic protrays.

1. Coco-peat: It is prepared from the waste of coconut husk, has good porosity, improved drainage and air movement activity, completely free from infestation of any pest or pathogen. It is commonly being used as a medium under protected cultivation of ornamental crops like roses and gerberas and for raising the nurseries of vegetables and ornamental plants in the developed countries.

2. Perlite: It is a light rock material of volcanic origin. It is essentially heat expanded aluminum silicate rock. It's role in a mix is to improve aeration and drainage. If this ingredient is used in amix, the horticultural grade should be selected since it has larger particle size and is thus more effective. It is neutral in reaction and provides almost no nutrients to the mix (except for small amounts of sodium and aluminum).

3. Vermiculite: It is heat-expanded mica. It is very light in weight and has minerals (magnesium and potassium) for enriching the mix, as well as good water holding capacity. Neutral in reaction (pH), it is available in grades according to sizes. Grade 1 includes the largest particles and grades 4 and 5 are fine in texture. The most commonly used grades are 2 and 4. Its fineness, incidentally, makes it prone to being compressed easily in the mix. To reduce its potential, a mix including vermiculite should not be pressed down hard.

Material Required

Plug trays, propagation material, growing media (cocopeat, perlite, vermiculite or other soil less mixture), rose cane and mulching material.

1. After sowing the seed a thin layer of this mixture should be sprayed on the plug trays and a light irrigation must be provided with the help of rose cane.

2. After a light irrigation a polythene sheet is placed on the plug trays for better germination by conserving moisture and temperature.

3. When germination takes place seed start sprouting the mulching material should be removed from plug trays.

4. After care and management of seedling like irrigation, fertigation should be followed till seedling become ready for transplanting. Fertilizers are not added to the growth medium, but nutrients are supplied to the growing seedling in the artificial medium through fertigation every day.

5. Pest and disease problems can be minimized by careful construction and maintenance of the protective nursery structure. Some general precautions will help in reducing the number of sprays: Sticky traps are an important part for managing insect pest in nursery.

Procedure

1. Plug trays should be treated either by solarization or 2-4% formaldehyde.
2. After treating plug trays media is prepared in the ratio of 3:1:1 by incorporating vermiculite, perlite and cocopeat respectively.
3. These three components of media mixed thoroughly with adequate amount of water.
4. Plug trays should be filled with this mixture then single seed sown in middle of the cavity.
5. Can be used with a variety of vegetables like cucurbits etc.

Precautions

1. Closing the doors properly without any gaps to exclude insects.
2. Repairing holes in the net whenever noticed.
3. Avoiding excess irrigation that promotes diseases.
4. Disinfecting the trays, nursery tools and nursery area for hygiene maintenance in nursery. 5. Sterilizing the growing medium.
6. Installing sticky traps in between the two doors to catch any insects that do enter.
7. Remove covering plastic sheets after germination of seeds.
8. Attack of insect-pest and diseases may be checked regularly and adopt precautionary control measures in time
9. Do not damage seedlings due to improper packing during transportation.
10. Do not allow seedlings to auto contact with soil always keep on stands.
11. Do not perform chemical sprays while people are working inside the nursery and always use protective cloths during sprays.
12. Install aluminate sheet under the root for hotter months to avoid extreme temperature. And unfold during winters.
13. Always maintain records of information of seeds and sowing date etc. to analyze the performance of nursery.

Advantages of Plug Tray Nursery

1. Achieving high plant densities in less area.
2. Using land unsuited for production.
3. Raising of nursery at times independent of the weather.
4. Eliminating some operations like excess root growth, soil born infections and weeds.
5. Lowering transportation costs because of light weight media.

Galangal (*Alpinia galangal* L.) is an Important Underutilized Medicinal Plant of India

Article ID: 10436

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Abstract

Galangal (*Alpinia galangal* L.) is an evergreen underutilized shrub, belongs to the family Zingiberaceae and grows well in marshy lands of tropical and subtropical tracts of India. It has been grown naturally in the terai zone of West Bengal with bright sunshine hours. Galangal is a major source of therapeutic agents having remarkable revival use for health care in the last two decades throughout the world.

The rhizome is the economic parts, used against rheumatism, bronchial catarrh, bad breath and ulcers, whooping colds in children, throat infections, to control incontinence and fever. Rhizome splits are used as planting material for commercial cultivation. Marshy and unutilized areas can be successfully brought under the cultivation of galangal plant.

A fertilizer dose @ 80 : 100 : 60 kg N : P_2O_5 : K_2O per ha and FYM (farmyard manure) @ 5 tonnes is sufficient to raise a successful crop. The rhizome is ready to harvest during last week of February when the crop becomes 12-month-old. The rhizomes, thus harvested, contain about 0.32 % – 0.35 % oil on dry weight basis.

Introduction

Since the down of civilization, the medicinal plants have been using for ameliorating the sufferings of mankind. After food medicines are the second most essential requisite for mankind. Medicinal plants are the important source of the secondary metabolites (glycoside, coumarins, flavonoids, steroids etc.) and potential source of raw drugs.

The up dated information confirms that out of 200,000 medicinal plants of the world, India Contributes about 15% of it i.e., 3000 – 3500 in numbers and 90% of these plants are used as prophylactic, curative and Suppressive drugs in the Indian system of medicine (Roy & Pandey, 2005).

The world health organization (WHO) estimated that 80% of the populations of developing countries rely on traditional medicines, mostly drugs from plants for their primary health care needs (Anonymous 2000). According to 1994 UNDP report, the annual value of medicinal plants derived from developing countries is approximately 32 billion US dollars.

Galangal is an evergreen underutilized shrub whose botanical name is *Alpinia galangal* L. and belongs to the family Zingiberaceae. It grows well in marshy lands of tropical and sub-tropical tracts of India. Galagal is grown naturally in terai region of West Bengal where it is locally known as Pundi plant.

Mostly cultivated in South-East Asia, probably Southern China, Indo China, Thailand, Malaysia and Indonesia etc. The plant grows from rhizomes in clumps of stiff stalks up to two meters in height with abundant long leaves which bears red fruits.

The robust rhizome has a sharp, sweet taste and smells like a blend of black pepper and pine needles. The red fruit is used in traditional Chinese medicine and has a flavour similar to cardamom. The leaves exhibit shades of light to dark green colour or white. Some are flushed with purple or silver underneath (*Amnomum* spp., *Alpinia* spp., *Kaempferia* spp. etc.).

These make them commercially popular as foliage plants. The attractive inflorescences of some species are wildly used as cut flowers. The importance of plants as a major source of therapeutic agents has assumed greater importance during the recent years because of the remarkable revival in use of plants for health care in the last two decades throughout the world.

This has resulted in the large-scale exploitation of some medicinal plants as raw materials for pharmaceuticals. In order to obtain sustainable supply large scale cultivation of large number of medicinal plants was necessitated.

The value of global trade of the medicinal plant products has been put over US$ 75 billion per year and is growing @ 12.5% annually. The trade of medicinal plants in India is estimated to the tune of 675 crores per year. The export of medicinal plants from India appears to be growing faster.

Conservative estimates put the economic value of medicinal plant species globally indicates an upward trend and World Trade in medicinal plant and related products is expected to rise to S$ 5 billion by 2050 AD (Sharma, 2004). In India medicinal plants offer low cost and safe health care solution. It is estimated that 80 percent of the world's population depends directly on plant-based medicine for their health care.

Approximately 3000 plant species are known to have medicinal properties in the world. The Rig-Veda (3700 B.C.) mentions the use of medicinal plants. Our traditional system of medicine *viz.* Ayurveda, Yunani, Siddha, Homeopathy etc. use herbs for treatment.

Table 1: Botanical classification of Pundi:

Botanical name	Alpinia galanga
Kingdom	Plantae
Order	Zingiberales
Family	Zingiberaceae
Subfamily	Alpinioideae
Tribe	Alpinieae
Genus	Alpinia
Species	galanga
Unranked	Angiosperms
Unranked	Monocots
Unranked	Commelinids

Chemical Composition

The rhizome contains up to 1.5% essential oil (1, 8 cineol, α-pinene, eugenol, camphor, methyl cinnamate and sesquiterpenes). In dried galanga, the essential oil has quantitatively different composition than in fresh one.

Whereas α-pinene, 1,8-cineol, α-bergamotene, trans-β-farnesene and β-bisabolene seem to contribute to the taste of fresh galanga equally, the dried rhizome shows lesser variety in aroma components (cineol and farnesene, mostly). The resin causing the pungent taste (formerly called galangol or alpinol) consists of several diarylheptanoids and phenyl alkanones (the latter are also found in ginger and grains of paradise). Furthermore, the rhizome is high in starch.

Sensory Quality

Warm, sweet, spicy fresh galanga has a distinct fragrance that comes close to fir or pine needles; dried galanga is more spicy and sweet-aromatic, almost like cinnamon.

Culinary Uses

The rhizome is a common ingredient in Thai soups and curries, where it is used as fresh in chunks or thin slices, mashed and mixed into curry paste, or dried and powdered. Indonesian rendang is usually spiced with galangal. Greater galangal is used in Russia as a flavoring for beverages, including a liqueur called nastoika.

Medicinal Uses

The economic part is rhizome which is used against rheumatism, bronchial catarrh, bad breath and ulcers, whooping colds in children, throat infections, to control incontinence and fever. Alpinia species show promise as anti-fungals, hypotensives, enhancers of sperm count and motility. Anti-tumor and anti-dementia effects have been observed in rodents.

Galangal is a stimulating aromatic and has been successfully employed to aid the digestive process, preventing fermentation and removing flatus. It is useful in case of dyspepsia, preventing vomiting or sickness of the stomach and facilitating digestion. It may be used in all cases in which a stimulating aromatic is indicated. It tones up the tissues and is sometimes prescribed in fever.

Homoeopaths use it as a stimulant. It has some reputation as a remedy for perineal relaxation with hemorrhoids and for a lax and pendulous abdomen. It is used as a snuff to treat cold and flu symptoms. Galangal Root has also been used as a digestive aid, especially in combating dyspepsia and flatulence. It is also seen as a remedy for seasickness and motion sickness.

It is used against nausea, flatulence, dyspepsia, rheumatism, catarrh and enteritis. It also possesses tonic and antibacterial qualities and is used for these properties in veterinary and homeopathic medicine. This herb has a constricting or binding effect, for example: one that checks hemorrhages or secretions by coagulation of proteins on a soft surface. It also restores, nourishes, and supports the entire body; it exerts a gently strengthening effect on the body.

			
Fruits	**Flowers**	**Dried Rhizome**	**Fresh Rhizome**

Distribution

It has commonly seen in the marshy and low lands of tropical and subtropical tracts of India, particularly in South India, and North-East India. It has been grown naturally in the in terai zone of West Bengal.

Brief Package of Practices

Climate & Soil: The plant is grown in tropical and subtropical humid climate with sufficient rainfall and bright sunshine hours. It has been grown successfully on sandy-to-sandy loam soils.

Propagation material: Rhizome splits are used as planting material for commercial cultivation. Seed propagation is not feasible due to low germination rate.

Sowing attributes: It can be raised before onset of monsoon however soil having sufficient amount of moisture crop can be raised in the month of February to April. Rhizomes of approximately 50 g weight with8–10 internodes are directly planted on the field. The rhizomes sprout in 15–20 days in the field. One-year crop planted at a spacing of 30 cm × 30 cm while spacing for two-year crop is 45 cm × 45 cm.

Nutrient & weed management: FYM (farmyard manure) @ 5 tonnes is applied in the field at the time of land preparation. Crop can respond well with a fertilizer dose of 80: 100: 60 kg N: P2O5: K2O per ha. Half of the nitrogen (40 kg) is applied through urea at the time of planting. The rest of nitrogen should be applied in two equal splits, one at the time of first earthing-up and second at the time of 2nd earthing-up.

If required, lime @ 2 tonnes may also be applied in the field one month before planting to counter the acidic nature of soil. Well-decomposed humus or vermicompost may also be used as manure instead of FYM. Manual weeding should be done thrice at 60, 90 and 120 days after planting.

Harvesting: The best time for harvesting of rhizome is last week of February when the crop becomes 12-month-old. At this stage, the leaves turn pale or start drying. The rhizomes, thus harvested, contain 0.32% to 0.35% oil on dry weight basis. Generally, the crop can be harvested after either one or two years.

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Eco-Friendly and Modern Methods for Plant Disease Management

Article ID: 10437

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Indigenous technical knowledge (ITKs) has been very popular among the rural communities as they have been in practice from generations. These practices have been put in use by the people after conforming their effectiveness and practical utility in managing a number of pests and diseases.

Among a number of ITKs in practice, cow's milk, cow dung and cow urine have been used by almost all the rural communities for controlling diseases in crop plants. The antagonistic properties of cow's urine are well known. Various formulations of cow's milk and its other products have been in use where people adopt traditional and indigenous knowledge-based formulations for diseases management.

In other words, it is an organic way of disease management. A number of diseases have been reported to be controlled by use of cow dung and its urine-based formulations.

Cow Urine

Cow urine is one of the ingredients of "Panchagavya" (urine, dung, milk, curd, and ghee) which is capable of treating many diseases as it has several medicinal properties and it is the best remedy to cure fungal and bacterial diseases.

It has some excellent germicidal properties with antibiotics and antimicrobial activity as well. Therefore, cow urine is capable of killing variety of germs and also act as immunity booster. Cow urine contains many beneficial properties i.e., chemical properties, potentialities and constituents which help in removing all the ill effects and imbalances of body caused by infectious agents.

Cow urine contains 95% water, 2.5% urea, and the remaining 2.5% a mixture of salts, hormones, enzymes, and minerals. It has been considered that cow urine is very useful in agricultural operations as a bio-fertilizer and bio-pesticide as it can kill number of pesticide and herbicide resistant bacteria, viruses, and fungi.

Cow urine in combination with plant extracts is used to prepare disinfectant which is biodegradable and eco-friendly with good antibacterial action. Majority of people in India use cow urine to get rid of various diseases due to its therapeutic values. Cow urine has several biological activities such as antioxidant, anti-diabetic, antitumor and anti-protozoan.

Cow urine is used in agricultural system as a pesticide from time immemorial. Basically, it contains Quninolones and Flavoquinolnes. It showed antifungal activity against plant pathogens like *Fusarium oxysporum, Claviceps purpurea, Rhizopus oligosporus, Aspergilus oryzae, Curvularia* spp., *Alternaria helianthi* and *Cladosporium spp.* Cow urine has been proved to be inhibitory to the mycelial growth of *F. oxysporum* f. sp. *Cucumerinum, F. solani* f. sp. *Cucurbitae* and *S. sclerotiorum* that cause disease in cucumber.

Cow urine sprayed in fig plot had less incidence of rust and defoliations and application of 50 ml of cow urine in 500 ml of water reduced the virus, fungus and bacterial incidence in vegetable crops. Spraying of 200 ml of cow urine mixed with 2 liters of water was found effective in controlling the brinjal damping off in nursery. Spraying 10% cow urine three times at 10 days interval, exhibit good control of chilli leaf spot followed by half-liter cow urine along with half-liter sour buttermilk mixed with nine litres of water once in seven days twice.

Cow urine and cow dung showed positive response in suppression of mycelial growth of *Fusarium solani* f. sp. *Cucurbitae, S. sclerotiorum* and *F. oxysporum* f. sp. *cucumerinum* and protective effect on Fusarium root rot and wilt of cucumber.

Cow Milk

Cow milk contains mainly proteins, "lactoferin B" which is antimicrobial against various fungal species. The curd and buttermilk are enriched with a high proportion of lactic acid bacteria. The presence of lactic acid bacteria also produces antifungal metabolites *e.g.,* cyclic dipeptides, phenyllactic acid, proteinaceous compounds, and 3-hydroxylated fatty acid.

The amino acid proline present in milk also induces resistance in crop plants. Spraying of half liter of milk mixed in 4.5 liters of water sprayed at weekly intervals act as a preventive control measure against mildew, mosaic virus and blights. Cow milk have also been found effective in controlling *Tilletia tritici* in wheat and powdery mildew in pumpkin.

Cow milk and 10% bougainvillea leaf extract reduced the incidence of *zucchini yellow mosaic virus* (ZYMV) when it is applied from plant emergence until initiation of flowering on zucchini (*Cucurbita pepo*). Cow milk spray controlled powdery mildew caused by *Sphaerotheca fuliginea* on Zucchini under greenhouse conditions.

Panchagavya

In Sanskrit, Panchagavya means the blend of five products obtained from cow. It contains ghee, milk, curd, cow dung and cow's urine. Panchagavya was mentioned in the scripts of Vedas and Vrikshayurveda. In our ancient literature of Ayurveda, it is described as Panchgavya Chikitsa. When these products are suitably mixed and used with its miraculous effects not only on plant but on humans too. Panchagavya is used in different means such as foliar spray, soil application along with irrigation water, seed or seedling treatment etc. Panchagavya has been tested for different crops and found to enhance growth, vigor of crops, resistance to pest and diseases and improvement of keeping quality of vegetable and fruits. It contains beneficial microbes like lactic acid bacteria *(Lactobacillus),* yeast *(Saccharomyces),* actinomycetes *(Streptomyces),* photosynthetic bacteria *(Rhodopsuedomonas)* and certain other fungi *(Aspergillus).*

For making approx. 2 litres of panchagavya the following ingredients are required (Shilaja et al., 2002).

1. Fresh cow dung – 0.5 kg.
2. Fresh cow's urine – 0.3 litres.
3. Cow's milk – 0.2 litres.
4. Cow's curd – 0.2 litres.
5. Cow's ghee – 50 gms.
6. Jaggery – 50 gms.
7. Water or sugarcane juice – 0.3 litres.
8. Ripe banana fruit – 2-3 nos.
9. Tender coconut water – 0.3 litres.
10. Toddy – 0.2 litres.

(If toddy is not available, we can ferment 0.3 litres of tender coconut water by keeping it in a pot for 1 week. That will become toddy.)

First day: Mix 300 ml of cow urine and 300 ml of coconut water in container.
Fourth day: Add cow ghee to cow dung and mix thoroughly in earthen container.
Sixth day: Add cow urine to ghee and cow dung mixture.
Eight day: Mix the remaining ingredients like curd, cow milk (boiled and cooled), jaggery, ripe banana, tender coconut, water and toddy.

Stir the prepared panchagavya twice daily in morning and evening. Panchagavya will be ready by 19th day. Filter the contents to remove the debris.

Panchagavya in Plant Disease Control

Panchagavya is effective in controlling wilt of banana and reduction in plant disease index. Increase in plant vigor and fruit yield in tomato using Panchgavya have also been noticed. Drenching with Mahapanchgavya @10% successfully controlled the wilt of tomato. Modified panchagavya mixture (mixture of cow milk, curd, ghee, dung and urine supplemented with yeast and common salts) have been found most effective for the management of panama disease of banana. Panchagavya has also been found to suppresse the disease caused by *R. solani*. Three sprays of either cow urine (1: 10), cow milk (1:10) and vermiwash 1:2 and panchagavya (3%) was best in reducing rust severity in soybean when applied at ten days interval starting from the onset of the disease.

Xeriscaping-Water Wise Gardening

Article ID: 10438

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Introduction

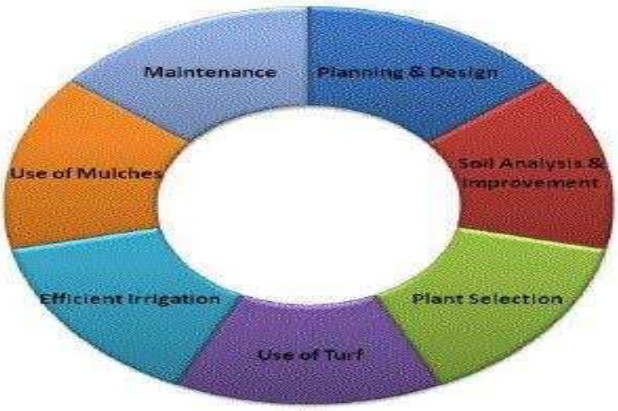
A landscaping approach that uses small amounts of water but maintains a traditional look. The xeriscape concept has been adopted in many areas of the country experiencing drought or long-term dry conditions. The goal of a xeriscape is to create a visually attractive landscape that uses plants selected for their water efficiency. Xeriscape-type landscape is low maintenance — saving time, effort and money. In urban areas, about 25% of the water supply is used to water landscapes and gardens. In the summer, about 60 % of the water the average household uses may be for landscape maintenance.

The term "xeriscape" was invented by Nancy Leavitt, Colorado in 1980. Xeriscaping a greek word 'xeric' means dry or arid and 'scaping' means landscape. Planning and designing of a landscape with limited use of water. It is also known as smart scaping, water-wise, water efficient and water saver gardening. Quality landscaping that conserves water and protects the environment.

Xerogardening refers to landscaping and gardening in ways that reduce or eliminate the need for supplemental irrigation. Xeriscape utilizes native plants or plants that are native to a similar environment requires minimum supplemental water or other inputs (i.e., fertilizers, pesticides, maintenance, etc.) is aesthetically pleasing and functional which provides colour, pleasant odours, artistic interest, etc. provides screen, windbreak, shade and provides food (human /or wildlife) also attracts hummingbirds, butterflies, birds, etc.

Principles of Xeriscape

1. Planning and Design.
2. Zoning Plants.
3. Soil.
4. Efficient Irrigation.
5. Selection of plants.
6. Maintenance.



Planning and Design

1. First of all a design or sketch should be made on paper.
2. Mention all the area which comes under the designing like residential area, private area etc.

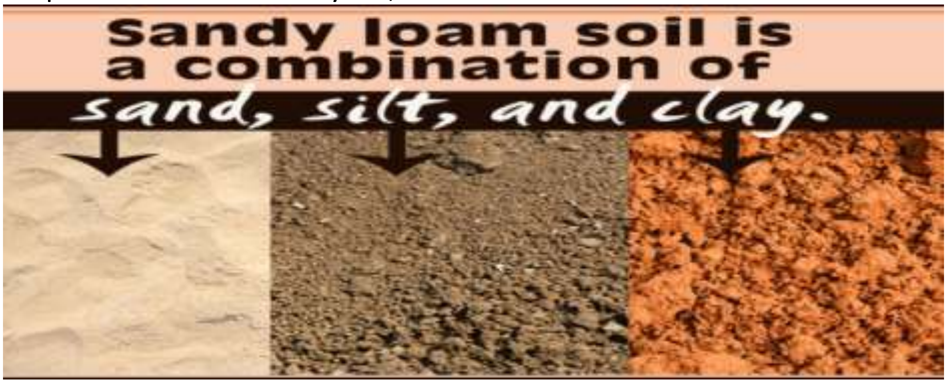
3. Conducting a site analysis to determine environmental features such as soil type, seasonal sun directions, shade and wind direction.
4. Study the natural contours and drainage patterns of the land.

Zoning Plants

1. Then divide the area where xeriscaping should be done into different zones on the basis of availability of water viz. low, moderate and high-water requirement zone.
2. The concept behind this next step is to place plants with the same requirements for water and sunlight into the same areas or hydro zones (watering zones).

Soil

1. It should be well drained, aerated and having high moisture retention capacity.
2. Add organic manures like farmyard manure, compost, vermi-compost and poultry manure.
3. Most xeric adapted plants do best in sandy silt, well-drained soils.



Efficient Irrigation

1. Xeriscape requires minimum three years for proper establishment.
2. Annuals, perennials and ground cover 15-20 cm deep in the soil.
3. For watering micro irrigation systems like drip and sprinkler are most suitable.

Selection of Plants

1. Always select those plants in a group which require same soil, light, and water.
2. Use only locally available plants. For adding colors in landscape use of different flowering shrubs, trees and bedding plants should be done.

Typical Characteristics of Xeric Adapted (Drought Tolerant) Plants

1. Fleshy, thick stems and leaves (succulents such as cactus, agave).
2. Narrow, spiny or net-like leaves (pines and junipers, grasses).
3. Desert flowers (desert marigold, California poppy).
4. Waxy coated leaves (western sand cherry).
5. Ground cover plants (monkey grass, trailing juniper).

Maintenance

1. Low-maintenance is one of the benefits of xeriscape.
2. It includes pruning, mowing, watering, weeding, fertilization and integrated pest management.

Xeriscape Benefits

1. Saves Water.
2. Less Maintenance.

3. Less Fertilizers or Pesticides.
4. Improves Property Value.
5. Pollution Free.
6. Provides Wildlife Habitat.

Conclusions

Xeriscape is one of the important landscape practices mostly suitable for dry region of India but in our country most of the people shifted towards traditional landscape that is, high water using gardens. So, a lot of water is wasted in maintaining the gardens, hence there is a lot of scope in adopting the xeriscape technique.

Xeriscaping offers a way to have beautiful, landscapes without excess water use. Lower-water-use areas can be very attractive if the xeriscape principles are employed properly. Xeriscape concept makes our landscapes more compatible with the environment.

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Evaluation of Wine Varieties for Grapes Grafted Over 110 R and Dogridge Rootstocks

Article ID: 10439

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Grapes is one of the most important fruit crops of the world, it belongs to family Vitaceae includes 12 genera and about 600 species. The most important genus of economic importance is Vitis from which maximum cultivated grapes belong. Genus Vitis includes about sixty species of which *Vitis vinifera* is the most important one contributing to about 90% of the world's grapes. Other important species are *Vitis rotundifolia, Vitis labrusca, Vitis aestivalis* and *Vitis vulpine.*

Grape production consumption of world according to FAO 71% used for wine, 27% as fresh fruit consumption, 2% as dried fruit consumption. About 90% grapes produced are freshly consumed in India.

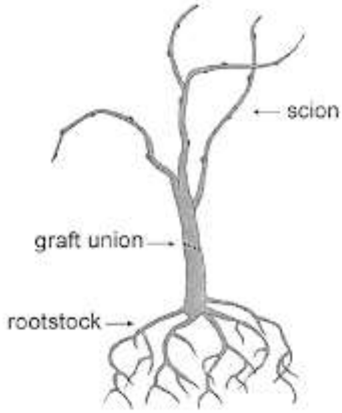
Grape is a good source of sugar (12-27%), acid and minerals. Fresh grapes also contain some vitamins, pectin and enzymes. Grapes can be processed into a variety of products like juice, raisins, jam, wine, coloured compounds and seed oil. Grape wine is one of the most important grape products. Wine is one of the functional fermented foods and has many health benefits.

Image showing different grapes for wine production purpose

India is a major grape producing and exporting country. The major grape growing states are Maharashtra (83.5%), Karnataka (11.7%), Punjab (2%), Tamil Nadu (1.8%) and Telangana (1%) amounting nearly 90% of the total production.

In Madhya Pradesh area of grapes spread as concentrated spot of Malwa region as Mandsaur, Ratlam, Indore, Khandwa and Burhanpur.

Grapevine cultivars have a reputation for producing premium quality wine include Cabernet Sauvignon, Shiraz, Sauvignon Blanc and Riesling. Cabernet Sauvignon and Pinot Noir are for red wine production and Ungi Blanc are suitable for white wine production with different growth, yield and quality parameters. Wine grapes belong to the species *Vitis vinifera* but are grown primarily for wine production. Quality wines can only be produced form quality grapes.



Images showing use of rootstocks for quality grape production

Commercial wine grape production in India has begun in 1980's. Wine grapes in most parts of the world tend to be smaller, seeded and have thicker skin high acidity and low sugar content are preferred for making dry or table wines, while sweet or dessert wines are prepared from berries with high sugar content and moderately low acid. Wine is prepared only in limited quantities in India. Red Burgundy wine in France is 100% form Pinot Noir cultivar and Chianti Classico in Italy is mainly from Sangiovese cultivar. Wine is the principal product from grapes. Most of the vineyards in Europe, North and South Africa, South America, Australia and the USA concentrate on wine making. Berries with these grapes are also harvested at a time when their juice is roughly 24% sugar by weight. Cabernet Sauvignon made popular by the red wines from France's Bordeaux region, this grape is now grown in most of the world's popular wine regions. The wines from this grape are usually medium to full bodied with an aroma that is reminiscent to blackcurrants or cassis.

Image showing different white grape varieties

Most of the vineyards over the world are grafted on commercial rootstocks, which are hybrids of three species; *Vitis berlandieri, Vitis riparia* or *Vitis rupestris* that were developed before 1930 from American Vitis species to control phylloxera damage. Grafting is a compulsory practice because *Vitis vinifera* is highly susceptible to Phylloxera infestation. Now-a-days, the grafting technique has also been used to control vigour, yield, wine quality and to increase tolerance to environmental stress.

Rootstocks perform differently with different soils and climates; thus, regional rootstock evaluations are essential in determining which rootstock is best suited to a particular environment. Rootstocks vary in their root characters in terms of root density, root length, etc. so different varieties behave differently for fruitfulness depending on environment, training system and position of shoot, pruning time, etc. Never cultural practices such as use of rootstock leading to dense canopy may inhibit the successful induction and initiation of inflorescence and cause a decline in fruiting potential. Various reports specified that rootstock purely influence in vine growth fruit quality. Wine quality as well as yield.

Dogridge and 110R is going important in Indian viticulture and the majority of vineyard are being established on these rootstocks to overcome the adverse effects of abiotic stresses such as drought and salinity. Besides this, rootstocks are known to influence the growth pattern of scions after grafting and some may even induce resistance to diseases by various physiological and biochemical changes in grafted vines. Dogridge rootstock takes more than 10-12 months to attain graftable thickness at the desired height of 45-60 cm when raised in a nursery bed or in poly bags.

Image showing common types of wine of different grape cultivars

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Potassium Nitrate and Salicylic Acid Effects on Acid Lime

Article ID: 10440

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Acid lime (*Citrus aurantifolia* Swingle) under citrus group belongs to family Rutaceae. It originated in India and is commonly known as 'Nimbu'. The word Kagzi being derived from kagaj which means paper denotes thinness of rind.

It is the third most important citrus fruit crop in India next to mandarins and sweet oranges. It is generally grown under both tropical and subtropical climatic conditions in the plains and up to 1200 m MSL. It is a good source of vitamin-C with good antioxidant properties. It contains 6.3-6.6 % citric acid. Its attractive appearance, penetrating aroma of peel and excellent taste gives a remarkable position to acid lime which is grown widely throughout the world. The genus citrus is important economically and is known for its juice and pulp throughout the world. The fruits are extensively used for preparation of squashes, pickles, syrups and cordials, citric acid and for table purpose in daily life of Indians. Lime is used in making candy, chocolate, ice cream, pastries. 100 gram of fruit juice contains 80 percent of water, carotene (26 IU), Vitamin B1 (20 mg), Vitamin C (63 mg), Riboflavin (0.1 mg), Iron (1.83 mg), Copper (0.16 mg), Oxalo-acetic acid (0.30%), Malic acid and alkaline salt (8.2%). Therefore, it is very essential for human health.

Image showing fruits of Kagazi lime

In India, it is commonly cultivated in the states of Andhra Pradesh, Telangana, Karnataka, Odisha, Madhya Pradesh, Maharashtra, Assam, Bihar, Chhattisgarh, Manipur, Jharkhand, Tamil Nadu, Tripura and Mizoram. In India, citrus is one of the major fruit crops, and it is cultivated in 286,000 ha area along with the production of 3148,000 MT.

In Madhya Pradesh, it is cultivated in Dhar, Barwani, Khargon, Khandwa, Ujjain, Ratlam, Mandsaur, Neemuch, Shajapur, Gwalior, Burhanpur, Hoshangabad, Morena, etc. an important region in Madhya Pradesh where acid lime is grown is Malwa, respectively.

Acid lime flowers normally thrice a year i.e., ambe bahar (Jan-Feb), mrig bahar (June-July) and hasta bahar (Sep-Oct). Among all these bahars; hasta bahar crop which comes to harvest during summer gets highest remunerative prices. Since the discovery of the plant growth regulators, they have been used to manipulate plant growth and development for the improvement of quality and quantity of the produce in order to enable the fruit growers to meet the pressure of increasing demand for food of high and better quality.

Image showing fruiting on the plant

Foliar spray of potassium nitrate could be incorporated to enhance the photosynthetic efficiency of leaves and a possible increase in translocation of assimilates into the fruits resulting in larger fruit size and also plays an important role in the interplay of metabolic events involved in fruit ripening and senescence. Foliar application of potassium nitrate (KNO3) increased leaf K more rapidly compared to soil-applied fertilizers because plant uptake was much faster. but the positive effect lasts for a shorter period of time.

Salicylic acid (SA) classified as a plant hormone-like substances, has been reported to play an important role in the regulation of plant growth and development. It stimulates flowering and tuberization in a range of some angiosperm species, increases flower life, besides improving flowering number or density and fruit set percentages. Exogenous application of SA may influence a range of diverse physiological processes in plants such as ion uptake and transport, photosynthesis, ethylene biosynthesis, and enhances yield and fruit quality of different fruit crops. Moreover, it can function as ABA inhibitor and regulates the activities of antioxidant enzyme, therefore increase plant tolerance to the abiotic stress.

Image showing fruit retention and drop as well

Salicylic acid (SA) could induce the alternative oxidase enzyme activity in mitochondria which is involved in stress alleviation and enhances specific secondary metabolites of plants. SA is most readily accessible as plant growth regulator compared with acetyl salicylic acid and methyl salicylate and it is safe to human and environment and plays an important role in protecting plant cells from senescence.

Improved Production Technology of Grapes

Article ID: 10441

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Introduction

Grape (*Vitis* sp.) belongs to the family Vitaceae which is a commercially important fruit crop of India. It is a temperate crop which has got adapted to sub-tropical climate of peninsular India.

Origin

Grape cultivation is believed to have originated in Armenia near the Caspian Sea in Russia, from where it spread westward to Europe and eastward to Iran and Afghanistan. Grape was introduced in India in 1300 AD by invaders from Iran and Afghanistan.

Area & Production

India is among the first ten countries in the world in the production of grape. The major producers of grape are Italy, France, Spain, USA, Turkey, China and Argentina. This crop occupies fifth position amongst fruit crops in India. The area under grape is 1.2 % of the total area of fruit crops in the country. Production is 2.8% of total fruits produced in the country. About 80% of the production comes from Maharashtra followed by Karnataka and Tamil Nadu.

Economic Importance

The fruit contains about 20% sugar in easily digestible form besides being rich in calcium and phosphorus. World over it is grown mainly for wine making (82% production), raisin making (10% production) and rest for table purpose (8%). In India, however it is mostly consumed as fresh fruit and only a limited quantity is utilized for the production of liquor, dry fruits like raisins etc.

Agro-Climatic Requirements

Grape is a versatile crop that can adjust to any type of climate. The ideal climate is in the Mediterranean region. In North India it is grown under sub-tropical conditions. Sandy to clayey and loamy soil with good drainage and irrigation facilities is suitable for the cultivation of Grapes.

Soils having pH value from 6.5 to 7.5 are most suitable. Temperature ranging from 15-35^0 C is ideal for shoot growth and normal physiological processes of the grapevine. Vines do not grow and fruit well when the temperature falls below 10^0 C. Locations where the annual rainfall does not exceed 900 mm. are ideal for its cultivation.

Varieties Cultivated

List of commercial varieties utilized for specific purposes is given in the following:

Category	Varieties
Table grapes	Anab-e-Shahi, Bangalore Blue, Beauty Seedless, Bhokri (Pachadrakshi), Cheema Sahebi, Delight, Gulabi, Kali Sahebi, Kandhari, Perlette, Pusa Seedless and Thompson Seedless.
Raisin Grapes	Thompson Seedless, Arkavati
Wine Grapes	Bangalore Blue, Thompson Seedless and Arka Kanchan

Land Preparation

Land is leveled by a tractor or bulldozer as per the requirement, soil type and gradient. In case of drip irrigation, leveling need not be perfect. The size of the plot will vary with the type of training system used. In case of bower and telephone or "T" trellis the ideal size could be 60 X 80 m. and 90 X 120 m. respectively.

Planting

Grape is usually propagated by hard wood cuttings, though propagation by seed, soft wood cuttings, layering, grafting and budding is also used in some cases.

The grapevines are usually planted in pits. The size of the pit may vary from 60 to 90 cm. depending upon the soil type. In central Maharashtra and northern parts of Karnataka the spacing adopted for Thompson seedless and its mutants is 1.8m X 2.4 m.

The pits need to be opened about a month before planting. Planting is usually avoided during the rainy season. The best time for planting is February-March in North India, November-January in the peninsular India. After one month of planting, the young plants need staking and training.

Training Systems

In India systems like bower, kniffin, telephone, head and slanting trellis have been tried in the past, but the bower and telephone system are being followed on a large scale. About 80% of the vineyard area in India is on bower system.

Bower

This system is most widely used in commercial cultivation of grapes. As the shoots start growing from the newly –planted rooted cuttings in the main field, only the best shoot growing vertically is allowed to grow along the stake provided up to the bower height.

Kniffin (Also Called Espalier System)

The system is less expensive than Bower, yet it is less commonly followed. It is suitable for training moderately vigorous varieties having less degree of apical dominance.

Telephone System

T-trellis is used in this system of training. It is a mini discontinuous bower with shoots hanging downwards with three topped wires and T-shaped support, the trellis looks like a telephone pole and wires.

Head System

This is the least expensive of all the training systems.

Pruning

The prevailing pruning practices in India can be broadly grouped into the following categories:

1. Single Pruning- Single cropping: This system is prevalent in North India. Since only one growing season is available, grapevines are pruned with the onset of spring or during late winter (mostly January-February).

2. Double pruning – Single cropping: This system is predominantly followed in Maharashtra, north interior Karnataka in case of Thompson Seedless, and Andhra Pradesh on Thompson Seedless and Anab-e- Shahi grapes. Thus, in this system of pruning, a cycle of two prunings resulting in one crop is practiced.

3. Double pruning – Double cropping: This system is in vogue in Anab-e-shahi and Bangalore Blue grapes in the south interior Karnataka and in Anab-e- Shahi, Bhokri and Gulabi in Tamil Nadu. As a result, three crops are harvested in two years, and the crop is harvested almost throughout the year.

Irrigation

Irrigation practices vary considerably in different regions of India depending upon the rainfall pattern, time of pruning, different growth stages, water-holding capacity of soil, variety grown, training system followed and spacing of vines. Irrigation is provided once in every three days in newly planted vineyards by allowing water into a small circular basin of 50 cm radius. Heavy irrigation is provided soon after pruning in order to wet the entire root zone thoroughly and induce active growth in the vine. Light irrigation is given is given at an interval of 10-12 days during winter and 5-7 days in summers. Irrigation frequency is reduced during anthesis, fruiting stage and also after berry softening to improve fruit quality.

Nutrition

Recommended doses of nutrients for different varieties under different agro-climatic regions are given in table below: (kg/ha):

Variety	Region	N	P_2O_5	K_2O
Anab-e-Shahi	North India	366-600	300-550	183-1200
	Telangana	435	305	784
	South interior Karnataka	500	500	1000
Beauty Seedless	North India	165	-	-
Cheema Sahebi	Maharashtra	600	240	120
Gulabi, Himrod, Perlette	North India	444-715	457-1332	460-1000
Thompson Seedless	North India	444-1100	1332	1332
	Maharashtra	666-1000	500-888	666-800
	South interior Karnataka	300	500	1000

Plant Protection Measures

Insect Pests: Insect pests mostly observed are flea beetle, thrips & wasps. For controlling these spraying with Dichlorovas, Dimethoate is recommended.

Diseases: The Crop is suspect to diseases like downy mildew, powdery mildew, black rot, wilt, leaf blight etc. Timely treatment and control measures are needed.

Disorders: Some of the disorders observed in case of grapes are post-harvest berry drop, berry cracking, leaf cholorosis, dead arm.

Harvesting and Yield

In North India, plants start fruiting after two years of planting. Berries start ripening from the end of May in early varieties. However, most of the varieties are harvested after they have changed color near the tip and have become sweet. A day prior to picking, the broken, decayed, deformed, under-sized berries are removed. The clusters are usually harvested during the early hours of the day before the temperature rises above 20^0 C. Yield varies according to variety and climatic conditions etc. The average yield of Anab-e-Shahi and Bangalore blue is 40-50 tones/ha while that of seedless varieties is 20 tones/ha. Average yield of 20-25 tones/ha. is considered good.

Post-Harvest Management

Grading: Grading is mainly done based on the size and color of the grapes to maintain uniformity of berries in a package. While grading, size of the berry is the criterion but not the size or shape of the bunch.

Pre-Cooling: Pre-cooling is done to reduce the field heat, moisture loss and subsequently increase the storability of grapes.

Packing: Table grapes meant for local market are picked and packed directly in containers in the field. Table grapes meant for long distance markets and those for overseas markets are packed differently in the packing shed. Raisin, juice and wine grapes are subjected to suitable treatments and processed.

Storage: The shelf life of grapes is only one week at room temperature. The storage life of grapes can be increased by employing suitable means to reduce desiccation, decay due to growth of fungi e.g., *Botrytis, Cladosporium, Alternaria* etc. and bio-chemical deterioration. Ideal conditions for storage are low temperature (0^0 C) and high humidity (92-96%).

Improved Production Technology of Acid Lime

Article ID: 10442

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Botanical name: *Citrus aurantifolia* Swingle.

Family: Rutaceae.

Chromosome no: 2n= 18.

Origin: India.

Soil and Climate

The crop can be cultivated in both Tropical and Sub-tropical climate. It can be grown up to 1000 m above MSL. Deep well drained loamy soils are best suited for the cultivation.

Season

The planting is done from December – February and June – September.

Planting

Healthy seedlings are planted during June to December at 5 to 6 m spacing in 75 cm x 75 cm x 75 cm pits.

Irrigation

Irrigate copiously after planting. After establishment of the crop, irrigation is given at 7 – 10 days interval. Water stagnation should be avoided.

Manures and Fertilizers Per Plant

N is applied in two doses during March and October. FYM, P_2O_5 and K_2O are to be applied in October.

Manures and Fertilizers	1st year	Annual increase	From 6th year
FYM	10 kg	5 kg	30 kg
N	200 g	100 g	600 g
P	100 g	25 g	200 g
K	100 g	40 g	300 g

Spray Zinc sulphate at the rate of 0.5% (500 g/100 lit of water) thrice in a year (March, July and October) after the emergence of new flushes.

After Cultivation

The branches of main stem up to 45 cm from ground level have to be removed. Green leaves @ 30 kg per tree are applied once in 3 months.

Intercropping

Legumes and vegetable crops can be raised during pre-bearing age.

Growth Regulator

To increase the fruit set, spray 2, 4 – D @ 20 ppm during flowering stage. For fruit retention, spray 2, 4 – D @ 20 ppm or NAA @ 30 ppm after fruit set (marble size).

Plant Protection Measures

Sucking pests:

White fly	For control, spray Quinalphos 25 EC @ 2 ml/lit
Black fly	For control, spray Monocrotophos 36 WSC @ 1.5 ml/lit
Aphids	Spray methyl Demeton 25 EC or Monocrotophos @ 1 ml/lit or neem oil 3ml/lit or Fish oil resin soap 30 g/lit or Quinalphos25 EC 2ml/lit to control the pest.
Rust mite	For control, spray Dicofol 18.5 EC @ 2.5 ml/lit or Wettable sulphur 50 WP @ 2 g/lit.

Fruit sucking moth: *Tinospora* weed host have to be destroyed. Bait with fermented molasses plus Malathion 50 EC at the rate of 1 ml/lit can be used for control. Bag the fruits with polythene bags punctured at the bottom.

Shoot borer: Prune the withered shoots 4 cm below the dried portions and spray Monocrotophos 36 WSC @ 1 ml/lit or Quinalphos25 EC @ 1.5 ml/lit or Carbaryl 50 WP @ 2 g/lit.

Stem borer: The branches containing grubs have to be pruned. Plugging the fresh holes with cotton soaked in Monocrotophos solution mixed @ 5 ml/20 ml of water will also control the pest.

Fruit fly: To control fruit fly, spray Malathion 50 EC @ 1 ml/lit or Fenthion 100 EC @ 1 ml/lit with 1% crude sugar (10 g/lit). Set up bait with Methyl eugenol 0.1% solution mixed with Malathion 50 EC 0.05% between 6 a.m. and 8 a.m.

Mealy bugs:

a. Debark the branches and apply methyl parathion paste.
b. Use sticky trap on the fruit bearing shoots at a length of 5 cm.
c. Use Dichlorvos (0.2%) in combination with fish oil resin soap (25g/lit) as spray or for dipping the fruits for two minutes.

Nematodes: Apply Carbofuran 3 G @ 75 g/tree to control citrus nematodes in severe infestations. Apply 20 g Pseudomonas fluorescens formulation per tree at a depth of 15 cm and 50 cm away from the trunk once in four months. Soil application of Phorate @ 2 g followed by drenching with 1 % of Metalaxyl plus Mancozeb 72 WP @ 50 ml/ cutting/ poly bag/ kg of nursery soil is done for controlling citrus decline.

Diseases

Twig blight: Prune dried twigs and spray 3% Copper oxychloride or 0.1% Carbendazim at monthly intervals to reduce the spread of disease.

Canker: Immediately after pruning one spray of Copper oxychloride (COC) 0.3% is done followed by 4 sprayings with Streptocyclin100 ppm + COC 1.5 kg/ha at monthly intervals.

Tristeza virus: Remove the infected trees and destroy. Spray Methyl demeton 25 EC or Monocrotophos @ 1 ml/lit to control the aphids which spread the disease. Use pre-immunized acid lime seedlings for planting.

Harvest

The crop starts bearing from 3rd year after planting.

Post-Harvest Treatment

Treating the fruits with 4% wax emulsion followed by pre-packing in 200-gauge polythene bags with 1 % ventilation improves the shelf life for more than 10 days.

Yield

The crop yields about 25 t/ha/year.

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Basic Concept of Flower Forcing in Bulbus Crops

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It is important to lift these bulbs on time, use flowering-sized bulbs, and proper planting media as described under the rooting room bulb section of this Article.

Alstromeria

Normally, No.1 sized rooted rhizomes are planted in late summer to early fall. They are used only as cut flowers and will need support netting.

This crop is flowered year-round. Light is critical, and they need a 13-to-16-hour photoperiod and a light intensity of at least 50 klx. Plants grow best at 50^{0} to 60^{0} F. They are normally grown for 2 or more years and require a $Ca\ (NO3)_2$ fertilizer program.

Amaryllis (Hippeastrum)

It is one of the easiest crops to force and is primarily used as a pot plant. Bulbs are produced in early winter forcing. Bulb larger than 22 to 24 cm need to be used. They should be forced at 70^{0} to 80^{0} F and require no specific light intensities and no fertilization.

Anemone

Generally, tubers 3 to 5, 5 to 6, or 6 cm and up 3 are used. This crop must be forced at 45^{0} to 50^{0} F; temperature over 60^{0} F must be avoided. It requires a very well-drained planting medium and a good fertilizer program. Anemones do best at a light intensity of 25 klx.

Caladiums

Caladium in a wide range of colors and shapes. A critical factor to observe is that the tubers must be stored at 70 to 75^{0} degree F and the plants forced at 75-to-80-degree F. Caladium do not tolerate temperature below 70^{0} F for any period of time. A light intensity of 30 to 40 klx is preferred.

Dahlias

Dahlias are forced only as potted plants. They should be forced at a light intensity of 50 klx and at 63-degree F to 65^{0} F. Once they begin to grow, they require frequent watering and a moderately heavy fertilizer program.

To dwarf some cultivars, A-Rest (ancymidol) Must be used as a soil drench 10 to 14 days after planting.

Dutch Iris

To flower, this species requires a sequence of high-cool-warm temperature. They are given either 10 days at 89.5^{0} F for 3 days, followed by 63^{0} F for 2 to 4 weeks and then 6 weeks at 48^{0} degree to 50^{0} F. After this, they are planted in a 55-degree F greenhouse.

The greenhouse must provide high light intensities, and the planting medium must be kept moist. In the greenhouse, the bulbs should be fertilized with 200 ppm nitrogen of 20-20-20 and Ca (No3) 2 on a 3-to-4-day alternate basis.

This should start about 2 weeks after planting in order to allow the roots to develop. For late forcing, the bulbs are held (retarded) at 86^{0} F until 8 weeks prior to the desired planting date.

Freesia

Freesias are used both as cut flowers and potted plants. Normally, 5 to 7 cm corms are used. Freesias are very sensitive to fluride injury. They should be forced at 50 to 55^{o} F as cut flowers and 55 to 60^{o} F as pot plants and light intensities over 25 klx.

Lilies

The forcing of Asiatic and Oriental hybrids as cut flowers and potted plants has markedly increased in the past decade. In general, 10, 12 up to 18 to 20 cm bulbs are used. It is very important that for the earliest forcing that Asiatic and Oriental hybrids be precooled at 35-degree F for a minimum of 6 and 8 weeks, respectively. For late forcing the bulbs must be frozen in at 30^{o} F. Lilies need a light intensity of at least 25 klx to minimize flower abortion and abscission. They should be forced at 55 to 63^{o} and need a moderate fertilizer proforma using Ca $(NO3)_2$ and potassium nitrate (KNO_3). Root-rot disease can be a serious problem, and preventive fungicidal preplant dips and post planting soil drenches should be used.

Ranunculus

Tuberous roots of 3 to 5, 5 to 6 and 6 cm and up are used for forcing either as cut flowers or potted plants. The crop must be forced at 45 degree to 50^{o} F. Temperature over 60^{o} F must be avoided. Ranunculus force best at a light intensity of 25 klx or higher.

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Application of Nano Technology: Prospects and Challenges

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Nano technology is fascinating field of science dealing with a manipulation of atom by atom and thus process and products evolved from Nano science are the most precise once that is impossible to achieve by the conventional system. Nano technology applications are expected to revolutionize the food sector in the near future.

The potential applications include superior processing techniques, improved food contact materials, better quality, shelf-life of food products and novel packaging materials with better mechanical, barrier and antimicrobial properties, by manipulation of matter on an atomic, molecular, and supramolecular scale can improve the properties of bioactive compounds like delivery properties, solubility and absorption through cells.

Nano tubes are utilized in partial hydrolysis of the milk protein α-lactalbumin by a protease from *Bacillus licheniformis* can be made to self-assemble into similar nanotubes under appropriate environmental conditions. Whereas nanosensors are detecting gases, pathogens or toxins in packaged foods and also electrochemical glucose biosensor was nanofabricated by layer-by-layer self-assembly of polyelectrolyte for detection and quantification of glucose, risk assessment report has been published about Magic.

So, a list of factors potentially affecting human health and ecological risks of nanoparticles. Nano Recently, there is considerable interest in exploring the potential of nanotechnology in encapsulation of bioactive materials such as compounds with poor water solubility, peptide, protein, drugs, and large hydrophilic molecules and delivery of biologically active substances, also enhancing the flavor and other sensory characteristics of foods and introduce antibacterial nanostructures into packaging.

Clay nanocomposites are being used to provide an impermeable barrier to gasses such as oxygen or carbon dioxide in lightweight bottles, cartons and packaging biodegradable films. Storage bins are being produced with silver nanoparticles embedded in the plastic. The silver nanoparticles kill bacteria from any material that was previously stored in the bins, minimizing health risks from harmful bacteria.

Nano-coatings and films are currently used on a wide variety of foods, including fruits, vegetables, meats, chocolate, cheese, candies, bakery products, and French fries. Now a days Nanoemulsions also used in food industries. And application of nanotechnology in food-industry focusing specifically on applications which are most likely to be commercialized in the immediate future.

Introduction

In the 1950's, physicist Richard Feynman, considered "the father of nanotechnology", launched the idea on the power of manipulating molecules and atoms, resulting in components so small they are invisible to the naked eye (Hall, J. S., 2005).

However, Nanoscience is the study of particles on an atomic or molecular scale, whose size is measured in nanometres. A nanometre is a billionth of a metre. Thus, nanotechnology can be described as a collection of methods and techniques for processing materials at an atomic and molecular scale to create products with special physicochemical properties in relation to conventional products (Antonio et al., 2014).

It is emerging as a rapidly growing field with its wide application in science and technology for manufacturing of new materials at nano scale level, where unique phenomenon enables novel applications (Albrecht et al., 2006, Ravichandran and Sasi, 2006). The resulting materials and systems can be designed to exhibit novel and significantly improved optical, chemical, biological, and electrical properties such as nanotubes, nanomaterials, nanowire, etc.

Therefore, it is clear that the new nanoscale products replace the old because of their efficient functions (Warad and Dutta, 2005). In fact, nanotechnology has the potential to revolutionize agriculture and food systems. The nanoscale level of foods can affect the safety, efficiency, bioavailability and nutritional value properties as well as the molecular synthesis of new products and ingredients (Aguilera, 2005). The nano scale food additives used to influence texture, flavour, provide functionality and even to detect pathogens and also detecting food spoilage and releasing nano-anti-microbials to extend the shelf life.

Application of Nanotechnology in Food Industry

Nanotubes: Nanotubes are essentially bucky balls that have been on two sides with additional atom groups added in the characteristic hexagon shape to form a hollow carbon tube (Scott, 2005). Whereas partial hydrolysis of the milk protein α-lactalbumin by a protease from *Bacillus licheniformis* results in building blocks, which self-assemble into nanometer-sized tubular structures at appropriate conditions and also increases stability can be controlled. These nanostructures promise various applications in food, nanomedicine and nanotechnology (Graveland-Bikker, J. F.; Kruif, C. G. de, 2006). Single walled-carbon nanotube field-effect transistors (SWNT-FETs) functionalized with olfactory receptor-derived peptides (ORPs) which can recognize trimethylamine so it helps determine the quality of three kinds of sea food (oyster, shrimp, and lobster), but were also able to distinguish spoiled sea food from other types of spoiled foods without any pre-treatment processes (Lim Jong Hyun *et al*., 2013). And also, Carbon nanotube composites - dendrimer can be used as an effective adsorbent for removal of dyes form coloured effluents from aqueous solutions in a batch system and also avoided pollutants produced in many industries and have different adverse effects on water resources.

Nanosensors: The development of novel sensors and biosensors with interest for food industry is one of the key fields for the now a days nanobiotechnology and nanomaterial science. The functionalized nanomaterials are used as catalytic tools, immobilization platforms or as optical or electroactive labels to improve the bio-sensing performance exhibiting higher sensitivity, stability, and selectivity. Nanomaterials are playing an increasing role in the design of sensing and biosensing systems with interest for applications in food analysis (Perez-Lopez, B.; Merkoci, A. 2011). And nanosensors for detections of gasses in package, small molecules and pathogens in food (Wang, 2014). And also, specific detection of sucrose and fructose in several commercial fruit juice samples and the results were compared with those obtained with a commercial spectrophotometric enzymatic kit (Antiochia, R. 2014).

Nanocomposite: Fish protein isolate FPI/ fish skin gelatin FSG-ZnO nanocomposite films, especially those prepared at pH 3, exhibited strong antibacterial activity and thus could be used as an active food packaging material (Arfat, Y. A., 2016). Nano-silicon dioxide particles effectively hydrolyzed olive oil with modified stability, adaptability, and reusability (Bai *et al*., 2006) And also antimicrobial activity by silver nanoparticles on the above-mentioned microorganisms propose the possibility of a more cost-effective antibacterial agent against dysentery causing microbes.

Nano-coatings: Active food coating plays a role of a barrier to the outside environment to protect food products. Whereas gold was coated (Nanolayers of 40 nano meter thickness) on one side of apple, cucumber, lettuce and tomato, by Physical Vapor Deposition (PVD) method, in high vacuum condition at room temperature. Deposition angle of gold nanoparticles were vertical to all species. After coating we kept them in normal room temperature and it leads to increases the shelf-life products in normal room temperature (Kangarlou, H.; Shirvaliloo, S., 2012).

Nano-emulsions: Nanoemulsions are colloidal dispersions that contain small oil droplets (r<100 nm) that may be able to overcome many of the challenges of fortifying foods and beverages with omega-3 fatty acids. The composition and fabrication of nanoemulsions can be optimized to increase the chemical and physical stability of oil droplets, as well as to increase the bioavailability of omega-3 fatty acids (Walker, R. *et al*., 2015). And also, in food products can facilitate the use of less fat without a compromise in creaminess, thus offering the consumer a healthier option. Products of this type include low fat nanostructured mayonnaise, spreads and ice creams (Chaudhry *et al*. 2008).

Challenges

The nano particles are more reactive, more mobile, and likely to be more toxic. Toxicity is the most important issue that must be addressed before the commercial exploitation of nano particles. Where as to determine the effects of these materials on the normal micro flora of the alimentary canal of the consumers. Currently no regulations exist for specific control or limit for the production of nano sized particles (Sozer and Kokini, 2008). Particle size, mass, chemical composition, surface properties, and aggregation of individual particles are the properties of nano materials that determine the impact on the body.

Conclusion

Nanomaterials used as food additives or food packaging materials must not cause any health risks for consumers or to the environment. Further, research studies are required to investigate the hazards of nanomaterials, taking the size as a main factor even though some of the chemical materials in the form of large particles are safer than when they are in the nano state. Hence, commercial application of nanotechnology derived products can be done only after the safety issues are resolved. There is also an immediate need for regulation of nanomaterials before their incorporation into food and dairy processing including packaging. In addition, nanotechnology-derived products need to demonstrate their economic competitiveness prior to commercialization. Until now information related to the economic competitiveness of nanotechnology-derived products is almost lacking.

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Importance in Woman Agripreneur in Agriculture Development

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Introduction

Women comprise half of the world population with enormous potentials. Unfortunately, realistic and potential role of women in society has remained disregarded and unchanged since centuries. India in general is a patriarchal society, where women are dependent on their male counterparts of the family.

When we talk of status of women, it fabricates a picture of inequality, discrimination, illiteracy, weaker-sex, dependency and exploitations. These are the major gender issues apart from rate of women`s participation in educational and economic fields, which is lower in comparison to those of the menfolk. Here, it is important to emphasize that the status of women can only be improved through economic independence. In farming though rate of their participation is higher than those of the male member but generally as unskilled and low paid workers.

This has negative impact on agricultural productivity at one hand and on the other the women are less paid or no paid. Thus, development of women entrepreneurship is the need of the hour to increase their participation in income generating activities and thereby bringing about desired agricultural development.

Women do not work only to support their families but also to create their identity in the male dominated society and be independent. Therefore, agripreneurship will help to make rural women economically and socio-psychologically empowered.

Factors Contributing to Start-up Women`s Enterprise

It is very important to understand the factors that contribute to starting up of woman entrepreneurs. There are mainly three factors responsible for starting up of women entrepreneurs as discussed below:

1. Chance entrepreneurs are those who start a business without any clear goals or plans. Their business probably revolved from hobbies to economic enterprises over time.

2. Forced entrepreneurs are those who are compelled by circumstances to start a business (e.g., death of a spouse, the family facing financial difficulties),as their primary motivation, hence tend to the financial.

3. Created entrepreneurs are those who are “located, motivated, encouraged and developed through, for instance, entrepreneurship development programs.

Emphasis is laid on the created entrepreneurship by Krishi Vigyan Kendras (KVK) and other government or non-government organizations as the created enterprises are permanent ones.

Categories of Women Entrepreneurship

There are three categories of women entrepreneurship as given below:

1. Upper Crust: Established in big cities, having higher level technical and professional qualification, focus on non-traditional items and having a sound financial position.

2. Mid-range entrepreneurs: Established in cities and towns, having sufficient education both traditional and non-traditional items, undertaking women services-confectionery and bakery, kinder garden, creches, health clinics and beauty parlours etc.

3. Grassroots entrepreneurs: It includes the illiterate women, financially weak, who are involved in family business such as agriculture, horticulture, animal husbandry, dairy, fisheries, agro-forestry etc.

Status of Women Entrepreneurship in India

The emergence of entrepreneurs in a society depends to a great extent on the economic factors prevailing in the society. In the advanced countries of the world, there is a huge phenomenal increase in the number of self-employed women, who are no longer confined to the hearth and home. The entrepreneurial capacity of women has made a mark in many areas, and women have entered the industrial segment, too. It is time to foster and harness the entrepreneurship of women in a big way. According to the facts revealed by the Sixth Economic Census by the National Sample Survey Organization, only 14% of business establishments in the country are being run by female entrepreneurs. This means, out of the 58.5 million functional businesses, only 8.05 million of them have a female as a boss. The data collected by the survey also revealed that most of these women run small scale companies and about 79% of them are self-financed. So, it can be concluded from these figures that the status of women entrepreneurship in India is very low.

For the upliftment of women various vocational training courses have been conducted by different government, non-government and other welfare organizations, such as Indian Agricultural Research Institute (IARI), Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAU), Krishi Vigyan Kendras, Home Science Institutions and social welfare societies. These vocational training courses help rural women to sustain themselves through self-employment and to make them self-reliant economically. But there is still a tremendous need to identify and address problems that women face in setting up an enterprise especially in small-scale sector.

Agripreneurship

It is defined as generally sustainable, community-oriented, directly marketed agriculture. Sustainable agriculture denotes a holistic, system-oriented approach to farming that focuses on the interrelations of the social, economic and environmental process. Simply stated, agripreneurship means, entrepreneurship in the broad field of agriculture.

Role of Agripreneurship in Agricultural Development

Earlier emphasis was almost limited to enhancing production and productivity of various agricultural enterprises (seed to seed). Now-a-days focus is on increasing income and profitability and welfare of farmers (rupee to rupee). Another important issue is sustainability of profitability, natural resources and environment. Sustainable agriculture denotes a holistic and system-oriented approach to farming. It considers interrelationship of the social, economic and environmental processes.

There are many areas and sub-areas in agriculture. In each area enormous number of commodities are available. Based on the needs, agro-climatic conditions and available resources, agripreneurs can select and adopt some commodities and flourish it. There is so much scope to improving profitability through value addition. Thus, it is essential to train the jobless with special emphasis on women residing in rural areas in agri-business management. It is also important to sustain in competitive atmosphere of globalization of economy by providing finance and required equipment and machinery.

Scope of Rural Women in Agripreneurship

Agriculture is the lifeblood of the economy in most developing countries, and food processing accelerates agricultural production and promotes sustainable agricultural intensification. Therefore, more attention needs to be paid for the development of rural women entrepreneurship in food processing, preserving and packing of the products.

Through food processing and preservation, the income of the women entrepreneurs can be improved which will gradually improve the earning potential capacity of women. Food processing bring a wider range of benefits to enterprising women in developing countries which include the potential for adding value to basic agricultural produce and dairy which will eventually improve the small-scale women producers and entrepreneur's income-earning ability, allowing improved use and control of local resources and helping to create employment for rural women. Women entrepreneurship in food sector can be started as given below:

S. no.	Agricultural Sectors	Products
1	Value addition in cereals &pulses	Dalia, Wheat flour, Maida, Waddiyan Papad etc.
2	Value addition to milk	Milk products, Skimmed Milk, Milk power, Ice cream ,Butter, Ghee, Khoa, Skimmed powder, Sweets, Flavoured Milk, Dahi, Lassi, Kulfi, Kheer, Peda and Pudding etc.
3	Value addition in vegetables and fruits	Pickles , Jam ,Jellies, Murabba, fruit cheese, juices Squashes , Fruit Juice beverages , Chutney ,Sauces , Candies and dried Fruits & vegetables etc.
4	Bee Keeping	Pollens, Wax and Honey
5	Mushroom Cultivation & processing	Pickle Making , Fresh & Dried Mushrooms
6	Commercial Barkery	Cakes, Cookies, Biscuits, ready to eat foods, Namkeen etc
7	Tiffin service	Breakfast, Lunch, Dinner.

Emerging Benefits of Rural Women`s Agripreneurship

It helps in reducing migration to urban areas, improves the economic status of rural women, achieves the goal of balanced growth i.e., eco-friendly development, reduce the post –harvest losses of perishable goods, improvement in rural infrastructure, enhances employment opportunities, rural women`s empowerment, unexploited and underexploited natural resources can productively utilize and unorganized women resources could be channelized.

Constraints in Women Aripreneurship

Dual role at workplace and home, lack of finance, non-cooperation from the family, sun availability of required equipment, lack of proper knowledge, lack of management skills, lack of storage and warehousing, low level of risk-taking attitude, low level of self-confidence, lack of marketing, complicated procedure of availing credit, weak linkages between the women entrepreneurs and government agencies are the major constraints in development of women agripreneurship.

Strategy to Develop Rural Women Agripreneurship

The following are the major planks of strategy:

1. Family and community sensitization.
2. Massive skill development training programs backed up with follow up and marketing linkages.
3. Credit facilities.
4. More funds should be provided to research organizations like CIPHET.
5. Formation and follow up of SHGs/FPOs/WPOs.
6. Ensured marketing of the products.
7. ICAR, CAUs, SAUs, NIRD, MANAGE, NABARD, KVKs, ATMAs and reputed NGOS should be actively involved.
8. Rewarding the successful women entrepreneurs.
9. Converging efforts of different agencies and institutions involved in this task.

Conclusion

With proper guidance, finances, trainings and skill development a large number of women can be motivated to earn their own living by establishment of the enterprises. There is great need to explore more women, who are enthusiastic and have skill, strong willpower, need and potential to start, operate, manage and bear risk of staring up an enterprise and to do something productive. Success lies in marketability of the products. Each agricultural produce /product has essentially at least one health benefit. Segmentation of consumers is required on the basis of the benefits in terms of time, place, season, existing problems, their requirements, food habits, etc. and value addition. An entrepreneur has to keep his /her eyes, ears and nose open all the time. Understanding the consumers/buyers is also important. Becoming hard worker to smart workers the prerequisite as. Commodities are not sold in markets but it is the is idea which is sold.

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Ecological Weed Management: A Novel Approach for Sustainable Agriculture

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Abstract

Ecological Weed Management is a combination of methods aimed at achieving long-term weed suppression by using ecological interactions between crops, weeds, soil and other taxa fostered by appropriate management of agro-ecosystems with the least possible use of direct weed control methods, e.g., chemicals. Ecological management of weeds differs in several ways from traditional weed management.

The challenge in this context is to develop integrated weed management systems that reduce herbicide use and maintain sustainable crop production without compromising the farmers' income and natural resource health. The basic principles in Ecological Weed Management are enhancing crop competitiveness in order to minimize the competitive weed pressure on the crop.

It emphasizes the integration of agronomic, genetic, mechanical, biological and chemical means of weed management that promote crop growth and development in an environmentally safe agro-ecosystem with less weed-interference.

Sustainable farming is a system for managing natural resources in such a way that future generation production functions are not enough.

Merits of Ecological Weed Management

1. Low cost for weed control.
2. Easy to adopt.
3. No residual problem.
4. Technical skill is not much involved.
5. No damage to crops.
6. Effective weed control.
7. Crop-weed ecosystem is maintained.

Demerits of Ecological Weed Management

1. Immediate and quick weed control is not possible.
2. Weeds are kept under suppressed condition.
3. Perennial and problematic weeds cannot be controlled.

Ecological Weed Management Strategies

1. Competitive crop and crop's cultivars.
2. Time, method, rate of sowing and row spacing.
3. Crop rotation, trap, catch & cover crops.
4. Sole, inter- and mixed cropping.

5. Time and method of irrigation.
6. Kind, rate time and method of fertilization.
7. Summer fallowing/ Ploughing.
8. Soil Solarization.
9. Stale seedbed technique.
10. Flooding and drainage.
11. Resistant crops and crop's cultivars for parasitic weeds.
12. Residue incorporation into soil.

Competitive Crop and Crop's Cultivars

1. Crop species: Crop species differ in their pattern of germination, tillering, branching, nature and orientation or inclination of the leaf, root growth, relative growth rate, plant stature / height, total growing duration, etc. and therefore variation in their competitive ability to smother weeds is quite obvious.

2. Crop variety / cultivar: The better competitive ability of WH-291 and HD-2285 than HD-2009 and S-308 against wild oat (Avenaludoviciana Dur.) under late- sown condition.

Sowing of Crop (Time, Method, Rate of Sowing and Row Spacing)

1. Time of sowing: Under almost weed-free or less weedy environments, the crop may germinate a little earlier or later than its normal sowing time and have initial growth. For example, when wheat is being sown on October, weeds pose more competition than on November or December.

2. Method of sowing: Line sowing usually encounters less weed infestation, and makes it easier to control it than broadcasting. In wheat, FIRBS is of recent introduction from CIMMYT, Mexico and has been found to be useful in reducing overall weeds including Phalaris minor wheat competition mainly on the elevated bed, but the furrows remain highly populated with weeds.

3. Rate of sowing: Increasing the initial seedling strength of a crop, there is a greater chance of a healthy and competitive crop that could smother weeds itself. Sowing rate and percent viability and seed germination typically determine crop density.

4. Row spacing: It is necessary to search out suitable row spacing close enough, which does not invite intra-species / intra-specific finishing between crop plants.

5. Crop Rotation: Crop rotation is defined as the practice of growing different crops year after year sequentially on the same piece of land. Crop rotation is highly effective against parasitic weeds such as Striga hermonthica / asiatica mainly in sorghum and maize, Brassicas Orobanche ramose and solanaceous crops.

Change Crop Ecology

Shallow / deep roots, cold / warm season, row / drilled crops, heavy / light feeders and foliage density. Cultural practices change: dates of cultivation, mowing, fertilization and planting / harvest.

Cropping Practice

1. It is a fact that suitable intercropping or mixed cropping under rainfed and unirrigated conditions is more remunerative than sole cropping, but under assured irrigation, sole cropping may be superior to maximizing sole crop yield.

2. Live mulch / cover crop: Live mulch is nothing more than a living cover preserved by growing a cover crop. A food crop is planted directly in it without the tillage or chemical ploughing (using herbicide) destroying the established cover.

3. Trap and Catch Crops: These crops should be included in crop rotation especially for controlling Striga and Orobanche parasite weeds but not for Cuscuta. Trap crops are nothing but false hosts exuding stimulants for the germination of striga and inducing germination of striga seeds.

Scheduling of Irrigation

Time and method of irrigation affect weed emergence and growth, submergence controls many weeds, drip irrigation reduces weed proliferation leaving less soil area wetted near the tree crops and alternate furrow lessens weeds in dry furrows.

Soil Solarization

This is a method of utilization of solar energy for the desiccation of weeds. In this method, the soil temperature is further raised by 5 – 10ºC by covering a pre-soaked fallow field with a thin transparent plastic sheet.

Stale Seedbed

A stale seedbed is one where one or two initial flushes of weeds are destroyed before a crop is planted. This is achieved by soaking a well-prepared field with either irrigation or rain and allowing the weeds to germinate and then by ploughing or non-residual herbicides to destroy them.

Summer Fallowing / Ploughing

The purpose of fallowing is to expose weed seeds, underground vegetative structures of deep-rooted perennial weeds such as Cyperus species, Cynadondactylon, Digitariaabyssinicaetc, insects, pathogens, deep tillage nematodes to the hot sun and kill them with solarization.

Residue Incorporation into Soil

Lentil crop residues are phytotoxic to wheat, and from sunflower to multiple crops to mustard. In this direction too, weed research can be given priority, as nowadays enough crop residues are piled up and the farmers are facing the problem of residue disposal, mainly in rice in southern India.

Conclusion

Increasing use of chemical substances in agriculture has led to many environmental and health problems. It is therefore high time and challenge for all farmers to work on the aspects that use least of chemicals in agriculture, and ecological weed management is one of them. This aspect enhances crop competitiveness so as to minimize the crop 's competitive weed pressure.

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Varroa Mite - A New Prospective Intimidation to Apiculture Industry

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Honeybees and their usefulness are known to man from ancient time. The modern beekeeping became possible after the discovery of movable frame hive in 1851 by L. L. Langstroth. In India first attempt was made to keep bees in movable frame hives during 1882 and 1883-84 from Bengal and Punjab area, respectively.

The number of honeybee colonies has been grown across the world in last 50 years. The poor bee health has reached alarming levels in some regions of the world. Different species of pests cause damage to honeybees resulting in economic losses, among them varroa mite is very important ecto-parasite threats to commercial beekeeping throughout world.

The varrora mite, *Varroa destructor* Anderson and Trueman (Acari: Mesostigmata) was first time described in 1904 from Java (Indonesia) on *Apis cerana* (Deosi and Chhuneja, 2017a). This mite is parasitizing the European honey bee, *Apis mellifera* L. (Hymenoptera: Apidae) and responsible for loss of more than 50 per cent of *A. mellifera* colonies worldwide (Martin *et al*., 2012).

According to Gulati *et al*. (2009), ninety per cent apiaries and fifty per cent colonies of Haryana state are affected by this mite only. It is feed on haemolymph of brood and adult bees cause colony disorder, weakness, decreasing brood and deforming immature and mature bees (Kotwal and Abrol, 2013).

Biology

The number of reproductive cycles and sex ratio from various bee stage sources, the mite could complete maximum of three reproductive cycles both in worker and drone brood. There were 26.20 and 33.40 per cent mites collected from worker brood and adult bees, respectively which could complete the first reproductive cycle.

The second and third reproductive cycle was recorded 10.20 and 11 per cent and 2.01 & 3 per cent mites, respectively. In case of drone brood 32, 25 and 25 per cent mites with their source of drone brood itself, worker brood and adult worker bees, respectively completed first reproductive cycle, 10, 9 and 10 per cent for the second and 3.01, 2.01and 2.01 per cent for the third cycle.

The male: female ratio was found varied between 1:0.70 to 1:0.84 during various seasons in worker brood, while it ranged between 1:0.83 to 1: 1.23 in spring. However, it varied from 1:2.93 to 1:3.50 in drone brood during spring (Deosi and Chhuneja, 2015). Deosi and Chhuneja (2017a) recorded that the total developmental time for male and female mite was 141.28±0.24 and 149.06±0.31 hrs in worker brood, while in drone brood for the male and first to fourth female was 140.65±0.24, 152.52±0.49, 153.68±0.19, 152.50±0.28 and 154.22±0.17 hrs, respectively.

Seasonal Incidence

A survey was carried out in South Gujarat revealed that the presence of Varroa mite on honey bees with its peak activities during last week of April (Anonymous, 2016). Brar (2016) observed higher mite incidence infesting *A. mellifera* colony in stationary condition than migratory condition. Hussain *et al.* (2018) reported that the incidence of Varroa mite was higher in the month of November and April.

Honeybee and Varroa Mite Interaction

The defensive behaviour of honey bees against Varroa mites consisting of auto-grooming and allo-grooming leads to the injury and death of mites (Thakur et al. 1997). Stanimirovic et al. (2010) found grooming potential in the honey bees by recording the percent damage mites based on the total number of fallen mites in the three consecutive generations of unselected and selected queens which showed that grooming behaviour of honey bees has low heritability character. Kavinseksan (2013) found that Russian bees have more efficient grooming behavior which killed Varroa mites as compared to the Thai bees. The average injured mite percentage of the Russian honey bee colonies (36.9±1.8per cent) was significantly higher than that of the Thai colonies (27.8±1.9per cent).

Losses

Nearly twenty honey bee viruses have been discovered and the majority of them have an association with Varroa mites, which act as a physical and or biological vector (Kevan *et al*. 2006). Dahle (2010) revealed that the rate of colony losses among beekeepers was significantly lower in regions without *V. destructor* as compared to those where the presence of the mite was verified. Parrey (2011) found that benefit cost ratio decreases with increase in the level of Varroa mite infestation. Deosi and Chhuneja (2017b) reported that Varroa mite infested colonies lead to significant reduction of wing size and weight in worker bee, *A. mellifera*.

Management

Toomemaa *et al.* (2010) reported a water solution of 0.5% oxalic acid (OA) gave effective control of the mite and was not toxic to bees, whereas higher concentration of OA (1.0 and 1.5%) were highly toxic to bees.The different essential oil and formic acid applied @ 5ml/ hive for Varroa mite control showed that garlic oil gave significantly superior results in reducing the Varroa mite population up to three weeks with an overall mean value of 75.03 per cent followed by formic acid giving 72.94 per cent mite mortality (Goswami and Khan, 2013). Rasool *et al*. (2017) reported that taufluvalinate (2 strips per colony) was found highly effective against the *V. destructor* followed by formic acid 85% @ 2 ml per colony. However, botanical green leaf extract mixture (*Artemesia annua* + *Matricaria chamomilla* + *Juglans regia*) @ 150ml/colony was found highly effective against Varroa mite followed by *M. chamomilla*.

Conclusion

It is the most serious ecto-parasitic mite on honeybee species in worldwide and active round the year with its peak incidence during month of April, June and November. The grooming behavior of honey bee is hygienic in nature which helps in removing the mites from its body. It has low heritability in *A. Mellifera* but, highly effective in Russian bee strain. It reduces bee colony strength and morphometric effects on honey bee. It can be managed with botanicals and chemicals such as oxalic acid, formic acid and taufluvalinate.

Future Thrust

Need to:
1. Survey on seasonal incidence of Varroa mite in different region.
2. Evaluate eco-friendly effective management practices for small beekeepers.
3. Identify naturally occurring resistant honey bee strain against Varroa mite in commercial stock.

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Importance of Genetic Improvement of Roots in Vegetables

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Introduction

Roots are essential for plant productivity and serve a variety of functions, such as water and nutrient uptake, forming symbioses with other microorganisms in the rhizosphere, anchoring the plant to the soil, and acting as storage organs. The deferent interactions of a root with its environment depend on its organization and structure, from the cellular to whole-plant level. To face future challenges in crop production dictated by global climate changes, breeders and plant researchers collaborate to develop productive crops that are able to withstand a wide range of biotic and abiotic stresses.

Increasing Productivity

To feed growing population 9 billion by 2050 by improving root system. High yield is possible through large and filled sink size (i.e., filled grains). This can be done when root supplies sufficient nutrients to above ground plant parts. Breeding efforts to improve crop yield are in general focused on aboveground, shoot-related phenotypes, whereas the roots as 'hidden half' of the plant are still an under-utilized source of crop improvement. Trials aimed to select for new cultivars with improved crop yield are in general performed under optimal nutrient concentrations, which has often led to selection for smaller and less plastic roots . Moreover, modern cultivars develop in general faster and the earlier initiation of shoot sinks stimulates the investment of biomass into the shoots rather than into the roots.

Enhancing Tolerance to Abiotic Stresses

Drought resistance a boon for rainfed agriculture. "More crop per drop". Salinity resistance- 16% of the world's cultivated land and near half of all irrigated lands are affected by salinity. Crop yield is driven by the combination of climate, soil, management, and genetics. Under optimal circumstances the soil provides plants with stability, water, and nutrients. However, soils are heterogeneous environments, strongly influenced by outside factors. Nutrient deficiency, drought, salinity, flooding, and temperature are major drivers of the current and future yield gap. Researchers and breeders work together to develop crops that are able to with stand these stresses. However, current crop selection is mainly focused on the shoot, whereas most major drivers of the yield gap affect soil properties, directly influencing the root system.

Improving Efficiency of Nutrients Supplied

Excess nutrients remain unused and washed off from fields to rivers, poisoning coastal water. Nutrient deficiencies. E.g., Only 10-20 % of supplied P is available to plants.

Root Response to Abiotic Stress

1. Root morphology change:

a. Change in response to phosphate deficiency: Phosphate is a building block of nucleic acids and membrane phospholipids. Because of the high phosphate demand of plants, limitation in phosphate has a strong effect on plant growth Efficient uptake of phosphate is therefore essential. High plant cycling, in combination with low mobility, leads to accumulation of phosphate in the topsoil. To optimally forage the soil for phosphate, plants need to develop a shallow root system. The root system architecture (RSA) response to phosphate deficiency in Arabidopsis is well-characterized. A strong shift from main root growth to lateral root growth is observed, which leads to a short root with a high number of long laterals. In addition, a strong proliferation of root hairs is observed.

b. Deep rooting and selective root placement for nitrate: In contrast to phosphate, nitrate is highly mobile in soils and is therefore prone to leaching. In environments where nitrate is limiting, deeper soil layers can often other nitrogen supplies. Consistently, availability of phosphate and nitrate has contrasting effects on RSA. Low nitrate availability in general limits plant growth. However, low nitrate availability does not limit primary and lateral root elongation, enabling the root system to reach deeper layers of the soil. This shift in investment results in an increase in root: shoot ratio.

c. Drought - searching for water supplies: Besides nutrient limitation, water limitation is the biggest driver of the yield gap. Most crops have high water requirements and are poorly drought resistant. However, irrigation is already responsible for 70% of the total use of available freshwater. The present focus of plant breeders therefore is on improving water use efficiency of crops. When water availability is limited, the soil osmotic potential decreases and plants are confronted with osmotic stress. Plants cannot take up water and sometimes even loose water to the soil. The high surrounding osmotic potential leads to loss of turgor, starting in the root. The combination of rapid sensing and signalling, followed by adjustments on both cellular and organ level can enable the plant to limit water loss and survive drought stress. Drought stress leads to distinct changes in RSA, both on whole-root system and sub-organ level.

d. Temperature effects on root system architecture: The exposure of both mono- and dicot plant roots to temperatures below or above their optimum temperature generally decreases:

i. Primary root length.
ii. Lateral root density (numbers of lateral roots per unit primary root length).
iii. The angle under which lateral roots emerge from the primary root, whereas the average lateral root length is unaffected (Mcmichael et al., 1993; Nagel et al., 2009).

In addition, roots suffering from supra optimal temperature stress starts to initiate second and third order laterals (Pardales et al., 1999) and are characterized by an increased average root diameter (Qin et al., 2007). In general, the modulating effect of sub- and supra optimal RZTs on RSA development reduces the volume that roots may access for the uptake of water and nutrients.

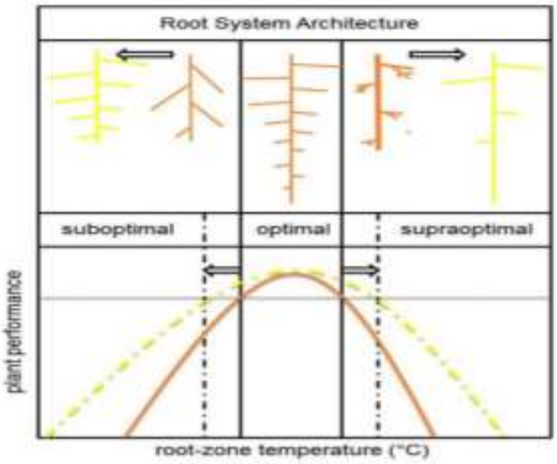

FIGURE 2. Schematic overview of the effect of root-zone temperature on plant performance and underlying general changes in RSA (brown).

To broaden the temperature range for optimal plant performance (yellow), plants should invest in lateral root formation (suboptimal temperature range) and/or axile root length (supraoptimal temperature range). The adaptive value of these RSA changes is, respectively, an increased root surface area to improve resource uptake capacity and drought adaptation by penetration to lower soil layers.

2. Hormonal activity:

Hormones from roots as signals for the shoots of stressed plants: Stress in root system altered gene expression / metabolism. This results in Increase or decrease in hormone production transport into xylem sap by this transport to Shoot system/ targeted cells it causes the change in Metabolism (senescence, stomata closer). By changing in the metabolism, the plants escape from stress condition.

Table 1: Main biochemical processes involved in the regulation of root development in plants subjected to abiotic stress conditions.

Biochemical process	Abiotic stress	Reference
Higher production of abscisic acid	Drought	Davies et al. (2005)
Ethylene synthesis	Nutrient deficiency	Vysotskaya et al. (2008)
	Drought	Aloni et al. (2006)
	Water logging	Vidoz et al. (2010)
Changes in auxin and cytokinin Concentrations	Drought	Aloni et al. (2006)
	Water logging	Armstrong and Drew (2002)
	Salt	Ruzicka et al. (2007)

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Root Improvement by Marker Assisted Selection (MAS) in Vegetables

Article ID: 10449

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Introduction

Vegetables are considered as protective foods and also play an important role in providing a balance diet contains adequate energy source (CHO), vitamins, minerals, fat, easy digestive fibre and protein. A most of the protein (60.2%) consume in India is from cereals. About two million people in the world, suffer from deficiency of vitamins and minerals. Most affected are women and children. Vegetables being chief source of proteins, Vitamins, minerals play a significant role in correcting nutrient deficiency. According to National Institute of nutritional Hyderabad, the daily requirement of Nutrients proteins, vitamins, minerals etc., can be met if an individual takes 280g vegetables per day. This should include 110g leafy vegetables, 85g of root of tuber vegetables at present the vegetables consumption in India is only 210g per head per day. Marker Assisted Selection (MAS) refers to indirect selection for a desired plant phenotype based on the banding pattern of linked molecular (DNA) markers. MAS is based on the concept that it is possible to infer the presence of a gene from the presence of a marker which is tightly linked to the gene of interest in the vegetable crops.

Important Applications of MAS in Plant Breeding are Briefly Presented Below

1. MAS are very effective, efficient and rapid method of transferring resistance to biotic and abiotic stresses in crop plants.
2. It is useful in gene pyramiding for disease and insect resistance.
3. It is being used for transfer of male sterility and photo period insensitivity into cultivated genotypes from different sources.
4. MAS are being used for improvement of quality characters in different crops such as for protein quality in maize, fatty acid (linolenic acid) content in soybean and storage quality in vegetables and fruit crops.
5. MAS can be successfully used for transferring desirable transgene (such as Bt gene) from one cultivar to another.
6. MAS are very effective in introgression of desirable genes from wild into cultivated genotypes.

Marker Assisted Selection: Steps Involved

1. Selection of Parents: Selection of suitable parents is an important step in marker aided selection. The parents should be such so that we can get usable level of polymorphism (variation) in the RFLP markers. In other words, parents with contrasting characters or divergent origin should be chosen. This will help in identification of DNA of both the parents and also their segments in F2 generation in various recombination's. For selection of parents, we have to screen germplasm and select parents with distinct DNA. The parents that are used for MAS should be pure (homozygous). In self- pollinated species, plants are usually homozygous. In cross-pollinated species, inbred lines are used as parents.

2. Development of Breeding Populations: This is the second important step for application of marker aided selection. The selected parents are crossed to obtain F1 plants. F1plants between two pure-lines or inbred lines are homogeneous (alike phenotypically) but are heterozygous for all the RFLPs of two parents involved in the F1. The F2 progeny is required for the study of segregation pattern of RFLPs. Generally, 50-100 F2 plants are sufficient for the study of segregation of RFLP markers.

Selection of lines form Germplasm

Isolation of DNA from each plant

Scoring of marker

Correlation with morphological traits

3. Isolation of DNA: The third important step is isolation of DNA from breeding population. The main advantage of MAS is that DNA can be isolated even from the seedlings and we need not to wait for flowering or seed development stage. The DNA is isolated from each plant of F2population. Standard procedures are available for DNA isolation. The isolated DNA is digested with specific restriction enzyme to obtain fragments of DNA. The DNA fragments of different sizes are separated by subjecting the digested DNA to agarose gel electrophoresis. The gel is stained with ethidium bromide and the variation in DNA fragments can be viewed in the ultraviolet light. The DNA of chloroplasts, when digested with specific enzyme, produces about 40 fragments of different sizes. The nuclear DNA of higher plants, when digested with specific restriction enzymes, produces millions of fragments in a continuous range of sizes. It is a tedious job to identify individual DNA fragment in such cases.

4. Scoring RFLPs: The polymorphism in RFLPs between the parents and their involvement in the recombinants in F2 population is determined by using DNA probes. The labelled probes are used to find out the fragments having similarity.

The probe will hybridize only with those segments which are complementary in nature. Generally, 32P is used for radioactive labelling of DNA probe. Now non-radioactive probe labelling techniques are also available. In this way RFLPs are determined.

5. Correlation with Morphological Traits: The DNA marker (say RFLPs) are correlated with morphological markers and the indirect selection through molecular markers is confirmed. Once the correlation of molecular markers is established with morphological markers, MAS can be effectively used for genetic improvement of various economic traits.

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Improved Precision Production Technology of Marigold

Article ID: 10450

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Botanical name: *Tagetes erecta* L.
Family: Asteraceae
Chromosome no: 2n= 24
Origin: Mexico

Marigold cultivation in field	**Marigold cultivation in controlled environment**

Introduction

African marigold (*Tagetes erecta* L.) is an important traditional flower crop under cultivation throughout India. It is extensively used in religious and social functions in different forms. Marigold is widely grown in gardens and pots for display purpose. It has great economic potential in loose flower which find industrial application in preparation of natural dyes and essential oils. It is used as mosquito and nematode repellents. Now-a-days Xanthophyll pigments gained economic interest as a feed additive for poultry industry to improve the pigmentation of broiler skin and the egg yolk.

Propagation

Marigold is mainly propagated by seeds. Seeds can easily be collected by crushing the flowers after drying.

Soil and Climate

Marigold can be successfully cultivated on a wide variety of soils. Soil that is deep, fertile, friable having good water holding capacity, well drained and with soil pH of 7.5 is ideal for its cultivation. Saline and alkaline soils are not suitable for the cultivation. It requires continuous warm climate, and extreme hot and cool condition are not good for its growth. It grows well in all seasons. The optimum temperature required for its growth is 15 to 21°C.

Field Preparation

Main field is ploughed using four different implements viz., chisel, disc, cultivator and rotovator. Azospirillum and phospobacteria each @ 2 kg/ha is applied before the last ploughing. Raised beds (4 feet width x 94 feet) length are formed.

Nursery Preparation

The seedlings are raised inϖ protrays Protrays (54 x 27cm) with 98 cells of 3.5cm diameter and 8mm thickness is ideal.

Seed Rate

Generally, marigold is propagated through seeds and optimum seed rate in precision production of marigold is about 200g/ha.

Image showing seeds of marigold

Transplanting

Seedlings are transplanted within 18 – 20 days.

Spacing

For proper and better growth of the flowers there should be taken a proper spacing in marigold fields and it must be about 90 x 22.5cm.

Irrigation

By adapting such irrigation method much water is saved and sufficient amount of water can be given to the crop so drip irrigation is acquired which is applied once in 2 days. Proper moisture maintenance is a must for good growth of the crop.

Drip system of irrigation in the field of marigold flower

Nipping

An important cultural practice carried out 20 days after transplanting.

Fertilizer Application

75% of the total recommended dose of NPK (67.5:67.5:56.25 kg/ha) is applied through drip irrigation. Water soluble fertilizers viz., Urea Polyfeed (19:19:19) and Potassium nitrate are used.

Micronutrient Application

Foliar application of FeSo4 @ 0.5% and Znso4 @ 0.5% at 30 and 45 days after transplanting.

Integrated Pest and Disease Management

Application of Spinosad @ 0.75ml/litre for managing the flower borer (*Helicoverpa armigera*). Soil application of *Pseudomonas flourescens* @ 2.5kg/ha followed by foliar application of *Pseudomonas flourescens* @ 0.5 % for leaf spot.

Yield

Yield generally varies as per the varieties and various adopted practices for its production but about 32.5 tones/ha flowers of marigold can be obtained.

Xanthophyll Content

By practicing of precision production technology large amount of xanthophylls content can be obtained i.e., 1.99g/kg of flowers.

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Clathrin Coated Vesicles (CCV)

Article ID: 10451

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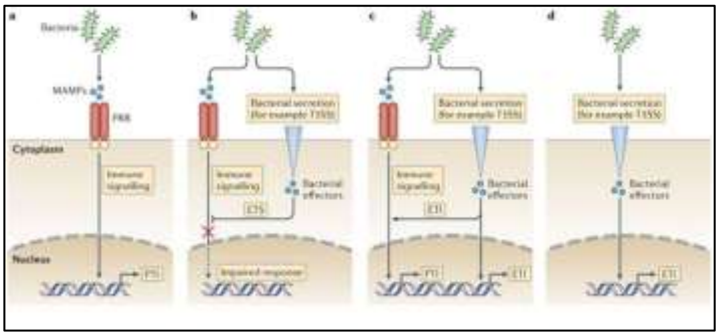
Introduction

1. Endocytosis and Exocytosis.
2. PTI and ETI (Pattern triggered immunity and Effector triggered immunity).
3. Vesicular trafficking.

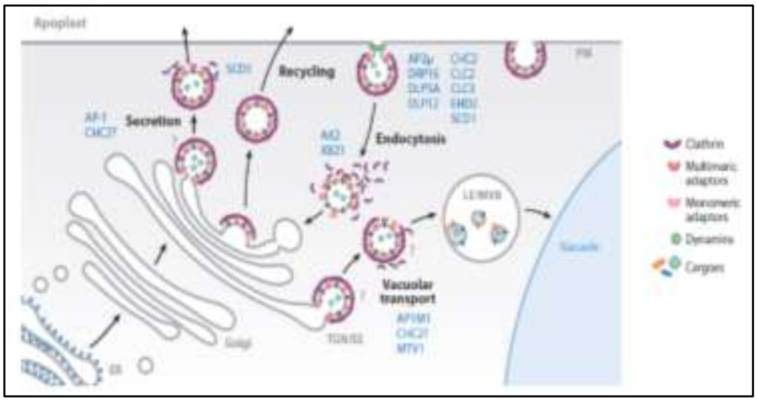
Plants utilize a two-layered immune system comprising pattern-triggered immunity (PTI) and effector-triggered immunity (ETI) to combat potential infections by invading pathogens. In PTI, plasma membrane (PM)-localized pattern-recognition receptors (PRRs) detect structurally diverse microbe- or pathogen-associated molecular patterns (PAMPs) that are derived from invading pathogens and plants have evolved resistance proteins to recognize pathogen effectors directly or indirectly, triggering ETI responses to stop infection when PTI fails. Although their mode of activation differs, both PTI and ETI utilize overlapping immune signaling networks; however, ETI responses are more robust and prolonged and have a higher amplitude.



These processes are mainly achieved by the addition and removal of proteins or carbohydrates through an elaborate intracellular membrane system. Because this process involves transporting components in small, membrane-bound vesicles between intracellular membrane compartments and the host cell surface, it is referred to as vesicular trafficking.

The various types of endocytosis include constitutive endocytosis, during which components are removed from the cell surface in the absence of any stimulus, mostly to counterbalance an increase in the cell surface due to constitutive secretion, as well as ligand-induced endocytosis, during which specific proteins are internalized from the PM in response to a stimulus (or pathogen) as a means to desensitize cells to the stimulus and/or attenuate signaling. the late steps in endocytic recycling and secretion, namely the transport and fusion of early endosomes derived vesicles with the PM, are referred to as exocytosis.

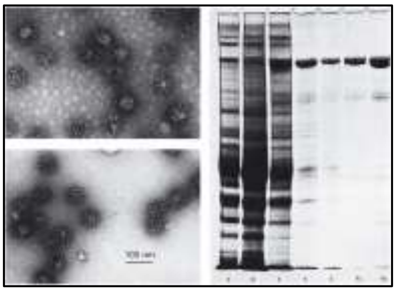
A complex and dynamic vesicle trafficking network ensures that components with immune functions reach their site of function, namely the cell surface, to contribute to effective immunity. For example, if immune cargo enters an erroneous vesicular trafficking route, it will be delivered to an incorrect subcellular compartment, resulting in a nonfunctional component that cannot fulfill its cellular role(s) in defense.



Clathrin- "An Accidental Discovery"

In 1975, a young postdoc at the MRC Laboratory of Molecular Biology published a paper in the Journal of Molecular Biology, entitled 'Coated vesicles from pig brain: purification and biochemical characterization'. For the postdoc, Barbara Pearse, this was the culmination of 2 years' work, which had started off as an attempt to purify tubulin. The classical method for purifying tubulin is to allow brain extracts to go through two cycles of microtubule assembly followed by disassembly, but this only works on very fresh tissue. What Barbara didn't realize was that the brains she got from the local slaughterhouse were already a day old. So, when she looked at her prep in the electron microscope, she didn't see any microtubules, but she did see intriguing structures that looked to her like sliced tomatoes.

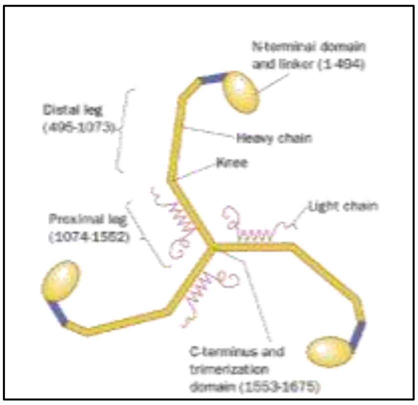
When she showed the images to colleagues, they recognized the structures as the 'vesicles in a basket' that had been described by Toku Kanaseki and Ken Kadota some 5 years earlier. So, in the end, Barbara decided to purify coated vesicles instead of tubulin, captivated not only by their tomato-like appearance but also by several reports in the literature about their possible role in endocytosis, although that word was not yet in common use. When she analysed her purest fraction by SDS-PAGE, she found that it was dominated by a single protein with a molecular weight of ~180K. In the final paragraph of her paper, reproduced below, she made a number of points that would set the scene for thousands of papers in the years to come.



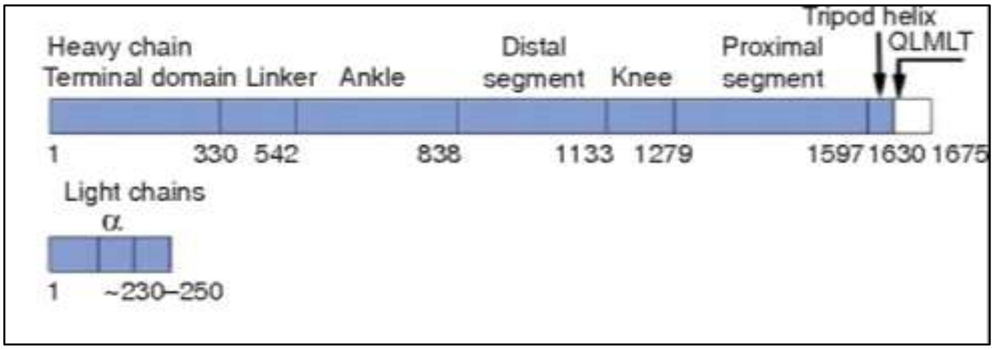
Structure of Clathrin

Biochemical characterization of preparations of highly enriched coated vesicles from a variety of tissue sources led to the identification of the major coat constituents as two oligomeric proteins, clathrin and AP complexes. Clathrin consists of three 192-kDa heavy chains (HCs) each bound to either of two 30-kDa light chains, LCa or

LCb. This complex is called a triskelion, based on its three-legged appearance when viewed by negative stain or rotary shadowing. Triskelions are the assembly units of the polygonal lattice composed of hexagons and pentagons that demarks the bud site and eventually encases the transport vesicle. Each triskelion leg is comprised of an extended HC molecule oriented with its C terminus at the vertex.



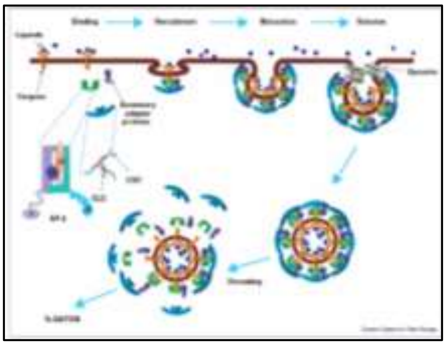
The central hub of a triskelion contains three regions: a small globular domain at the extreme C-terminus, a trimerization domain that constitutes the vertex, and a proximal leg, to which the LCs are bound. The distal leg segment and the globular, 50 kDa terminal domain located at the N terminus of each HC are connected to the hub through a protease-sensitive bend, also called a knee. Clathrin triskelions are structurally heterogeneous because the distribution of the two LCs among them is random.



CCV Components

1. Core components.
2. Multimeric adapter proteins.
3. Monomeric adapter proteins.
4. CCV accessory proteins.
5. Uncoating proteins.
6. Other CCV associated components.

Clathrin Mediated Endocytosis (CME)



AP-2 complexes are recruited to the plasma membrane by the α subunit binding to PIP2 (red), but rapidly cycle on and off. Electrostatic interactions between PIP2 and the μ subunit may open up the complex and expose additional binding sites. Interactions with cargo further stabilize the open conformation of AP-2 and enable the coated pits to mature more efficiently.

Clathrin also stabilizes the association of AP-2 with the plasma membrane: one triskelion recruited to two AP-2 complexes increases the residence time of the AP-2 at the plasma membrane and results in the recruitment of more clathrin and AP-2. The coated patch keeps growing, incorporating various early-arriving alternative adaptors, such as CALM and the muniscins FCHo1/FCHo2. Dynamin is recruited to the neck of the deeply invaginated coated pit to facilitate scission from the plasma membrane. Immediately after scission, uncoating machinery is recruited, including auxilin and OCRL1.

Functions

1. Clathrin mediated endocytosis.
2. Post-Golgi trafficking.
3. Protein trafficking to the vacuole.
4. Secretion of newly synthesized cargo.
5. Recycling of endocytosed proteins to plasma membrane.
6. Delivering cell wall, lipid and protein components to plant specific cell plate during cytokinesis.
7. Involve in the regulation of plant immune responses.

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Drying Technology in Vegetables

Article ID: 10452

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Introduction

Drying or dehydration is one of the most effective means to extend the shelf life of perishable fruits and vegetables. The main purpose of dehydration in preserving fruits and vegetables is to remove moisture so that water activity of the dehydrated products is low enough of aw less than 0.6 for preventing the spoilage and the growth of pathogenic microorganisms and subsequently to reduce the spoilage reactions. Dehydration is also used in combination with other preservative factors such as initial heating of vegetable in boiling water and salt solution to extend the shelf life of vegetables. Dehydration significantly reduces the cost of transportation and storage due reduced weight and volume of dehydrated vegetables. Unlike fresh vegetables, dehydrated vegetables do not require refrigeration during storage. Sun drying has been used since ancient times to produce dehydrated vegetables. This method is expensive but the effectiveness of drying depends on bright sunshine and longer drying times. The dried vegetables with sun drying are not widely acceptable due to unhygienic quality.

Drying of Okra (*Abelmoschus esculentus* L.)

Nutritional and Health benefits:

a. Effective prevention of colon cancer and skin discoloration due to presence of phytochemicals such as lutein, indoles, sulforaphane, carotenoids, isoflavones, etc.

b. Higher presence of many nutrients including vitamins A, B6, C, iron, fiber, calcium and folic acid Stabilization of blood sugar through okra fiber from the intestinal tract.

c. Lubrication of large intestine due to its bulk laxative qualities of fiber.

d. Absorption of water and movement of stool in bulk.

e. Significant role in lowering serum cholesterol and reducing the risk of heart diseases.

f. Role in healing ulcers and to keep joints limber.

g. Help in neutralizing acids and temporary protective coating for the digestive tract.

h. Suitable treatment for lung inflammation, sore throat and irritable bowel syndrome.

i. Protection of cancer expansion of colorectal cancer and reducing the risk of cataracts.

j. Highly perishable crop having shelf life of 2-3 days at ambient storage temperature.

Usage: Dried okra is fried in refined oil along with spices followed by addition of water for rehydration during curry preparation.

Quality Attributes

1. Retention of Vitamin C (6-8 mg/100g).
2. Rehydration ratio (3-3.5) in boiling water for 4-5 min.
3. Recovery of dried okra slices (6.5-7.25%).

Okra

↓

Sorting, Grading and Washing

↓

Blanching in boiling water containing 0.1% magnesium oxide for 1 min followed by dipping into 1% sodium sulphite solution for 10 min

↓

Cutting into 0.25-0.3 cm slices

↓

Drying in cabinet dryer at 55-60oC for 6-8 hr

↓

Cooling at room temperature

↓

Packaging in polypropylene pouches and storage at ambient temperature (20-25oC) for 6-8 months.

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Drying of Carnation CV. Master in Microwave Oven For Preparation of Dry Flowers

Article ID: 10453

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Introduction

The beauty and fresh look of cut flowers and cut foliage is lost due to microbial activities and biochemical changes. The fresh look of cut flowers can be retained only for a few days in vase even after using efficient post-harvest management techniques and vase chemicals. The main characteristic of dried flowers includes novelty, longevity, aesthetics, flexibility and year-round availability. Dehydrated or dried ornamental plant parts are generally inexpensive and are sought for their everlasting and attractive appearance. Silica gel drying is little expensive but the same silica gel can be used repeatedly. Sand is also used for drying after removal of organic materials and salts before use. Since sand is heavier, it takes longer time for drying compared to other materials. Borax is also used for dehydration of Carnation flowers; borax does not weigh heavy as silica gel and sand. The charm of dried ornamental plant parts can be maintained from few months to years if protected the dried flowers from the damage from high humidity and microbial activities. In the present study efforts have been made to standardize the embedding media to dry carnation flowers with microwave oven drying.

Materials and Methods

The flowers of Carnation cv. Master subjected to different drying treatments in microwave oven after embedding them in three media viz., quartz sand (M1), silica gel(M2) and borax(M3). In microwave oven, flowers were dried for three durations viz., 120 seconds (D1), 150 second (D2) and 180 seconds (D3). The experiment was laid out in a Factorial CRD with three replications and ten flowers per replication. The texture of dry flowers was observed by feel method and a score card technique was used to determine the degree of brittleness of the flower and the scale is given as 0 - very high, 1- high, 2- low and 3- very low. Shape of dry flower was observed by feel method and a score card technique was used as 0- very poor, 1- poor 2- moderate 3- good 4- very good. Overall acceptability of flowers was concluded by considering the color change and retention of structural integrity of visual scores. The details of color scores are as follows: o-total change, 1- higher change, 2- moderate change, 3- slight change 4- no change. The details of retention of structural integrity as follows: 0 - very poor, 1- poor, 2- moderate, 3- good and 4- very good.

Results and Discussion

Microwave oven drying was quick as it uses both microwave energy and hot air energy in combination as a medium for drying. Among the media, quartz sand recorded the maximum dry flower weight (4.24 g) while among the durations; the maximum dry flower weight (6.40 g) was noticed at 120 seconds. The interaction between quartz sand and 120 seconds duration recorded maximum dry flower weight (6.58 g) followed by silica gel at 120 seconds (6.42 g) which were on par with each other (Table 1). This is in accordance with Kumaresan (2000). This may be due to quick release of maximum amount of moisture by agitating water molecules with the help of electronically produced microwaves and the hygroscopic nature of silica gel.

Maximum dry flower diameter was observed with quartz sand at 120 seconds (3.76 cm) followed by silica gel at 120 seconds (3.68 cm) and the lowest dry flower diameter (3.06 cm) was observed with silica gel at 180 seconds. Among the media silica gel recorded the highest anthocyanin content (14.00 mg). The anthocyanin content increased with increase in temperature. The darkening of flowers could be due to increase in temperature more moisture is liberated to outside and also increase in concentration of the pigments following water loss (Oren Shamir, 2001).

Maximum number of petals (Table 2) was recorded with quartz sand (60.77) which was on par with silica gel (59.77) while the minimum number of petals was recorded with borax (57.66). The decrease in petal number with borax could be due to the adherence character of borax. With the removed moisture from the flower, borax become wet and sticks to the flower petals. Significantly maximum textural score was recorded with quartz sand (2.51) followed by borax (1.68) and silica gel (1.00). Maximum score for the shape of carnation dry flowers was recorded at180 seconds duration (3.22) followed by 150 seconds (2.84) and the minimum score was observed at 120 seconds (2.08) duration. The score values steadily increased with quartz sand from initial duration of drying (1.60) to final duration of drying (2.66). For overall acceptability of dry Carnation flower maximum score was observed with silica gel (Table 3) at 150 seconds of drying (5.13) followed by borax at 150 seconds of drying (5.00), while the minimum score was observed with quartz sand at 120 seconds of drying (4.13).

Table1: Effect of different media and duration of microwave oven drying on flower weight (g) of Carnation dry flower cv. Master:

Media	Duration (Seconds)			Mean
	120 (T1)	150 (T2)	180 (T3)	
Quartz sand (M1)	6.58	3.44	2.72	4.24a
Silica gel (M2)	6.42	3.30	2.91	4.21a
Borax (M3)	6.20	3.30	2.60	4.03b
Mean	6.40a	3.34b	2.73c	
	F-Test	SEM+/-	CD 5%	
Media (M)	**	0.05	0.12	
Duration(D)	**	0.05	0.12	
M X D	**	0.10	0.21	

Table2: Effect of different media and duration of microwave oven drying on number of petals of dry Carnation cv. Master:

Media	Duration (Seconds)			Mean
	120 (T1)	150 (T2)	180 (T3)	
Quartz sand (M1)	63 .00	60.66	58.66	60.77a
Silica gel (M2)	62.00	59.33	57.66	59.77a
Borax (M3)	60.66	57.66	54.66	57.66c
Mean	61.88a	59.33b	56.88c	
	F-Test	SEM+/-	CD 5%	
Media (M)	**	0.59	1.24	
Duration(D)	**	0.59	1.24	
M X D	NS	1.03	2.16	

Table3: Effect of different media and duration of microwave oven drying on overall acceptability of Carnation dry flower cv. Master:

Media	Duration(Seconds)			Mean
	120 (T1)	150 (T2)	180 (T3)	
Quartz sand (M1)	4.13	4.66	4.20	4.33b
Silica gel (M2)	4.80	5.13	4.46	4.80a
Borax (M3)	4.66	5.00	4.60	4.75a
Mean	4.53b	4.93a	4.42b	
	F-Test	SEM+/-	CD 5%	

Media (M)	**	0.13	0.27
Duration(D)	**	0.13	0.27
M X D	**	0.22	0.48

**** Significance at (P<_0.05) NS: Not significant**

Figures bearing same letters did not differ significantly.

Conclusion

The overall acceptability of dry carnation flower was good with silica gel at 150 seconds duration of drying in microwave oven (5.13) followed by borax at 150 seconds of drying (5.00).

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Empowering Farmers through Farmer Producer Organizations in the Era of COVID-19

Article ID: 10454

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Farmer Producer Organization (FPO)

Farmers Producer Organization are groups of farmers coming together on the basis of principle of membership, to pursue specific common goal and developing farming as economic activities that benefit their members and maintaining relations with partners working with them. FPO includes farmers group registered as Producer Company under Companies Act, 2013 (previously under the companies' act 1956). Besides this, FPO also includes farmers group registered under cooperative society act as well as farmers group registered under Trust act.

Role of FPO to Cope Up with COVID-19 Pandemic

Keeping in view the disruption of supply chain in agriculture due to covid-19 in India, there is a need to focus more on the promotion of Farmer Producer Organizations (FPOs) as these are tools of aggregation to take care of total supply chain aspects in general and marketing problem in particular.

Benefits of FPO

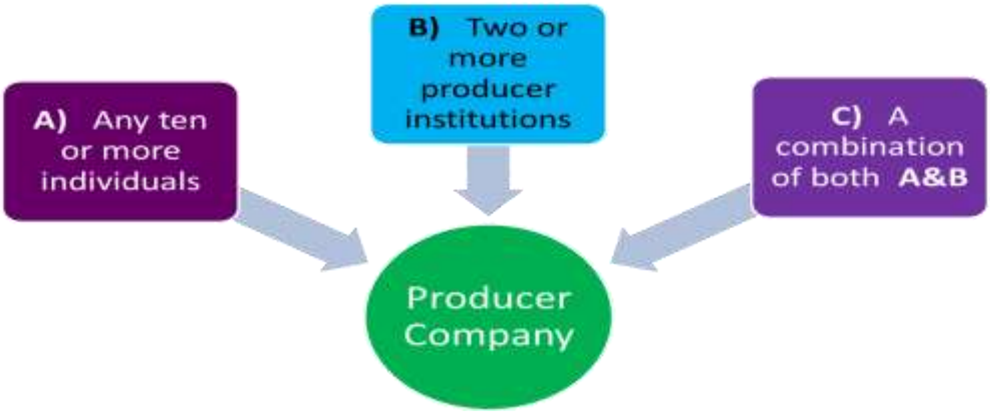
1. Enables members to pool their produce inside the company for a consideration and the company can in turn sell those produces under a single brand.
2. It helps to develop a strong bargaining power in the market.
3. Reduced or avoids Intermediaries.
4. Helps to raise more funds which can be used to purchase good quality seeds, make bio-fertilizers logistics and Marketing.
5. Shared Knowledge.
6. Availing Loans/credit facilities from NABARD and other Banks.
7. Limited liability.

Basic Requirements for Formation of FPO

1. For incorporating a Producer Company, minimum 5 Directors and 10 members are required. Board of Directors are also members of FPO.
2. The minimum one share should be subscribed by each member.
3. The registered office address has to be situated in India.

Who can Form FPO?

All the members of a producer company should be involved in agriculture.



Documents Needed for Formation of FPO

1. Copy of PAN card of all the members.
2. Identity Proof of all the members (anyone of the below mentioned):
    a. Passport or
    b. Driving Licenses or
    c. Voter ID.
3. Resident proof of all the members (anyone of the below mentioned):
    a. Mobile bill or
    b. Telephone bill or
    c. Bank statement or
    d. Electricity bill.
4. Resident proof must not be older than 2 months from the date of furnishing the proof:
5. Photograph of each member.
6. Proof of address of registered office – Sale deed or lease deed or Property tax receipt or rental agreement.
7. Utility bill for the registered office address – EB Bill or Mobile Bill or Telephone Bill not be older than 2 months.
8. Producer Certificate from District Agriculture Officer/Tahsildar.

Formation Process of FPO

1. Collection of Proofs such as PAN, ID and Residence proofs
2. Apply Digital Signature for members
3. Apply and reserve a name for the FPC
4. Prepare incorporation documents such as Memorandum of Association (MOA) and Article of Association (AOA) and get it signed
5. Submit the incorporation documents to the Registrar and get the certificate of incorporation.
6. File INC 22 within 30 days from the date of incorporation.
7. File INC 20A within 180 days from the date of incorporation.

Objectives of FPO

The objectives of the FPO shall relate to all or any of the following matters, namely:

1. Production, harvesting, procurement, grading, pooling, handling, marketing, selling, export of primary produce of the members or import of goods or services for their benefit: Provided that the Producer Company may carry on any of the activities specified in this clause either by itself or through other institution.
2. Processing including preserving, drying, distilling, brewing, vinting, canning and packaging of produce of its members.
3. Manufacture, sale or supply of machinery, equipment or consumables mainly to its members.

4. Providing education on the mutual assistance principles to its members and others.
5. Rendering technical services, consultancy services, training, research and development and all other activities for the promotion of the interests of its members.
6. Generation, transmission and distribution of power, revitalization of land and water resources, their use, conservation and communications related to primary produce.
7. Insurance of producers or their primary produce.
8. Promoting techniques of mutuality and mutual assistance.
9. Welfare measures or facilities for the benefit of members as may be decided by the Board.
10. Any other activity, ancillary or incidental to any of the activities referred to in clauses (a) to (i) or other activities which may promote the principles of mutuality and mutual assistance amongst the members in any other manner.
11. Financing of procurement, processing, marketing or other activities specified in clauses (a) to (j) which include extending of credit facilities or any other financial services to its members.
12. Every Producer Company shall deal primarily with the produce of its active members for carrying out any of its objects specified in this section.

Primary Produce

1. Produce of farmers, arising from agriculture (including animal husbandry, horticulture, floriculture, pisciculture, viticulture, forestry, forest products, re-vegetation, bee raising and farming plantation products), or from any other primary activity or service which promotes the interest of the farmers or consumers.
2. Produce of persons engaged in handloom, handicraft and other cottage industries.
3. Any product resulting from any of the above activities, including by-products of such products.
4. Any product resulting from an ancillary activity that would assist or promote any of the aforesaid activities or anything ancillary thereto.
5. Any activity which is intended to increase the production of anything referred to in sub-clauses (i) to (iv) or improve the quality thereof.

Memorandum of Association and Articles of Association

The Memorandum of Association and the Articles of Association of the Producer Company, duly signed by the subscribers are required to be presented to the Registrar of the state where the Company's registered office is proposed to be set up.

Memorandum of Association

The Memorandum of Association is a document which sets out the constitution of a company and is therefore the foundation on which the structure of the company is built. It defines the scope of the company's activities and its relations with the outside world.

The first step in the formation of a company is to prepare a document called the memorandum of association. In fact, memorandum is one of the most essential pre-requisites for incorporating any form of company under the Companies Act, 2013.

The memorandum of association of a company contains the objectives of the company which it shall pursue. It also determines the scope of its operations beyond which its actions cannot go.

Articles of Association of Producer Company

Articles of Association will provide the information regarding, who can be a member, their voting rights, appointment of Directors, CEO and chairman their duties and responsibilities, tenure in office and rotation and reappointment, usage of surplus funds in the company, relationship with other producer companies and institutions. The AOA also has the procedure for transferability of shares, cancellation of membership; ascertain who is a active member, allotment of shares, the credit, loans or advances which may be granted to a member and the conditions for the grant of the same. The members can also include any other condition by passing a special resolution.

As per Section 581G of the Act, the contents of the Articles of a Producer Company shall contain Mutual Assistance Principles and other provisions.

Management of Producer Company

1. Minimum – 5 and Maximum – 15 Directors.
2. Period 1- 5 years.

Appointment of Directors

First Directors – members signing the MoA and AoA as Directors; however, an Election should be conducted within 90 days of registration. (within 365 days in case of Interstate co-op)

1. By Members.
2. By Directors.

Vacation of Office of Directors

1. Personal criteria:

a. Convicted by Court for moral turpitude and sentenced to imprisonment for not less than 6 months.

b. Defaults in payment of loan taken from Producer Company in which he is Director.

2. Official capacity:

a. Defaults in repayment of loans and default continues for more than 90 days

b. Not filed annual accounts / returns – continuous 3 FY

c. Failed to repay deposits / withheld price or patronage bonus / interest / pay dividend – continues for 1 year

d. Defaults in holding election for the office of Director

e. Annual Governing Meeting not called according to provisions of the Act – exceptions of natural calamity or other reason.

Powers & Functions of Board

1. Dividend payable.
2. Include new members into the company.
3. Formulating objectives and strategies.
4. Appointment / superintendence / control of CEO & other officers.
5. Make sure the books of accounts are maintained properly; Prepare annual accounts (present in AGM with Auditor’s report & reply to qualifications).
6. Buy and sell properties in the ordinary course of business.
7. Investment of funds in the ordinary course of business.
8. Sanction loans to members not being the Directors or his relatives.
9. Other such acts – in discharge of its functions / exercise its powers.

Meetings of Board

1. Frequency once in every three months and at least four meetings should be conducted every year.
2. Notice in writing – given by CEO – 7 days in advance – to Directors in India at address in India.
3. Quorum – 1/3 of total strength – minimum of 3.
4. Fees / allowance for attending meeting – decided by Members in General Meeting.

Chief Executive Officer (CEO)

1. Appointment is mandatory and on full time basis.

2. Other than members.
3. Ex officio Director and not retire by rotation.
4. Qualification / experience / terms & conditions of appointment determined by Board.
5. Entrusted with substantial powers of management.
6. Under general superintendence, direction and control of Board.
7. Accountable for performance of the Producer Company (PC).

Powers of CEO

1. Manage affairs of PC
2. Operate / authorize to operate bank account.
3. Safe custody of cash / assets.
4. Sign documents as authorized by the Board.
5. Maintain books of accounts, prepare annual accounts, present audited accounts to Board & members in AGM.
6. Inform members about operations & functioning of PC.
7. Make appointments subject to delegated powers.
8. Assist Board in formulation of policies / objectives / strategies.
9. Advise Board on legal & regulatory matters.
10. Exercise powers required in ordinary course of business.
11. Any other functions / powers as delegated by the Board.

General Meetings

1. Mandatory every year – gap of not more than 15 months between two AGMs, however extension can be given by Registrar of Company (except for 1st AGM) – not more than 3 months.
2. First AGM – within 90 days from incorporation.
3. Quorum - 1/4th.
4. Chairman to have casting vote.
5. Annual filing and annual return - within 60 days.

Booksof Accounts

Every Company should have a Bank account. The company is also required to maintain all bills, vouchers, receipts, total purchases and sales, if the company is involved in manufacturing process, they are also required to maintain their daily stock, daily usage, labor and other aspects related to monetary transactions in separate files.

Internal Audit

Every Producer Company shall have internal audit of its accounts carried out, at such interval and in such manner as may be specified in articles, by a chartered accountant as defined in clause (b) of sub-section (1) of section 2 of the Institute of Chartered Accountants Act, 1949 (38 of 1949).

Financial Statement

1. Financial Statement is the formal record of the activities of the company that every company needs to maintain for every financial year.
2. Financial Statement reveals the PROFIT or LOSS statement of the company and FINANCIAL POSITION of the company.
3. Financial Statement for every financial year need to be preserved in the company for next 8 YEARS from the end of the financial year to which the financial statement belongs to.
4. The auditor audits the financial statement for every financial year and presents his opinions and qualifications, if any.

Components of Financial Statement

1. Balance sheet: It covers equity, liabilities and assets.
2. Profit and loss statement: It reveals the income and expenses of the company.
3. Cash flow statement: It reveals the liquid assets of the company and ability to pay debts.to pay the debts.
4. Statement of changes in equity.

Business Plan

It reveals following facts about Producer Company:

1. General Company Description:

a. Mission and vision statement.
b. Company goals and objectives.
c. Who will be your customer.
d. Describe your Industry.
f. Your strengths and core competencies.
g. Legal form of ownership.

2. Products & Services:

a. Describe in depth your products or services (technical specifications, drawings, photos, sales brochures, and other bulky items).
b. Factors that make you Unique.
c. Pricing/Fee structure.

3. Marketing Plan:

a. Explain about the market that you have identified to target
b. Carry market research - competitors, customers, existing products, current demand, your share in market, what would be the barriers to enter into that market and how will you overcome them.
c. Decide your Niche, build a strategy, start promotion
d. Pricing.
e. Proposed location.
f. Distribution channels.

4. Operational Plan:

a. Production.
b. Location.
c. Operational cost.
d. Working hours.
e. Legal requirements.
f. Human resource.
g. Inventory.
h. Suppliers (accounts payable management).
i. Credit policy (accounts receivable management if required).

5. Management and Organization:

a. Who will manage on day-to-day basis
b. Use organizational chart if more than 10 employees work for the company
c. If you are seeking loans or investors, include resumes of owners and key employees.
d. Also list who will be your Board of directors, Management advisory board, Attorney, Accountant, Insurance agent, Banker, Consultant or consultants, Mentors and key advisors.

6. Personal Financial Statement.

7. Start-up Expenses and Capitalization:

a. All expenses before commencing a business.

b. Cost more than you estimate.
c. Allocate funds in case of few contingencies.
d. Explain how you have arrived at the expenditures.

8. Financial Plan:

a. A five years profit and loss projection.
b. A cash-flow projection.
c. Projected balance sheet.
d. A break-even calculation.
e. Rations.

9. Appendices.

10. Refining the Plan: Modify the Business Plan based on the requirement, whether you are going to give it to a Banker or an Investor.

11. Executive Summary: What will be your product? Who will be your customer? Who are the owners? What do you think the future holds for your business and your industry?

The Government of India has approved formation of ten thousand new FPOs during 2019-20 to 2023-24 and granted Rs.5000 crores for promoting these organizations. These FPOs will be registered under Indian Company Act. FPOs working in plain areas should have at least 300 farmers as member to get benefit of above mentioned granted funds. Similarly, FPOs in hilly areas should have at least 100 members for realizing this benefit.

Sticky Mucilage Plants Act as Flypaper Traps Mechanism

Article ID: 10455

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The flypaper trap utilises sticky mucilage or glue. The leaf of flypaper traps is studded with mucilage-secreting glands, which may be short (like those of the butterworts), or long and mobile (like those of many sundews). Flypapers have evolved independently at five times. There is evidence that some clades of flypaper traps have evolved from morphologically more complex traps such as pitchers.

The leaf of a *Drosera capensis* bending in response to the trapping of an insect

In the genus *Pinguicula,* the mucilage glands are quite short (sessile), and the leaf, while shiny (giving the genus its common name of 'butterwort'), does not appear carnivorous. However, this belies the fact that the leaf is an extremely effective trap of small flying insects (such as fungus gnats), and its surface responds to prey by relatively rapid growth. This thigmotropic growth may involve rolling of the leaf blade (to prevent rain from splashing the prey off the leaf surface) or dishing of the surface under the prey to form a shallow digestive pit.

***Pinguicula conzattii* with prey**

The sundew genus (*Drosera*) consists of over 100 species of active flypapers whose mucilage glands are borne at the end of long tentacles, which frequently grow fast enough in response to prey (thigmotropism) to aid the trapping process. The tentacles of *D. burmanii* can bend 180° in a minute or so. Sundews are extremely cosmopolitan and are found on all the continents except the Antarctic mainland. These species are so dependent on insect sources of nitrogen that they generally lack the enzyme nitrate reductase, which most plants require to assimilate soil-borne nitrate into organic forms.

***Drosera capensis* responding to captured prey**

Closely related to Drosera is the Portuguese dewy pine, *Drosophyllum,* which differs from the sundews in being passive. Its leaves are incapable of rapid movement or growth. Unrelated, but similar in habit, are the Australian rainbow plants (Byblis). Drosophyllum is unusual in that it grows under near-desert conditions; almost all other carnivores are either bog plants or grow in moist tropical areas. Recent molecular data (particularly the production of plumbagin) indicate that the remaining flypaper, *Triphyophyllum peltatum*, a member of the Dioncophyllaceae, is closely related to Drosophyllum and forms part of a larger clade of carnivorous and non-carnivoroSus plants with the Droseraceae, Nepenthaceae, Ancistrocladaceae and Plumbaginaceae.

Pests of Caster

Article ID: 10456

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Shoot and Capsule Borer: *Conogethus punctiferalis*. Pyralidae: Lepidoptera

1. Capsule bore hole and these capsule webs together and this covered with silken frass.
2. Larva is pale green with pink tinch and also spar hairs with dark prothorax.
3. Adults is yellow with black spot.

Sap Feeders

Leaf hopper: *Empoasca flavescens*: Cicadellidae; Hemiptera: Leaf margins are yellow than it will eat brown symptom is curled and dry away the leaf.

Thrip: *Redrothrips Syriacus:*

a. Both nymphs and adult's sac the sap and result are crinkling.
b. Silvery appearance of leaves.
c. Nymphs are pink to red.
d. Adult are black.

White fly: *Trialerodes ricini*: Aleyrodidae; Hemiptera: Water-soaked spot is present, yellowing and drying of leaves, colony of whitefly, nymphs and adults under surface of leaf, yellowish white adult.

Leaf Feeders

Hairy caterpiller complex: *Euproctis franterna, Porthesia scientillans, Dasychila mendosa*

***Notolophus postica* – Tussock caterpillar:**

Woolly bear - *Pericalliya recini*

i. All the leaf feeder belonging to the family Arctidae; Lepidoptera
ii. Symptom is defoliation
iii. Larva is reddish brown, with red head surrounded white hairs with long tuft of hairs all over the body free anal long tuft of hairs
iv. Yellow moth, few black spot
v. Head brown, generally yellow color larva, yellow strip with red mid line, hairs presence all over the body, Black color hairs.
vi. Adult is yellow with green, yellow spot in forewing.
vii. Greyish brown larva dark yellow thorax prolegs are crimson color.
viii. Adult is yellowish brown moth
ix. Brown head with pairs of pencil of hairs prothorax tuft of yellow hairs laterally first two abdominal segment dorsally four abdominal segments long brown hairs in the eight abdominal segments.
x. Adult is brown color moth with stout abdomen
xi. Sexual dimorphism is noticed in adult.
xii. Larva is black and sticky hairs
xiii. Adult is grey to brown color moth with black spot.

xiv. Hind wings are pink to orange woolly bear.

Caster Slug. *Parasa lepida*: Cochilidae; Lepidoptera

1. Defoliation, Leaving mid rib alone
2. Larva is slug like ventrally flat, Green body with white lines
3. Four rows scale Adult is green moth.
4. Forewing is banded with brown color (Parrot color).

Caster Semilooper: *Achaea janata*

Parallelia algira:

a. Belongs to family Noctuidae and Lepidoptera
b. Defoliation leaving mid rib alone
c. Semiloopers different color grey to brown color head, red spot seen on third abdominal pairs seen in anal.
d. Greyish black with prominent white line running from the fore wing.

Pests of Cotton

Article ID: 10457

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Cotton Aphid - *Aphis gossypii* Glover (Aphididae: Homoptera)

Nature of damage:

a. The greenish brown soft bodied small aphids infest the tender shoots and the under surface of leaves in very large numbers and suck the sap.

b. Severe infestation results in curling of leaves, stunted growth and gradual drying and death of young plants.

c. Black sooty mound develops on the honey dew of the aphids which falls on the lower leaves affecting photosynthetic activity.

d. The Economic Threshold Level (ETL) is 10% affected plants counted randomly.

Life history:

a. The alate as well as apterous females multiply parthenogenetically and viviparously.

b. In a day a female may give birth to 8 – 22 nymphs which become adults in 7 – 9 days.

Management strategies:

a. Spray application of dimethoate 0.03 % or methyl demeton 0.025 % or monocrotophos 0.04 % or imidacloprid 0.01 % affords protection.

b. Include also imidacloprid seed treatment for sucking pests @ 3 – 5g /kg seed that protects the crop around 30 – 45 days or so.

Cotton Leaf Hopper - *Amrasca biguttula biguttula* (Cicadellidae: Homoptera)

Nature of damage:

a. Both the nymphs and adults suck up the plant sap from the under surface of leaves.

b. The leaves show symptoms of “hopper burn” such as yellowing, curling, bronzing and sometimes drying up, and these symptoms are expressed differently depending on how the different varieties react to the toxic saliva of the insect.

c. The vigor of the plants is impaired to a great extent.

d. The ETL is 2 Jassids or nymphs per leaf or yellowing in the margins of the leaves.

Life history:

a. The female leaf hopper inserts about 15 eggs inside leaf veins and the incubation period ranges from 4 to 11 days.

b. The nymphal period occupies 7 - 21 days depending on the weather conditions.

Management strategies:

a. Spray application of dimethoate 0.03 % or methyl demeton 0.025 % or monocrotophos 0.04 % or imidacloprid 0.01 % affords protection.

b. Include also imidacloprid seed treatment for sucking pests @ 3 – 5g /kg seed that protects the crop around 30 – 45 days or so.

Cotton Whitefly - *Bemisia tabaci* (Aleyrodidae: Homoptera)

Nature of damage:

a. In cotton the nymphs are found in large numbers on the under surface of leaves and drain of sap due to sucking.

b. Severe infestation results in premature defoliation, development of sooty mold on honey dew excreted, and shedding of buds and bolls and bad boll opening.

c. The ETL is 5- 10 nymphs or adults per leaf before 9 A.M.

Life history:

a. The female whitefly lays the eggs on the under surface of tender leaves.

b. The egg and nymphal periods occupy respectively 3 - 5 and 9 - 14 days during summer and 5 - 33 and 17 - 73 days in winter.

c. The pupal period is 2 - 8 days.

d. The total life-cycle ranges from 14 - 107 days depending upon the weather conditions.

Management strategies: Spray application of acephate 0.075 % or imidacloprid 0.01 % or acetamiprid 0.01% or neem oil 0.3 % brings about control of the pest.

Spotted Bollworms - *Earias insulana* & *E. vittella* (Noctuidae: Lepidoptera)

Nature of damage:

a. The initial infestation takes place on 6-week-old crop in which the larva causes detopping (drooping and drying of the shoot) due to its feeding by boring into it.

b. In the later stages of the crop, the buds, flowers and bolls are damaged and a larva may migrate and attack fresh parts. Heavy shedding of early formed flower buds due to the pest is a common feature in cotton fields. The lint from attacked bolls will not be clean.

c. The ETL for this pest is 5% damaged fruiting bodies or 1 larva per plant or total 3 damaged squares / plant taken from 20 randomly selected plants.

Life history:

a. The moth of *E. vittella* has green fore wings with a white streak on each of them whereas that of *E. insulana* is completely green.

b. The female moth deposits 2 or 3 eggs on bracts, leaf axils and veins on the under surface of leaf. The egg is crown-shaped, sculptured and deep sky blue in color.

c. A female may lay about 385 eggs and the incubation period is about 3 days.

d. The larva becomes full grown in 10 – 12 days. The larva of *E. vittella* is brownish with a longitudinal white stripe on the dorsal side and without finger-shaped processes on its cream-colored body and orange dots on prothroax.

e. The boat shaped tough silken cocoon is dirty white brownish and may be found on plants or on fallen buds and bolls. The pupal period is 7 – 10 days.

f. The total life cycle ranges from 20 to 22 days.

Management strategies:

a. The infested portions as well as shed buds and bolls should be removed and destroyed.

b. Periodical spray application of compounds like phosalone 35 EC @ 1.5 to 2.5 l/ha or carbaryl 50 WP @ 2.5 to 3.0 kg. /ha or endosulfan 35 EC @ 1.5 to 2.0 l/ha or monocrotophos 40 SC @ 1.0 to 1.25 l/ha or profenofos 50 EC@ 0.75 to 1.0 kg /ha or thiodicarb 75 WP@ 625 g/ha etc. has been reported to be effective.

c. The synthetic pyrethroids fenvalerate and permethrin @ 100 - 150 g a.i./ha, cypermethrin @ 80 g a.i./ha, and deltamethrin @ 12.5 to 15 g a.i./ha are very effective in controlling the bollworms of cotton which may be alternated with other groups of insecticides.

Pink bollworm - *Pectinophora gossypiella* (Gelechiidae: Lepidoptera)

Nature of damage:

a. The larva enters the developing boll through the tip portion and the entrance hole gets closed up as the boll matures.

b. It feeds on the seeds and moves to adjacent locule by making a hole through the septum.

c. The infested flower buds shed prematurely.

d. A typical rosette-shaped bloom when examined will contain the larva.

e. The infestation results in the seeds being destroyed in addition to retardation of lint development and weakened lint and staining of the lint both inside the boll and in the gin.

f. Further, infested bolls open prematurely and expose it to invasion by saprophytic fungi.

g. The seeds from damaged bolls show lower germination.

h. The infestation ranges from 40 to 85 %. The ETL for pink bollworm is 8 months / trap per day for 3 consecutive days and the traps are to be installed @ 5/ha. or 10% infested flowers or bolls with live larvae.

Life history:

a. The adult is a small dark brown moth and a female lay flattened and striated eggs on the bolls or in between bracts or on buds and flowers, the average being 125 eggs.

b. The egg period varies from 4 - 25 days.

c. The 15 mm long pinkish larva with dark brown head and prothoracic shield becomes full grown in 25 - 35 days and pupates in a thin silken cocoon among the lint, inside a seed or in double seeds, in between bracts or in cracks in the soil.

d. The pupal period is about 6 – 20 days.

e. Both short – cycle larvae and long-cycle larvae occur in Northern India and hibernation during winter takes place in the larval stage.

f. In South India the insect is not known to hibernate in any stage of its development.

Management strategies:

a. Need based spray application of carbaryl 50 WP @ 2.5 kg/ha or quinalphos 25 EC @ 2 - 3 l/ha or profenofos 50 EC @ 1.5 - 2 l/ha based on ETL.

b. Fumigation of seeds with methyl bromide at 1.5 kg/100 cu. m. for 24 hours or with aluminum phosphide at 18 tablets/100 cu. m. or heat treatment for a few minutes at 60°C kills hibernating larvae in seeds.

Pitcher (Insectivorus) Plants Act as Pitfall Traps Mechanism

Article ID: 10458

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Carnivorous plants that derive some or most of their nutrients from trapping and consuming animals or protozoans, typically insects and other arthropods. However, carnivorous plants generate energy from photosynthesis. Carnivorous plants have adapted to grow in places where the soil is thin or poor in nutrients, especially nitrogen, such as acidic bogs. True carnivory is thought to have evolved independently nine times in five different orders of flowering plants and is represented by more than 12 genera. This classification includes at least 583 species that attract, trap, and kill prey, absorbing the resulting available nutrients. Additionally, over 300 proto carnivorous plant species in several genera show some but not all of these characteristics. A 2020 assessment has found that roughly one fourth are threatened with extinction from human actions.

Pitcher of *Nepenthes lowii,* a tropical pitcher plant that supplements its carnivorous diet with tree shrew droppings

Pitfall Traps

A passive trap, pitfall traps attract prey with nectar bribes secreted by the peristome and bright flower-like anthocyanin patterning within the pitcher. The linings of most pitcher plants are covered in a loose coating of waxy flakes which are slippery for insects, causing them to fall into the pitcher. Once within the pitcher structure, digestive enzymes or mutualistic species break down the prey into an absorbable form for the plant. Water can become trapped within the pitcher, making a habitat for other flora and fauna. This type of 'water body' is called a Phytotelma. The simplest pitcher plants are probably those of Heliamphora, the marsh pitcher plant.

In the genus Sarracenia, the problem of pitcher overflow is solved by an operculum, which is essentially a flared leaflet that covers the opening of the rolled-leaf tube and protects it from rain. Possibly because of this improved waterproofing, Sarracenia species secrete enzymes such as proteases and phosphatases into the digestive fluid at the bottom of the pitcher; Heliamphora relies on bacterial digestion alone. The enzymes digest the proteins and nucleic acids in the prey, releasing amino acids and phosphate ions, which the plant absorbs. In at least one species, Sarracenia flava, the nectar bribe is laced with coniine, a toxic alkaloid also found in hemlock, which probably increases the efficiency of the traps by intoxicating prey.

The pitchers of *Heliamphora chimantensis* are an example of pitfall traps

Darlingtonia californica, the cobra plant, possesses an adaptation also found in *Sarracenia psittacina* and, to a lesser extent, in *Sarracenia minor*: the operculum is balloon-like and almost sealing the opening to the tube. This balloon-like chamber is pitted with areolae, chlorophyll-free patches through which light can penetrate. Insects, mostly ants, enter the chamber via the opening underneath the balloon. Once inside, they tire themselves trying to escape from these false exits, until they eventually fall into the tube. Prey access is increased by the "fish tails", outgrowths of the operculum that give the plant its name. Some seedling Sarracenia species also have long, overhanging opercular outgrowths; Darlingtonia may therefore represent an example of neoteny.

***Darlingtonia californica*: Small entrance to the trap underneath the swollen "balloon" and the colourless patches that confuse prey trapped inside**

The second major group of pitcher plants are the monkey cups or tropical pitcher plants of the genus Nepenthes. In the hundred or so species of this genus, the pitcher is borne at the end of a tendril, which grows as an extension to the midrib of the leaf. Most species catch insects, although the larger ones, such as Nepenthes rajah, also occasionally take small mammals and reptiles. *Nepenthes bicalcarata* possesses two sharp thorns that project from the base of the operculum over the entrance to the pitcher. These likely serve to lure insects into a precarious position over the pitcher mouth, where they may lose their footing and fall into the fluid within.

The pitfall trap has evolved independently in two other groups. The Albany pitcher plant *Cephalotus follicularis* is a small pitcher plant from Western Australia, with moccasin-like pitchers. The rim of its pitcher's opening (the peristome) is particularly pronounced (both secrete nectar) and provides a thorny overhang to the opening, preventing trapped insects from climbing out.

The final carnivore with a pitfall-like trap is the bromeliad *Brocchinia reducta.* Like most relatives of the pineapple, the tightly packed, waxy leaf bases of the strap-like leaves of this species form an urn. In most bromeliads, water collects readily in this urn and may provide habitats for frogs, insects and, more useful for the plant, diazotrophic (nitrogen-fixing) bacteria. In *Brocchinia*, the urn is a specialised insect trap, with a loose, waxy lining and a population of digestive bacteria.

Darlingtonia californica **note the small entrance to the trap underneath the swollen "balloon" and the colorless patches that confuse prey trapped inside**

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Use of Microarray Technology in Animal Health

Article ID: 10459

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Introduction

Molecular detection techniques continue to increase its utility in clinical microbiology laboratories. The implementation of various in vitro nucleic acid amplification techniques, led by multiplex PCR, real-time PCR, isothermal amplification methods and nucleic acid hybridization techniques for the detection of pathogenic microorganism. Although not likely to completely replace culture techniques in the near future, molecular applications in the diagnosis of infectious diseases have become common place in academic medical centers and tertiary-care facilities. The further advancement of molecular infectious disease diagnostics is dependent on the ability of multiplexing technologies, or the ability to detect and identify more than one pathogen simultaneously from the same specimen, to be implemented in clinical microbiology laboratories with ease and accuracy. One approach to multiplex detection and characterization is microarray analysis. Today, microarray technology is one of the popular tools in molecular biology with its main advantage being that, unlike other traditional methods, it is not limited to investigating 'one gene at a time' (Georgii et al., 2005).

A microarray is a 2D array on a solid substrate (usually a glass slide or silicon thin-film cell) that assays large amounts of biological material using high-throughput screening miniaturized, multiplexed and parallel processing and detection methods. Microarray is a technology which allows quantitative, simultaneous monitoring and expression of thousands of genes (Naidu and Suneetha, 2012). The basic principle behind microarray is the base complementarity, i.e., the base pair 'A' is complementary to 'T' and 'C' is complementary to 'G'. In a microarray, many thousands of spots are placed on a rectangular grid with each spot containing a large number of pieces of DNA from a particular gene. The different DNA fragments are arranged in rows and columns which identity each fragment is known through its location on the array.

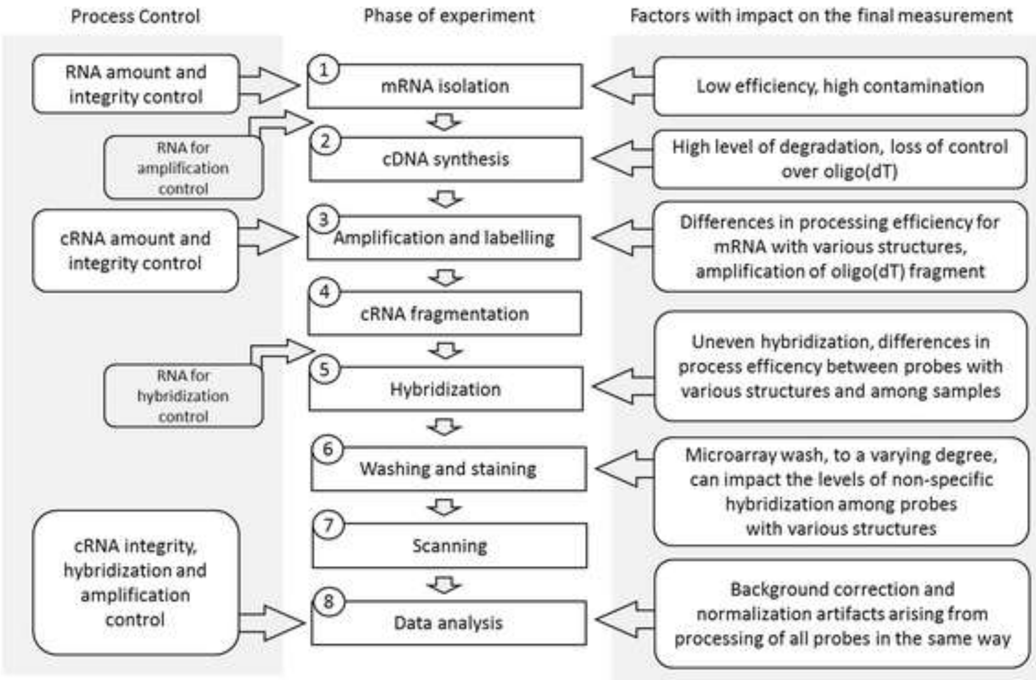

Fig.1 Individual steps of a microarray experiment and factors which affect their reliability (Right panel describes factors that may affect experimental outcomes, left panel typical methods that are used to validate each of the processing steps)

When the sample of interest contains many copies of mRNA, bindings will occur, indicating that the gene from the transcribed mRNA is highly expressed. The quantity of hybridization can be determined through a fluorescent or radioactive tag and a brighter signal is detected when more copies are bind (Govindarajan et al., 2012). The output of a microarray experiment is called a "gene expression profile." Microarray technologies can be broadly categorized into DNA microarrays and protein microarrays. In general, all microarray assays contain five discrete experimental steps – biological query, sample preparation, biochemical reaction, detection, data visualization and modelling (Fig.1).

Applications of Microarray

Microarrays technology has been evaluating the differential expression of genes and typing of microbial pathogens by hybridization of separate RNA populations obtained under different conditions or from different genetic backgrounds using reverse transcription. It is also widely used to analyses genome mutations and amplifications, and to characterize mixed microbial populations. In addition, massively parallel sequencing performed by microarray analysis offers the opportunity of sequencing directly from complex clinical specimens. This metagenomics approach will allow a comprehensive analysis of every nucleic acid in the specimen.

DNA microarrays have been used to reveal the presence of antibiotic resistance genes and to identification of various infectious disease pathogens such as Avian influenza (H5N1), FMD, Viral Hemorrhagic Fever (Marburg virus), and SARS virus etc. It has been carried out to characterize diseases cells in comparison to healthy cells. This helps in finding the discovery of target.

It can be used to screen potential compounds, identify the antibiotics and toxicity of the lead compound that will help in the discovery of more effective antibiotics and vaccines which deciding proper medication for the patient. It used to diagnose a number and state of diseases, most notably cancer. Also, can be used to decide a patient's treatment and therapy on the basis of his/her genetic makeup.

Limitations of Microarray

At their fundamental, microarrays are simply devices to simultaneously measure the relative concentrations of many different DNA or RNA sequences. While they have been incredibly useful in a wide variety of applications, but it is expensive and have a number of limitations. First, arrays provide an indirect measure of relative concentration.

That is the signal measured at a given position on a microarray is typically assumed to be proportional to the concentration of a presumed single species in solution that can hybridize to that location. Second, especially for complex mammalian genomes, it is often difficult (if not impossible) to design arrays in which multiple related DNA/RNA sequences will not bind to the same probe on the array (Wu et al., 2018).

Also includes, a microarray can only detect sequences that the array was designed to detect, initial high cost for the synthesis of gene-specific primers, ambiguities in the interpretation of the ratios of hybridization and cross-hybridizations to paralogous genes.

Future Perspectives of Microarray

With the upcoming of microarray technology numerous genetic markers and their functions will be identified in shortest possible time. The information can be utilized in the medical research for the disease diagnosis, defining sensitization profiles of populations in epidemiological studies as well as the production of the smart drugs.

It could be more reliable in any field by making cost efficient through developing the related software and robotics technology. Combining DNA microarray with proteomics can help in understanding the way in which pathogens react in the microenvironment. Further, the experiments should be confirmed independently with other techniques like northern blotting, RT-PCR and protein expression before giving the concluding remark.

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Bael Fruit *(Aegle marmelos)*

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Introduction

Aegle marmelos or Bael is one of the tree species having medicinal values, also known as golden apple, begal-quince, and stone apple in India belongs to the Rutaceae family. It is native to northern India with further cultivation in other parts of India as well as in Bangladesh, Thailand and Pakistan. It has certain spiritual significance in India as are usually planted near Lord Shiva temples and routinely worshiped by the devotees. It is a seasonal fruit and mostly available during May and June. Every part of this tree such as root, bark, leaf, flower and fruit have various significant uses. The wild variety of fruit is not popular for commercial purposes and smaller in size than the cultivated type.

Botanical Description

Aegle marmelos is a slow-growing, medium sized tree, up to 12-15 m tall with short trunk, thick, soft, flaking bark, and spreading, sometimes spiny branches, the lower ones drooping. Young suckers bear many stiff, straight spines. A clear, gummy sap, resembling gum arabic, exudes from wounded branches and hangs down in long strands, becoming gradually solid. The deciduous, alternate leaves, borne singly or in 2's or 3's, are composed of 3 to 5 ovals, pointed, shallowly toothed leaflets, 4-10 cm long, 2-5 cm wide, the terminal one with a long petiole. Fragrant flowers, in clusters of 4 to 7 along the young branchlets, have 4 recurved, fleshy petals, green outside, yellowish inside, and 50 or more greenish-yellow stamens.

Chemical Constituent

Several studies suggested presence of varied classes of compound viz., phenolic acid, alkaloids, coumarins, terpenoids, fatty acids in Bael plant. Beal leaves contained γsitosterol, aegelin, lupeol, rutin, marmesinin, β-sitosterol, flavones, glycoside, oisopentenyl halfordiol, marmeline and phenylethyl cinnamamides and a wide range of organic acids, minerals, carbohydrates, vitamins, fibers make a highly nutritious fruit with immense health benefits.

Pharmacological Properties and Medicinal Use

Bael fruits and leaves are used to treat digestive problems (dysentery, dyspepsia, vomiting, mal-absorption), neurological diseases, edema, and rheumatism. Additionally, Bael is reported as an important item in industrial food processing and also used for extracting pharmaceuticals and many other economically important herbal compounds. Plant parts exhibited various protective effects against the wound, radiation, microbes, free radical generation and natural healing power. Also, considerable antifungal activity of Bael essential oil against pathogenic strains of *Aspergillus species* and *Candida albicans* have been found. The methanol extract of leaves of *Aegle marmelos* showes significant analgesic activity and immunomodulatory action. The dried pulp of bael is astringent. It reduces irritation in the digestive tract and an excellent remedy for diarrhoea and dysentery. A decoction of the astringent unripe fruit, combined with fennel and ginger, is prescribed in cases of haemorrhoids. The ripe fruit is also laxative and demulcent. It helps in the healthy function and eases stomach pain. It has been surmised that the psoralen in the pulp increases tolerance of sunlight and aids in the maintaining of normal skin colour. It is employed in the treatment of leucoderma. Marmelosin derived from the pulp is given as a laxative and diuretic.

Besides having anti-inflammatory and antipyretic activity, a leaf extract from the plant has been found to have insecticidal activity against the brown plant hopper, an important pest of rice plant in Asia. For medicinal use, the young fruits, while still tender, are commonly sliced horizontally and sun-dried and sold in local markets. Compound purified from Bael have been proven to be biologically active against several major disease including cancer, diabetes etc. The bitter, pungent leaf juice, mixed with honey, is given to allay catarrh and fever. With black pepper added, it is taken to relieve jaundice and constipation accompanied by edema. The leaf decoction is said to alleviate asthma. Being a versatile species, there still scope to further explore the usefulness and properties of this indigenous species.

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Role of Toxins in Plant Disease Development

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The outbreak of an unknown disease which killed innumerous poultry birds in the year 1961 lead to the coining of term mycotoxin. Later it was discovered that the disease due to which it happened it was result of contaminated of poultary feed with a toxin produced by the filamentous fungus *Aspergillus flavus*. Toxins are basically the metabolites having biological activity and it may be expressed by their inhibitory or lethal effects on human or animal health. These are the metabolites produced by microorganisms in the form of low molecular weight compounds that are toxic to plant and animals. These are important in necrotrophic phase. A vast majority of toxins has been isolated so far but all are from the group of saprophytic pathogens. While, obligate parasites like rust, powdery mildew, downy mildew etc. have not reported to have any type of toxins being isolated from them. For a chemical to be qualified as Toxin, the hypotheses are that a toxin should produce all symptoms characteristic of the disease. While, the sensitivity to toxic will be correlated with susceptibility to pathogen and the toxic production by the pathogen will be directly related to its ability cause disease. The toxin associated with plant diseases fail to exhibit all the above characters except, Victorin the toxin metabolite of *Cochliobolus victoriae.*

The think tanks and scientists have categorised toxins in different ways out them the most accepted classification of toxins those based upon source of origin, specificity to host, producing organism and Biological Activity. Based upon source of origin, toxins are categorised as Pathotoxins, Phytotoxins and Vivotoxins.

Pathotoxins: When the precursor is a pathogenic microorganism the toxin thus produced is termed as pathotoxin. It encompasses the phyto-toxic substances produced by them. These are primary determinants (initiation) of disease and the pathogenicity. Pathtoxin induces all the typical symptoms in reasonable concentrations and is correlated with pathogen city. The toxins produced by them are host specific. H.V. toxin, T. toxin, A.M. toxin are some to cite under this category.

Phytotoxins: When the agent producing toxin, which are toxic to host and non-host plants are known as phytotoxins. These toxins are considered as phytotoxins as they are Non-specific toxins. These toxins are required for virulence and are important for secondary disease inducing. Ex. Tab-toxin, Ten-toxin, Phaseolotoxin.

Vivotoxins: this group includes those toxins which don't act as the initial inciting agent but are produced in the infected tissues and functions in disease development. Fusaric acid, pyricularin are the few to quote

On the basis of specificity to host, toxins are grouped as host specific toxins and non-host specific toxins.

1. Host specific toxins are those toxins which adversely affect the specific host of the pathogen and are normally essential for pathogen city. When applied to a susceptible host, these toxins reproduce all disease symptoms. For example, the oat Victoria blight causing pathogen, *Helminthosporium victoriae* (*cochliobolus victoriae*) produces this toxin (H.V. Toxin) and only susceptible varieties of oat can be affected. The genetic makeup of oat varieties with victoria gene alone is susceptible to the pathogen and sensitive to toxin. Similarly, *Helminthosporium maydis* causing southern corn blight produces T. Toxin which is a polyketide and, in its production, single genetic locus is involved. HC Toxin in infected maize plants is being produced by leaf spot of maize causing pathogen, *Helminthosporium carbounm* this toxin is a cyclic peptide and is specific certain maize lines. It has been observed in fruit crops like apple the leaf blotch of apple causing pathogen, *Alternaria mali* produces AM Toxin which is host specific and is limited to selective susceptible varieties of apple.

2. In comparison to former, the later i.e., non-host specific toxin includes those toxins which are toxic to both host and non-host crops. These are the metabolic products of the pathogen, but do not have host specificity and affect the protoplasm of many unrelated plant species that are normally not infected by the pathogen. These are also known as phytotoxins or General toxins. Ex. Tab-toxin, Ten-toxin, Phaseolotoxin.

Taking in to consideration the producing organism, a wide variety of organisms produce toxins. But chiefly toxins are grouped as those produced by fungus and those produced by bacteria.

1. The main fungi that produce aflatoxins are *Aspergillus flavus* and *Aspergillus parasiticus*, which are abundant in warm and humid regions of the world. Aflatoxin-producing fungi can contaminate crops in the field, at harvest, and during storage.

2. Bacterium *Pseudomonas s*pp. produce a wide spectrum of phytotoxic compounds. The toxins produced by *Pseudomonas syringae* are varied in origin and include monocyclic β-lactam (tabtoxin), sulfodiaminophosphinyl peptide (phaseolotoxin), lipodepsinonapeptide (syringomycin), and polyketide (coronatine) structures. The symptoms produced by Pseudomonas syringae include chlorosis and necrosis of plant tissues, which are caused, in part, by antimetabolite toxins. This category of toxins, which includes tabtoxin, phaseolotoxin and mangotoxin, is produced by different pathovars of *Pseudomonas syringae.*

The biological activity of toxins classifies the toxins in to chiefly three class of causing Enzyme inhibitor (Pyricularia, Fusaric acid), Anti- Metabolite (Tab- toxin) and Membrane affecting (Victorin).
1. An irreversible inhibitor inactivates an enzyme by bonding covalently to a particular group at the active site. The inhibitor-enzyme bond is so strong that the inhibition cannot be reversed by the addition of excess substrate. Fusaric acid is a specific inhibitor of dopamine β-hydroxylase, the enzyme which converts dopamine to norepinephrine.

2. Host metabolism have an adverse effect as a result of antimetabolite activity of toxins as they inhibit the biosynthesis of essential amino acids and induce the depletion of the intracellular levels of such compounds, thereby acting as antimetabolites. A striking example of Tabtoxin has been shown to be a dipeptide precursor that must undergo hydrolysis by a peptidase to yield the biologically active form, tabtoxinine-p-lactam (TβL).

3. The pathogens which produce toxins and as a result of which massive electrolyte leakage is induced. Because the plasma membrane is the first site of interaction between invading microorganisms and the plant protoplast, it became obvious that the plasma membrane plays an important role in disease development. Victorin has been shown to bind to the P protein of the glycine decarboxylase complex (GDC) in mitochondria, and induce defence-related responses such as phytoalexin synthesis, extracellular alkalization and programmed cell death.

Toxin employs an array of strategies to distress, weaken or kill the host plant in order to gain access to nutrient. Understanding toxin biosynthesis pathways and their regulation, the mode of action and how this relates to fungal virulence will not only help to gain new insights into cellular but opens the avenues of new research.

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Bitter Brinjal *(Solanum gilo)*: Highly Market Demand Vegetable Crop in Mizoram

Article ID: 10462

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Introduction

Mizoram is endowed with a rich genetic resource for the diverse groups of flora that exists in plant type, morphological and physiological variations with tremendous potential for cultivation of different horticultural crops. Among the different underutilized vegetable crops grown, *Solanum gilo*, commonly known as bitter brinjal belonging to the family Solanaceae, is widely seen grown by the people of Mizoram in homestead and *jhum* field as mixed cropping with ginger, chilli, brinjal, beans, tuber crop etc. under rainfed conditions and form an integral part of dietary system. It forms a local cuisine when the fruits are boiled. It is also used in preparation of stews, chutneys, fries etc.

A self-pollinating crop by nature although some outcrossing of up to 30% is possible. Wide variations exist within and between the species including variation in characters like diameter of corolla, petiole length, leaf blade width, plant branching, fruit shape and colour (Chinedu *et al*., 2011). The fruits are round, the top and bottom are flattened out and have grooved portions with a length of 5-6 cm and a width of 6-7 cm containing small seeds with stalk curved or erect (Knapp, 2011).

Fig 1: Flowering, fruiting and harvesting stage of bitter brinjal *(Solanum gilo)*

Their uses in indigenous medicine include the use of roots and fruits as a carminative and sedative and to treat high blood pressure, leaf juice as a sedative to treat uterine complaints, anti-emetic, weight reduction to treatment of several ailments including asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastro-oesophageal reflux disease, constipation, dyspepsia (Bello et al., 2005).

Fruits possess analgesic, anti-inflammatory, anti-asthmatic, anti-glaucoma, hypoglycaemic, hypolipidemic properties (Odetola et al., 2004).

Conclusion

Most of the landraces are still in wild form which is yet to be properly identified, domesticated and used which is most essential to preserve them. Above all, popularization of this crop is required to generate awareness for its cultivation and conservation at farm and community level. The paradigm of being one of the preferred crops in the region due to its taste, medicinal values, providing significant sources of food and nutrition to humankind.

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Jeevamrit: A Boon for Soil Health

Article ID: 10463

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Summary

Organic farming practices have garnered a lot of attention from farmers and researchers because of their advantages in terms of improving soil fertility, soil health and sustainable productivity. Use of jeevamrit is one such practice. Jeevamrit is used as an organic fertilizer that contains a huge amount of beneficial microflora and acts as a tonic to enhance microbial activity in the soil. Jeevamrit is a minimal effort preparation that enriches the soil with indigenous microorganism needed for mineralization from native cow dung, cow urine, pulse flour and jaggery. It increases the availability and uptake of applied as well as native soil nutrients which ultimately results in better growth and yield of the crop.

Introduction

Organic farming is a crop production system that relies on ecological processes, biodiversity and cycles adapted to local conditions to sustain the health of soil, ecosystem and people. Organic farming practices are acquiring significance because of their advantages in terms of soil fertility, soil health and sustainable productivity. One such practice that mainly benefits the soil microflora is the use of 'jeevamrit'. Jeevamrit is used as an organic fertilizer and is claimed to be a panacea for organic farming to fulfil the nutritional requirement of crops as well as for pest management and reduce the cost of production (Amareswari and Sujathamma, 2014). Jeevamrit was developed and popularized by Palekar (2006) as an essential part of soil management technique in zero budget natural farming (ZBNF).

Microorganisms are well activated in soil by the addition of jeevamrit which also maintained soil productivity and act as food support for beneficial microbes. Jeevamrit contains a huge amount of microbial load which multiply in the soil and acts as a tonic to enhance microbial activity in the soil. It contains macronutrients, essential micronutrients, many vitamins, essential amino acids, growth-promoting factors like Indole acetic acid, Gibberellic acid and many beneficial microorganisms. Presence of numerous useful beneficial microorganisms *viz.,* nitrogen fixers, phosphorus solubilizers, potash solubilizers, actinomycetes and fungi in jeevamrit makes it an elixir for soil health. Jeevamrit is a low-cost improvised preparation that fills the soil with indigenous microorganisms required for mineralization of the soil. Jeevamrit is minimal effort preparation that enriches the soil with indigenous microorganism needed for mineralization from native cow dung, cow urine, pulse flour and jaggery. Variety of microorganisms such as nitrogen fixers (*Azotobacter* sp., *Azospirillum* sp.) and phosphorous solubilizing bacteria (*Bacillus* sp. *Pseudomonas* sp*., Aspergillus* sp.) etc are present in the cow dung (Devakumar *et al.,* 2014). When applied in acidic or alkaline soils, it subsequently creates favourable conditions for the availability of maximum nutrients to plants.

Preparation of Jeevamrit

Jeevamrit can be easily prepared by farmers using ingredients that are commonly available in rural areas. Usually, one would need cow dung (5 kg), cow urine (5 litres), jaggery (1 kg), chickpea flour (1 kg), virgin soil (0.5 kg) and water (50 litres) (Devakumar et al., 2014). Mix all the ingredients in a drum with the help of a wooden stick. Shake the mixture 2-3 times per day regularly for 5-7 days for proper fermentation. Maximum population observed on 10th day after preparation in jeevamrit. The prepared liquid formulation can be applied to the soil through irrigation water.

Cow dung is an essential component of the organic formulation and serves as a source of advantageous microorganisms. Presence of naturally occurring beneficial microorganisms predominantly, bacteria, yeast, actinomycetes, and certain fungi have been reported in cow dung based organic manures. Cow urine enhances the resistance of plants against a wide range of plant pathogens like mycoplasma, viruses, bacteria, fungi, nematodes and insects causing diseases and damages. As both cow dung and cow urine are rich in amino acids, these enhance the nitrogen content of jeevamrit. Jaggery contains approximately 30 per cent of recommended daily intake of potassium for plants, which is the quality nutrient for plants, needed for growth and reproduction, and imparts drought resistance to the plants. Soil as a bio inoculant two handfuls of soil taken from the roots of the banyan tree (or any other old tree found close to the farm which acts as the inoculums of various beneficial microorganism like nitrogen fixing and phosphate solubilizing bacteria. Soil is rich in NPK content, rich in nitrogen-fixing bacteria, and is more fertile.

Nutrient Composition of Jeevamrit

The nutrient composition of jeevamrit (Table 1) is not consistent and it varies from source to source. The variation might be due to differences in cow breed, animal feed, other inputs used and environmental conditions.

Table 1. Nutrient composition of jeevamrit (Gore et al., 2011):

Parameters	Value
pH	7.07
Total soluble salts (EC)	3.40 dsm-1
Total nitrogen	770 ppm
Total phosphorus	166 ppm
Total potassium	126 ppm
Total zinc	4.29 ppm
Total copper	1.58ppm
Total iron	282 ppm
Total manganese	10.7 ppm

Advantages

1. Jeevamrit is effective in the rapid build-up of soil fertility through enhanced activity of soil microflora and fauna. It acts as an agent to increase the microbial count and friendly bacteria in the soil.

2. It increases the plants' immunity thereby confers resistance against pest and diseases. Various metabolites produced by beneficial microorganisms such as organic acids, hydrogen peroxide and antibiotics, are effective against pathogenic micro and microorganisms.

3. It increases the availability and uptake of applied as well as native soil nutrients which ultimately results in better growth and yield of the crop.

4. Usage of jeevamrit helps to increase the earthworm count in the soil; earthworm movements in the soil increases the porosity of soil which has a higher water holding capacity. It improves aeration, brings up minerals from deep in the subsurface that are often in short supply in surface layers.

Conclusion

Jeevamrit is a panacea for organic farming, to fulfil the nutritional requirement, for pest management and at the same time, reduces the cost of production also. Jeevamrit is an elixir for soil health. It can increase the productivity of crops when applied in combination with other organics due to enhanced microbial and enzymatic activities. The beneficial impact of jeevamrit could be attributed to high microbial load and growth hormones which might enhance the soil biomass, thereby sustaining the availability and uptake of applied as well as native soil nutrients which eventually results in the better growth and yield of crops. It can also improve immunity if crops against numerous insect pests and diseases.

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Farming for Fuel

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Abstract

In the recent years, the growth of energy markets has expanded the role of agriculture as a provider of the feedstock to produce biofuels. However, with a high population density and limited natural resources, expanding the role of agriculture beyond food security is a challenge. This paper highlights two critical areas which need an immediate attention, i.e.:

1. Expansion of biofuel sources.
2. Reducing the gap between potential yield and actual yield for biofuel crops.

Introduction

There is a growing interest in India to enhance energy security and promote rural development by expanding the usage of biofuels. The National Policy on biofuels introduced in the year 2009 and approved by the Union Cabinet in May 2018 aimed at taking forward the indicative target of achieving 20% blending of biofuels with fossil-based fuels by 2030. The Policy aimed at meeting the larger goals, such as, adoption of green fuels, national energy security, fighting climate change, generating employment etc. One of the key factors driving the need towards biofuel policy was that 10 million litres of E10 biofuel could save Rs 28 crore in forex and around 20,000 tonnes of carbon dioxide emissions (Ministry of Petroleum and Natural Gas, 2018). The increase in budget allocation of National biofuel fund in F22 to Rs 10 million from Rs. 0.1 million re-emphasises government's focus on expanding the usage of biofuels.

Traditional biomass, including firewood, charcoal and animal dung continues to provide important sources of energy in many parts of the world. More advanced and efficient conversion technologies now allow the extraction of biofuels – in solid, liquid and gaseous forms from materials such as, wood, crops and waste material (FAO, 2008).

The current expansion and growth of energy markets has significantly expanded the role of agriculture as a provider of feedstock for production of liquid biofuels for transport – ethanol and biodiesel. Clearly, there is an increasing demand for certain agricultural commodities which can lead to farm income growth. However, there is also an increasing competition of natural resources, i.e., land and water for expanding the production of biofuel crops. This implies an appropriate strategy need to be adopted to expand production of bio diesel crops.

This article looks at possible solutions of expanding biofuel production. The following section provides an overview of biofuel crops. The subsequent section discusses the challenges in India in expanding biofuel production. Section 3 is on the way forward and section 4 concludes the paper.

Overview of Biofuel Crops

Biofuels are energy carriers that store the energy derived from biomass (FAO, 2006). Biofuels can be classified according to sources and types. They may be derived from forest, agriculture or fishery products or municipal wastes as well as from agro industry, food industry and food service by-products and wastes. The National Bio-Fuel policy categorized biofuels as first generation (1G), second generation (2G) and third generation (3G) fuels. The 1G category of biofuels include bioethanol and biodiesel; 2G comprises ethanol and municipal solid wastes and 3G includes bio compressed natural gas (Business Today, 2018). According to the Renewable Energy Policy Network for the 21st Century (REN21), global biofuel production grew steadily from 23 BL per year in 2002 to over 110 BL per year. However, during 2011 to 2012, growth rates plunged, and the annual production of biofuels in 2015 was back to its 2010 levels. Production of ethanol, however, has doubled since 2005, reaching 85.6 BL in 2010 and 94 BL in 2014, led primarily by Brazil and the United States (REN21, 2014).

Amongst the 1G and 2G biofuels, there is a hierarchy regarding popularity, starting with biodiesel (produced mainly from canola, soybean, barley and palm oil), bioethanol (produced mainly from corn, wheat, and sugarcane) and finally, other types of vegetable oil and biogas (Ganguli, et.al, 2018). A brief overview of the sources of ethanol and biodiesel crops is given below:

1. Ethanol: Feedstock holding significant amount of sugar, or materials that can be transformed into sugar, such as, starch or cellulose can be used to produce ethanol. Sugarcane, sugar beet and to a lesser extent sweet sorghum are commonly used as feedstocks. Maize, wheat, cassava are the starchy feedstocks. The use of biomass containing sugar that can be fermented directly to ethanol is the simplest way of producing ethanol. Ethanol can be blended with petrol or burned in its pure form in slightly modified spark-ignition engines. (FAO, 2008).

2. Biodiesel: Biodiesel is produced by combining vegetable oil or animal fat with an alcohol and a catalyst through a chemical process, which is known as transesterification. Globally, the most popular oil seed crops used for biodiesel production are rapeseed in Europe, and soybean in Brazil, and the United States of America. In tropical and subtropical countries, palm, coconut and jatropha oils are mainly used. Biodiesel can be blended with traditional diesel fuel or burned in its pure form in compression ignition engines (FAO, 2008).

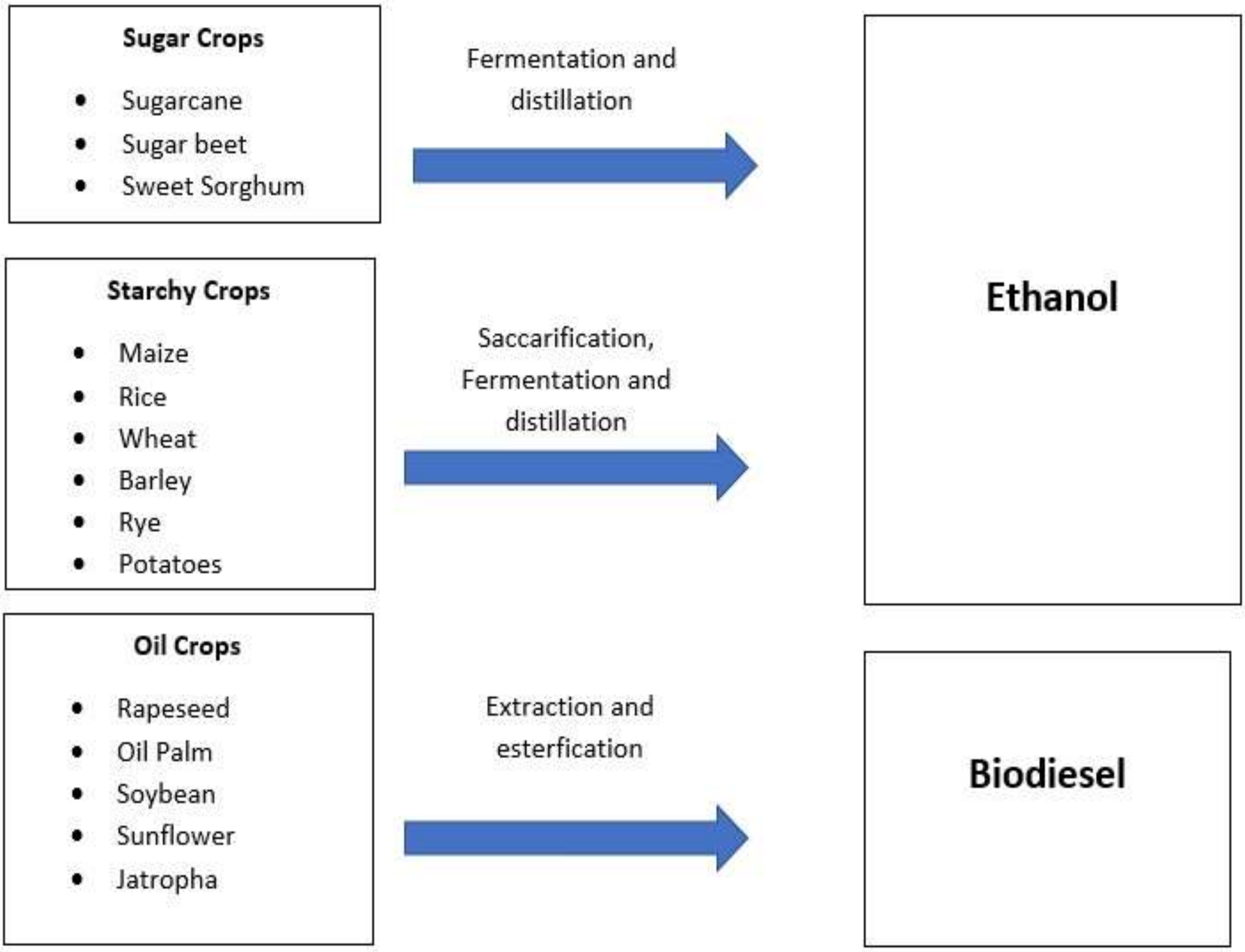

Fig 1: Conversion of agriculture feedstock into liquid biofuels (Source: FAO)

Challenges of Bio-Fuel Production in India

Government of India has set targets of 10% bioethanol blending of petrol by 2022 from a current level of 5% and to raise it to 20% by 2030 under the ethanol blending programme to cut carbon emissions and reduce India's dependence on imported crude oil. Despite the wide scope of National Biofuel Policy, there are several challenges which need to be addressed. One of the foremost problems in India is high population and a high population density that impose a limit on the use of land as well as food security.

1. Food security: The National Policy on Biofuels, 2018 envisages that during an agriculture crop year, when there is projected over supply of food grains, conversion of surplus quantities of food grains to ethanol based on the approval of National Biofuel Coordination Committee will be allowed (Ministry of Petroleum and Natural Gas, 2018).

Currently, the major source of ethanol production is molasses. As per our estimates, if the entire sugarcane crop, i.e., 355 million tonnes in 2018-19 is used for sugar production, estimated production of molasses would be 16 million tonnes. The estimated ethanol yield would be about 3.6 BL (using conversion ratio of Purohit and Fisher, 2014).

However, about 70 to 80 percent of the sugarcane is used for sugar production, while the remaining gets diverted towards the production of alternative sweeteners (jaggery and khandsari) and seeds (Raju et al., 2009). Further, 33 percent of the available molasses is used in alcoholic beverages, 25 percent by industry, and 4 percent for other applications.

The remaining is diverted for blending with transportation fuel. Under the circumstances, if India is to achieve the 20 percent blending targets set out in the National Policy on Biofuels, without compromising industrial, potable and other needs, the country will need to produce 6.7 BL of ethanol by 2020 and 9.1 BL by 2030 (Purohit and Dhar, 2015), which is approximately three times the current level of production.

Table1: Ethanol Availability in India:

Year	Ethanol Production from molasses	Ethanol use			Net ethanol availability for blending
		Potable	Industry	Other	
2010	2.72	0.88	0.68	0.10	1.06
2015	3.01	1.04	0.79	0.11	1.08
2020	3.22	1.22	0.91	0.13	0.96
2025	3.43	1.44	1.06	0.15	0.79
2030	3.64	1.69	1.23	0.17	0.56

Source: Purohit and Dhar,2015

Jatropha curcas has also emerged as an important crop for ethanol production. However, it is scarcely grown, and productivity of this crop remains unknown. To match India's proposed level of biofuel production, it needs to produce 22% more biofuel by 2030, but the annual production growth in 2019-2025 falls short by as much as 86%. Clearly, the target set out by NBP, 2018 cannot be met without expanding the biofuel sources.

2. Limited land: To expand the production of biofuel crops, land expansion is required. The policy discourages agricultural land from being converted to cultivate non-edible crops, and instead promotes the use of wasteland. The National Wastelands Development Board defines wasteland as that which is under-utilised or can be made productive by the proper use of technology, soil, and water treatment.

The Indian Space Research Organisation produces a comprehensive wasteland atlas for India. However, the wastelands also include pastoral lands, grazing areas and grasslands, all of which are important sources of fodder for communities and provide important ecosystem services. Therefore, it is difficult to locate wasteland in India, and far easier to convert agricultural fields for biofuel use (Mandal, 2020). As limited land will continue to pose challenge, it is critical to increase production per unit of land.

Way Forward

1. Expand biofuel sources- crop residues: Crop residue has been identified by several researchers as a significant source for production of biofuels. Agricultural residues available for energy applications were estimated at 160 million tonnes in 2018. Assuming, 20 percent of agricultural residue is lost in collection, transportation and storage and that ethanol yields 214 lge/ton dry matter (tdm) for cellulosic-ethanol, 32 Mt of residue could be used to produce approximately 28 BL of ethanol annually (Ganguly et.al, 2018). The Biomass Atlas of India estimates that an additional 104 Mt of biomass is available in India in forest and wastelands that can be converted into biofuels (Baka, 2014). This suggests that if potential of crop residue is fully explored, it would be adequate to meet the 20 percent blending target by 2030-31.

Table 2: Biofuel potential from Net Availability of Agricultural Residues:

Crop Residue	Agriculture residue used for fodder, fuel, other purposes			Net agri residue availability for biofuels			Net ethanol availability		
	Fodder	Fuel	Other	Fodder	Fuel	Other	Fodder	Fuel	Other
Rice straw and husk	80.8	11.1	8	13.8	15.8	17.8	3	4	5.3
Wheat straw	86.4	0	13.6	0	0	0	0	0	0
Jowar stalk	100	0	0	0	0	0	0	0	0
Bajra stalk	89.8	0	10.2	0	0	0	0	0	0
Maize stalk and cobs	81	19	0	7.4	8.5	9.7	1.6	2.1	2.9
Other cereals stalk	100	0	0	0	0	0	0	0	0
Gram waste	0	100	0	9.5	9.7	10	2	2.4	3
Tur shell and waste	3.5	48.5	48	2.9	3.1	3.3	0.6	0.8	1
Lentil shell and waste	3.5	48.5	48	1	1.3	1.4	0.2	0.3	0.4
Other pulses-shell and waste	3.5	48.5	48	6.3	6.4	6.9	1.3	1.6	2.1
Groundnut waste	0	13.2	86.8	1.8	1.9	2.1	0.4	0.5	0.6
Rapseed waste	0	100	0	11.8	13.9	15.9	2.5	3.5	4.8
Another oilseed waste	0	100	0	23.1	27.8	32.2	4.9	7	9.7
Cotton seeds and waste	0	100	0	14.1	15.3	16.2	3	3.8	4.9
Cotton gin and trash	0	100	0	0.3	0.3	0.4	0.1	0.1	0.1
Jute & mesta waste	0	100	0	2.2	2.6	2.8	0.5	0.7	0.9
Sugarcane bagasse and leaves	11.8	41	47.2	35.9	42.6	48.2	7.7	10.7	4.5
Total				**130.2**	**149.3**	**166.8**	**27.9**	**37.3**	**50.1**

Source: Purohit and Dhar, 2015

2. Reduce the gap between potential yield and actual yield for biofuel crops: Farming for fuel in a populous country, like India, with limited natural resources is possible with high crop yield. However, the productivity for most crops that can be used for biofuel production in India is below the global average. Sugarcane and potato are the only two crops where All India average productivity exceeded the global average in 2019. Nevertheless, productivity of all biofuel crops is significantly below the global best. Yield across agriculture regions may differ due to several factors, i.e., soil conditions, tillage, practices of farming, mechanization etc. Future trajectories of biofuel usage are closely linked to future crop yield. Whatever be the reason for the differences in yield, reducing the gap between potential yield and current yield is critical for enhancing biofuel production.

Table 3: Productivity of biofuel crops in 2019: India vs Global:

Crops	India	Global Average	Global Best
Sugar crops			
Sugarcane	80.1	73.0	125.5 (Peru)
Starchy crops			
Maize	3.1	5.9	30.2 (Jordan)
Rice	4.1	5.0	8.7 (Australia)
Wheat	3.5	3.8	9.4 (Ireland)
Barley	2.8	3.1	8.6 (Belgium)
Potatoes	23.1	20.8	50.3 (United States)
Oil crops			
Rapeseed	1.5	2.1	4.4 (Denmark)
Soybean	1.2	2.7	4.2 (Turkey)
Sunflower	0.8	2.1	4.4 (Israel)

Source: FAO

Conclusion

The blending target in India set out by the National Biofuel Policy will remain a distant possibility unless effective measures are taken. The two critical necessities if India is to meet its blending mandates, are expansion of biofuel sources and increase in yield of biofuel crops. Given the amount of crop residues that India generates on an annual basis, and the ensuing pollution owing to the current disposal mechanisms for these residues, adoption of crop residue for ethanol production seems a very feasible solution. Secondly, the yield of most crops which can be used for biofuel production is significantly below global average. Reducing the gap between potential yield and actual yield will be the key to determine the future use of these crops in biofuel production.

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Sorbitol – Its Applications in Different Fields

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Introduction

Sorbitol, commonly known as glucitol, is a sugary alcohol that has a sweet taste that is slowly metabolized by the human body. It can be obtained by lowering glucose, which converts the converted aldehyde group (−CHO) into the primary alcohol group (−CH2OH). Most sorbitol is made from potato starch, but it is also found in nature, for example apples, peaches, pears and prunes. It is converted to fructose by sorbitol-6-phosphate 2-dehydrogenase. Isomer of sorbitol mannitol, another sugar alcohol; The two differ only in the orientation of the hydroxyl group on carbon 2. Commercially, sorbitol is sold in the form of a 70% solution, a clear colourless or pale-yellow syrup with a sweet cooling taste.

Sorbitol is a hexavalent sugar alcohol and is a common component of many edible fruits. Although known for many decades, it has not found commercial applications because its extraction from the fruit is so expensive. This water-soluble compound is found naturally in some fruits, including apples, apricots, dates, berries, peaches, plums, and figs. It's also commercially manufactured from corn syrup for use in packaged foods, beverages, and medications. Commercially, sorbitol helps to retain moisture, add sweetness and texture to products, as well as promote digestive and oral health.

Applications of Sorbitol

1. Confectionery: In confectionery, sorbitol is used in combination with sugar to increase the shelf life. The function of sorbitol is to reduce the hardness of the sugar associated with the staleness in the candy. It also helps to improve softness, taste and texture. An added benefit of butter creams is better taste. Sorbitol can be used in diabetic chocolates. Sorbitol is used as a humectant and softener in grated coconut, its determined advantage over inverted sugar is that it does not darken the product. Sorbitol 70% mixed with peanut butter reduces dryness and shrinkage and improves spread ability.

2. Textiles: Sorbitol is primarily a distributing agent in textile applications, humectants body agent and sequestering agent. In print, 2% to 3% sorbitol solution 70% (depending on the weight of the gum in the dye paste) prevents the levering of the paste, improves the brightness and intensity of the colour, helps to penetrate, prevents bleeding and promotes levelling. In textile size, sorbitol acts as a humidifier and especially in winter it protects the adhesive film from drying out and maintains its plasticity. In finishing, it gives a soft feel, good drape and proven size stability to the fabric.

3. Tobacco: The moisture content of cigarettes is very important, and the change in moisture content due to the change in humidity can be reduced if sorbitol is used as a conditioner. Also, sorbitol is non-volatile and therefore there is no risk of losing conditioner during drying and other pressing operations. Sorbitol is compatible with a variety of ingredients used in the tobacco blend. Due to its sweet and cooling taste, sorbitol contributes to the conditioning of the product as well as the taste of chewing tobacco.

4. Pharmaceuticals: Sorbitol finds the use of as a bodying agent in medicinal syrups and nectars. The use of sorbitol in cough syrups reduces the tendency of bottle caps to stick due to sugar crystallization. Sorbitol is a good humectant and plasticizer and is useful in emulsion ointments, non-fat soluble ointments and gelatine capsules. Ointments, creams and pastes have been shown to help with sorbitol's ability to spread satisfactorily.

Aqueous sorbitol solutions do not decompose during fermentation, so sorbitol bandage finds increasing use in the preparation of dental formulations for the cavity.

5. Cosmetics: Sorbitol is widely used in cosmetics; humectant (O / W) to reduce water loss from oil in creams and as an emollient. Sorbitol solution has been proven to be a 70% useful additive to enhance the aesthetic appeal of glycerine carbolic soap by giving good transparency. Generally speaking, sorbitol solution can replace up to 70% of other humectants, with less than 10% of humectants by weight.

6. Toothpaste: Sorbitol effectively replaces glycerine and sugar in toothpastes, giving the plasticity and sweetness of the sorbitol, the humectant and plasticizing properties of the sorbitol at the required level.

7. Skin cream and cream foundation: Sorbitol replaces glycerine as a humectant and conditioning agent and helps to reduce grease and reduce dispersed particle size.

8. Emulsion: Sorbitol prevents water loss by evaporation from an oil-in-water emulsion and is more effective than glycerine of ration when it is less than 10%.

9. Foods: Sorbitol gives frozen desserts, body and texture, as well as some sweetness. Sorbitol is used in frozen desserts for diabetics because it is slowly absorbed from the intestine and metabolized as fructose. In the manufacture of sugar-free chewing gum, sorbitol provides water-soluble solids; It is believed that 70% solution of sorbitol prevents the fermentation of acids by microorganisms in the mouth and therefore does not contribute to the occurrence of tooth decay. In artificially picked canned fruits, the undesirable after saccharin taste is avoided by the use of sorbitol. In low-calorie soft drinks, sorbitol is found to be used as a body agent, and in addition as a sequencing agent in canned soft drinks.

Conclusion

Sorbitol is a type of carbohydrate called sugar alcohol or polyol, which is a water-soluble compound that occurs naturally in most fruits and vegetables. Sorbitol is commercially produced from glucose for use in packaged foods and beverages to provide sweetness, texture and moisture retention. Sorbitol can be used in diabetic chocolates, as a dispensing agent, and as a humectant.

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Digital Tool for Farming Advisory and Climate Action

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Introduction

Digital agriculture is the use of digital technology to integrate agricultural production from the paddock to the consumer. These technologies can provide the agricultural industry with tools and information to make more informed decisions and improve productivity. Digital agriculture refers to tools that digitally collect, store, analyse and share electronic data and information along the agricultural value chain. Digitalization is the use of digital technologies and data as well as interconnection that result in new or changes to existing activities. In present day agriculture, soft resources like knowledge and skills are as important as hard resources like inputs, and sometimes more important.

Agriculture Risk

The agricultural sector is exposed to a variety of risks which occur with high frequency. These include climate and weather risks, natural catastrophes pest and diseases, which cause highly variable production outcomes. Production risks are exacerbated by price risks, credit risks, technological risks and institutional risks.

1. Production risk: Agriculture is often characterized by high variability of production outcomes. Unlike most other entrepreneurs, farmers are not able to predict with certainty the amount of output that the production process will yield due to external factors such as weather, pests, and diseases.

2. Post-Harvest Risks: Storage – Indian loses about one of the third of harvest due to poor storage.

3. Market Risk: Input and output price volatility is important source of market risk in agriculture. Prices of agricultural commodities are extremely volatile.

- **a. Market Information:** Information asymmetry due to variety of reasons.
- **b. Access:** Challenge due to high transportation costs.
- **c. Price volatility:** Price volatility tends to benefit speculators- not farmers.

4. Ecological Risk:

- a. Limited Land- degrading soil health poses risk to future productivity.
- b. Limited water- Declining ground water table and erratic rainfall poses a serious challenge irrigation.

Digital Technologies to Manage Risk and Create Opportunity

Digital technologies useful to understand strategies and mechanisms used by producers to deal with risk and for the purpose of this discussion to distinguish between informal and formal risk management. Technologies that are important for modern agriculture are remote sensing, drones/unmanned aerial vehicles, big data and analytics, mobile soil testing laboratories, soil health cards, digital soil maps, mobile money/digital wallets and sensors networks.

Farming Cycle

To understand where technology can play an empowering role, let us analyze the farming cycle and the needs at the various stages. Information on weather soil testing inputs like seeds, fertilizers, pesticides etc. Time and techniques for harvesting best practices pest management storage grading market information commodity prices mandi information.

Information and Communication Technology

ICT includes devices, networks, mobiles, services and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios and satellites.

Digital Advisory Tools

There are various modes push and pull SMS, interactive voice response, mobile apps through which extension services are provided either individually or in combination. While SMS and interactive voice response services are accessible from both conventional and smart phones, mobile apps require smart phones.

Voice Call Based Advisory Tools

1. Kissan call center: The purpose of these call centers is to respond to issues raised by farmers, instantly, in the local language. To optimally utilize the strengths of both these systems, it was proposed to take full advantage of professionally managed call center mechanism and dovetail it with the specialized Subject Matter Specialists knowledge of Agricultural Scientists and Extension Officers, so as to facilitate its reach to the farming community.

2. Krishi Vani: Using a special SIM card in their mobile phones, farmers can get up to 35 voice messages per week free in the regional language. The messages are in 16 categories such as weather, market, crop information, government schemes, nutrition, health, livestock, etc.

Website Based Advisory Tools

1. e-Choupal: ITC Limited has provided computers and Internet access in rural areas across several agricultural regions of the country, where the farmers can directly negotiate the sale of their products with ITC Limited. Online access enables farmers to obtain information on mandi prices, good farming practices, and to place orders for agricultural inputs like seeds and fertilizers.

2. e-NAM (National Agriculture Market): e-NAM is an online trading platform for agricultural commodities in India. The market is helping in better price discovery and provide facilities for smooth marketing of their produce. The market is helping traders and exporters in procuring quality products in bulk, at one place and ensure transparent financial transactions.

Television Based Advisory Tools

DD Kisan: Channel is dedicated to agriculture and related sectors, which disseminates real-time inputs to farmers on new farming techniques, water conservation and organic farming among other information.

Mobile Apps Based Advisory Tools

Mobile App: A software application developed specifically for use on small, wireless computing devices, such as smart phone and tablets, rather than desktop. Mobile apps can come preloaded on the handheld device as well as can be downloaded by users from play store or the internet. Mobile Apps available for weather forecasts, mapping, GPS tracking App, ranching App.

1. Kissan Suvidha: Kissan Suvidha mobile Apps provide Weather, plant protection, input dealers, Agro advisories, market price.

2. Kheti Badi: It is a social initiative apps have following features- detailed information about organic farming, Cultivation techniques of fruit and vegetables, recipes of ZBNF (Zero budget natural farming).

3. Fertilizer Calculator: The completely offline soil test-based fertilizer recommender (STFR) app for Android. Get calculations according to the area of farm or the number of plants/trees. Choose your preferred unit of calculation: kg/hectare, kg/acre, kg/tree.

4. Agri-market mobile app: Agri Market mobile app can be used to get the market price of crops in the markets within 50 km of the device's location.

5. Mandi Trades: A location based F2S (Farm to Shop) trading platform for agriculture product. Provides Agri-businesses, the technology and expertise needed to create a smarter and low-cost food supply for consumers in India.

Apps Use for Climate Advisory

1. Mausam: It will provide current weather information, include temperature, humidity, wind speed and direction for 200 cities.

2. Damini: Lightning Alert- Damini app is monitoring all lightning activity which are happening in specifically for all India. Damini lightning Apps is developed by IITM Pune and ESSO (Earth System Science Organization. Details description of instruction, precaution is provided in apps while in lightning prone area.

3. Meghdoot: It is available on android and ios is simple to use once you sing in with name, mobile number state and District. The advisories include wind Speed, Its Direction, Humidity and Rainfall every three hours.

Conclusion

Digital tools play a crucial role in disseminating information to farmers enabling them to decide on the cropping pattern, use of high-yielding seeds, fertilizer application, pest management, marketing, etc. Digital advisory is a potential tool for improving decision making in agriculture. In the last few decades, information and communication technologies (ICTs) have provided immense opportunities for the social and economic development of rural people.

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Endophytes and its Role in Management of Phytopathogens

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Introduction

The term endophytes derived from two Greek word first ‘endon’ meaning within and second ‘phyton’ meaning plant. An endophyte can be defined as “a microorganism such as fungi or bacteria that expends either the complete or part of its lifecycle within the healthy tissues of a living plant, typically causing no symptoms of disease”.

Endophytes are recorded from lower plant to higher plant hosts (Stone *et al.,* 2000). They live in phyllosphere as well as in endorhiza. Endophytes are ubiquitous, share symbiotic relationship with their hosts (Tejesvi *et al.,* 2005) and are found in all plant species (Naik *et al.,* 2008; Stone *et al.,* 2000). A single plant organ (leaf, stem or root) of a plant can harbor many different species of endophytes.

Endophyte is a topographical term and includes bacteria, fungi, actinomycetes and algae which spend their whole life, or a period of their life cycle, inside healthy plant tissues without causing any disease symptoms. Fungal endophytes are generally from the phylum Ascomycota. A number of endophytes are now known that grow within seaweeds and algae. One such example is *Ulvella leptochaete*, which has recently been discovered from host algae including *Cladophora* and *Laurentia* from India. Bacterial endophytes may belong to a broad range of taxa, including α-Proteobacteria, β-Proteobacteria, γ-Proteobacteria, Firmicutes, Actinobacteria etc. bacterial endophytes have been found to become intracellular in root and shoot cells of many plants.

History

Endophytes were first described by the German botanist Johann Heinrich Friedrich Link in 1809. They were thought to be plant parasitic fungi and they were later termed as “microzymas” by the French scientist Béchamp. The term ‘endophyte’ was coined in 1866 by German scientist, Heinrich Anton De Berry and described the endophyte, an organism that lives within plant.

Movement of Endophytes

Endophytes enter the plant tissues chiefly through the root zone, on the other hand, above ground portions of plants, may also be used for entry. Endophytes may be transmitted either vertically (directly from parent to offspring by seed germination) or horizontally (from individual to unrelated individual i.e., from plant to plant), cuts, wounds and natural openings like stomata. Reproduction through asexual or sexual spores leads to horizontal transmission, where endophytes may spread between plants in a population or community. Some endophytes that frequently transmitted vertically may also produce spores on plants that can be transmitted horizontally (e.g., *Epichloe festucae*).

Endophyte-Host Interactions

Several vital activities of the host plant are known to be influenced by the presence of the endophytes.
1. Endophytes may benefit host plants by preventing pathogenic or parasitic organisms from colonizing them by creating a "barrier effect" where the local endophytes outcompete and prevent pathogenic organisms from taking hold.
2. Endophytes may also produce chemicals which inhibit the growth of competitors, including pathogenic organisms.

3. Endophytes are also known to increase expression of defense-related genes in plants, making plants more resistant to many potential pathogens.
4. Endophytes have also been shown to enhance plant development and increase nutrient (phosphorus and nitrogen) uptake into plants.
5. Endophytes also help plants to survive under drought and heat condition.

Importance of Endophytes

Endophytes are the potential sources of biologically active natural products which are useful in medical, agricultural and industrial applications. The main industries that used microbial enzymes and products are the food, textiles, leather, pharmaceuticals, cosmetics, chemicals, energy etc. Some medicinally important compounds like novel antibiotics, antimycotics, immunosuppressants, and anticancer compounds have been isolated, purified and characterized from endophytes in the recent past (Strobel and Daisy, 2003).

Endophytes are well known for the production of various classes of natural products and have been reported to exhibit a broad range of biological active and are grouped into various categories, which include alkaloids, terpenoids, steroids, lactones, phenolic compounds, quinones, isocoumarin derivatives, flavanoids, and peptides etc (Zhang et al., 2006). Importantly, secondary metabolites produced by endophytes provide a variety of fitness enhancements and exert several beneficial effects on host plants, such as stimulation of plant growth, nitrogen fixation, and improve the plant's ability to tolerate abiotic stresses like drought, salinity and decrease biotic stresses by enhancing plant resistance to insects, pathogens and herbivores.

The growth stimulation by the microorganisms can be a consequence of nitrogen fixation or the production of phytohormones, biocontrol of phytopathogens in the root zone (through production of antifungal or antibacterial agents, siderophore production, nutrient competition and induction of systematic acquired host resistance, or immunity) or by enhancing availability of minerals.

Role in Plant Disease Management

Endophytes are now attracting great interest from researchers as an alternative tool in controlling plant pathogens. Endophytes attack phytopathogens in two ways, first through direct methods which include competition, hyperparasitism, antibiosis, lytic enzyme production etc. and second through indirect methods by inducing plant defense system, promoting plant growth and physiology, stimulation of plant secondary metabolites (Chakraborty et al., 2021). Dennis and Webster (1971) described that fungal endophytes are known to produce a number of antibiotics, such as trichodermin, trichodermol, trichotoxin, harzianum and harzianolide. These compounds were responsible for most of the inhibition of fungal pathogen.

S. No.	Endophytes	Host	Disease management	References
1.	*Chaetomium globosum*	Wheat	Tan spot *(Pyrenophora tritici-repentis)*	Istifadah and Mcgee (2006)
2.	*Beauveria bassiana* strain 11-98	Cotton	Seedling disease *(Rhizoctonia solani)*	Griffin (2007)
3.	*Fusarium verticillioides*	Maize	*Ustilago maydis*	Lee et al., 2009
4.	*Fusarium equiseti* and Pochonia chlamydosporia	Barley	*Gaeumannomyces graminis* var. tritici	Macia-Vicente et al., 2009
5.	*Bacillus atrophaeus, B. tequilensis, B. subtilis* subsp. spizizenii, *Streptomyces cyaneofuscatus, S. parvus, S. acrimycini*	Beans	Anthracnose disease *(Colletotrichum lindemuthianum)*	Gholami et al., 2013
6.	Bacillus and Streptomyces	Bean	*Sclerotium rolfsii*	Gholami et al., 2014

7.	Streptomyces and Bacillus	Bean	White mold disease *(Sclerotinia sclerotiorum)*	Gholami et al., 2014
8.	Serratia strain B17B, Enterobacter strain E, Bacillus strains IMC8, Y, Ps, Psl and Prt	Bell pepper	Blight *(Phytophthora capsici)*	Irabor and Mmbaga (2017)
9.	*Ochrobactrum pseudintermedium* (CB361-80), Erwinia herbicola (CC37283)	Cucumber	Angular leaf spot (*Pseudomonas syringae* pv. lachrymans)	Akbaba and Ozaktan (2018)

Conclusion

Endophytes have great potential as biocontrol agents against phytopathogens. We will have to understand the host-pathogen-endophyte interaction and there is need to focus more on isolation and identification of efficient endophytic microbes for its utilization in management of phytopathogens.

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Applications of RNA Interference Technology in Nematode Management

Article ID: 10468

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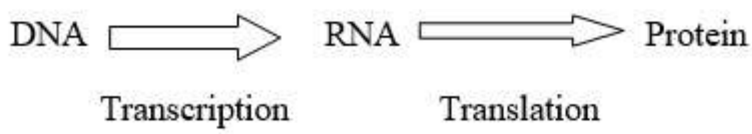
1. RNA interference is defined as the double stranded RNA triggers the silencing of specific genes through mRNA degradation.
2. It is an Important tool in the field of molecular biology.

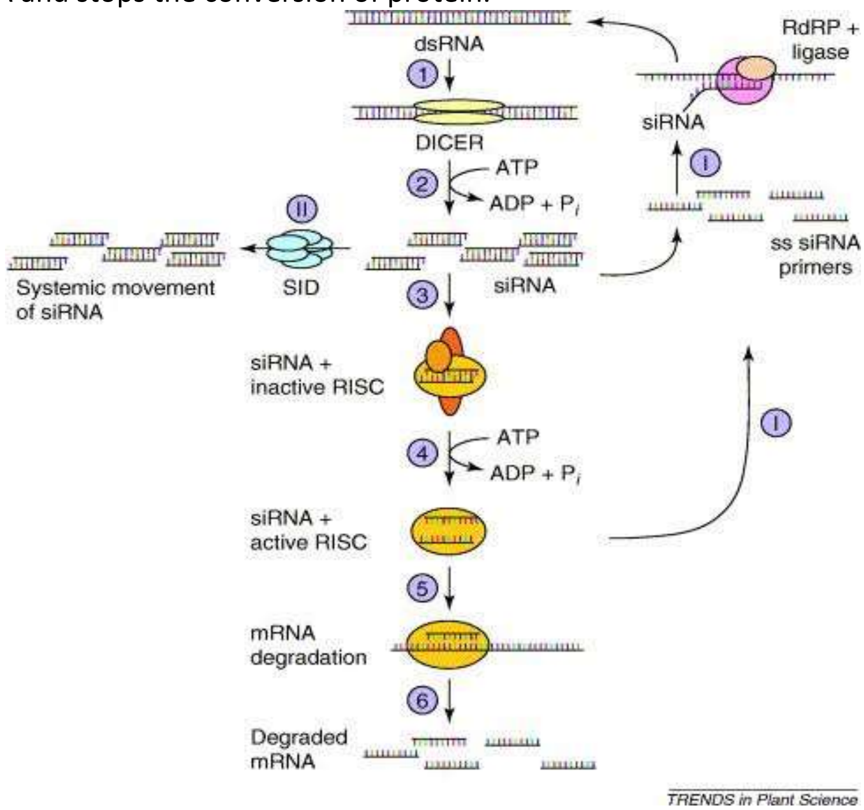
(Rosso et al.,2005)

Central Dogma of Life



Steps Involved in RNAi

1. dsRNA cleave the double strand in to single strand by using Dicer-2 Ribonuclease.
2. RISC (RNA induced Silencing) added to the Single stranded RNA.
3. Degrading of m-RNA and stops the conversion of protein.



Applying of dsRNA to Nematodes

1. Microinjecting Worms with dsRNA.

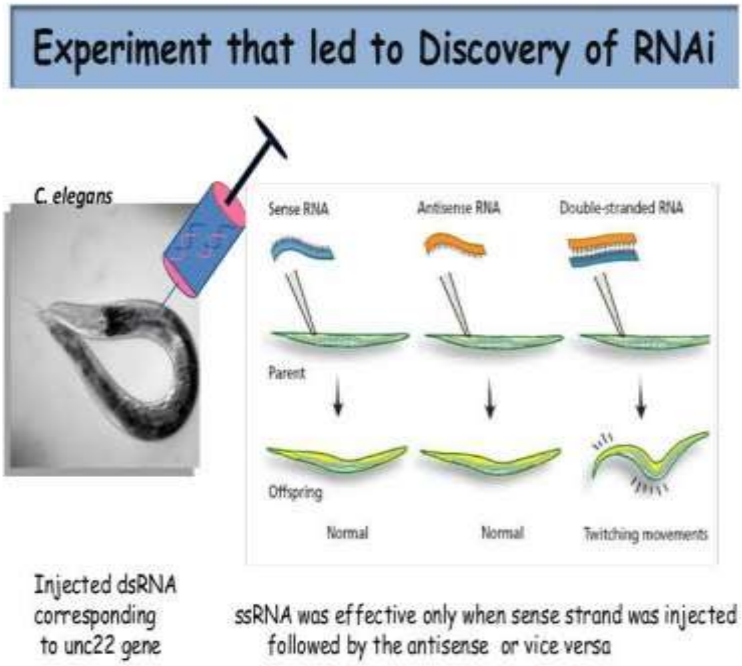
2. Soaking of nematodes in dsRNA.
3. Feeding of dsRNA though their food.

Microinjection into unc-42 rde-1 Animals Crossed to N2 Males to Examine Zygotic RNAi Phenotypes

RNAi by microinjection results in embryonic arrest, this could reflect a maternal function for the targeted gene.

rde mutant hermaphrodite*Wild type N2 male

RNAi–unfunctional



Soaking of Worms in dsRNA

1. RNAi soaking experiments with plant parasitic nematodes typically use dsRNA at concentrations from 1–5 mg/ml.

2. *G. pallida* J2 were incubated for 24 hr in a 10-fold serial dilution of dsRNA targeting the flp-12 gene, with concentrations from 0·1 mg/ml to 1 pg/ml.

3. A similar potency was observed when the *M. incognita* flp-18 gene was silenced by siRNA (Dalzell *et al.,* 2010).

4. Some proof-of-concept studies have shown extremely promising results; a high level of resistance to root-knot nematode was achieved by targeting a parasitism gene expressed in the subventral gland cells of *M. incognita.*

5. *flp* genes encode neuropeptides involved in motor activities, thus an assessment of migratory ability is an appropriate test for effective RNAi of these genes.

6. Silencing of *M. artiellia* chitin synthase was assessed by staining chitin in egg shells and testing the hatching rate of treated eggs.

7. A pharyngeal gland expressed calreticulin *(mi-crt*) gene of *M. incognita* displayed maximum transcript repression 20 hr after removal from a 4-hr exposure to dsRNA whereas transcript of polygalacturonase (*mi-pg-*

1) was unaffected at the same time point and displayed optimal silencing after 44 hr. The transcript level of both genes had returned to normal after a 68-hr recovery period.

8. A detoxification role was proposed for *B. xylophilus* acetylcholinesterase ace-3 when RNA interference in plant parasitic nematodes 635 silencing of this gene increased susceptibility to xenobiotic compounds.

Conclusion

This may be used to manage nematode problem in field and doubling the farmers income.

Reference

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Role of Mobile Apps in Agriculture

Article ID: 10469

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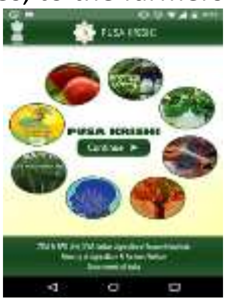
Application of mobile phone in agricultural sector is playing a vital role for the improvement of farmers agricultural business. It improves better understanding of market situation as well as weather by mobile phone communication as it is easy, fast and convenient way to communicate and get answers of respective problems. Mobile phone keeps aware of weather forecast for agriculture which has given new approach and direction to farmers to communicate directly with each other. The study revealed that mobile phone has benefits of portability, flexible content delivery capability and two-way communications to deliver low-cost but highly customized solutions (Mittal et. al.2009). Agriculture mobile apps with amazing new products make it more and easier to handling fields and its related information and also generate farm maps and enabling the usage of drones.

Different Types of Agricultural Mobile Apps

1. Kisan Suvidha: This app was developed by Ministry of Agriculture & Farmers Welfare, Govt. of India and helps farmers to get the information of weather, market price, agro advisory, soil health card, dealers' information, plant protection.

2. Pusa-Krishi: This app was developed by Ministry of Agriculture & Farmers Welfare, Govt. of India. This mobile app was launched for farmers in order to take the technology to farm fields. It provides information related to new varieties of crops developed by the (ICAR), resource conserving cultivation practices, farm machinery and its implementation and production technologies, to the farmers.



3. Bhuvan Hailstorm App: It was developed by Ministry of Agriculture & Farmers Welfare, Govt. of India to capture crop loss, which has happened due to hailstorm, along with photographs and geographical locations.

4. Crop Insurance App: Department of Agriculture & Farmers Welfare (DAC&FW) developed the app to calculate the Insurance Premium for notified crops based on area. This app is available in Hindi and English as of now and can be converted to regional languages by filling translated texts in a web.

5. IFFCO Kisan Agriculture: This app helps to access to various modules including agricultural advisory, weather, market prices, agriculture information library in the form of text, images, audio and videos in the selected language. It also offers helpline numbers to get in touch with Kisan Call Centre Services. The app supports eleven languages across India including English. It was developed by IFFCO Kisan, a subsidiary of Indian Farmers' Fertilizer Cooperative Ltd.

6. e-NAM Mobile: it was developed by: Small Farmers' Agribusiness Consortium (SFAC), Ministry of Agriculture & Farmers Welfare, Govt. of India. National Agriculture Market (NAM) is a pan-India electronic trading portal promoted by Government of India. It helps to access to arrivals and price related information to farmers and other stake holders on their smart phones.

Advantages of Agricultural Mobile Apps

1. Information: information is a key to survival of farmer and mobile apps offer farmers any information they need at just the one click.

2. Market access: Mobile apps help farmers to gather more information on the market to enhance their business.

3. Increasing efficiency: High tech equipment coupled with mobile apps makes a vast difference in efficiency.

4. Payments: Mobile apps can save a lot of time for both the farmer and the client regarding payment which makes quick and easy.

5. Better treatment of crop diseases: Diseases often create devastating results if not taken care of. With the help of an app, farmer can solve their problem without visiting any agricultural specialist by simply looking right on the phone for adequate treatment.

Conclusion

The evolution of technology creates a lot of opportunities for expanding farmers' businesses. It has changed their working pattern and helped them to aspire for higher goals. There are some of use of fertilizer and pesticides. Now, the farmers have got the advantage of making decisions based on advanced results rather than only intuition or tradition. Mobile apps have useful benefits, starting from better land management judgments to quality yield and have got the advantage of making decisions based on advanced results rather than only intuition or tradition.

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Mutation: Its Role in Crop Improvement

Article ID: 10470

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Summary

The genetic variation is prerequisite for any crop improvement program. Therefore, in any breeding programme, it is the first step to create, develop and use the variation. But while, the existing genetic variability is not sufficient to achieve breeding objective. Then one has to go for creation of genetic variation. The ways to create genetic variation are domestication, germplasm collection, plant introduction, hybridization, mutation, polyploidy, somoclonal variation and genetic engineering. Among the different ways of creating variability by adopting mutation, when other remaining techniques fails then only mutation is adopted because the mutation occurs at very low-rate identification of mutant is also needs long duration.

Introduction

Mutation is a sudden heritable change in a characteristic of an organism. It may be the result of a change in a gene, a chromosome that involves a several genes or a change in a plasmagene. Mutations produced due to the changes in the base sequence of a gene are known as gene/point mutation. Gene mutation can be easily and clearly shown by fine genetic analysis, techniques available with microorganisms. Some mutations may be at chromosomal level called as chromosomal mutations. In, clonal crops, it leads to gross changes in chromosomal structure, sometimes even in number, unless cytological analysis is done. Mutation was introduced by Hugo de Vries in 1900. Mutagenic action of gamma rays & X- rays was discovered in 1928 by Stadler in barely and earned Noble prize in 1946 for the mutagenic effect detection.

Gene Mutation

Base Substitution: There are two types of base substitution:

a. Transition.
b. Transversion.

Transition: When a purine is replaced by another purine (A/G) or a pyrimidine is replaced by another pyrimidine (T/C) is known as transition. Base substitution affects the base sequence of only one codon which leads to only one amino acid alterations.

Transversion: In transversion a pyrimidine is replaced by another purine or vice versa. Then, these are eight different types of possible transversions. The transition / transversion replaces only one amino acid in the concerned protein. Hence, the base substitutions are not deleterious but sometimes may generate codons which does not code for any amino acid knows as mis/non sense codons. It also acts as a terminator of the polypeptide chain. Non sense codons are more deleterious than other base substitute mutation. Since, the polypeptide produced by such alleles is incomplete or usually inactive.

Addition & Deletions

Insertion of one/more bases in a DNA molecule is called base addition, while a loss of one/ more bases is known as base deletion, both leads to mutation. If the number of bases added/ deleted in multiple of 3, one to several amino acids would be either added/ deleted from the polypeptide chain and has a profound effect on the activity of the polypeptide. Hence there will be shift in the reading frame. Hence, they are called as frameshift mutations.

Mutagens

The agents that induce mutations are known as mutagen. Mutagens may be of different kinds like radiation (physical) and chemicals (chemical). The different mutagens may be grouped as Physical mutagens (Ionizing) such as α-rays, β–rays, fast neutrons, thermal neutrons are particulate radiations, whereas, X-rays, gamma rays are non-particulate physical mutagens. Non-Ionizing radiations like Ultraviolet radiations. Chemical Mutagens like Sulphur, nitrogen, epoxides, amines, sulphates, sulphonates like EMS, MMS are powerful chemical mutagenic agents.

Applications

Helps in improving both oligogenic & polygenic characters. It has been employed in improving morphological and physiological characters.

1. Inducing the desirable mutant alleles, which are not present.
2. Improving well adapted high yielding variety.
3. Improving quantitative characters like yield.
4. F1 hybrids from intervarietal crosses may be treated with mutagens to develop mutant.
5. Inducing translocations which are essential.

Limitations

Frequency of desirable mutations are very low. The large screening population is needed. Linkage drag of desirable mutations with the undesirable mutations is associated.

Conclusion

A Combination of conventional breeding, mutational breeding and biotechnological procedures can provide a means of producing new varieties, hybrids with range of applications and adaptability to the changing climatic conditions.

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Biodrainage: An Environment Friendly Technique to Deal with Waterlogging and Salinity

Article ID: 10471

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Abstract

The introduction of canal irrigation without adequate provision for drainage in arid and semi-arid regions has resulted in rising of groundwater table leading to waterlogging and salinization in large areas in irrigation commands. These problems are due to various factors, including seepage from unlined canals, inadequate provision of surface and subsurface drainage, over-irrigation and use of poor-quality groundwater for irrigation. Globally, about 10% of the land area is affected by waterlogging and over 6% by salinity (FAO, 2008). In India, different levels and types of salinity affect about 6.7 million ha of land, of which nearly half are under irrigated agriculture (ICAR, 2010). It is projected that about 13 million ha in the irrigation commands of India will be affected by waterlogging and soil salinity by 2025. Conventional sub-surface drainage systems can be a potential solution to these problems provided these are properly designed, installed, maintained and operated. But these are more expensive and also causes environmental problems. Due to the limitations of the conventional engineering-based drainage systems there is a need for alternative approaches to maintain the agricultural sustainability in the long term. The alternative approaches must be effective, affordable, socially acceptable, environment friendly, sustainable and upgrade natural resources of land and water. Biodrainage comprising of deep-rooted vegetation with high rate of transpiration seems the promising option.

Keywords: Biodrainage, Salinization, Waterlogging.

Introduction

Biodrainage can be defined as pumping of excess soil water using bio-energy through deep-rooted vegetation with high rate of transpiration. The biodrainage system consists of fast-growing tree species, which absorb water from the capillary fringe situated above the level of ground water table. The absorbed water is translocated to different parts of plants and finally more than 98% of the absorbed water is transpired into the atmosphere mainly through the stomata.

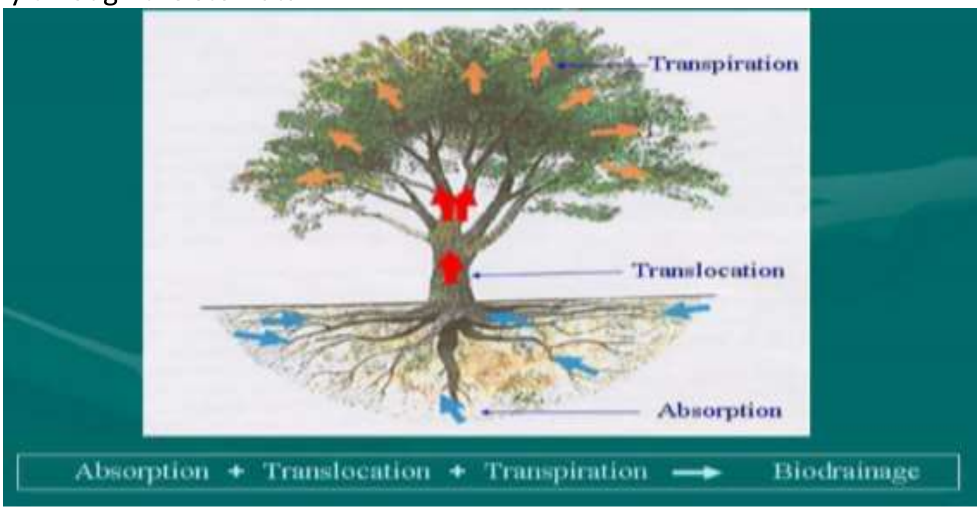

Figure 1: Concept of biodrainage (Jeet-Ram et al., 2008)

This combined process of absorption, translocation and transpiration of excess ground water into the atmosphere through the deep-rooted vegetation defines the concept of bio-drainage. Trees perform the function of removing water and other compounds like salts from soil and water and can be called as biological filters for waste disposal. Increase in tree densities leads to increase in root biomass which in turn helps to remove more moisture as well as increases the soil porosity for higher percolation. Fast growing Eucalyptus species known for luxurious water consumption under excess soil moisture condition are suitable for biodrainage. Hence, bio drainage through tree will be an eco-friendly way for reducing salinization and for drainage of excess water in addition to harvesting a quantum of biomass. The characteristics features of water-logged areas are wet, spongy surface, standing pools of water, poor aeration of soil, dark-colored surfaces in water. The mechanical and physical means of draining the water involves costly measures and the cheap source of drainage is biodrainage.

Merits of Biodrainage Over Conventional Drainage Systems

The merits of biodrainage technique over the conventional engineering based sub-surface drainage systems are as given below:

1. It is cost effective.
2. Here is no such maintenance cost after third year.
3. There is no operational cost because the plants use their bio-energy to drain out the excess ground water into the atmosphere.
4. There is no such requirement of drainage outfall and disposal of drainage effluent.
5. There is no issue of environmental pollution, as the plants drain out filtered fresh water into the atmosphere.
6. In- situ solution of the problem of water logging and salinity.
7. It can be considered both preventive as well as curative system for waterlogging and salinity.
8. Moderates the temperature of the surrounding by transpiration and a cushion for.
9. It helps in moderating the temperature of the surrounding by transpiration and a cushion for moderating frost, cold and heat wave impacts.
10. It is involved in the process of carbon sequestration.
11. It helps in purification of the atmosphere by absorbing carbon dioxide and releasing oxygen.
12. It provides ways for generating higher income to the farmers due to the production of food, fodder, fuel wood and small timber.
13. It assures people's participation as the biodrainage plantations on farmer's field belong to the individual farmers.

Significance of Biodrainage

Thornburn and George (1999) that the evaporation from the soil takes place up to a depth of 4 m. Therefore, we must have a planning to keep this soil depth of 4m free from waterlogging to minimize the process of salinization of soils and to sustain the productivity of crop. For this, we need fast growing trees like Eucalyptus having their root system penetrating at least up to this depth.

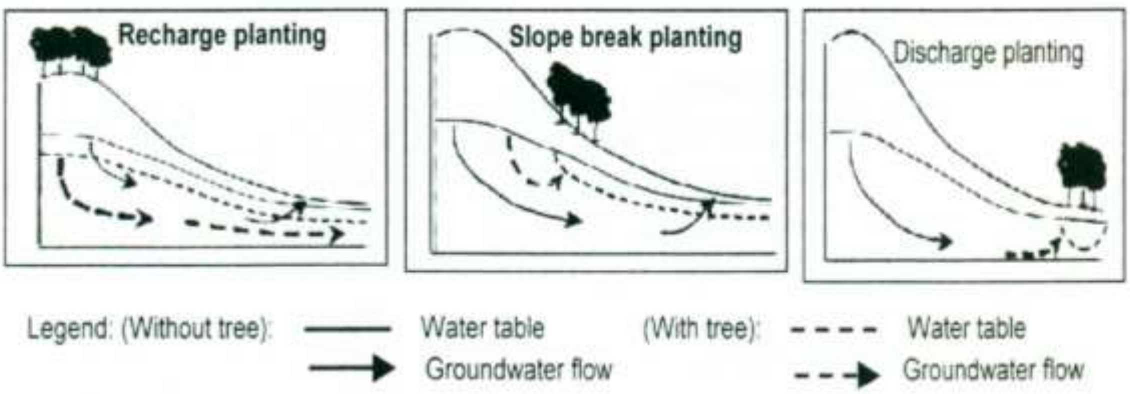

Figure 2: Different biodrainage systems (Denecke, 2000)

The bio-drainage technique could be applied both as curative (for waterlogged areas) and preventive (for potentially waterlogged areas).

Recharge planting and slope break planting (Fig. 2) may be adopted situations when there is a perched water table as well as the water cannot easily move down due to the presence of impermeable layer below.

Suitable Tree Species for Biodrainage

Species of tree that can be used successfully for the purpose of biodrainage are:
Tamari troupii, Acacia pennatula, A. tortilis, Casuarina glauca, C. equisetifolia), Eucalyptus camaldulensis, Leucaena leucocephala Casuarina cunninghamiana, Eucalyptus tereticornis, Acacia auriculiformis, Guazuma ulmifolia, Leucanea shannonii, Samanea saman, Albizzia caribea, Senna atomeria, Terminalia arjuna, Pongamia pinnata Syzygium cumini.

Mechanism of Biodrainage

The root systems of trees expropriate saturated zone or unsaturated capillary fringe above water table and control shallow water table. The primary objective of a bio-drainage system is to lower a shallow groundwater table to below the critical depth of the capillarity-induced evaporative processes that cause salinization that is 2 m below ground surface (Heuperman et al. 2002; Kapoor 2001).

For efficient biodrainage system, trees should be fast growing having high-rate transpiration system so that they absorb sufficient quantity of water from the capillary fringe above the ground water table. The roots of herbaceous annuals have less or no contact with water table.

The absorbed water is translocated to different parts of plants and finally more than 98% of the absorbed water is transpired into the atmosphere mainly through the stomata. Under ideal conditions, a tree canopy can reduce the level of water table by 1–2 m over a time period of 3–5 years (Gafni and Zohar, 2001; Heuperman et al., 2002; Kapoor, 2001). The process of absorption, translocation and transpiration of excess ground water into the atmosphere by the deep-rooted plants defines the concept of biodrainage.

Conclusion

In order to solve the problem of waterlogging as well as salinization caused due to agricultural development and increased use of irrigation demands the biodrainage plantation of trees and salt-tolerant crops as an integrated part of the landscape and farming keeping in mind the cost and environmental issues involved in using the traditional drainage technologies.

Plantation of suitable salt tolerant deep rooted fast-growing trees with high transpiration rates helps in reclamation of waterlogged area, control of water table, improvement in crop productivity, provides shelter belts, additional wood and forest products, and biodiversity. The problems related with the increase in salinity in the root zone can be postponed effectively using biodrainage systems in semi-arid and arid areas.

Biodrainage can be effectively used for water table management both in dry lands and irrigated areas. For better performance biodrainage plantation may also be raised on potentially waterlogged areas to prevent their conversion into waterlogged areas. In areas where the groundwater is being subjected to over-exploitation for irrigation and other purposes, resulting in a steep fall in the water table plantation of high biodrainage potential trees might reduce water-table further.

For the proper planning of bio drainage activities assessment of water and salinity in the landscape is much needed. Apart from advantages, biodrainage has its own limitations also as it requires large area of land, may not be very effective removing salts and performance of plantation is affected by increasing buildup of salinity in soil profile with time.

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Cash Crops – A View of Improving Farmer's Income

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Plants grown for commercial purposes, which are sold for high value in market unlike essential food crops like wheat, rice or vegetables. Cash crops are the crops which are grown by the farmers for selling it rather keeping it for their own use. Cash crop is scientifically known as a crop grown for its commercial value with the objective of making profit by selling them.

Cash crops offer income and employment opportunities to the rural economy. In addition, farmers generate capital for management improvements and innovation, and cash crops accelerate the build-up of institutions that enable further commercialization.

As any farming activity, cash crop agriculture requires the management of various types of risks such as soil degradation and price variability. Examples show that farmers employ several adaptive and risk reducing strategies, for instance by diversifying cropping patterns to cope with risks of harvest failures, price slums or loss of market access, and by establishing cooperatives or using agricultural commodity exchanges.

Importance of Cash Crop

1. It generates revenue to the nation.
2. It provides export product.
3. It provides employment opportunities.

Thus Cash Crops Allow

1. Farmers to earn a living.
2. Individuals to buy their food and buy a wider diversity of food than if they raise their own food.
3. Societies to grow and develop cities, industry, etc. (because everyone doesn't have to grow their own food anymore and instead can go to universities, work in factories, pursue science, build infrastructure, etc.).
4. Farms and regions can grow the type of crop that is:
    a. Most in demand.
    b. Best suited for their land and climate maximizing production.

In India, Cash crops are divided into three major groups:

Fibres and sugar crops	Drugs and beverages	Oil seeds
Cotton Jute Sugarcane	Tobacco Tea Coffee	Mustard, coconut, sesame (til), soy bean, castor seeds, linseed, and sunflower.

Sugarcane

India is considered as the original homeland of sugarcane and has the largest area under sugarcane in the world. India is the second largest producer of sugarcane after Brazil. The major sugarcane producing states are Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Bihar, Punjab and Haryana.

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Geographical Conditions of Growth

1. It is a tropical as well as sub-tropical crop.
   a. Sugarcane in North India is the sub-tropical variety and has low sugar content. Also sugar factories have to remain shut in winter seasons in North India. Also, sugarcane juice begins to dry up because of the long dry season in north India.
   b. Sugarcane in South India is of the tropical variety with high sugar content and high yield.
2. It grows well in hot and humid climate with a temperature of 21°C to 27°C and an annual rainfall of 75-100 cm.
3. Medium and heavy soils where irrigation facilities are available, which is ideal for its cultivation.
4. It can be grown on a variety of soils and needs manual labor from the time of sowing to harvest.
5. It is a long maturing crop planted between February and April. Harvesting begins in October and November.
6. It is a soil-exhausting crop and thus needs regular application of manure or fertilizers.

Cotton

Cotton is a major cash crop in India. India is believed to be the original home of the cotton plant. It is also one of the most important industrial crops of India.

Geographical Conditions of Growth:

a. Cotton grows well in black cotton soil. It can also be grown on alluvial and red soils.
b. It requires high temperature (20-35°C), light rainfall (50 to 80 cm) or irrigation, 210 frost free days and bright sunshine for its growth. Clear sky during the picking season is ideal.
c. It is a Kharif crop and requires 6-8 months to mature.


Important Producing Areas:

a. India is the fourth largest producer of cotton in the world. China, USA and Pakistan grow more cotton than India.
b. Cotton is cultivated in about 45% of the total sown area in the country.
c. The major cotton producing states are Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu, Punjab, Haryana and Uttar Pradesh.
d. India produces both short staple (Indian) cotton and long staple (American) cotton. American Cotton is called 'Narma' in the north-western part of the country.

Jute

India is the principal producer of Jute in the World. It is also known as the golden fibre. Jute fibre is obtained from the inner bark of the jute plant. It is used in making gunny bags, mats, ropes, yarn, carpets and other artifacts. Jute cultivation in India has recently suffered due to reduced demand as a result of increasing competition with artificial fibre and packaging material.

It is mainly grown in Ganges and Brahmaputra regions. The major jute producing states are West Bengal (largest producer in India), Bihar, Assam, Orissa and Meghalaya.

Geographical Conditions of Growth:

a. It is a soil-exhausting crop like sugarcane and lowers soil fertility rapidly. It thus grows well on the well-drained fertile soils in the flood plains where the soils are renewed every year.
b. High temperatures (24°C to 35°C), heavy rain (125 – 200cm) and low plain land are favorable conditions for the cultivation of jute.

Tobacco

Tobacco was brought to India by the Portuguese. Its leaves are used in making cigarettes, cigar, beedi etc. Its stem is used as potash fertilizer and its powder as an insecticide. *Nicotina tabacum* and *Nicotina rusticsare* are the important cultivated species.

Geographical Conditions of Growth:

a. It requires temperatures of 15°C to 40°C and rainfall of about 50cm or irrigation facilities. More than 100cm of annual rainfall and frost is harmful for the crop.
b. Fertile soils with good drainage are ideal as it is an exhaustive crop

Important Producing Areas:

a. Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and Bihar.
b. More than 1/3rd tobacco of the country is produced by Andhra Pradesh alone.

Oilseeds

Oilseeds produced in India include groundnut, mustard, coconut, sesame (til), soybean, castor seeds, linseed, and sunflower. Most of these are edible and used as cooking mediums. Some of these are also used as a raw material in the production of soaps, ointments and cosmetics.

Geographical Conditions of Growth:

a. Most oilseeds are grown as dry crops or in association with other crops e.g. mustard is grown with wheat.

Important Producing Areas:

b. India is the largest producer of oilseeds in the world. About 20% of the world's oilseed producing area is in India.

c. Different oilseeds are grown covering approximately 14% of the total cropped area of the country.

d. Major oilseed producing areas are the plateau of Malwa, Marathwara, Gujarat, dry areas of Rajasthan, Telangana and Rayalseema regions of Andhra Pradesh.

e. Madhya Pradesh ranks first (31%) in the total oilseeds production and is followed by Rajasthan and Gujarat.

f. The smaller oilseeds are grown mainly in the north (Gujarat, MP, Rajasthan, Punjab and Haryana) and the larger seeds in the south mainly Kerala, Tamil Nadu, Andhra Pradesh and Karnataka. A list of particular oilseeds and their producing states:

i. Coconuts – The southern coastal region in the states of Kerala, Tamil Nadu and Andhra Pradesh.

ii. Castor seed – Gujarat.

iii. Linseed – Chhattisgarh.

iv. Soya beans – Madhya Pradesh.

v. Mustard and rapeseeds – Rajasthan.

vi. Sunflower – Karnataka, Maharashtra and Andhra Pradesh.

Additional information:

a. A well-known global cash crop is coconut and it is grown in over 80 countries having a climate suitable for its growth. Coconut and its derivatives are widely used in cooking, and in making soaps and cosmetics.

b. Jatropha curcas is an example of a cash crop. It is used for the production of biofuel.
c. Black market cash crops are cocoa, cannabis and opium.

Conclusion

Cash crops are an essential part of sustainable development. Because, it is income generated crops and also provides farm households with means to save and invest in a more productive. Cash crops may have a catalytic effect on agricultural innovations as they add value and productivity in rural areas and provide better livelihood, standard of living to the farmers.

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Fertilizer - Application Methods and Practices

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Importance of Fertilizers Application

Since most of the soils do not provide the requisite nutrients necessary for the growth and health of plants, they have to be fed with fertilizers to overcome the deficiency. Also, fertilizers are not one-time materials that once provided do not have to be re-supplied. In fact, every time while harvesting, they remove some nutrients along with them. Thus, regular supply of fertilizers to plants is a must to ensure their regular growth and yield.

The method of application has to be chosen to suit the crop, soil moisture, soil type (clay and organic matter content), type of fertilizer, row spacing and method of cultivation.

Normally the Following Methods of Fertilizer Application Were in Practice

1. Broadcasting - spreading fertilizers uniformly all over the field
2. Placement – application of fertilizers in soil at a specific place like bands or pockets near the plants or plant rows
3. Foliar application - spraying of fertilizer solutions containing one or more nutrients on the foliage of growing plants.

Plants require macro nutrients of NPK at large quantity. Nitrogen is generally applied as basal and split application of top dressing which done by mostly broadcasted method for irrigated crops. Phosphorous is applied as basal through placement method. Potassium is applied by broadcasting. While using a complex fertilizer for the macro nutrients at the time of sowing, placement method is more suitable to apply fertilizer in the field. Micro nutrients are mostly applied as foliar sprays.

The main objectives of broadcasting the fertilizers at sowing time are to uniformly distribute the fertilizer over the entire field and to mix it with soil. Broadcasting is suitable for crops with dense stand, the plant roots permeate the whole volume of the soil, large doses of fertilizers are applied and insoluble phosphatic fertilizers such as rock phosphate are used. Top dressing is one of the broadcasting methods which spread fertilizers particularly nitrogenous and potassium fertilizers in closely sown crops like paddy and wheat after crop establishment, with the objective of supplying nutrients in readily available form to growing plants.

The main disadvantages of application of fertilizers through broadcasting are:
1. Nutrients cannot be fully utilized by plant roots as they move laterally over long distances.
2. The weed growth is stimulated all over the field.
3. Nutrients are fixed in the soil as they come in contact with a large mass of soil.

Various Methods in Placement Application

Plough sole placement: In this method, fertilizer is placed at the bottom of the plough furrow in a continuous band during the process of ploughing. Every band is covered as the next furrow is turned. This method is suitable for areas where soil becomes quite dry up too few cm below the soil surface and soils having a heavy clay pan just below the plough sole layer.

Deep placement: Placement of ammoniacal nitrogenous fertilizers in the reduction zone of soil particularly in paddy fields, where ammoniacal nitrogen remains available to the crop. This method ensures better distribution of fertilizer in the root zone soil and prevents loss of nutrients by run-off.

Drilling: In this method, the fertilizer is applied at the time of sowing by means of a seed-cum-fertilizer drill. This places fertilizer and the seed in the same row but at different depths. Although this method has been found suitable for the application of phosphatic and potassium fertilizers in cereal crops, but sometimes germination of seeds and young plants may get damaged due to higher concentration of soluble salts.

Side dressing: It refers to the spread of fertilizer in between the rows and around the plants. It is otherwise called as banding (placing fertilizers in bands to one or both sides of the rows).

The common methods of side-dressing are:

a. Placement of nitrogenous fertilizers by hand in between the rows of crops like maize, sugarcane, cotton etc., to apply additional doses of nitrogen to the growing crops.
b. Placement of fertilizers around the trees like mango, apple, grapes, papaya etc.

The Main Advantages of Placement Methods are as Follows

1. When the fertilizer is placed, there is minimum contact between the soil and the fertilizer, and thus fixation of nutrients is greatly reduced.
2. The weeds all over the field cannot make use of the fertilizers.
3. Residual response of fertilizers is usually higher.
4. Utilization of fertilizers by the plants is higher.
5. Loss of nitrogen by leaching is reduced.
6. Being immobile, phosphates are better utilized when placed.

Foliar Application

Fertilizers are dissolved in water and spray over the foliage of growing plants. Those fertilizer solutions are containing one or more nutrients. Several nutrient elements are readily absorbed by leaves when they are dissolved in water and sprayed on them. The concentration of the spray solution has to be controlled; otherwise, serious damage may result due to scorching of the leaves. Foliar application is effective for the application of minor nutrients like iron, copper, boron, zinc and manganese. Sometimes insecticides are also applied along with fertilizers.

Fertilizers for Foliar Application

1. Fertilizers which does not cause any scorching symptom on crop foliage that should be used.
2. Small quantities of required fertilizers are mostly used for foliar application. Ex. Micronutrients.
3. Urea spray in pulses required for flowering and pod filling to improve yield.
4. Anti-transparent and plant growth regulators are also used to spray to improve the drought tolerant ability and yield of many crops.

Precautions to be Followed for Foliar Spray

1. Spray at early morning and evening is optimum for foliar application
2. While spraying the nozzle should be kept at least 1 to 2 feet away from the foliage
3. Don't go for foliar spray at the time of cloudy weather
4. Use optimum concentration and correct dose of fertilizer for spray
5. Size of sprayer's nozzle is important. The increase in concentration depends on the nozzle type.
6. The spray should be fine as mist but not as droplets of water.

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Climate Smart Practices for Agricultural Sustainability

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Summary

Agriculture sector is witnessing radical changes and challenges at national and global level due to climate change. Climate change presents a major risk to long term food security as it may have multidimensional debilitating effects on agriculture. Intergovernmental panel (IPCC) on climate change has projected that by the end of this century, global earth temperature is likely to increase by 1.80C to 1.40C.

This would lead to more frequent hot spells, erratic rainfall pattern, droughts, cyclones and recession of glaciers. Moreover, dynamics of pests and diseases would be significantly altered. The projected increase in these events will result in greater instability in food production which ultimately threaten livelihood security. Therefore, producing enough food for increased demand against the background of changing climate scenario call for a paradigm shift in the innovation-driven agricultural research system.

Agriculture undoubtedly, is highly dependent on the natural resources. Rain fed agriculture has huge potential if natural resources, especially soil and water are scientifically and efficiently managed. If we continue to exploit the natural resources at the current level, productivity and sustainability is bound to suffer. Climate smart practices address climate risks in agriculture by improving the scientific rule and investment setting to attain sustainable agricultural progress in order to ensure the food availability under climate change.

For example, conservation agriculture helps reduce or rather reverse the natural resource degradation by improving soil health and reducing ground water and environmental pollution. The soil moisture conservation and soil temperature moderation can help to a large extend in overcoming the adverse effects of climate change. Potential of conservation agriculture, zero tillage, precision agriculture and micro-irrigation needs to be perfected for different agro-regions.

Next generation precision agriculture along with geospatial technology (GIS, GPS) would benefit in production efficiency. This would require obtaining relevant parameters and simulation of the most complex systems with the application of increasingly powerful computers, sophisticated software and advanced sensors. Improved long-range weather prediction technology would be required to take advantage of precision operations for crop and resource application.

This may also contribute to the better understanding of global warming and climate change. Similarly, bio-risk is increasing in agriculture with climate change and owing to trans-boundary insect-pests and diseases. It is adding cost, reducing food production and adversely affecting farm income. To overcome the problems of bio-risk, efforts would be made to develop effective and integrated risk and disaster management production systems and institutional mechanisms, which would bear risk. Bio-risk intelligent system (such as early warning system, drought indicators etc.) would be developed for taking informed decision at the local, regional and national levels.

Furthermore, developments in frontier science- molecular biology, biotechnology, nanotechnology and information technology would be well integrated in redesigning agriculture in an era of climate change by improving adaptation and mitigation research. So, there is an urgent need to train the researchers, extension personnel, farmers on climate smart practices and to create adequate human resource to address emerging climatic challenges.

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Floral Biology of Papaya

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Introduction

Papaya, *(Carica papaya),* also known as papaw or pawpaw, is a succulent fruit of belongs to the Caricaceae family. It is diploids (2n=2x=18) with a basic chromosome number (x=n=9). Today, it is grown throughout the tropical world and in warmer parts of the subtropics. In papaya blooming takes place generally after 3-6 months of transplanting, and identification of the desired plants during the planting phase facilitates in developing the orchard with appropriate design. In the subtropics, preference is given to dioecious varieties such as Pusa Nanha and Pusa Dwarf, due to their dwarf stature and high yields.

In contrast, in the tropics, gynodiocious varieties are preferred because of their high yield potential. In both cases, the major limiting factor is incompetency to identify the sex type of the seedlings prior to planting. Sex expression in papaya is controlled by a single gene with three alleles, which have a pleiotropic effect.

Floral Biology

Papaya is a polygamous plant with three basic types of flowers viz., staminate, pistillate and hermaphrodite (bisexual). Of these, only the pistillate is stable, while hermaphrodite and male flower vary in sex expression under different environmental conditions. High temperature (>35^{o}C) leads to female sterility (induce maleness). Male plants bear fruits during summer season are known as carpellody. The carpellody formation is in below 20^{o}C, low elevation/ cool winter.

Staminate Flowers

The staminate flowers serve as pollinators. These plants have flower stems 1 to 1.5 m long hanging out from trunk. The individual flower is small, tubular and contains only stamens.

Pistillate Flowers

The pistillate flowers are large, yellow, borne singly or in-group of three in the leaf axils near the trunk. The flowers have fine, tall, twisted, fleshy petals that surround an ovary, which swells and turns into fruit. The fruits developed from the pistillate flower are spherical to oblong in shape with a thick, yellow to orange colored flesh in different cultivars with a small cavity in which numerous rounds, wrinkled black seeds adhere.

Hermaphrodite or Bisexual Flowers

It has both male and female organs, Individual flower are 3.5 to 4.5 cm long with a tubular base that widens into goblet shape and then spreads out into 5 thick yellow-colored recurred petals.

Among these petals, the male organs i.e., the stamens are present and the female organs containing oblong ovary which turns into cylindrical fruits. High temperature and low humidity accelerate the anther dehiscence time.

In papaya, a high percentage of pollen germination can be achieved with 5% sucrose solution. Papaya pollen can be stored for up to 5 years without losing its viability if the proper storage conditions are created.

The stigma becomes receptive one day prior to anthesis and it remains receptive two days after flower anthesis. The best time to cross is between 8-10 hours in the forenoon during sunny days.

Pollination

If the papaya plant is pollinated properly, it will produce a light crop of fruits that lack uniformity in size and shape. Therefore, hand pollination is recommended in commercial plantations that are not entirely bisexual. Sometimes, seedless fruit may observe in the areas where the gynodioecious variety/ hybrid dominate the cultivation. These seedless fruits are due to lack of proper pollination and fertilization.

Sex Reversal

The tropical plant papaya is one of the few trioecious plant species, which means that papaya plants can have one of three sexes: male, female, or hermaphrodite. In papayas sex is genetically determined by the sex chromosomes: as in humans, female papayas have two X chromosomes, whereas, male have an X and a Y chromosome, hermaphrodite have an X and slightly different Y chromosome called Yh. Papaya growers mostly plant hermaphrodite papayas as they can self-pollinate and produce more uniform fruits and offspring. However, environmental effects, such as heat, can induce a so-called sex reversal that leads to the production of male flowers on hermaphrodite plants and can lead to yield loss. Plants of the reverse sex remain genetically hermaphrodites and may turn back and produce hermaphrodite flowers again. This indicates a difference in gene expression that causes sex reversal rather than genetic mutations.

Genetics of Sex Expression

The sex expression of papaya is controlled by a single gene, with three alleles which have a pleiotropic effect. The sex homologues were designated as: M_1 for male, M_2 for hermaphrodite and m for female (Hofmeyer assigned symbol). All combinations of dominant alleles, such as M_1M_1, M_2M_2 and M_1M_2, are lethal to the zygote. This makes all males and hermaphrodite into enforced sex heterozygotes. Twenty-five percent of the seeds in their fruits are non-viable. The genotypes for sex are M1m for the male, M2m for the hermaphrodite and mm for the female. According to Ram hypothesis: 2 types of male are observed:

1. Pure male is $M_1^{rr}m$.
2. Sex reversing male are $M_1^{RR}m$ or $M_1^{Rr}m$.
3. Sex reversal in papaya is governed by single gene (R).

Male and hermaphrodite trees undergo various degrees of sex reversal, depending on seasonal changes and climate. The female tree is the most stable form.

		
Female flower	**Male flower**	**Hermaphrodite Female**

Catface or Carpellody

The "cat face" or carpellody is specific to papaya. The appearance of carpellodic fruits can vary from those that resemble female fruits to those that are severely deformed with ridges or longitudinal seams. Carpellodic fruits are generally rounded rather than the more typical pyriform shape and are unmarketable. Carpellody or "cat-face" fruits occur when the stamens develop abnormally into carpel-like fleshy structures. Sex expression in hermaphroditic papaya trees is variable and is influenced by environmental factors. The development of carpellodic fruits is favored by low night temperatures associated with high level of moisture and nitrogen. Carpellody is an inherited trait, so careful selection of seeds can reduce its occurrence.

Fig 2: Cat faced papaya fruit

Conclusion

There is need to identify plant sex form. About 10% of the male plants are kept in the orchards for good pollination where dioecious varieties are grown. As soon as the plants bloom, the additional male plants are uprooted.

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New Breeding Tools for the Rapid Development of Fruit Varieties

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Introduction

Together with global climate change, population pressure has contributed to growing demand for plant-based food (Varshney et al., 2011). Human diet is mainly focused on cereals, grains and tuber crops typically lacks a wide range of fiber, antioxidants, provitamins and other micronutrient compounds which is commonly found in the fruit and nut species (Heslop-Harrison, 2005).

In 2018, the world produced around 654 million tonnes of fruit (Anonymous, 2018). Changing climate and increasing global fruit demand has exerted immense pressure on fruit breeders to develop varieties for the changing scenario. Traditional fruit breeding remains a very slow and cumbersome process which has changed little over centuries.

Some important limitations in fruit breeding include long juvenility periods, significant field costs, and yearly limitations on flowering and fruiting related to chill and heat requirements. At present, many fruit crops are produced in a monoclonal situation, i.e., relying on one principal variety. This situation lends itself to vulnerability of pest outbreaks and the vagaries of weather. Rapid cycle breeding approaches are solution of all these problems.

Reducing the Length of the Breeding Cycle: Manipulating Cultural Conditions

In woody perennial plants, the length of the juvenile period is influenced by environment and is inversely correlated with vigour.

Accordingly, environmental conditions that reduce vigorous growth, such as mineral deficiency, low light, water stress, defoliation or cold stress, tend to delay the transition from the juvenile to adult phase, whereas the conditions that allow for vigorous growth can shorten the period of juvenility. Zimmerman (1972).

In apple (Malus domestica), where field-grown seedlings typically do not flower until they are at least 5 years old, plants can be promoted to the adult reproductive phase after as little as 10 months under optimal growth conditions. Zimmerman (1972).

The apical portion of the plant, having attained the adult state, can be grafted to a rootstock for further growth and maintenance. A drawback of such an approach is that plants can grow very tall and become difficult to manage in a controlled environment or greenhouse setting (Zimmerman et al.,1985).

Micro Budding- A Method to Shorten the Citrus Nursery Phase

Unlike in traditional shield 'T' budding in citrus, micro budding can be performed on just 5 months old commercial rootstocks, throughout the year in humidity controlled low-cost greenhouse structure that cuts down huge cost on labor and maintenance and shortens the nursery phase.

The method consists of a mini crown grafting of young citrus liners of about 3 mm diameter in which the bud is subsequently fixed and capped to the rootstocks, not tapped as with conventional budding. Within 2 weeks the micro budded rootstock begins to grow and micro tip caps are removed.

Trans Grafting

In the past two decades, there has been appreciable refinement of this pioneering technology, including the employment of additional flowering genes, use of inducible promoters to drive transgene expression, and recently, approaches to transmit the transgenic stimulus through grafting.

Plant species	Name of gene	Source	Trait	Achievement	Ref.
Apple *(Malus domestica)*	rolB	Apple	Control of scion vigor and reduce plant height	rolB transgenic rootstocks significantly reduced vegetative growth including tree height regardless of scion cultivar	Smolka et al., 2010
Grapevine *(Vitis vinifera)*	Shiva-1 lytic peptide	Grapevine	To control Pierce's disease (PD) *(Xylella fastidiosa)*	Non-transgenic scion resistant to PD	Dutt et al., 2007
Sweet cherry *(Prunus avium)*	PNRSV	Prunus necrotic ringspot virus (PNRSV)	Resistance to PNRSV in non-transgenic scions	Non-transgenic scion of sweet cherry grafted onto the transgenic rootstock showed resistance to PNRSV caused by the transportation(rootstock-to-scion) of hpRNA-derived siRNAs	Zhao and Song, 2014

Transgenic

Possibly the most exciting potential for reducing the length of the breeding cycle is the biotechnological manipulation of endogenous, genetic flowering pathways. Nearly 20 years ago, Detlef Weigel and Ove Nilsson showed that flowering could be triggered in aspen by transgenic expression of a gene from Arabidopsis called LEAFY (LFY). Since then, several genes have been identified for early flower production.

FasTrack Breeding

(Concept By: - Ralph Scorza, Principal Investigator University of California, The FasTrack Approach to Specialty Crop Breeding). A breeding system that uses a genetically engineered (GE) tree flowering gene that produces generation cycles of one year or less. FasTrack utilizes genetic engineering strategies, but the product released for commercial use is not a genetically modified plant. Thus, this technology has the potential to integrate into existing breeding programs.

Step 1: Transformation of seedling of the original type with early continually flowering (ECF) genetic construct

Step 2: Undertake initial cross of ECF original type with variety having desired characteristic (Drought tolerant). This cross will produce many genetic lines.

Step 3: Undertake multiple backcrosses, with original or drought tolerant lines. Use molecular markers to select traits.

Step 4: Following any number of backcrosses, and using molecular markers, select drought tolerant, non-ECF progeny with recurrent parent (original type) traits.

Conclusion

Integrating the FasTrack Breeding and other tools of new breeding system into convention breeding programs will result from the more rapid and less costly development of improved tree fruit varieties. The greater speed of variety development will allow breeding programs to move rapidly to develop fruit for consumption that is healthful, requires less pesticide use and is adapted to the environmental changes that affect production. These technologies have great potential to revive and expand tree breeding in general.

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Glauconite: An Alternative Source of Potassium Nutrition for Crops

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The response to green revolution technologies started waning in intensity and extent particularly for the realization of full potential of high yielding varieties it was felt the importance for balanced fertilization felt indispensably. It broke the earlier myth being pronounced that Indian soil are well supplied with native potassium this hypothesis at a time was further strengthen by soil scientist and agronomists who dealt chiefly with soil fertility management at the time. With time, turning a Nelson's eye to potash treatment led to deficiency, which with time emerged as a creeping sickness of soils and crops. Intensive cropping with objective to attain high productivity increased mining of soil potassium reserves there by amplifying potassium deficiency syndrome in Indian soils. Since incessant negative balance aggrandizes depletion of soil reserves, by and by potassium deficiency intensified in soils and crops. The outcome was that the soils that earlier were high in availability declined to medium category and those that were medium in potassium availability turned low. A major regression in productivity of food grains from 3.1% before 1990 to 2.1% thereafter was found to be attributed to increasing potassium deficiency.

Crops like coconut, areca nut, oil palm, cashew, tea, coffee, rubber chiefly grouped as plantation crops and spices/condiments are faced with double whammy of having big hunger for potassium and their being concentrated in acid soils which are inherently deficient in potassium. India needs to substantially raise potassium application levels from the current 17 kg K_2O/ha to at least 30 kg K_2O/ha due to surging potassium deficiency in Indian soils and shifting emphasis on cultivating potassium demanding nutritionally dense and foreign exchange earning crops, so this is the right time to pay more attention to potassium application in future and that has been neglected in recent past. Further the fragile economy of the country needs to contain the import bill. So, call of the hour is to urgently harness the indigenously available potash mineral resources.

Under such circumstances, indigenously available potassium bearing mineral glauconite (an iron potassium silicate having K_2O content 5-8%) could be an answer. As glauconite could be a better substitute to imported potash of amenability to low-cost open quarrying and proven agronomic benefits as source in its native form.

Glauconite being a sedimentary rock owes its origin to marine deposits over the time. It is generally believed to have sedimented in shallow marine seas near the interface of land and water over ages. It, therefore, lies on the top of lithosphere with little or no overburden. Glauconite – an iron-potassium-silicate is embedded in what is called 'greensand rock'. Besides potassium, it is a rich source of oxides of silica (Si ~50%), iron (Fe~16%), manganese (Mg~2 %) and some 30 trace elements of which zinc, copper, molybdenum are the most important. In comparison to muriate of potash, Glauconite when added to soil, discharges potassium gently and slowly into soil solution. This slow nutrient release ability of it over the time saves plants from usual root injury associated with concentrated and fast acting water-soluble muriate of potash.

Another benefit associated with slow release of potassium from glauconite bridges the possible groundwater pollution and leaching losses. This trait is of special significance in acid soils, which because of dominating positive charge are specifically vulnerable to repel a cation like potassium (K+). This nature of glauconite makes it admirably safe for soils and plants and overall ecosystem health and is also a more efficient potassium source. Added over it, long-lasting potassium release pattern matches very well with potassium loving perennial crops, which need maintenance of supply over extended periods of time. The limitation with utilization of glauconite as potassium source for crops is that if crop need immediate potassium replenishment in case of deficiency its slow-release nature can hinder the availability of potassium. So, it needs beneficiation to improve content of water-soluble K.

Physio-chemically, glauconite is a clay mineral and is a derivative of illite it weathers at a rapid pace and its potassium is available faster than that of feldspar – a high K bearing mineral. To soften hard water – a common practice in the American countries, glauconite is widely deployed attributing to its base/cation stashing power. This qualifies glauconite in both the categories as a fertilizer and a soil conditioner.

The glauconite mines currently lie commercially unexploited due to the readily availability of relatively low-priced imported potash. Beneficiation refers to the process that removes materials of little commercial value from an ore to synthesize a high grade or concentrated nutrient source. As far as beneficiation of glauconite is concerned, chiefly three methods are commercially applied including magnetic separation, acid extraction and inoculation with microorganisms.

In magnetic separation method, by applying magnetic force, iron is removed from mined material for increasing potassium concentration of glauconite. This method is cheap and environmentally safe. But, however, suffers from a severe limitation, which relates to the quantum of improvement in the potassium content of the upgrade product. In absolute terms, it works out to merely 1 percentage point elevation in potassium concentration.

The acid extraction processing of the ore is the second most adopted procedure. A proprietary 'K-Max process' developed by Potash West NL Australia is available for commercial exploitation. The process employs a concentrated hot acid leach that breaks down the glauconite, recovering all the potassium within the mineral within 6 to 8 hours. The process combines well with the open pit quarrying operations, which makes it economically more attractive. In India, a modified method is employed in which primarily chlorodizing-roasting of ore is done followed by acid leaching is employed to extract potassium.

The third route to upgrade potassium availability exploits the power of potassium mineralizing micro-organisms (KMMs). It is done by inoculating glauconite with appropriate microbes. KMMs increase glauconite- potassium availability due to acids produced during mineralization process. Alternatively, composting of plant and animal residues is done by enriching it with glauconite. Once again, organic acids generated during organic matter breakdown hasten release of glauconite- potassium.

In a nut shell it could be summarized that glauconite has potential for direct application to soils in a pro-environment manner. As glauconite provides potash as nutrient for plants and mixes homogeneously with the soil. It is having more or less uniform grain size owing to this property it also increases soil fertility and improves soil texture, porosity and permeability. In developed countries like USA, glauconite, is the only certified organic source of potash anywhere in the World and can be widely and economically used in Indian agriculture when the economy of country is burdened with the burgeoning costing over US dollar one billion annually. The call of the hour is that India ought to become self-sufficient in production in spite of relying on foreign imports.

Induced Systemic Resistance

Article ID: 10478

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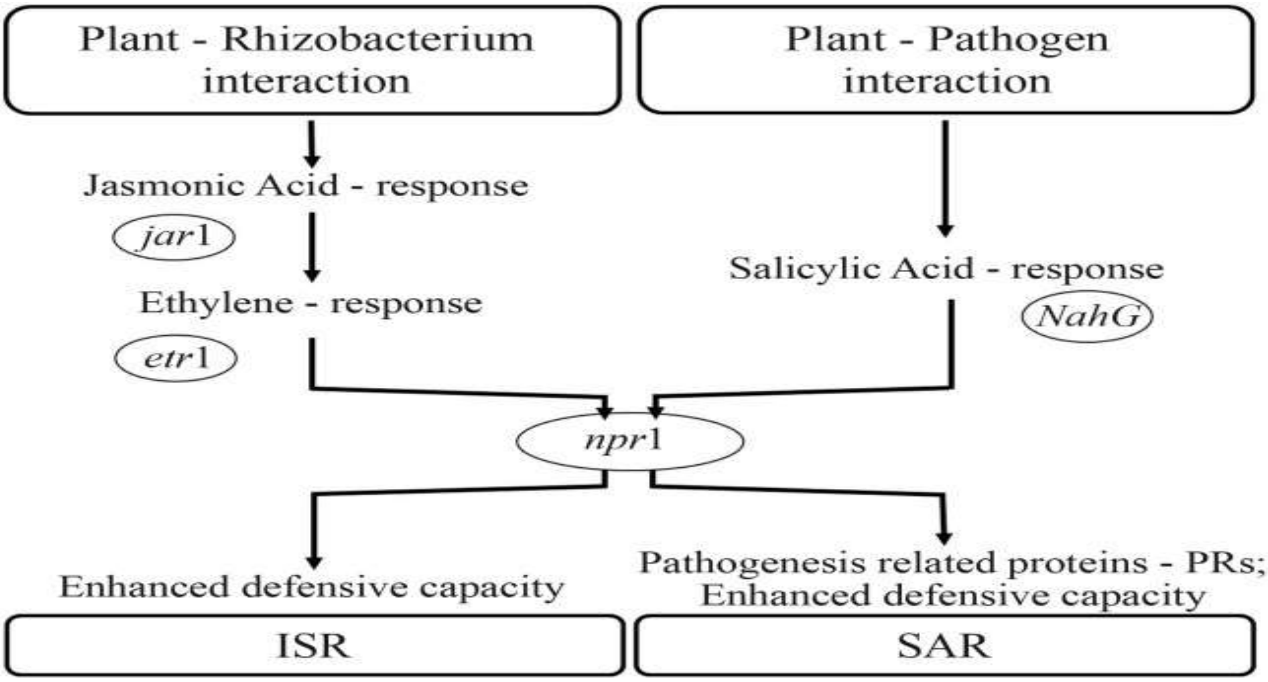
Introduction

The term induced resistance is a generic term for the induced state of resistance in plants triggered by biological or chemical inducers, which protects nonexposed plant parts against future attack by pathogenic microbes and herbivorous insects. Some of these responses are localized but others are systemic, spreading far from the attacked organ and inducing defensive responses in the entire plant (Pieterse *et al*., 2014; Verbon *et al*., 2017). Induced resistance is expressed not only locally at the site of induction but also systemically in plant parts that are spatially separated from the inducer, hence the term ISR. Generally, induced resistance confers an enhanced level of protection against a broad spectrum of attackers, induced resistance is regulated by a network of interconnected signalling pathways in which plant hormones play a major regulatory role. The signalling pathways that regulate induced resistance elicited by beneficial microbes.

Beneficial microbes in the microbiome of plant roots improve plant health. Induced systemic resistance (ISR) emerged as an important mechanism by which selected plant growth–promoting bacteria and fungi in the rhizosphere prime the whole plant body for enhanced defence against a broad range of pathogens and insect herbivores. A wide variety of root-associated mutualists, including *Pseudomonas, Bacillus, Trichoderma,* and mycorrhiza species sensitize the plant immune system for enhanced defence without directly activating costly defences.

Jasmonic Acid and Ethylene in Control of Induced Systemic Resistance



Signal Transduction leading to rhizobacteria-induced and ISR pathogen-induced SAR. (Van Loon, 1998).

Along with SA, the plant hormones JA and ethylene (ET) are also important regulators of the plant immune system. By using Arabidopsis mutants impaired in JA or ET signaling, it was demonstrated that JA and ET are central players in the regulation of rhizobacteria-mediated ISR. For many other PGPR, such as *Serratia marcescens*, *Pseudomonas protegens*, and *P. fluorescens*, and PGPF, such as *Penicillium* sp, *Trichoderma harzianum*, and *P. indica*, genetic evidence in Arabidopsis pointed to a role for JA and/or ET in the regulation of ISR. In accordance with its dependency on JA and ET signalling, rhizobacteria-mediated ISR was shown to be effective against attackers that are sensitive to JA/ET-dependent defences, including necrotrophic pathogens and insect herbivores.

Root Colonization

Initiation of ISR requires beneficial microbes to efficiently colonize the root system of host plants. For the establishment of a successful mutualistic association, host plants and microbes need to respond to reciprocal signals and accordingly prioritize their responses so as to develop a lifestyle that provides mutual benefits.

In the well-studied mycorrhizal and rhizobial symbioses, host-secreted strigolactones and flavonoids stimulate the production of symbiotic Sym and Nod factors by the microbes, which in turn activate a common symbiosis (Sym) signalling pathway in plant roots that is necessary for the establishment of a successful symbiotic relationship. How nonsymbiotic PGPR and PGPF establish a prolonged mutualistic interaction with plant roots is less well characterized, but a picture is emerging that a molecular dialog is also essential for these mutualistic interactions.

Beneficial ISR-eliciting microbes do not directly activate defense responses but sensitize the whole plant (a phenomenon called priming) for a faster and stronger activation of defense responses upon invasion by pathogens (Choudhary *et al*., 2007; Martínez-Medina *et al.*, 2017). Among the beneficial rhizosphere microbes that can activate the ISR are rhizobacteria, like *Pseudomonas simiae* (syn. P. *fluorescens*), *Bacillus subtilis*, *Paenibacillus polimyxa* and *Azospirillum brasilense;* rhizofungi, like *Trichoderma* spp., mycorrhizal fungi, like *Rhizophagus irregularis* (syn. *Glomus intraradices*) and Piriformospora indica; and non-pathogenic races of *Fusarium oxysporum* (Zhao *et al*., 2014; Verbon *et al.,* 2017).

Role of Induced Systemic Resistance

1. Plants treated with PGPR or biological agent supposed to be more rapidly to the pathogen attack due to activation of new system resistance in plant.
2. Reduce the negative effect of the pathogen and promotes positive response in plant.
3. Improve photosynthetic efficacy.
4. Increase nutrient absorption and nitrogen use efficiency.
5. Enhance growth and yield by eliminating harmful microorganisms.

Is Induced Systemic Resistance Constitutively Active in the Field?

The microbial community in the rhizosphere is extremely diverse, and members of many genera have the potential to elicit ISR. On top of that, many different microbial determinants have been implicated in eliciting ISR. Thus, the question of whether all plants in the field are already in the state of ISR seems reasonable, and it may explain some observations of inconsistent performance of induced resistance in the field.

However, there are many examples of PGPR or PGPF that induce ISR under field conditions when introduced to soil or planting material. This suggests that untreated plants do not constitutively express ISR or at least that they are not induced up to their full potential.

A demonstration that suppressive soils not only control a single target soilborne pathogen or disease but also stimulate the plant immune system would greatly enhance their standing as an important approach to managing diseases and insects in conventional and organic crop production systems.

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Nari: Nutri-Sensitive Agricultural Resources and Innovations

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The agricultural sector in India has made a valuable contribution for food security and economic development. But food security as well as nutritional security needs to be ensured. In our country, local fruits, vegetables, and nutritious food crops are grown in good quantities and they are rich in vitamins and minerals.

These crops can be grown in small home gardens as a kitchen garden under the guidance of housewives to provide nutrition security to the elders and young children of the house as per their need. Good production of crops, animal husbandry, fish and milk have able to provide food security to the country. But full success is needed to address the growing number of malnourished and underweight children and their nutritional problems.

To achieve success in food security as well as nutrition security, it is necessary to reduce the "nutrition gap". Building a healthy country requires nutrition in all areas. This requires linking agriculture to nutrition as well as the availability and consumption of healthy, wholesome and sattvic food to reduce the nutritional gap. In order to provide nutritious food to the whole family, different types of nutritious vegetables and fruits should be grown by the women of the house in form of kitchen gardens.

Keeping in view the need for nutrition security in rural areas, the Indian Council of Agricultural Research has launched a programme called "NARI" (Nutri-Sensitive Agricultural Resources and Innovations). The programme is women-centred and run for women by women. Appointed Home Scientists of Farm Science Centres are in the lead role of the management of this programme and they conduct this programme with the help of women's groups.

Main Purpose of the Programme

1. Link agriculture with nutrition to promote the nutrition sensitive agriculture.
2. Create awareness among rural women and youth about nutrition sensitive farming.
3. Create awareness about sustainable horticultural crop production through kitchen garden.

Major Objectives of the Programme

When the programme was launched, its main goal was to introduce it in about 100 Farm Science canters in the country by the year 2019-20. Benchmark surveys are conducted in the districts to determine the performance targets of NARI programme. The main objectives of this program are as follows:

1. To organize skill development programs for farm women to promote family farming for better food and nutrition security.
2. To organize various programs with a view to bring awareness among the rural women and youth about locally available food fortification, nutrition calendar, nutritious plate, etc. along with rural school.
3. To establish the “nutritional gardens” to ensure adequate nutrition.
4. To organize awareness and skill development programs for people involved in the development of children and women.

Major Activities of the Programme

1. Make women and youth aware about growing nutritious crops.
2. Make fortification of locally available food items.

3. Organization of demonstrations on sustainable crops and their varieties.
4. Provide education on sustainable nutritious crops production
5. Promote nutrition sensitive agriculture through demonstrations.
6. Develop skills for growing nutritious crops among rural women and youth through training.

The programme will help to create and spread awareness about food and nutrition security. The integration of knowledge of rural women and their working skills will accelerate the development of nutrition sensitive agriculture.

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Integrated Pest Management in Mango

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Introduction

Almost a dozen of insect pests has been found damaging the crop to a considerable extent causing severe losses and, therefore, may be termed as major pests of mango. These are hopper, mealy bug, inflorescence midge, fruit fly, scale insect, shoot borer, leaf webber and stone weevil. Of these, insects infesting the crop during flowering and fruiting periods cause more severe damage. According to an estimate, approximately 18% of our total crop produce is lost due to pests in spite of the facts that use of pesticides for pest control has also increased over the years including horticultural crops. A brief account of pests in mango crops is being presented here.

Hoppers

Hopper is considered as the most serious and widespread. Large number of nymphs and adult insects' puncture and suck the sap of tender parts thereby reducing the vigor of the plants. They also secret a sweet sticky substance which encourages the development of sooty mold. A low population of hoppers is found throughout the year but it shoots up during February-April and June-August. Shade and high humidity conditions are favorable for their multiplication. Such conditions usually prevail in old, neglected and closely planted orchards.


Mango hopper

Management strategy: Pruning, avoid high density planting and regulate flushes by reducing the inputs.

a. *Verticillium lecanii* and *Beauveria bassiana* Coccinellid beetles, spiders, reduviid keep

b. Hopper population in check. Spraying of Lamda cyhalothrin 0.0025%in mango orchard during off-season (November) especially on trunks.

c. Fogging orchard with a 1.5:8.5 of malathion and Diesel mixture has been found effective, cheaper and less time consuming than conventional spraying or Integrating chemical insecticides with neem products depending on hopper density.

First spray should be given at early panicle emergence with the following:

a. At high hopper density (>4 hoppers/panicle) spray Imidachloprid 0.005% or Lamda cyhalothrin 0.0025%.
b. At low hopper density (<4 hopper /penicle) spray Azadirechtin @3000 ppm 2mi/l or 10,000 ppm 1ml/l.
c. The second spray may be done with Lamda cyhalothrin 0.0025% at full length stage of panicles but before full bloom to avoid killing of pollinators. The third spray if required should be done at pea size fruit with Imidachloprid (as above).

Mealy Bug

It is a major pest that causes severe damage to mango. Nymphs and adults suck the sap and reduce the vigor of the plant. They secrete honey dew which encourages the development of sooty mold. The female, after copulation, crawl down the tree in the month of April-May and enter in the cracks in the soil for laying eggs in large numbers encased in white egg sacs. The eggs lie in diapause state in the soil till the month of November - December. Just after hatching, the minute newly hatched nymphs crawl up the tree. After climbing up the tree they start sucking the sap of tender plant parts.


Mango Mealy bug

Management strategy:

a. Polythene (400 gauge) bands of 25 cm width around the tree trunk in November December have been found effective barrier to stop the ascent of nymphs to the trees.
b. Spraying with malathion 0.08 % or profenophos 0.05 % mix with detergent powder (2 to 3 gram/10 lit of water) or spreader or sticker (1 ml per litre) + power oil or orchard oil (1 ml per litre) for killing the pest on foliage.
c. The entomogenous fungus *Beauveria bassiana* is found to be an effective bio-agent in controlling the nymphs of the mealy bug.
d. Flooding of orchards with water in the month of October kills the eggs and ploughing the orchards in the month of November exposes the eggs to sun's heat.

Inflorescence Midge

The midge damages the crop in three different stages. The first attack is at the floral bud burst stage then fruit set and tender new leaves encircling the inflorescence. The most damaging one is the first attack in which the entire inflorescence is destroyed even before flowering and fruiting. The flies lay eggs on inflorescence. Upon hatching, the minute maggots penetrate the tender parts and feed on them. The floral parts finally dry up and are shed. The mature larvae drop down into the soil for pupation. There are 3-4 overlapping generations of the pest spread over the period from January-March. Thereafter, as the weather conditions turn unfavorable, the mature larvae undergo diapause in the soil instead of pupating. They break diapause in following January.

Inflorescence midge

Management strategy:

a. As the larvae pupates in the soil, ploughing of the orchards expose pupating as well as diapausing larvae to sun's heat which kills them.

b. Soil application of carbaryl dust also kills pupating as well as diapausing larvae in the soil. The insecticide in the soil should be applied after monitoring larval population on white sheet below the tree

c. Spraying of 0.05 per cent Fenetrothion or 0.045 per cent Dimethoate or 0.04 per cent Diazinon at the bud burst stage of the inflorescence has been found effective in controlling the pest population.

d. No definite control measures against mango leaf-gall-makers have been evolved as yet. If infestation is severe, especially in young orchards, spray dimethoate.

Fruit Fly

The oriental fruit fly is one of the most serious pests of mango in the country, which has created problem in the export of fresh fruits. *Bactrocera dorsalis* and *B. zonata* are the most common fruit flies. The female punctures the outer wall of the mature fruits with the help of its pointed ovipositor and insert eggs in small clusters inside the mesocarp of maturing fruits. After hatching, the larva feeds on the pulp of fruit which appears normal from outside, but drops down finally. The mature maggots fall down into the soil for pupation. The emergence of fruit fly starts from April onwards and the maximum population is recorded during May-July which coincides with fruit maturity.

Mango Fruit fly

Management strategy:
a. Soil raking around and below trees to a depth of 6 cm. Twice – two weeks after start the fruit maturity and three weeks later. Ploughing may be done in winter.
b. Collection and destruction of fallen fruits weekly starting from initiation of fruit maturity.
c. MAT @ 10 blocks /ha starting from 45 days prior to fruit maturity. Replace the blocks after 30 days or even early.

Install khokha trap: A mega trap can be prepared from an any packaging material (khokha) in which solution of methyl eugenol can be absorbed. Make circular (9 cm diameter) or rectangular (9 cm x 12 cm) holes in the walls of khokha. A solution will be prepared by mixing methyl eugenol 40 ml + ethyl alcohol (or any other solvent) 60 ml + Dichlorvos 76 EC 10 ml. This solution will be impregnated on the inner walls of mega trap with the help of brush. For one square feet area 2 ml solution is needed. Recharge with the solution at weekly interval. During recharge, half of the quantity i.e., 1 ml/sq. ft is needed. Two to three mega traps (prepared from khokha of 1 ft length, 1 ft breadth and 1 ft deep) are required per hectare. These traps will be kept for mass trapping of fruit fly in fruit orchard at various locations.

a. BAT (0.1% insecticide,10% jaggery or banana in water) starting 45 days prior to fruit maturity. Spray in spots of 40 ml at a rate of 200 spots (approximately 8 l/ha). Apply bait spray in spots to surroundings hedges also.
b. One spray of Deltamehtrin 0.0014 percent + Azadirachtin (3000ppm) 2ml/l three weeks prior to harvest.
c. Avoid delay in harvesting and, if needed give post-harvest hot water treatment within 24 hr. after harvest.
d. Hot water treatment or vapour heat treatment (VHT) of fruits before storage and ripening for killing the larvae can be done. After proper harvesting select uniform sized undamaged fruits. Dip them in 5%solution of sodium chloride in cold water for one hour. This will kill 95% eggs in fruit epicarp and also remove the externally present pesticide residues.Post-harvest immersion of mango fruits in hot water at 48 + 10C for 45-60 minutes give 100% mortality of fruit fly eggs in the epicarp without affecting fruit quality.

Stem Borer

Grub of this beetle feeds inside the stems boring upward resulting in drying of branches. Eggs are laid either in the slits of tree trunk or in the cavities in main branches and stems covered with a viscous fluid. Pupation takes place within the stem. Beetle emerges in July-August. There is only one generation of the pest in a year.

Stem borer of Mango

Management strategy: Exclude alternative host trees from mango orchards and remove the dead trees and infested branches from the garden to prevent the spread of the pest.

a. Swab coal tar + Kerosene (1: 2) on the basal part of the trunk up to 3 feet high after scraping the loose bark in order to deter the females from laying eggs.

b. Alternatively, carbaryl 0.1 per cent can be swabbed at bimonthly or put Carbofuron 3G at the rate of 5 g per hole and then plug it with copper oxychloride paste or plug it with mud. Close the holes by the cotton plugs dipped in chloroform or kerosene or,

c. Apply few drops of Carbon disulfide or fenvularate or dichlorovos or keep aluminum phosphide tablets in the holes and plug the same. If infestation is severe then apply the copper oxychloride paste on the trunk of the tree to prevent disease incidence.

Shoot Gall Psylla

It is a very serious pest of mango in many parts of India, particularly in Terai region of U.P., north Bihar and West Bengal. This pest creates green conical galls in leaf axis. The activity of the pest starts from August. The galls dry out after emergence of psyllid adults in March. The females lay eggs in the midribs as well as in lateral axis of new leaves. Nymphs emerge from eggs during August-September and crawl to the adjacent buds to suck cell sap. As a result of feeding, the buds develop into hard conical green galls. The galls are usually seen during September-October. Consequently, there is no fruit set. There is only one generation of the pest in a year.

Shoot gall psylla

Management strategy:

a. The galls with nymphs inside should be collected and destroyed to prevent carryover of the pest.

b. The pest can effectively be controlled by spraying Monocrotophos (0.05%) or Dimethoate (0.06%) or Quinalphos (0.05 %) at 2-week intervals starting from the middle of August.

Stone Weevil

Mango Stone weevil

Female lays eggs on the epicarp of partially developed fruits or under the rind of ripening fruits. Newly emerged grubs bore through the pulp, feed on seed coat and later cause damage to cotyledons. Pupation takes place inside the seed. Discoloration of the pulp adjacent to the affected portion has been observed. This is major pest that affects the export and processing industry. There is only one generation in a year.

Management strategy:

a. Spot application of fenthion (0.05%) or carbaryl (0.1%) during off season (December - January) on tree trunks up to the height of two meters should be done.
b. Sticky bands should be applied at upper end of tree trunk to prevent migration of weevils to branches for egg laying on fruits during February.
c. Collection of all the fallen infested fruits and their destruction.
d. Keep the tree basins clean to prevent hiding of adult weevils.
e. Spray deltamethrin (0.0025%) six weeks after fruit set and 15 days thereafter spray fenthion (0.05%).

Leaf Webber

Initially caterpillars feed on leaf surface gregariously by scrapping/Later they make web of tender shoots and leaves together and feed within. Several caterpillars may be found in a single webbed up cluster of leaves.

Mango Leaf webber

Management strategy:

a. Pruning of overcrowded and overlapping branches.
b. Mechanical removal of infested webs by leaf web removing device and burning them.
c. Ploughing of orchard done earlier for mealy bug control checks its population.
d. Two to three sprays commencing from last week of July with carbaryl (0.2%) or quinalphos (0.05%). This spay will also take care of mango psylla *(Apsylla cistellata).*

Label Claim Pesticides for Mango

Name of Pesticides	Pest
Buprofezin 25% SC	Hoppers
Deltamethrin 2.8% EC	Hoppers
Dimethoate 30% EC	Hoppers
Malathion 50% EC	Mango hopper, Mealy scale
Imidacloprid 17.8% SL	Hoppers
Lambda-cyhalothrin	Hoppers
Monocrotophos 36% SL	Bug mite, Gall maker, Hopper
Oxydemeton – methyl 25% EC	Hoppers
Thiamethoxam 25% WG	Hoppers

Conclusion

IPM strategies make use of cultural management (pruning, cultivation, sanitation, proper nutrition to enhance vigor and fruit bagging) conservation of beneficial insects (pollinators and bio control agents) and proper pesticide management. This brochure on IPM for mango production emphasizes prevention of pests through destruction of source and prevention of its spread.

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Instigation of Gardening

Article ID: 10481

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Abstract

Gardens have become essential to modern civilization. Garden serves the purpose of public recreation and education. It is the virtual treat for the people who are in harsh strains and stresses of daily life. Gardening helps to develop useful hobbies and skills in flower and dry flower arrangements. In gardens, ornamental plants are often grown for their flowers, foliage or as a whole. Besides the beautiful scenery, kitchen gardening helps to ensure a better-balanced diet because of the fresh vegetables produce obtained by their own effect.

Introduction

Indians were first to choose gardens as the ideal atmosphere for meditation. There is a note in the literature like Ramayana (Asokavana) along with the other vanas "Brindavan" and "Rajavanam". The primary goal of the gardening is imitation of nature and improvement over nature. Landscape architecture has come to play a vital role in the developments of home, public institutions, public places like bus stand, railway stations, towns and cities. Practical and spiritual aspects of gardening are shown in an impressive body of literature.

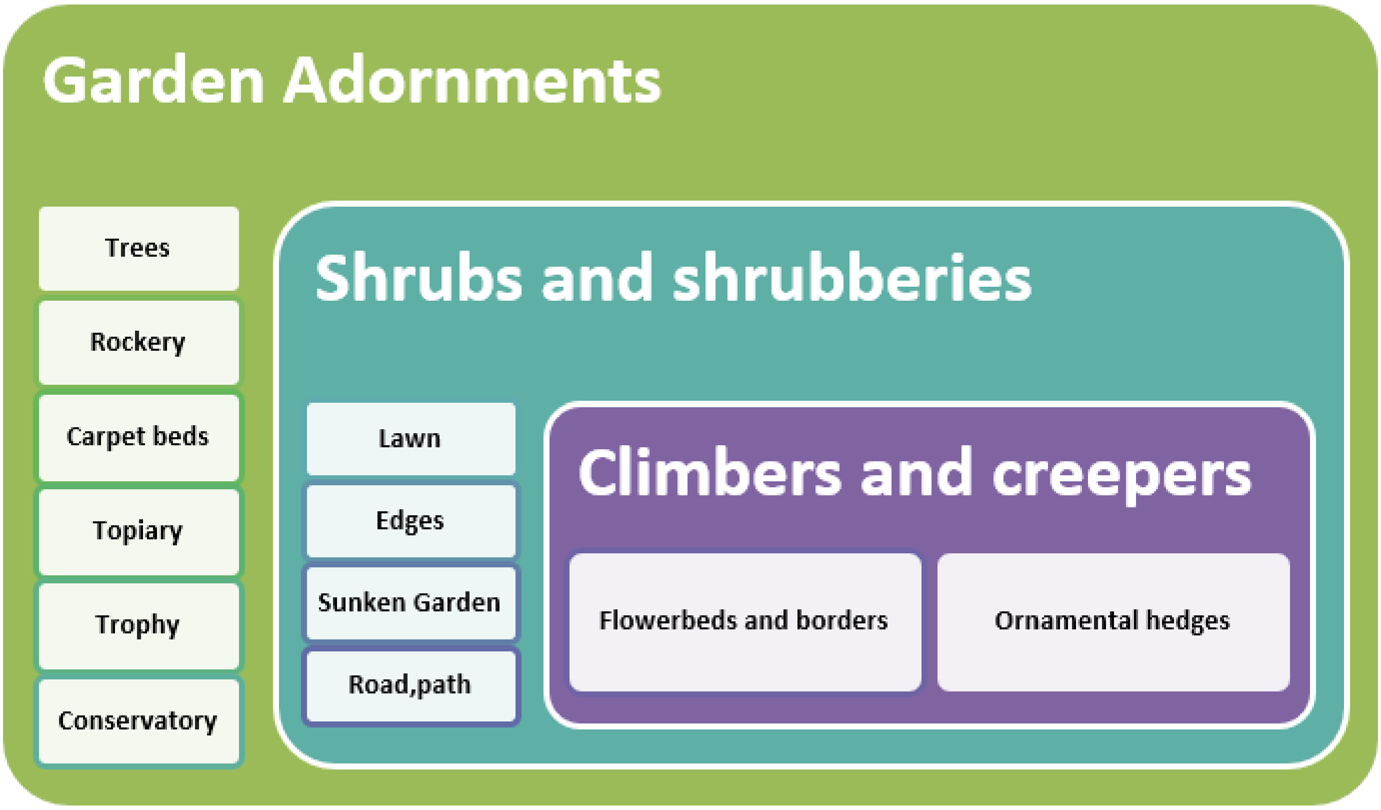
Year	King	Contribution
6th to 10th Century	King Ashoka	Roadside avenue planting
11th Century	King Somadeva	Gardening to fine art
13th Century	King Hamira	Gardening to fine art
14thto16th Century	Moghul Emperors	Estabilshment of Moghul style gardens
16th Century	British	Establishment of England and continental Europe gardening

Agri-Horticultural societies have been established with the sole objective of promoting horticulture, more particularly gardening. These societies organize annual flower shows and garden competitions to promote healthy attitude among the public to develop gardening.

Famous Gardens in India

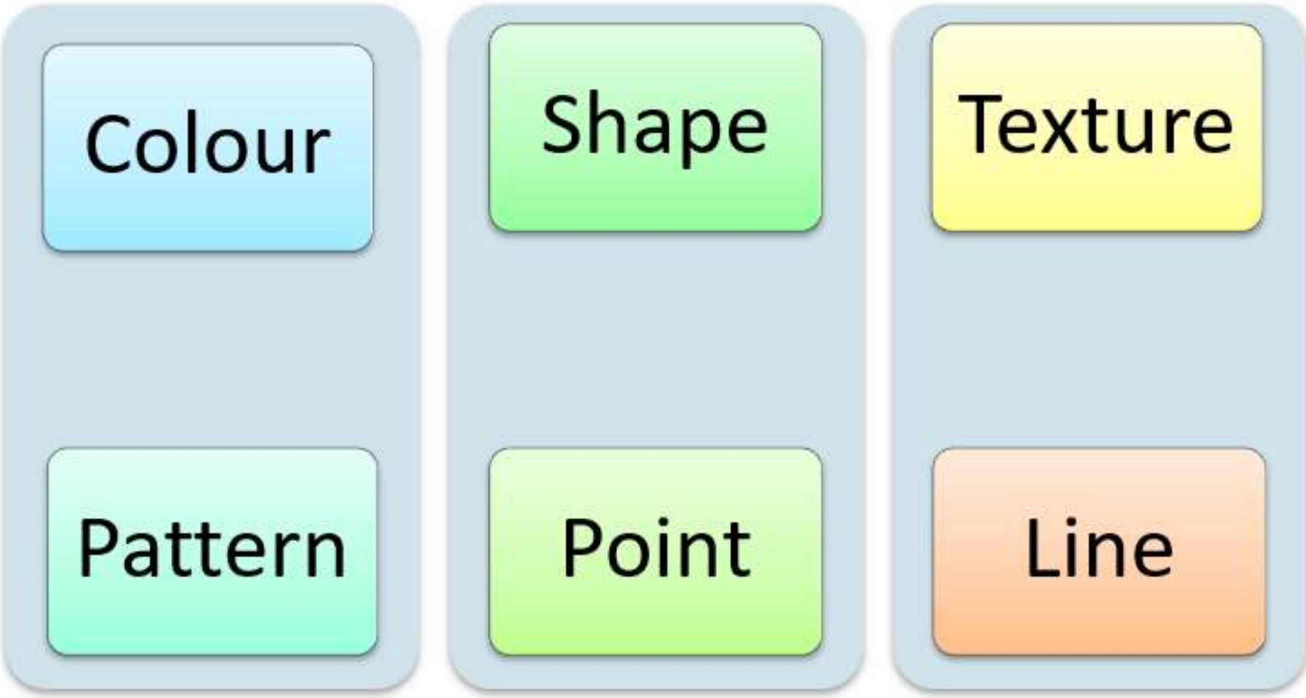
Moghul Gardens	*British Garden*
Fatehpur Sikri (U.P)	*Lal Bagh (Bangalore)*
Pinjore Garden (Punjab)	*Sims Park (Ooty)*
Shalimar Bagh Garden (Lahore)	*Bryant Park (Kodaikanal)*
Tajmahal Garden (Agra)	*Government Botanical Garden (Ooty)*

Components of Garden

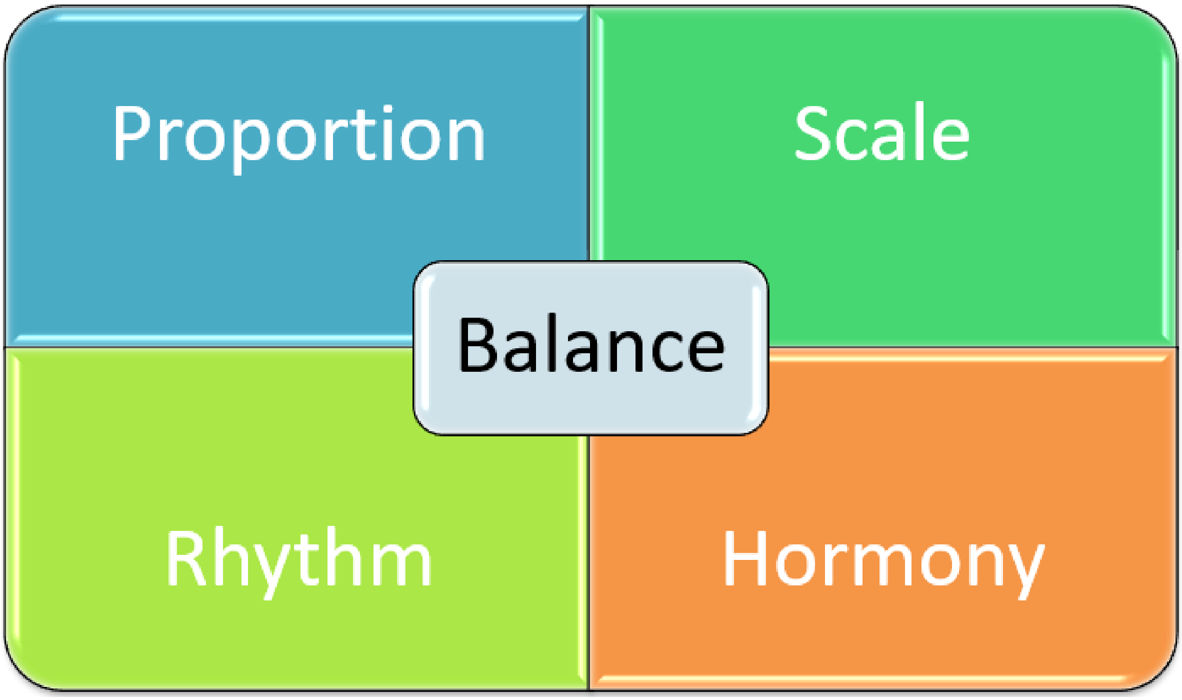


Landscape Gardening

It involves integration of space, plants and other accessories in an aesthetic manner to meet the needs of man. It mainly concentrates on spatial design which depends on the land. Landscape is done in everywhere like plains, plateaus, hills, river beds, natural ponds, and mountains. The perception of beauty is chiefly concerned with visual perceptions only in the garden. The components of beauty of landscape are as follows.



The beauty components by themselves do not convey beauty unless or otherwise they are combined together in a proper manner. The following principles are to be followed to derive the aesthetic value of a garden.



Conclusion

Landscape provides all sort of environmental benefits as natural coolants, environmental cleaners, water protectors, air cleaners, noise minimizers. Science tells us, is what people instinctively feel about the plants and green spaces in their lives that the connection makes their lives better, and they want to make an effort to incorporate it into their lives.

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Lal Bagh Garden	**Tajmahal Garden**

Organic Production Technology of Tissue Culture Banana

Article ID: 10482

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In the present scenario, the world is moving towards the consumption of organic product from agriculture. Due to frequent use of chemical fertilizers, living organisms especially humans are facing a lot of health problems like blood pressure, cardiac attack, diabetes, week immunity level etc. In this respect people now know that, only organic products can help them in minimizing these health disorders.

The chemicals used also have adverse effect on the soil health, composition, fertility, etc. decreasing the fitness of the crops. Production of crops requires knowledge of nutrient composition of soil and their requirements in crops, pathogenic diseases and their management. About 70-million-hectare land (1.0% of total land) is under organic cultivation and the marketing of organic products has reached 97 million dollars worldwide in the recent years.

In India, Madhya Pradesh is the leading state in organic cultivation with an area of about 9100303.83 hectare, followed by Maharashtra, Karnataka, Meghalaya, Mizoram, and Nagaland. These states are increasing day by day in terms of area and productivity of organic products. Inorganic cultivation the chemical fertilizers are easily replaced by manure, biopesticides.

With the help of ITK, -biodynamic, rishi, panchgavya and homa the organic production technology minimizes the input cost of crop production. In fruits, banana is one of the most demandable crops of the world. In India, banana is cultivated in large areas of all states. India covers about 8,45,000 ha area with production of approximately 2,81,37,000 thousand metric tons of banana.

Tamil Nadu, Gujarat, Andhra Pradesh, Maharashtra, Bihar, Karnataka, Madhya Pradesh and Uttar Pradesh are the major commercial banana producing states of India. As per the database, Maharashtra has highest productivity with 65.70 metrictons/ha, while the national productivity is 30.5 metric tons per ha. Banana contributes to about 37% of total fruit production of India and occupies approximately 20% area of land of the total area used for fruit crops production.

Jalgaon is a major banana growing district of Maharashtra which occupies 50,000 hectares area mostly grown by suckers. Now, tissue culture technique is being widely used in enhancing the production and productivity of banana. In organic production of banana, tissue culture plants are most suitable for commercial cultivation, as the tissue culture propagated plants are free from biotic stresses and age of plant, maturity time of bunchesare identical. The yield and quality of fruits is comparatively better than the sucker propagated plants.

Varieties

In India several high yielding varieties are available which are commercially cultivated by the farmers. These are Rasthali, Poovan, Gain Nane (G-9), Robusta, Dwarf Cavandish, Nandran, Populu, Red Banana, Chinia, Alpan, and B.B. Battisa.

Agro-Climate

Banana is a tropical fruit crop. It requires 130C– 380C temperature, relative humidity of about 75-78 % with pH ranging from 6.0-7.5.

		
Mature plant of G-9	**Inter cropping of Coriander with banana**	**Inter cropping of Vegetable pea with banana**

Planting Method

10-12 kg FYM/3-4 kg vermi-compost is used in 60X60X60cm dimension pits at 1.8mx1.8m distance. Biofertilizers like *Azospirillum,* PSB, potassium soluble bacteria at the rate of 20g50g per pit at the of pit preparation can also be used to enhance the productivity of the field. As recommended, 200g N, 75g P and 300g K plant fertilizers are required along with micro nutrients like $Znso_4$(500g), ferrous sulphate (200g), copper sulphate (200g), boric acid (100g) per 100 litre of water spray in concentration of 0.5%,0.2% and 0.1%, respectively play a vital role in improving the morphological and physiological aspects of banana and its production. To protect the plants from soil-based diseases, *Bavariana basiana* and *Trichoderma* at 50-60g per pit can be used.

Planting Method

About 3086 plants are needed for one hectare area of cultivation. July-August is the main season of planting banana.

State	Planting time
Maharashtra	Kharif: June – July Rabi: October – November
Kerala	Rainfed: April – May Irrigated crop: August – September
Tamil Nadu	February – April November – December

Intercropping

Banana can be planted along with brinjal, tomato, vegetable pea, coriander, radish, cauliflower, broccoli, ginger, spinach and some other Amaranths as inter/cash crop for around 6-8 months to enhance the per capita income. Cucurbit crops are avoided in banana field as they can spread viral infections in banana crops. On an average, 40-45 tones production per acre area can be achieved which are in cash of Rs.1.25lakhs from TC banana cultivation. Income may be received by the farmers from intercropping of vegetable pea and coriander (leaves) Rs.3.25 lakhs as net profit per acre in a season.

Some Special Operations which are Influence the Productivity

1. Desuckering: Removal of unwanted sucker from mother plant.

2. Deflowering: Removal the style and perianth just after flowering.

3. Pruning of leaves: Infected, older leavesare pruned to protect the plant from diseases.

4. Earthingup: Supporting plants with soil after 3-4 month from planting. It is to protect the plant from wind and water logging condition.

5. Removal of male buds: Removal of male buds after gapping of last hand of fruit. It helps in increasing bunch weight and finger length, weight.

6. Bunch spraying: Spraying of neem seed extract of about 5% to protect the bunches from thrips scaring beetle attack.

7. Bunch covering: Protecting the bunches from sunlight and enhancing the quality of fruits. Green and white clothes are used generally for covering.

8. Propping: Due to heavy weight of bunches plant go out of balance. This affects the production and quality will be affected.

Major Insect and Pest of Banana

1. Stem Borer: Insects destroy the rhizomes and stem. It is common in summer & rainy season. *Bavariana basiana* @2.0-2.5kg/ha in the root zone of plants can be used to avoid insects.

2. Rhizome Borer: Caterpillars destroy the rhizomes from inside. Uprooting the effected plants and using *Bavariana bariana* @1.5-2.0kg/ha at time of planting or using pheromone traps @5traps/ha and spraying the neem oil@5% on rhizome can avoid caterpillars.

3. Aphids: Biodynamic insecticides/neem seed extract (5%) can be sprayed 4/5 times to.

Common Diseases that Occur in Banana

1. Panama wilt: Infected plant show yellowness, and leaves turn yellow. It is common in sick soils and poor deranged soil. Affected plants are uprooted and burned. 1.0-2.0kg of dead lime in effected pits is sprayed. Use of 10-15 g Trichoderma per pit at planting time can reduce infection. 3% panchgavya can also be used after every irrigation.

2. Singatoka/ leaf blight: Appearance of yellow spots on leaves that later convert into brown color rings. Uprooting the effected plants and using of Bordeaux mixture, 1% linseed oil spray, etc. may prevent disease infection.

3. Nematodes: Black spots appears on roots of infected plants. 1.0kg per plant of neem cake can be used to prevent the diseases caused by nematodes.

4. Bacterial wilt: It occurs in young plants. Plants get rots and give out a stinky smell. for
20% jeevamrit or 2% Trichoderma solution can be sprayed on the plants to in order to control the bacterial wilt.

5. Bunch top/ clustering in top leaves: The disease is caused by aphids. Dwarf varieties are more susceptible than the tall varieties. It can be managed by the use of biodynamic liquid pesticide/ neem seed extract (5%) spray. The effected plants can be removed from the field and kerosene oil can be sprayed at the place.

Harvesting

The first bunch of bananas are ready to harvest after 12-13 months and second ratoon crop bunches are harvested after 8-9 months from harvesting of first bunches. On an average, 100 Tones/ha banana is produced. 3 crops can be taken in a period of 28 to 30 months.

Maturity Indices

It is estimated on the basis of fruit shape, angularity, grade, diameter measured through the median finger of the second hand, starch content and number of days after flowering.

Net Profit of Banana Cultivation Per Acre Area

Farmers can receive around Rs. 3.25 lakhs net profits from banana fruits, Rs.0.5 lakhs from selling disease free suckers, Rs. 0.75 lakhs from intercropping of vegetable pea and Rs. 0.50 lakhs from coriander leaves.

Economic Importance

Banana has high nutritive value and is a rich source of carbohydrates and vitamin-B. It is one of the popular fruits that is consumed in both ripe and raw form. It is also a good source of calcium, magnesium, potassium and phosphorus. It is easy to digest and is free from cholesterol. When used regularly, it reduces the risks of heart diseases. It is highly recommended for patients suffering from arthritis, high blood pressure, kidney disorders, ulcers and gastroenteritis.

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Role of Microorganisms in Nutrient Mobilization and Soil Health

Article ID: 10483

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Introduction

1. To fulfill these requirements, we totally rely on non-renewable chemical fertilizer/nutrient sources that leads. to the increasing demand of NPK fertilizer is by 1.5, 2.3 and 3.7 % per annum.
2. Microbes as the best alternative aid for the plant nutrient supply.
3. The fundamental concept of organic farming has its base in the role of indigenous microbial abundance.
4. Microbes increase bio-availability of nutrient.

The Fertility of the Soil Depends Upon

1. Quantitative nature of the microorganisms.
2. Organic matter content.
3. Nature of microbial products which bind the soil particle together.
4. Humus content.

Planting Method

10-12 kg FYM/3-4 kg vermi-compost is used in 60X60X60cm dimension pits at 1.8mx1.8m distance. Biofertilizers like *Azospirillum,* PSB, potassium soluble bacteria at the rate of 20g50g per pit at the of pit preparation can also be used to enhance the productivity of the field. As recommended, 200g N, 75g P and 300g K plant fertilizers are required along with micro nutrients like $Znso_4$(500g), ferrous sulphate (200g), copper sulphate (200g), boric acid (100g) per 100 litre of water spray in concentration of 0.5%,0.2% and 0.1%, respectively play a vital role in improving the morphological and physiological aspects of banana and its production. To protect the plants from soil-based diseases, *Bavariana basiana* and *Trichoderma* at 50-60g per pit can be used.

Mobilization

Basic mechanism through which microbes promote nutrients bioavailability includes nutrient fixation, mobilization and transformation. Nutrient mobilization is the process of making nutrients movable or capable of moving by the physiochemical or biochemical ways. Microbes play a very important role in nutrient mobilization through the biochemical actions like release of organic acids, proton extrusion and lowering pH. Bacterial, fungal inocula and organic amendments can mobilize nutrient reserves.

Nutrients Mobilized by Microorganism

1. Nitrogen.
2. Phosphorus.
3. Potash.
4. Iron.
5. Zinc.
6. Sulphur.

Phosphorus Mobilization

Organic P mobilization:

- **a. Direct way:**
  - i. Lowering pH.

ii. Hydrolyze organic P.

b. Indirect way:

i. Release of CO_2

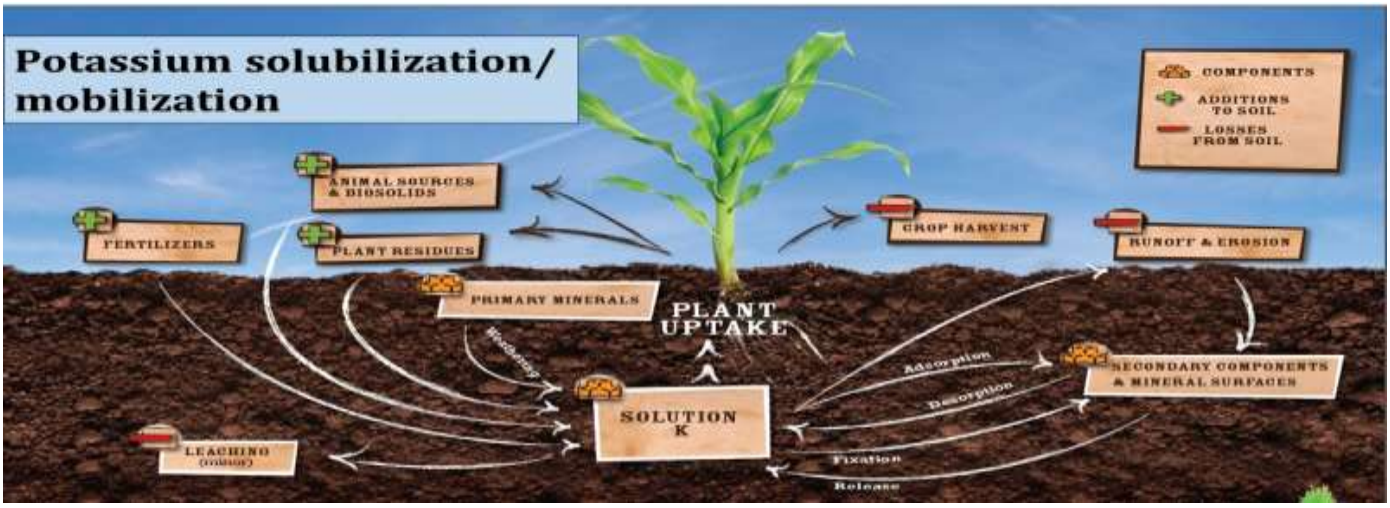
ii. Release of Protons.

Phosphorus Mobilizing Microorganisms

Bacillus, Beijernckia, Burkholderia, Enterobacter, Flavobacterium, Microbacterium, Pseudomons, Mesorhizobium Cicero, Mesorhizobium mediterraneum, Aspergillus, Penicillium

K Mobilization

K is present in very small amount ranging from 0.04 to 3.00%. Despite of being in limited amount, 98% of this K is bound within the Phyllosilicates structures. The remaining 2% exists in soil solution or on exchange sites to become available for the plants. Hence, soil fertility is decreased due to low availability of this nutrient. Many microorganisms in the soil are able to solubilize unavailable forms of K-bearing minerals, such as micas, feldspar, illite and orthoclase by excreting organic acids which either directly dissolves rock K or chelate silicon ions to bring the K into solution.



K Mobilizers

Frateuria sp., *Acidothiobacillus ferrooxidans, Bacillus mucilaginosus, B. edaphicus, Burkholderia* sp., *Pseudomonas* sp., *Rhizobium* sp., *Funneliformis mosseae, Rhizoglomus intraradices, Aspergillus terreus, A. niger, Cupriavidus necator.*

Fe Mobilization

Iron is the fourth most abundant element available on earth and predominantly exits in nature in ferric (Fe^{3+}) form. It is sparingly soluble, therefore not readily available for plant and its limitation is a problem for plants on as much as 30% worldwide. Iron tends to form insoluble complexes in aerobic soils of neutral to basic pH.

In soil ferrous (Fe^{2+}) is oxidized to ferric (Fe^{3+}) thereby forming insoluble compounds and leaving a very low amount of iron for plant assimilation. Some strains of bacteria synthesize low molecular mass proteins known as siderophores. They have high affinity to chelate and solubilize iron from mineral or organic compounds.

Generally, siderophores have high affinity to form complexes with ferric (Fe^{3+}) uptake of the complexes by the cell membrane of both gram positive and negative bacteria reduces ferric (Fe^{3+}) – ferrous (Fe^{2+}).

Siderophore Producing Bacteria for Iron Chelation

Bradyrhizobium japonicum, Rhizobium leguminosarum, Sinorhizobium meliloti, Pseudomonas Enterobacter genera, Bacillus rhodococcus.

Zinc Mobilization

Zinc is required in relatively small concentration although prevalence of Zn deficiency in crop is due to low solubility of Zn rather than low Zn availability. 50% of Indian soils are Zinc deficient.

1. Solubility of Zn decrease with:
    a. Increase in pH.
    b. High organic matter.
    c. Bicarbonate content.
    d. High magnesium to calcium ratio.
    d. High availability of P and Fe.

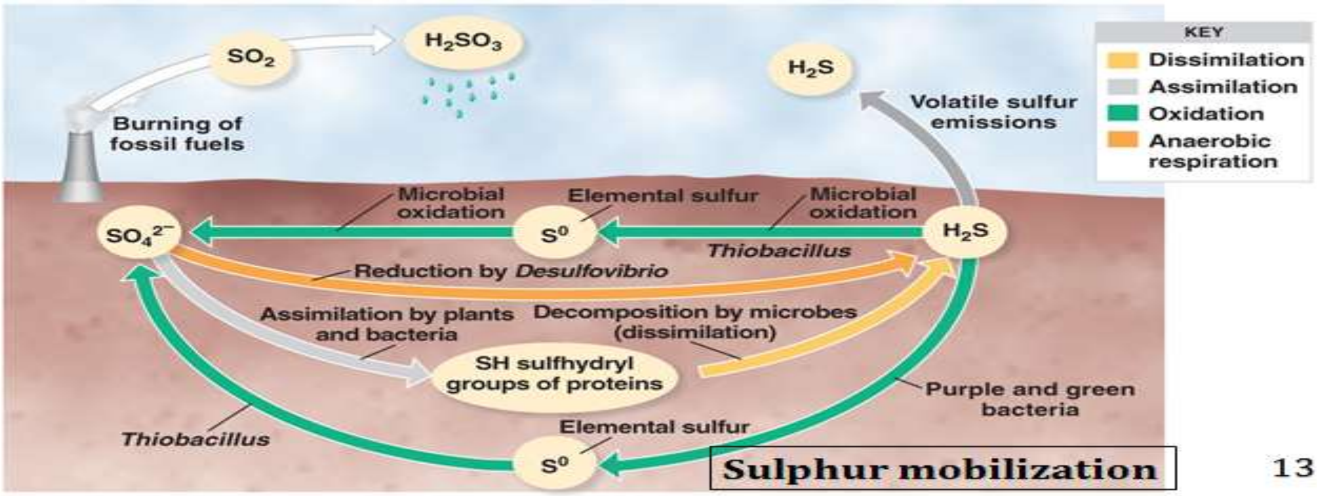
2. The Zinc applied to agriculture fields as Zinc sulphate (Soluble) get converted to different insoluble forms like:
    a. Zinc hydroxide [$Zn(OH)_2$] at high soil pH.
    b. Zinc Carbonate [$ZnCo_3$] in calcium rich alkali soils.
    c. Zinc phosphate [$Zn_3(PO_4)_2$] in near neutral to alkali soil with large application of P fertilizers.
    d. Zinc sulfide [ZnS] under reducing conditions particularly during flooding.

3. The soluble form of Zn fertilizers applied to the fields become readily insoluble forms that cannot be assimilated by plants which leads to the Zn deficiency in crops

4. The microbes solubilize the Zn by lowering the pH by gluconic acid and indole acetic acid production example: *Acinetobacter* sp., *Burkholderia* sp.

Sulphur Mobilization

In agricultural soil, most of the Sulphur (>95%) is present as sulphate esters or as carbon bounded Sulphur rather than inorganic Sulphur. The two-major form of organo-S, Sulphur-esters and sulfonates are not directly available to plants which rely upon microbes in soil and rhizosphere for organo- S mobilization. Different Sulphur forms are interconverted and immobilized Sulphur is mineralized to yield plant available inorganic Sulphur. Organic form of Sulphur is metabolized by soil microorganism to make it available for plant in an inorganic form like mineralization, immobilization, oxidation and reduction.



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Sulphur Mobilizing Microbes

Pseudomonas, Klebsiella, Salmonella, Enterobacter, Serratia, Comamonas, Lolium perenne.

Soil Health

The capacity of soil to function, within land use and ecosystem boundaries, to sustain biological (plant and animal) productivity, maintain (or enhance) environmental (water and air) quality, and promote plant, animal and human health.

Soil Microorganisms

The soil microflora includes bacteria, fungi, protozoa, algae and viruses. Among the different group of microorganisms inhabiting the soil, bacteria are found to be most abundant. There exists a great nutritional and physiological versatility in soil bacteria. In addition, soil also contains a large population of actinomycetes, which are filamentous bacteria known to produce various antibiotics. The bacteria along with other microorganisms in the soil play an important role in the bio-geochemical cycling and soil fertility.

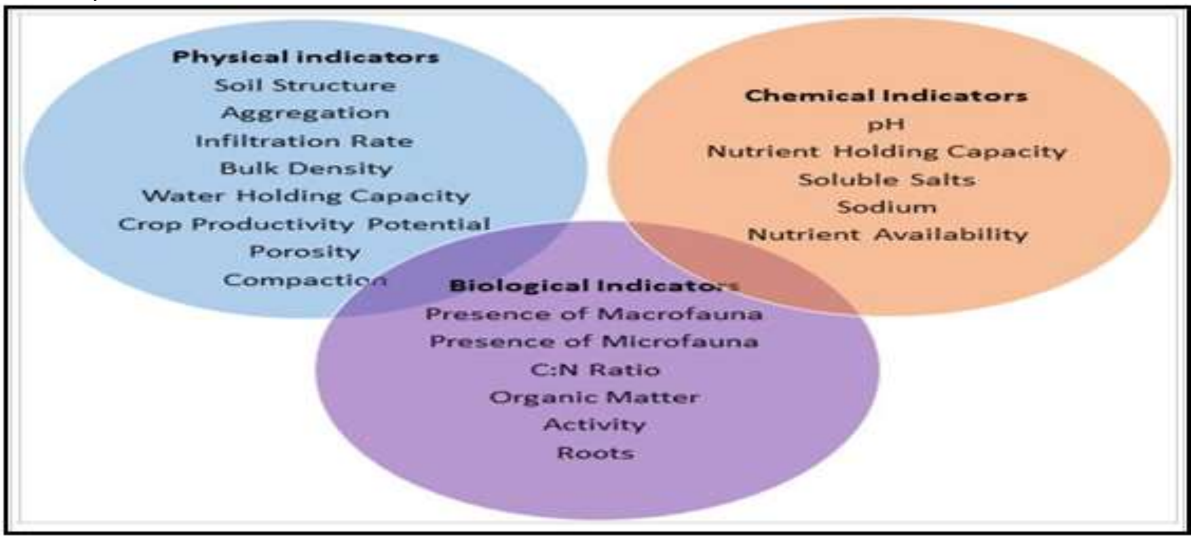
Bacteria in Soil

1. Nitrogen-fixing Bacteria:
    a. Symbiotic Nitrogen Fixers
    b. Non-symbiotic Nitrogen Fixers
    c. Azotobacter
    d. Azospirillum
    e. Acetobacter
    d. Azoarcus
2. Phosphate Solubilizing Microorganisms.
3. Other Plant Growth Promoting Rhizobacteria:
    a. Cyanobacteria.
    b. Mycorrhiza.

Components of Soil Health

Soil health-involving biological, chemical, and physical aspects is influenced by every aspect of soil and crop management:

1. Biological component.
2. Physical component.
3. Chemical component.



Soil health indicators can be divided into three categories: Physical, Biological and Chemical

Table. Selected examples of microbially mediated soil transformation that influence the plant nutrient availability:

Nutrient	Microbial transformation
Nitrogen	Mineralization, Immobilization, nitrification, denitrification, urea hydrolysis, N_2 fixation, extracellular protease and chitinase activity
Phosphorus	Mineralization, immobilization, extracellular phosphatase activity, acidic dissolution of mineral P, facilitated uptake mycorrhizal fungi

Potassium	K solubilization/Mobilization
Sulphur	Mineralization, immobilization, oxidation, reduction, extracellular sulfatase activity
Iron	Change in oxidation state. Production of siderophores, chelation
Zinc	Facilitated uptake by mycorrhizal fungi
Copper	Facilitated uptake by exudates and mycorrhizal fungi
Manganese	Change in oxidation state

Microorganism's Role in Soil Health

1. Microorganisms possess the ability to give an integrated measure of soil health, an aspect that cannot be obtained with physical/ chemical measures and/or analyses of diversity of higher organisms.
2. Microorganisms also affect the physical properties of the soil.
3. Production of extra-cellular polysaccharides and other cellular debris by microorganisms help in maintaining soil structure as well as soil health.
4. Thereby, they also affect water holding capacity, infiltration rate, crusting, erodibility, and susceptibility to compaction.
5. Changes in microbial populations or activity can precede detectable changes in the soil's physical and chemical properties.
6. Collectively, soil microorganisms play an essential role in decomposing organic matter, cycling nutrients and fertilizing the soil.
7. Soil microbes are also important for the development of healthy soil structure.
8. Soil microorganisms are both components and producers of soil organic carbon, a substance that locks carbon into the soil for long periods. Abundant soil organic carbon improves soil fertility and water-retaining capacity.
9. Soil microorganisms may provide a significant means of reducing atmospheric greenhouse gasses.

Cattle Breeds in India

Article ID: 10484

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Livestock plays an important role in Indian economy. In India the livestock census is conducted across the country periodically since 1919. The total livestock population of India is 535.78 million, and the country showing a growth by 4.6% over livestock census year 2012. The total number of cattle's in the country is 192.49 million, buffaloes 109.85 million, goats 148.88 million, sheep 74.26 million, pigs 9.06 million, and poultry 851.81million respectively, in 2019 showing an increase of 0.8 % over previous census. In India, about 20.5 million persons depend upon livestock for their living. Total livestock contributed 16% to the revenue of small farm households as against an average of 14% for all rural families. Livestock provides income to two-third of rural community. It also gives job to about 8.8 % of the population in country. India has enormous livestock resources. Livestock sector pays 4.11% GDP and 25.6% of entire Agriculture GDP.

With the facts, it is imperative to understand different species and their breeds, which is contributing in human life with some products. In the given document 6 species are profiled namely Cattle, Buffalo, Goat, Sheep, Pig and Poultry with the basic purpose of their rearing.

Cattle Breeds

There are almost 37 kind of notified cattle breeds in India. Cattle are divided into three basic classes on the basis of utility:

1. Milch Breeds.
2. Dual Purpose breeds.
3. Draught Purpose breeds.

Milch Breeds

These breeds normally are kept for milking purpose, as these are high yielding native breeds of the country.

Gir

This breed is also called as Bhadawari, Desan, Gujarati, Kathiawari, Sorthi, and Surati. Originated in forests of Gir which is located at South Kathiawar in Gujarat, also found in Maharashtra and some part of Rajasthan. Basic colours of skin are white having dark red or coffee-brown spots or sometimes black or purely red. Horns are curiously curved, giving a 'half-moon' presence. Gir produce milk ranges from 1200-1800 kgs per lactation. This bread is famous for its strong and disease resistance.

Sahiwal

Originated in Montgomery region of undivided India. This breed also known as Lola having loose skin, Lambi Bar, Montgomery, Multani, Teli. This is the best native dairy breed. Sahiwal cow having reddish dun or pale red in colour, occasionally flashed with white spots. Heavy weight breed with symmetrical body and loose skin. The milk yield of Sahiwal breed is ranges between 1400 to 2500 kg per lactation.

Red Sindhi

This breed is also called as Red Karachi and Red Sindhi and Mahi also. It originated from Karachi and Hyderabad (Pakistan) regions of undivided India, and also reared in certain systematized farms in our country. The colour of this cow is red with shades varying from dark red to light red, strips found white. Milk yield varies from 1250 to 1800 kg per lactation. Bullocks quite lazy and slow can be used for road purpose and field work.

Tharparkar

This cow is originated from Tharparkar district of Sindh (Pakistan) in undivided India, it is also found in southern part of Kutch Gujrat and Sirohi, Jodhpur, Pali and Jaisalmer districts of Rajasthan. These varieties are white and grey of skin colour. Ears are semi-pendulous and forward-facing ears. Horns of Tharparkar is Lyre shaped. The cows are good milkers. Lactation yield varies from 1200-2000 kg/lactation

Rathi

Native place of Rathi is Bikaner district of Rajasthan. Presently, it is present in western part of Rajasthan, and Sirsa District of Haryana and Ferozpur region of Punjab. The animal basically is whitish in colour having big red patches across the body. Horns of animals are backward and outward orientation. Animal is hardy and gifted of surviving in strict weather conditions. Milk yield of this variety ranges between 1500-2500 kg per lactation.

Dual Purpose Breeds

These kinds of breeds are usually used as both milking and draught purpose. Bulls are of strong built, so these can be used for the purpose of ploughing the field.

Hariana

It breeds was native from Rohtak, Hisar, Jind and Gurgaon districts of Haryana and also famous in some part of state Punjab, UP and also some parts of MP. Horns are small in both male and female. The bullocks are powerful and use as work animals. Hariana cows are fair in colour. Milk yielding of this variety ranges 600 to 800 kg per lactation.

Kankrej

This variety is also known as Wadad or Waged, Wadhiar. Kankrej is originated from southeast part Rann of Kutch of Gujarat and some part of Rajasthan including Barmer and Jodhpur district. The horns of this breed are lyre-shaped. Colour of this breeds animal varies from silver-grey to iron-grey or steel black. Kankrej is valued for quick, strong, draught cattle. Suitable in ploughing and carting. The cows are good milkers producing about 1400 kg per lactation.

Ongole

Ongole is also known as Nellore. Home tract is Ongole taluk of this breed in Guntur district of AP. Large muscular breed with a well-developed hump. Suitable for heavy draught work. White or light grey in colour. Average milk yield of this breed is 1000 kg per lactation.

Krishna Valley

This breed is native of black cotton soil found the bank of river Krishna which is located at Karnataka and also found in some part of border districts of Maharastra. Animals are large, having an enormous frame with deep, loosely built short body. Tail having very log almost reaches to the ground. Normally grey white in colour with a blacker shade on four quarters and hind quarters in male. Adult's cows are more whitish in presence. The bullocks are powerful, strong animals useful for slow ploughing. The average milk production is about 900 kg per lactation.

Draught Purpose of Breeds

P These breeds are usually used for draught purpose, as the milk yield from cows is scanty, but bulls are strong, powerful for usage in farms and in transportation.

Amritmahal

Native tract of this breed is Karnataka state. Animals are usually grey in colour, but darker shades are being found. Muzzle, feet and tail are black. Animals have lengthy and sharp horn with black tip, which is a simply identification of this breed.

Nagori

Native tract of this breed is Nagaur district of Rajasthan, but due to strength of the bull, it is used in Rajasthan, parts of Gujarat and Haryana. Nagauri breed bulls as very heavy and strong. Animal's generally white and grey colour. The peculiar characteristic of animal is flat forehead, which helps in differentiation from Hariana bulls Ears are long and pendulous.

Exotic Breeds

Due to very high productivity of milk in comparison to indigenous breeds, some exotic breeds are very popular in India and are used widely. These breeds are mentioned below:

1. Holestein: Native of this breed is the northern parts of Netherlands, generally in the province of Friesland. Biggest dairy breed and jaggedly built is shape and having large udder. Breeds have typical pattern of black and white that make them easily unique. The milk production of Holestein breed is almost 8000 to 14000 kg per lactation.

2. Jersey: Originated from Jersey Island, U.K. Smallest of the dairy types of cattle. In India, Jersey breed has adapted well and is generally used in cross breeding with native cows. The special colour of Jersey cattle is reddish tan. Bowl-shaped forehead, and angular body. This breed produces of milk with 4.5% fat. Average milk yield of this breed is 5000-8000 kg per lactation.

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Application of Nanotechnology in Agriculture, Food and Allied Sciences

Article ID: 10485

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Introduction

Agriculture provides food for humans, directly and indirectly. The increasing world population, it is necessary to use the modern technologies such as bio and nanotechnologies in agricultural sciences. Nanotechnology has many applications in all stages of production, processing, storing, packaging and transport of agricultural products. Nanotechnology is an interdisciplinary field that has been entered in different range of applied sciences such as chemists, physicists, biologists, medical doctors and engineers. Nanotechnology will revolutionize agriculture and food industry by novation new techniques such as precision farming techniques, enhancing the ability of plants to absorb nutrients, more efficient and targeted use of inputs, disease detection and control diseases, withstand environmental pressures and effective systems for processing, storage and packaging. Nanotechnology improved the efficiency of medicine increases by use of nano particle in animal sciences.

Nanotechnology is defined especially as growing and exciting technology at the scale of one-billionth of a meter sweeping away the barriers between the physics, chemistry and biology. Nanotechnology is the design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometre scale. Nano medicine can design, build, manipulate, and optimize biological components at the Nano scale level. This includes the applications of nano materials and the fabrication of nano devices to be used in nano diagnostic, nano drug delivery and drug discovery. Overall nano refers to a size scale between 1 nanometre (nm) and 100 nm.

Applications of Nanotechnology in Animal Science

Nanotechnology will have a potential and ability on future approaches in veterinary and treatment of domesticated animals. Nanotechnology has the ability to provide appropriate solutions for providing food items, veterinary care and prescription medicines and vaccines for domesticated animals. Use of nano capsules for cap and protect of some particular enzymes and proteins would be effective in the livestock and poultry food rations in order to increase yield and effectiveness in the specific context. Taking certain medications such as antibiotics, vaccines, and probiotics, would be more effective in the treating infections, nutritional and metabolic disorders, when use in the nano level. Medicine use is in the nano level has multilateral properties to remove biological barriers for increase efficiency of medicine. Appropriate timing for the release of drug, self-regulatory capabilities and capacity planned are the main advantages use of nanotechnology in the drug treatment. Silver nano particles have been considered as a strong antiseptic (antibacterial and antimicrobial), and it's widely used for disinfection in the livestock and poultry places.

Applications of Nanotechnology in Pests and Plant Diseases Management

Today use of chemicals such as pesticides, fungicides and herbicides are the fastest and cheapest way to control pests and diseases. Also, biological control methods are very expensive currently. Uncontrolled use of pesticides has caused many problems such as: adverse effects on human health, adverse effects on pollinating insects and domestic animals, and entering this material into the soil and water and its direct and indirect effect on ecosystems. Intelligent use of chemicals on the nano scale can be a suitable solution for this problem. These materials are used into the part of plant that was attacked by disease or pest. Also, these carriers in nano scale have self-regulation, this means that the medication on the required amount only be delivered into plant tissue. Nanotechnology helps to agricultural sciences and reduce environmental pollution by production pesticides and chemical fertilizers by using the nano particles and nano capsules with the ability to control or delayed delivery, absorption and more effective and environmentally friendly; and production of nano-crystals to increase the efficiency of pesticides for application of pesticides with lower dose.

Applications of Nanotechnology in Food Industry

Oxygen is a problematic factor in food packaging, because it can cause food spoilage and discoloration. One of the applications of nanotechnology in the food industry is developing new plastic for food packaging industry. The nano particles are used in the production of these plastics. Nano particles have been found to zigzag in the new plastic, and preventing the penetration of oxygen as a barrier. In other words, the oxygen for entry into package should during longer route, and hence with the long route for oxygen molecules, food can be spoiled later. Recently, nano-coatings are produced for fruit that covering the fruits completely, and prevent of fruit weight loss and shrinkage. Biosensor is the best example of nanotechnology. Biosensor is composed of a biological component, such as a cell, enzyme or antibody, linked to a tiny transducer, a device powered by one system that then supplies power (usually in another form) to a second system. The biosensors detect changes in cells and molecules that are then used to measure and identify the test substance, even if there is a very low concentration of the tested material. When the substance binds with the biological component, the transducer produces a signal proportional to the quantity of the substance. So, if there is a large concentration of bacteria in a particular food, the biosensor will produce a strong signal indicating that the food is unsafe to eat. With this technology, mass amounts of food can be readily checked for their safety of consumption. So, nanotechnology play an important role in food industry.

Nano-Fibres

Nanotechnology with use of biological, chemical and physical processes plays a role in recycling the residual materials of agricultural products to energy and industrial chemicals. Nano-fibres are also used for encapsulating chemical pesticides, to prevention of scattering of chemical pesticides in the environment and water and soil pollution. This technology increases the chemical pesticides durability and security applications.

Nano Filtration

Due to big demand for freshwater in the world, developing new methods is essential for producing freshwater. The use of nano particles and nano-filtration provides possibility of refining and improving water with speed and accuracy. Also, nano-filter has a widespread application in eliminate microbial contaminants of water. In the new method for water desalination, hot saltwater is pass on thin sheets of carbon nano tube membranes, that have small holes (nano-holes). Only the steam passes through of this holes and liquid of water, salts and other minerals remain in the membrane. Cold water containers are located in the other side of membrane, that steam is converted to liquid again with passing through it. The most important features of carbon nano tubes can be including: smaller and denser holes; allowing high flow rate passing each hole. In the processing of dairy products are also used of nano-filters. Nano-filters, provides a selective passing particle. Also, nano-filtration is used to detect metabolites quality control in food industry and pathogenic factors, and is a major change in food packaging and storage.

Nanotech Sensor

Smart sensors, which are obtained by nanotechnology, are the powerful tools for track detect and control with animal and plant pathogen. Detection of very small amounts of a chemical contaminant, virus, or bacteria in agricultural and food systems is envisioned from the integration of chemical, physical and biological devices working together as an integrated sensor at the nano scale. The bio analytical nano sensors either use biology as a part of the sensor, or are used for biological samples. One of the major roles for nanotechnology-enabled devices will be the increased use of autonomous sensors linked into a GPS system for real-time monitoring. Nano smart dust and gas sensors are used in determining the number of pollutants and dust in the air. It is possible evaluation the presence of pollutants in the environment by these sensors in the few minutes.

Application of Nanotechnology in Agronomy

In general, precision agriculture is a new attitude in farm management. With use of nano sensors will be determined every small part of farm how much needs to fertilizer and chemical pesticides. Therefore, use of inputs will be optimal and safe products and economic efficiency is increased. Nano-sensors help to farmers in maintaining farm with precise control and report timely needs of plants. Nano sensors and nano-based smart delivery systems could help in the efficient use of agricultural natural resources like water, nutrients and chemicals through precision farming.

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Anthrax Disease in Animal, Symptoms, Treatment and Control

Article ID: 10486

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Introduction

India is the leading country across the world in milk production and secured second rank in cattle population. In India the livestock census is conducted across the country periodically since 1919. The total Livestock population of India is 535.78 million, and the country showing an increase the population of 4.6% over livestock census 2012.

The total number of cattle's in the country is 192.49 million, buffaloes 109.85 million, goats 148.88 million, sheep 74.26 million, pigs 9.06 million, and poultry 851.81million respectively, in 2019 showing an increase of 0.8 % over previous census. Among the all states, Uttar Pradesh has the maximum number of livestock of 67.8 million (68.7 million in 2012), after that on second position secured state is Rajasthan 56.8 million (57.7 million), followed by Madhya Pradesh: having 40.6 million (36.3 million) and West Bengal have 37.4 million (30.3 million).

So, India have very poor and unhygienic kind of husbandry condition that's why many diseases cause in animals, Anthrax is one of them. Anthrax spread in animals by bacteria. Anthrax disease is a vital domestic animal disease, occurs majorly in goats, cattle, sheep, and horses. Anthrax also happens in wildlife, such as hippos and elephants. It is occasional in humans and occurs mainly in countries that do not prevent industrial or agricultural exposure to infected animals or their products like uncooked infected meat.

Anthrax and Anthrax Cycle

Anthrax is an exceedingly infectious and deadly disease of livestock. Anthrax is affected by a relatively large spore-forming rectangular shaped bacterium called *Bacillus anthracis*. Anthrax causes acute mortality in ruminants. The germs produce extremely effective toxins which are responsible for the ill properties, causing a high mortality rate. Symptoms of the illness normally appear 3 to 7 days after the spores are swallowed or inhaled. Once symptoms begin in animals, they normally die within 2 days.

Hoofed animals, like cattle, deer, goats, and sheep, are the major animals affected by this disease. They normally get the disease by swallowing anthrax spores while grazing on pasture contaminated with anthrax spores. Inhaling (breathing in) the spores come inside the animal, which have property like odourless, colourless, and tasteless, that cause infection in animals and human also.

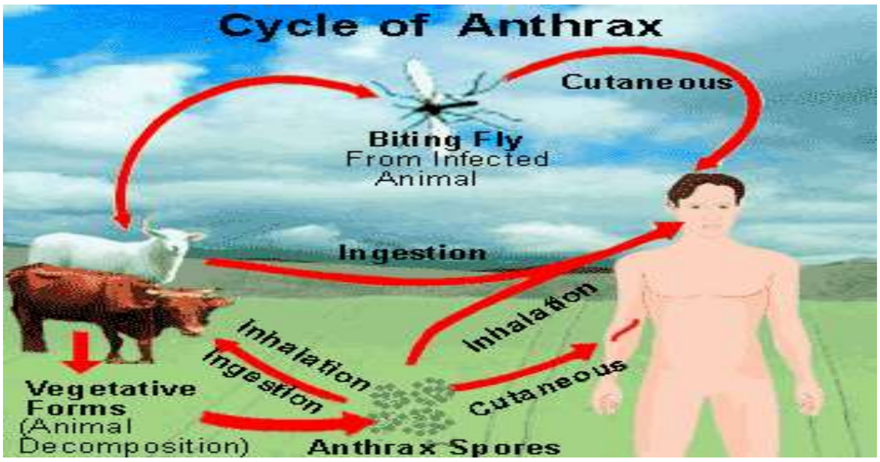

Fig. 1: Anthrax *(Bacillus anthracis)* disease cycle

Symptoms

1. Sudden passing away (often within 2 or 3 hours of being apparently normal) is by far the most common sign.
2. Very occasionally some animals may show trembling, a high temperature
3. Difficulty breathing, collapse and convulsions before death. This usually occurs over a period of 24 hours;
4. After death blood, may not clot, resulting in a small amount of bloody discharge from the nose, mouth and other openings.
5. Sometimes animals may have a fever and a period of excitement followed by staggering, depression, unconsciousness, difficulty breathing, seizures, and death.
6. Dark blood may ooze from the mouth, nose, and anus. Signs in pigs, dogs, and cats may be less serious.

Fig. 2: Anthrax *(Bacillus anthracis)* disease symptoms in animals

Treatment and Control

1. Due to the acute nature of the disease resulting in sudden death, treatment is usually not possible in animals even though Anthrax bacilli are clines. Treatment is of use in cases showing sub-acute form of the disease.
2. In most cases, early treatment can cure anthrax. The cutaneous (skin) form of anthrax can be treated with common antibiotics.

Preventive Measures

1. Regular annual vaccination of animals in endemic areas will prevent the disease from occurring.
2. Vaccination may be carried out at least a month prior to expected disease occurrence in endemic areas.
3. Never open a carcass of an animal suspected to have died from anthrax.

Contact a veterinarian immediately if the following symptoms are seen and seek advice on control measures to be adopted.

- a. Fever (106-108°F), loss of appetite, depression and dullness
- b. Suspended rumination3. Rapid pulse and heart rates
- c. Difficult breathing (dyspnoea)
- d. Lameness in affected leg
- e. Crepitation swelling over hip, back & shoulder
- f. Swelling is hot & painful in early stages whereas cold and painless inter.
- g. Recumbency (prostration) followed by death within 12-48 hrs.

Conclusion

A vaccine for livestock is commonly used in areas that have anthrax. To be effective, it must be used before the animal is exposed to the bacteria. The vaccine for livestock is not the same as the one for humans. The human vaccine has limited availability, such as for military personnel. No vaccine is available for pets. Handling a dead or sick animal or eating a dead animal infected with anthrax can spread anthrax to humans and other animals.

Anthrax is not spread by sneezing or coughing. Person-to-person spread of the disease is unlikely. Animals that die of anthrax can contaminate the soil with anthrax spores, so the bodies should be burned, not buried. Wear a mask and gloves when handling sick or dead animals. Vaccinate livestock as recommended.

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Nanotechnology in Dairy Industry and Food Industry

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The word nanotechnology is the combination of two words that is "Nano" that means smallest and "technology" means technology. So, nanotechnology is the science of very minor things. In other words, nanotechnology is the study, process and handling of material at a molecular level. One of its dimensions should lie in the range of (1-100) nm.

History of nanotechnology in dairy industry, in 2000 Kraft Foods started a first laboratory of nanotechnology in the food industry. Friesland Campina was the first food company that entered the market of milk products containing nanoparticles. Friesland Campina developed a milk-based beverage that claimed a faster calcium digestion. In food industry nanotechnology is widely used as active packaging.

Anthrax and Anthrax Cycle

Anthrax is an exceedingly infectious and deadly disease of livestock. Anthrax is affected by a relatively large spore-forming rectangular shaped bacterium called *Bacillus anthracis*. Anthrax causes acute mortality in ruminants. The germs produce extremely effective toxins which are responsible for the ill properties, causing a high mortality rate. Symptoms of the illness normally appear 3 to 7 days after the spores are swallowed or inhaled. Once symptoms begin in animals, they normally die within 2 days.

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Two Major Approaches Applied in Nanotechnology

Top Down: Top-down means substances starting with a larger piece of material and produces nanoparticles.
Bottom Up: In bottom up, involves construction of structures. That means large numbers of atoms or molecules are formed by chemical synthesis and then prepared through naturally occurring processes into a desired structure.

Nanofood

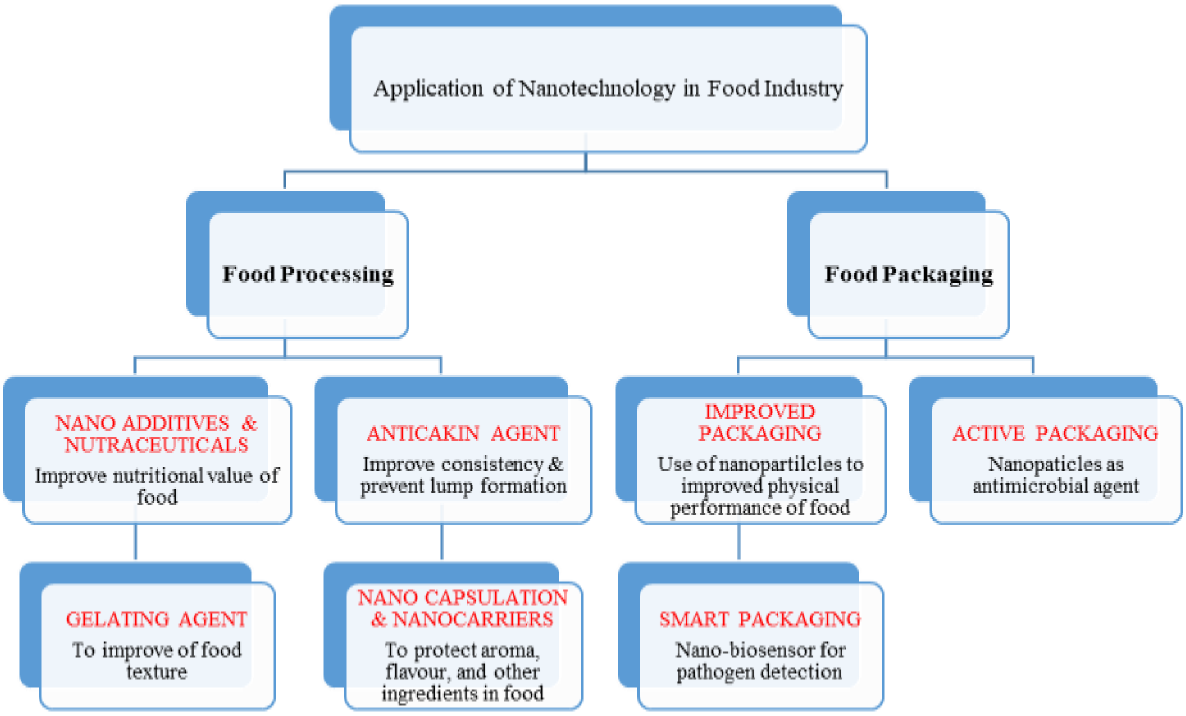
1. Food additives (nano inside).
2. Food packaging (nano outside).

Why Nanotechnology is Important?

In the 21st century, high demand of fresh, convenient, safe and longer shelf life having dairy and food products available in the market and it possible by nanotechnology. Nanotechnology create new and improved dairy and food products in all aspects including quality, purity, monitoring, processing, and packaging of dairy and food products. Nanotechnology is used for securing the dairy and food products throughout the production and transport channel to consumption. The packaged food products with the help of nanotechnology are proving more health beneficial and hygiene with the help of nanotechnology. Nano particles are using as food additives makes food to stay away from microbial contamination hence lengthening the lifespan.

Application of Nanotechnology in Dairy Industry

Application of Nanotechnology in Food industry



Nanoencapsulation

Systems of packaging capable to prolong the shelf life of foods, such as highly perishable fresh foods like vegetables, fruits, meat, and many more fooding material, without decreasing their characteristics in terms of quality and hygiene. Micro encapsulation can be considered as a real resource for food packaging also to mask unpleasant flavors and odors, or to supply barriers between the sensitive bioactive materials and the environment represented by food or oxygen.

Nanotechnology makes easy way to delivery vehicle for lipid soluble ingredients and protection from degradation during processing. It makes controlled site-specific release. Nanotechnology provides compatibility with other food constituents and it produce greater residence time and greater absorption.

Ice Cream Based on Nanofibers

A worldwide team of researchers from Colombia and Canada has found that addition of cellulose nanofibers from banana fruit stems and added to ice cream could help to slow melting, improves shelf life and possibly replace fat used to make the tasty treat.

Dip Strip Created by Nanofibers

A team of researchers led by principal and dean of college of dairy science, Amreli, Dr. Vimal Ramani have developed a nanotechnology-based dip strip. It used as the solution to control adulteration in milk. This nanotechnology-based dip strip resembles a paper strip, but is made of fibrous pad material using nano capillaries. It can detect eight types of impurities and threats, including the most commonly used urea, sodium carbonate maltodextrin, detergent, hydrogen peroxide and others present in the milk. It changes color with each impurity and detect easily.

Nanosensors

Packaging of dairy and food products equipped with nano sensors is also designed to track either the internal or external conditions of dairy products throughout the supply chain. Such packaging can monitor temperature or humidity over time and then provide relevant information of these conditions, such as through changing packaging color. In India a team of scientists led by Dr. PN Raju of the National Dairy Research Institute, Karnal, has developed sensor that can be fitted into the packet to sense the quality of the enclosed khoya or paneer and indicated through color change.

Conclusion

Nanotechnology has the ability to improve foods, making them delicious, healthier, and more nutritious, to generate new food products, new food packaging, and storage. Active packaging technology is a novel technology that improve food quality and safety by extending the shelf life. This technology also presents an opportunity to reduce the direct addition of chemicals to food. Intelligent food packaging, incorporating nano sensors could even provide consumers with information on the state of the food inside.

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Application of Nanotechnologies in Agriculture

Article ID: 10488

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Nanotechnology has a growing trend in the production and manufacture of all the equipment used in everyday life. This study examines the role of this technology in improving the production methods and performance of agricultural equipment. Nanotechnology is used in the production of construction materials and agricultural equipment coatings, such as the production of nano-polymer composites, metal nano composites, paints and coatings that are resistant to sunlight and wear in machinery, displays used with tractors and other equipment, propulsion of equipment, microprocessors, lubricants, smart glass, catalytic converters and filters for help to reduce global carbon emissions, protective coatings resistant to corrosion, scratches, wear and environmental factors. Abedini, et al., (2013). Nanotechnology is the ability to produce, control, and use nanometric materials. The particle size in nanotechnology is very important, since on a nanometric scale, the material dimensions are very effective in its properties, and the physical, chemical, and biological properties of each atom and molecule are different with the properties of the mass of the material. This size varies in different materials, but nanometric materials are commonly referred to as materials that have at least one dimension less than 100nm. Ganesh D. et al (2011) shows the positive effect of nano-fuel additive on emission reduction in a Biodiesel fueled CI engine. Prabaharan T. et al. (2019) presents implementation of nanotechnology in fuel cells. This method practically makes fuel cells non-polluting by the implementation of nano technology. Fuel cell has another problem of storing hydrogen as required by the fuel cells. This problem can also be overcome by implementing nanotechnology. The carbon-nanotubes can be used in storing hydrogen efficiently.

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Mechatronics in Precision Agriculture

Article ID: 10489

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"Mechatronics" concept is of Japanese origin conceptualized by Tetsoro Mori in (1980) and defined as the application and integration of electronics and computer technology to control and regulate the motions of mechanical systems. It is a multidisciplinary approach to design a product and manufacture through the integration of different branches of engineering. It involves application of electrical, electronic, mechanical, control and computer engineering technologies to develop product, processes and control systems with greater flexibility, ease in redesign and ability to reprogram (Pramod, K. P.). Agricultural mechatronics automate very slow, repetitive and dull task of farmers and allow them to focus more on improving overall production yields and efficiency. Some of the most common agriculture operations for which mechatronics can be used are: Crop monitoring and soil analysis, seeding and planting, fertilizing and irrigation, weeding and spraying, autonomous tractors, picking and harvesting, sorting and packing.

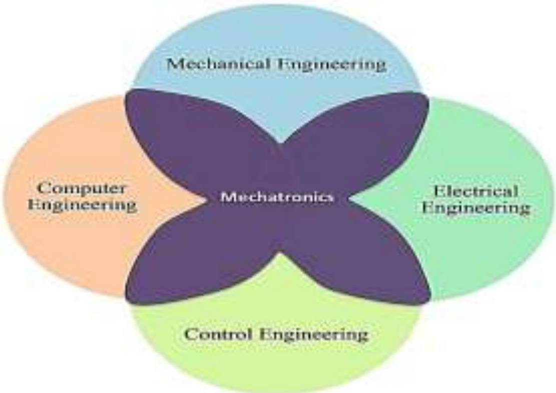

Fig. 1 Mechatronics: a multi-disciplinary approach

Mechatronic drive system can eliminate the effect of ground wheel slippage on planting quality and maintain the uniformity of seed distribution. Although the Quality Feed Index (QFI), missing-seed index and precision index become worse with the increase of forward speed, with the values of QFI of 89.93%, missing-seed index of 5.08% and precision index of 18.92% at the highest forward speed of 12 km/h. However, the mechatronic drive system can reduce the effect of forward speed on planting accuracy effectively. Planters equipped with the mechatronic drive system are suitable for high-speed planting. As compared to the mechanical drive system, the advantage of the mechatronic drive system efficiency is more noticeable especially when the forward speed is more than 11 km/h (Yang et al., 2015).

Precision agriculture interface with agricultural mechatronics is playing a key role in optimizing agricultural productivity in the developed countries. To prevent food crisis in the years to come, suitable technologies have to be developed to support the needs in precision agriculture which has to be promoted in the developing and the underdeveloped countries. Agricultural scientists, extension professionals and engineers from all branches of engineering have to join hands to develop more site specific, efficient, cost effective, environment friendly technologies suitable for small farm holdings. Agricultural mechatronics will be very much in demand in the developing and other

underdeveloped countries in future because precision agriculture which is in infancy stage in most of these countries. Since precision agriculture is an approach which optimizes productivity on a sustainable basis, it has immense potential for growth in the developing
and underdeveloped countries. Benji 2015.

Basic Components of Mechatronics System

1. Microcontroller.
2. Microprocessor.
3. Digital to Analog.
4. Drive circuits.
5. Actuators.
6. Mechanical system.
7. Sensor.
8. Signal conditions.
9. Analog to digital.

Objective of Mechatronics

1. Primary objective: Integration of mechanical systems with electrical electronic and computer systems and provide multi-disciplinary approach to product development and manufacturing system design.

2. Secondary objective:

a. To improve efficiency of the system.
b. To reduce cost of production.
c. To achieve high accuracy and precision.
d. For easy control of the system.
e. Customer satisfaction and comfort.

Benefit of Mechatronics

Accuracy, Cost effective, Flexible design, more user friendly, Smaller size, Safer, Precision control, more efficient, more reliable, enhanced feature and functionality.

Mechatronics play a vital role in forming the platform for advancements in emerging agricultural automation technologies. Precision planters with mechatronic drive system are more suitable for high-speed planting as compared to mechanical drive system. In the field of transportation, mechatronics application can be considered as an essential factor in improving agricultural productivity.

In the area of mechatronic design, the efficiency of farm machinery design process and the performance of farm gadgets/mechanisms can be improved considerably. Numerous opportunities for adoption of Mechatronics in agriculture are promising whereby productivity can be measured, reducing operator's drudgery, effective utilization of inputs like seeds, fertilizers, chemicals, time and labor and thereby reduces environmental pollution and soil degradation. In future, agriculture technologies will be dominated by precision and cloud data having cost effective technologies like smart tractors, unmanned aerial vehicle and wireless technology.

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Harvesting Practices of Pokkali Paddy in the Water-Logged Areas of Kerala

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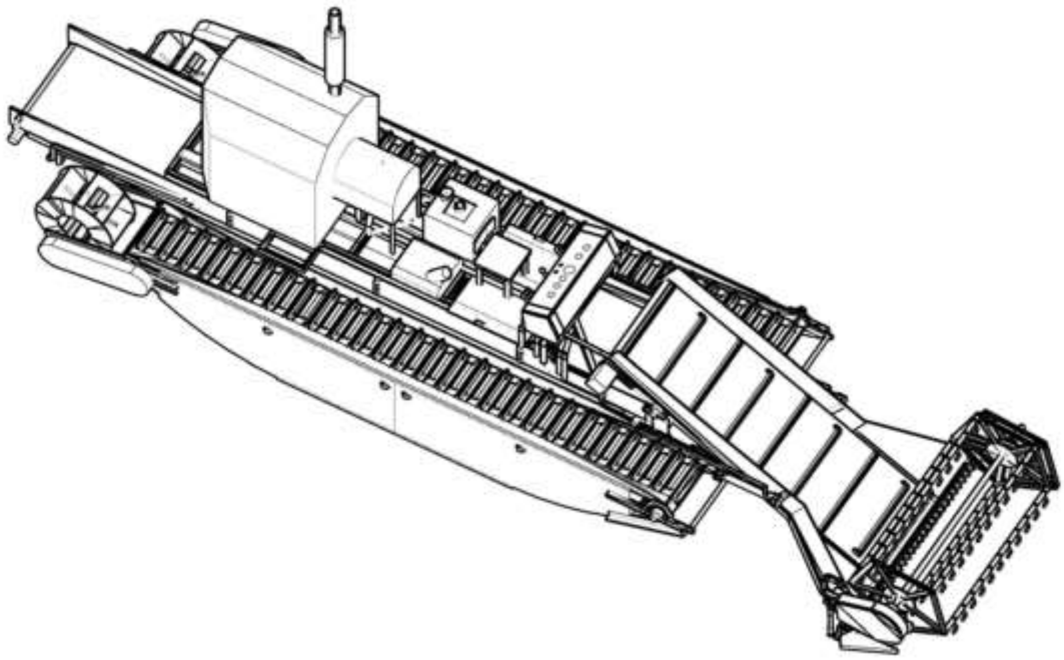
The term 'Pokkali' used in the common parlor refers to a salt tolerant traditional rice cultivar grown in the coastal saline soils of Kerala, India. The Pokkali field is a unique eco-system prevailing in the coastal tract of Kerala with rich bio diversity and amazing capacity to produce organic rice and shrimp alternatively. Rice is grown during non-saline period and the farmers carry out shrimp culture during the saline phase with both having unique symbiotic benefits. Pokkali areas lie in Trissur, Ernakulum and Alappuzha districts covering a total area of 8500 ha. It spreads over 34 Krishibhavans of these three districts. In the saline, water-logged Pokkali farm lands, rice and shrimps are farmed alternatively. In more than 90% of the single cropped lands, rice cultivation is done during the low saline phase from May/June to September/October; the traditional prawn filtration is taken up during the high saline phase which sets in December/January.

The Pokkali paddy varieties are having early seedling vigour and attain a height of 40-45 cm in 30-35 days. At this stage, when field conditions become favourable the mounds are made and a few seedlings are uniformly spread on the beds in the field. The clods give anchorage to the seedlings. Generally manuring and plant protection operations are not necessary for pokkali farming systems. The crop matures at about 120 days. The ear heads alone are harvested, leaving the straw behind in the fields. The average yield of rice with traditional rice varieties is 1500 kg ha-1.

The conventional method of harvesting of Pokkali paddy crop by using sickles. The various farming operations in Pokkali paddy cultivation, the harvesting is done by women labourers by walking on the swampy and marshy inundated paddy fields at waist-deep water, which is laborious, tedious and cumbersome.

Conventional practice of harvesting of Pokkali paddy crop

Due to these naturally adverse conditions prevailing in these lands and the non-availability of labourers, the paddy cultivation goes on decreasing every year. Hence, there was a great demand for a suitable harvesting machine, especially for harvesting the paddy, which is under water at the time of harvest due to tidal effects. Though a number of paddies combine harvesters are commercially available, none cannot be used in such marshy water-logged areas for harvesting paddy. Hence a power operated floating harvester, 'KAU Pokkali paddy harvester' with provisions for harvesting and conveying the ear heads of water submerged paddy stalks was developed and tested.



Conclusion

In conventional method of Pokkali paddy harvesting, manual harvesting using sharp sickles are practiced. For the harvesting, highly labour intensive, drudgery and more time-consuming operations are required. This has curtailed the area under Pokkali from 25,000 ha, a few decades back to a mere 8,500 ha now. Out of which, only 5,500 ha is under rice cultivation, the rest is either left fallow or used only for prawn farming. The paddy cultivation goes on decreasing every year. Hence, there was a great demand for a suitable harvesting machine, especially for harvesting the paddy, which is under water at the time of harvest due to tidal effects. To overcome these problems, KAU Pokkali paddy harvester was developed. It was operated by the hydraulic system, which consisted of a hydraulic cylinders and motors with a control valve. The Pokkali paddy harvester consists of floating barge, hydraulic system and harvesting unit viz. reel, cutter bar and conveyors.

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Organic Agriculture: An Immediate Necessity

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Abstract

As the world is facing more food crisis, it is high time to think of sustainable measures of food production that can cater to the needs of the rising population without hampering the environmental quality or degrading the soil. Organic agriculture is one of the best ways to develop a sustainable food production system for the future. However, even though there are a lot of advantages of organic farming, there are certain drawbacks that makes its less marketed among the consumers. This article gives a brief and crisp idea about the necessity of organic farming, its advantages and the drawbacks thereof.

Keywords: Organic, Agriculture, Sustainable, Food.

Organic Farming: A Necessity

The path of organic agriculture in India has its roots in the work of Howard who conceptualized this and it was later accepted by many scientists who followed this type of a farming (Howard, 1940).

Organic agriculture, otherwise known as Organic farming is a type of farming system that avoids the use of inorganic or chemical fertilizers, pesticides, growth regulators, and livestock feed additives. The basics of organic farming lie in its objectives of environmental, social, and economic sustainability (Stockdale et. al., 2001).

The key traits of organic farming include:

1. Protection of long-term soil fertility by maintaining adequate organic matter levels.
2. Fosters biological activity in the soil.
3. Careful mechanical intervention.
4. Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation.
5. Effective recycling of organic materials including crop residues and livestock wastes and weed.
6. Diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, and resistant varieties.

Organic farming lays a great emphasis on maintenance of soil fertility by returning all the wastes through the compost to bridge the gap between the NPK addition and removal from the soil. As the population is increasing day-by-day, most of the countries are forced to use chemicals and go with intensive agriculture to meet the rising demand of food requirements.

The prolonged and over usage of chemicals has, however, resulted in human and soil health hazards along with environmental pollution. Farmers in the developed countries are, therefore, being encouraged to convert their existing farms into organic farm.

The key factors affecting consumer demand for organic food is the health consciousness and the willingness of the public to pay for the high-priced produce. In general, consumers of organic products are an affluent, educated, and health-conscious group spurred by strong consumer demand, generous price premium, and concerns about the environment.

Because of these hidden benefits, conventional growers are turning to organic farming. In Europe, government policies aim to stimulate the organic sector through subsidies, consumer education, and support in the form of research, education, and marketing. Agricultural practices of India date back to more than 4000 years, and organic farming is very much native to this country. As mentioned in Arthashastra, farmers in the Vedic period possessed a fair knowledge of soil fertility, seed selection, plant protection, sowing seasons, and sustainability of crops in different lands. The farmers of ancient India adhered to the natural laws and this helped in maintaining the soil fertility over a relatively longer period of time.

Fig. 1. Various Aspects of Organic Farming

Advantages Organic Farming

1. They are free of harmful pesticides and additives.
2. They have less of any environmental implications than conventional farming.
3. Farmers can reduce their production costs since they don't have to spend a lot of money on chemicals and fertilizers.
4. They improve plant growth and physiological activities of plants.
5. In the long run, they save energy and protect the environment.
6. The nutritional value is higher in organic foods.

Drawbacks of Organic Products

1. Organic foods are much higher in price however; the farmers do not get the fair price of their produce.
2. As organic products are prepared in small quantities, marketing and distribution are not efficient enough.
3. Their perishability is higher as no preservatives are added to them.
4. Not enough production is there to feed the rising population.

Conclusion

The present society needs a system of cultivation that ensures both the quality of the food and conserves the environment at the same time. Organic farming is gaining momentum all over the world, however, a lot more research needs to be done in order to make it viable in terms of affordability and accessibility to all. Moreover, government support and local participation on a large-scale is required to bring about mass organic production at lower costs.

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Mitigation Measures and Adoptions in Agriculture Based on Climatic Change

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Introduction

Global climate change is a change in long-term weather patterns that characterize parts of the world. The term "weather" refers to short-term (daily) changes in the temperature, wind, and / or precipitation of an area (Merritts et al. 1998). In the long run, climate change will affect agriculture in many ways, such as quantity and quality in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability, and so on. Climate change is likely to have a direct impact on food production worldwide. An increase in average seasonal temperature shortens the duration of many crops and therefore reduces yields. In areas where temperatures are already close to the physiological maximum for crops, warming will immediately affect yields (IPCC, 2007). Drivers of climate change through changes in climate composition can directly affect food production through its effects on plant physiology. Agriculture's contribution to climate change and the negative impact of climate change on agriculture are expected to have a major impact on food production and pose a threat to food security and, therefore, require special agricultural measures to combat.

Description: Climate Change – Mitigation and Adaptation in Agriculture

1. Help farmers cope with current climatic risks by providing value-added weather services to farmers. Farmers can adapt somewhat to climate change by changing planting dates, selecting varieties with different growth periods, or changing crop rotations.

2. An early warning system should be put in place to monitor changes in pests and diseases. The overall pest control strategy should be based on integrated pest management because it takes care of multiple pests in a given environment.

3. Participating and cultivating formal plants to develop climate-resilient crop varieties that can withstand high temperatures, drought and salinity.

4. Developing short-term crop varieties that can mature before the onset of the maximum thermal phase.

5. Gene selection in crops with high yield potential per day to combat yield loss from heat-induced reduction during growing periods.

6. On-farm reservoirs in medium lands, pulses and oilseeds instead of rice in highlands, ridges and fur system in cotton crops, intercrops in place of pure crops in highlands, land grading and levelling, field carts by stabilizing stone and grass, run of bunds, run Further application of contour trenching, conservation furrows, mulching and farm yard manure (FYM) for collection.

7. Effective water uses such as frequent but shallow irrigation, drip and sprinkler irrigation, critical stages irrigation for high value crops.

8. Optimal fertilizer dosage, nitrogen and potassium fertilizer separation, deep position, limiting neem, karanja products and other nitrification inhibitors, acidic soils, use of micronutrients such as zinc and boron, effective use of sulfur in oilseed crops, integrated nutrient management.

9. Seasonal weather forecasts can be used as a supportive measure to optimize planting and irrigation patterns.

10. Provide greater coverage of weather linked agriculture-insurance.

11. Intensify the food production system by improving the technology and input delivery system. Adopt resource conservation technology such as no-tillage, laser land leveling, rice direct seeding and crop diversification, which can help reduce global warming potential. Crop diversification can be done by cultivating non-rice crops in rainfed topsoils to perform better under prolonged soil moisture pressure in Kharif.

12. Develop a long-term land use plan for ensuring food security and climatic resilience.

13. National grid grain storages should be established at the district level at the household / community level to ensure local food security and stabilize prices.

14. Provide incentives to farmers for resource conservation and efficiency by lending to farmers to switch to adaptive technologies.

15. Provide technical, institutional and financial assistance for the establishment of food, fodder and seed community banks.

16. Provide more funding to strengthen research to increase adaptation and mitigation potential of agriculture.

Conclusion

Climate change, the result of "global warming" is now beginning to show its effects around the world. The primary determinant of agricultural productivity is the climate, which has a direct impact on food production worldwide. Agriculture is the most sensitive sector to climate change because the climate of an area / country determines the nature and characteristics of vegetation and crops. An increase in average seasonal temperature shortens the duration of many crops and therefore reduces the final yield. Food production systems are very sensitive to climate change such as temperature and precipitation, which can lead to the spread of pests and diseases, thus reducing crop yields which ultimately affects the country's food security. The net impact of food security depends on global climate change and the ability to cope with and recover from global climate change. Resources such as soil, water and biodiversity need to be carefully managed to combat the impact of climate change on agriculture. To counter the impact of climate change on agriculture and food production, India needs to work at the global, regional, national and local levels.

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Role of PGRS in Stress Management

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Stress

Stress in biology is any change in environmental conditions that might reduce or adversely change a plant's growth or development.

Strasser 1998 defined it as 'a condition caused by factors that tend to alter an equilibrium', 'Stresses' that impact upon seeds can affect plant reproduction and productivity, and, hence, agriculture and biodiversity.

Plant Growth Regulators and their Role in Stress Management

Abiotic and biotic stresses affect the growth and yield adversely in agronomical important crop plants. Major growth regulators include phytohormones, simple ions like Ca2+ or various non hormonal molecules. These growth regulators initiate/activate a cascade of events either on their own or by evolving a cross-talk within them that finally recruits various transcription factors those in turn activate or suppress a variety of genes.

In this, we have tried to bring out the recent advances towards the mechanisms of hormonal regulators such as ethylene, auxin, gibberellins, jasmonic acid, abscisic acid, brassinosteroids, non-hormonal regulators like polyamine and salicylic acid and developmental regulators such as heat shock proteins, protein kinases, miRNA, histones and various other genes that are involved in plant stress management. The abiotic stress, which includes factors such as salinity, drought, and extreme temperatures, causes tremendous losses in agricultural production at the global level.

The Abscisic acid (ABA), ethylene, and Jasmonic acid (JA) are plant growth regulators with a well-documented plant response to abiotic stress. Contrastingly, SA, JA and ET play major roles in response to biotic stress conditions as their levels increase with pathogen infection. However, the mechanism of stress-response is not solely restricted to these hormones. Recent studies have provided substantial evidence for the crosstalk of ABA, SA, JA and ET with auxins, GAs and CKs in regulating plant defense response.

As mentioned earlier most of the abiotic stress is responded by variation in the levels of abscisic acid whereas, biotic stress enhances ethylene and jasmonic acid levels. It is now believed that other hormones such as gibberellins (GAs), auxin, cytokinin (CYT) and recently brassinosteroids (BRs) do also participate in various types of signal transduction during stress in plants. All phytohormones get activated during any kind of stress and either up regulate or down regulate several genes to let plant exert its effect. Some of the important phytohormones and their relevance in stress are re viewed.

Ethylene and the Response of the Stress

Synthesis of ethylene increases due to numerous stress factors such as injuries, salinity, drought, cold, the ozone layer, and the water logging. In mature plants of wheat, changes in the biosynthesis of ethylene differ in terms of the tolerance of the variety, and the degree of water deficit imposed.

In the drought-tolerant varieties, ACC oxidase activity increases in the first 24 hours of stressful treatment, while in sensitive varieties, it decreases. There are variations in the biosynthesis of ethylene in the susceptible and tolerant varieties of wheat.

In conditions of oxygen deficiency, ACC cannot be oxidized but is translocated in the shoots where it is rapidly transformed into ethylene.

Production of ethylene increases with temperature within determined intervals under water stress conditions, salt, mechanical injury and in the presence of pollutant ozone. However, in some cases, it was also observed a decrease in production, as in conditions of thermal excesses and prolonged water shortage conditions.

Recent studies have elucidated almost completely the role of ethylene in the plant have been identified the receptors with which it interacts, and some transcription factors mediated by ethylene were characterized (Guo & Ecker, 2004.

There have been no reported alterations in the signaling of ethylene in plants affected by saline stress. A homolog of the ethylene receptor gene NTHK1 of tobacco, suggests sensitivity to salinity of Arabidopsis plants by phenotypic transformation, the electrolyte equilibrium, and the comparative growth of the root under saline stress. The physiological and biochemical responses to conditions anoxia and hypoxia are very rapid, and the production of ethylene can be about 8-15 times higher than the level normal them.

ABA and the Response of the Stress

ABA is the main hormone that provides tolerance to abiotic stresses, especially to salinity and drought. It is known that the salinity, as well as the drought and low temperatures, ameliorates the ABA biosynthesis. The activated genes that encrypt the enzymes mandatory for the biosynthesis of this growth regulator may be catabolized at the end of the stressful time.

Within abiotic stress; drought, low temperatures, and salinity lead to cell dehydration. Plants respond to stress by exhibiting a wide variety of responses that involve rapid physiological changes such as stomatal closure to avoid plant water loss changes in the development patterns; or biochemical changes in the expression and accumulation of various response proteins that are speculated to perform a function in stress tolerance.

In higher plants, ABA is involved in the control of various physiological processes including development of seed and adaptations of a plant according to different types of environmental stress. Under conditions of water and saline stress, the ABA allows to maintain the water balance in the plant through the regulation of the degree of opening of the stomata.

In drought conditions, an ABA concentration in the leaves increases. The production of ABA in the roots and its transportation to the leaves is a mechanism of response to soil water deficit. It is a well-known role of ABA in the closure of stomata to prevent desiccation. From tolerance to salinity and other types of stress, the role of the ABA appears to be the regulation of water balance in the plant and the osmotic stress tolerance.

The role of the ABA in the osmotic stress tolerance is well known, and there is some evidence of the role of the ABA in the control of ion homeostasis. For example, the contents of ABA increased slightly only in the leaves of the rice cultivars tolerant to salinity versus sensitive cultivars.

The Jasmonic Acid and the Plant Response to Stress

The Jasmonic acid and its derivatives are considered to be components of the transduction of signals in the defense mechanisms of the plants and increases have been recorded in their endogenous levels in plants subjected to water stress.

They induce the expression of genes that encode specific proteins, which may include protease inhibitors, enzymes involved in the biosynthesis of flavonoids, osmotics, and lipoxygenase, and different proteins associated with the pathogenesis in relation to the role played by the JA and its derivatives in the responses to stress, there is evidence that tolerant plants have higher levels of these compounds than the sensitive ones.

In tomato, the cultivar Pear tolerant of salinity presented higher endogenous levels of JA and its precursor, 12-Phytodienoic Acid (cis-OPDA), than the sensitive cultivar Fruhstamm hellfrucht. In addition, both cultivars responded to salt stress by changing their levels of JA.

On the other hand, in response to the saline treatment, the accumulation of enzyme proteins involved in the synthesis of JA, such as lipoxygenase (LOX) and Allene oxide synthase (AOS), and protein induced by JA, the protease inhibitor (pin2) was observed. The accumulation of mRNA of Allene oxide synthase (AOS- mRNA) and protease inhibitor mRNA (Pin2- mRNA) was observed with treatment with NaCl and JA, indicating that the saline stress causes a differential response in sensitive and tolerant plants.

In soybean leaves subjected to the loss of 15% of the fresh weight, the levels of JA increased five times after two hours of stress, while it decreased the levels of control around four hours. In this research, it was noted that the implementation of the methylated JA, had no effect on the rate of transpiration but the rapid induction of JA levels observed in the leaves with water deficit is due to the loss of turgor and changes related to the transport of ions, while it had no influence on the closure of stomata.

Jasmonic acid forms in response to stress chemical or physical and attacks of pathogens. JA is involved in the regulation of some genes responsible for defense mechanisms such as chitinase B, thionine 2.1 and others.

Brassinosteroids and the Plant Response to Stress

BRs play a significant role in the amelioration various stresses. Moreover, BRs are also recognized as regulators of transcription and translation thereby improving the level of total proteins, enzymes, the rate of nitrogen fixation and finally the seed yield, at harvest.

BRs elicit various physiological responses in plants, including stem elongation, pollen tube growth, leaf bending and epinasty, root growth inhibition, induced synthesis of ethylene, activation of proton pump, xylem differentiation, synthesis of nucleic acids and proteins, activation of enzymes and photosynthesis. It has been proposed that the changes induced by BRs are mediated through the repression and/or depression of specific genes.

The rice and tomato, maize, cucumber and brome grass, with BRs improved their capacity of resistance to low temperature. Similarly, BRs increased the degree of tolerance, to high temperature, in wheat and brome grass. BRs also countered the drought stress in sugar beet, moisture stress in wheat, nickel toxicity in mustard), saline stress in chickpea, cadmium stress in chickpea and mustard, and induced seed germination and seedling growth in *Euca lyptus* and rice, under salinity stress.

Moreover, BRs activate antioxidative enzymatic defense system in rice seedlings, grown under salt stress. Furthermore, BRs have been successfully employed for economic gains, since treated plants develop stress resistance and produce more seeds, at harvest.

Cytokinins

In plants, CYT, the N6-substituted adenine-based molecules, are mainly synthesized by the addition of an isoprene moiety to ATP or ADP. These have been associated diverse processes including stem-cell control, vascular differentiation, chloroplast biogenesis, seed development, growth and branching of root, shoot and in orescence, leaf senescence, nutrient balance and stress tolerance. CYT has also been linked to nodulation in legumes, interactions with pathogens and circadian rhythms).

CYT have also been shown to be an important signal travelling from roots to the shoots. Root-produced CYT are clearly involved in responses to nutrient deprivation. Because these are produced mainly in roots, could be important in drought responses. There are evidences that provide information on the CYT content of xylem sap changes under drought conditions. In grapevines, reduction in zeatin (Z) and zeatin riboside (ZR) was found in plants that had been subjected to partial root zone drying. In sun ower, xylem sap, combined Z and ZR and combined isopentenyladenine and isopentenyladenosine concentrations in xylem sap decreased under drought-stressed conditions.

Auxin

Though auxins have long been considered as the phytohormone responsible for plant growth and phototropism recent evidences indicate that it may have a direct/indirect role in plant stress management as well. Some of the recent works in this direction are reviewed. Auxin responsive *GH3* genes have been shown to play role in plant defence res ponse in *Arabidopsis*. The *GH3-5* may be acting as bi functional modular for SA and auxin signaling during pathogen infection (Zhang *et al*. 2007). Over expression of another gene of this class, *GH3-8* resulted in enhanced resistance to *Xanthomonas* in rice which causes bacterial blight disease. Interestingly this resistance was independent of SA and JA signalling (Ding *et al*. 2008). NPK1 is amitogen-activated protein kinase kinase kinase identified in *Nicotiana tabacum* and plays important roles in cytokinesis and auxin signalling transduction and responses to multiple stresses. Expression analysis of *OsNPKL* genes under abiotic stresses suggests that the stress-responsive genes are mainly from the same subgroup. Especially clustered genes are induced by drought, salt, or cold stress.

Non-Hormonal Growth Regulators and their Role in Stress

Other growth regulators such as polyamines (PAs), SA, BRs and JA are becoming known as signaling molecules in diverse plant processes). These compounds fall into several groups - amino acids (e.g., proline), quaternary ammonium compounds (GB), polyols and sugars (mannitol, dononitil, trehalose, sucrose, fructan, etc.).

Polyamines

In plants, PAs are involved in various physiological events such as development, senescence and stress responses. It has been proposed that PAs are a new category of PGRs which are found to be involved in a wide range of physiological processes, such as tolerance to stresses, embryogenesis, cell division, morphogenesis, and development. These are also known to accumulate under salt stress conditions in different plant systems, resulting in protective effects, acting as free radical scavengers, stabilizing cellular membranes and maintaining cellular ionic balance under these conditions. In response to long-term salt stress the levels Spd and Spm were modulated suggesting their role in salt stress. The measurement of PAs levels in different rice cultivars showed that salt-tolerant rice cultivars maintain a high level of higher PAs, e.g., Spd and Spm. Free and bound PAs content in root tonoplast vesicles were closely related to salt tolerance of barley plants. Increased Levels of polyamines in several plant species such as spinach, lettuce, melon, pepper, broccoli, beetroot and tomato under salt stress.

Salicylic Acid

The role of SA in biotic and abiotic stress tolerance has been well documented. In plants, SA biosynthesis occurs via the shikimate-phenylpropanoid pathway, where, phenylalanine is first converted to trans cinnamic acid (t-CA) by phenylalanine ammonia lyase. It has been reported that the exogenous application of SA influences several developmental and physiological processes in plants such as seed germination, transpiration rate, stomatal closure, membrane permeability, growth and hypothesized that SA may accelerate the cell death of cadmium (Cd)-stressed roots to avoid Cd uptake by plants or may play positive roles in protecting the stressed roots from Cd-induced damage. Exogenous application of SA increased plant growth of maize significantly both in saline and non-saline conditions. Under salinity stress, lipid per oxidation and membrane permeability decreased by SA treatment. SA has also received much attention due to its role in plant responses to various other abiotic stresses such as ozone, UV-B, heat stress, drought, oxidative stress, salt and osmotic stress. SA is considered to serve as a signal in the induction of expression of genes. The application of SA has been found to increase tolerance of wheat and maize seedlings to salinity, water deficit, of tomato and bean plants to low and high temperature as well as of heavy metals of rice plants. It also plays a role in thermo genesis in lily, induces flowering in a range of plants, controls ion uptake by roots and stomatal conductivity.

Subsistence Farming and Commercial Farming: The Two Facets of Agriculture

Article ID: 10494

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Abstract
Agriculture is the mainstay of any economy. It has been into practice in some form or the other since the evolution of life on earth. This article throws light upon two important forms of farming that show a pragmatic shift in agriculture over the years. Previously, farming was just a means of sustenance and was done only for family consumption. But now with the increase in population and high market demand for different types of food products, also with the availability of technology, agriculture has shifted to a commercial enterprise where farming is done as an economic activity. Here we also show how the two methods of cultivation drastically differ from each other and ultimately figure out the need of the hour for a sustainable future.

Keywords: Agriculture, Commercial, Subsistence

Introduction
India is an agrarian economy. This means that agriculture is the source of livelihood generation for most of the people in the country and also majority of the population of the country live in the rural areas. They are engaged in agricultural and allied activities either directly or indirectly. The word agriculture is derived from the latin word “ager” meaning soil and “culture” meaning cultivation. In other words, we ca say that agriculture is the science and art of cultivating the soil to grow crops and rear livestock. This is a complete system which includes inputs, processing and finally harvesting of the output. The inputs here are seeds, fertilizers, machinery, which then, undergoes operations like ploughing, sowing, irrigation, weeding, and harvesting. And thus, we get the final outputs like crops, dairy and poultry products.

However, there are different types of farming/ cultivation practices taken up for generating a sustainable living. The two broad categories of farming are:
1. Subsistence Agriculture/ farming.
2. Commercial Agriculture/ farming.

Subsistence Farming
This kind of a farming is basically done for the consumption of the farmers or for they family only. This may be either Primitive type or Intensive subsistence farming. The only aim of this type of a farming is to meet the needs of the farmer and his family. Primitive subsistence farming is typically done on small areas of land with traditional tools like hoe, dao, digging sticks etc. This is a very traditional or rather natural method of farming as the natural environment like heat, rain, wind and condition of the soil contribute to the growth of crops. Primitive farming further includes:

Shifting cultivation: Here the farmer clears the cultivated land by burning the land after the harvest. This results in the maintenance of soil fertility so whoever uses the land next can get a good yield. This method is known by different names in different regions of India. Shifting cultivation is also practiced in some countries in South America and South East Asia

Nomadic herding: This kind of farming method involves herders and farmers travelling from place to place with their flocks of animals. And, the herders also source wool, meat, hide and dairy products from the livestock. Nomadic herding is very common in Rajasthan, Jammu & Kashmir with herders rearing sheep, goats, yaks, and camel. Intensive subsistence farming is quite in contrast to primitive farming. Farmers practice intensive farming on wider areas of land, use modern machinery and tools and add chemical fertilizers for better crops. This is more of a modern method of subsistence farming.

Commercial Farming

When crops are grown and animals are reared as an economic activity it is called commercial farming. Due to the need for a high amount of output, farmers cultivate larger areas of land, with heavy use of machinery. Commercial Farming has three main categories:

Commercial grain farming– Here the farmers grow grains and trade them in the market. Wheat, rice and maize are the most common crops of commercial grain farming. Farmers of Asia, Europe, temperate grasslands of North America generally practice this type of farming.

Plantation farming– Plantation farming is a mix of agriculture and industry and is practiced across a vast area of land. Plantation owners usually grow a single crop like banana, coffee, tea etc. in a plantation and use technological support to process the crop on the farm itself or a factory attached to it. The end product also works as a raw material for industries. For example, the rubber industry uses the rubber produced from its plantation as raw material.

Mixed farming– This farming method involves cultivation of crops, rearing livestock and growing their fodder. It is a common practice in parts of USA, Australia, and New Zealand, Europe, and South Africa to do mixed farming for a living.

Fig 1. Commercial Farming on a large-scale

Difference Between Subsistence Farming and Commercial Farming

Subsistence Farming	Commercial Farming
It is the farming practice where the crops are grown for personal consumption only (for the farmer and his family only).	It is the farming practice where the crops are grown for trade or for any economic activity to earn profit

	(apart from meeting the requirements of the farmer).
It is very much labour intensive.	It is capital intensive.
Usually, it is practised in smaller areas.	Practiced in very large areas.
Productivity is enhanced using organic manures.	Productivity is enhanced using inorganic fertilizers and modern inputs.
They depend on monsoons for irrigation.	Modern irrigation techniques and tools are used.
Usually, food grains and vegetables are grown.	All types of crops including cash crops, cereals, oilseeds, etc.

Conclusion

Today, with the advent of technology and better information available at the doorstep of the farmer, agriculture is shifting from the primitive subsistence farming to modern-day commercial farming. However, it is also important to understand that along with better economic condition, the sustainability of the environment matters a lot. With more intensive commercial farming taking place round the world, the quality of the soil is getting degraded day-by-day that creates a threat to the global climate. Thus, there is a need to shift to sustainable practices of commercial agriculture that involves an integrated approach of crop growth along with conservation of the natural environment. Also, more focus needs to be given to organic farming and only then commercial agriculture can succeed in feeding a large population with quality nutritious food and sustain this globe.

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Food Safety and Hygienic Practice Among Street Food Vendors in India

Article ID: 10495

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Introduction

Street food has experienced a significant growth in past few decades due to over growth of population and in demand of different taste. Street food consists of wide variety of ready to eat food and beverages which is prepared by street food vendors of local market and other public places. In India, street food plays an important role in meeting food and hunger requirements of lower- and middle-class people as well as to the students at affordable prices. Indians prefer to buy street food because of diverse culinary habits and wide range of regional cuisines with different cooking techniques. Beside this, it also plays an important role as a support to country tourism. Perhaps, it seems that middle class, lower class and students prefer street food more than restaurant food because it is cheap and quickly served. Despite of the economic benefits it is been recognized as a potential hazard to human health when food is not prepared under safe hygienic practices. Therefore, it has been implicated as one of most frequent cause for food borne illness in India.

Most of the street food vendors don't follow the food safety standard norms. Either they are unaware, neglecting it or they follow faulty practices with volume preparation of food which are the main cause of food borne illness among the consumers.

An appropriate training program, knowledge and awareness of food safety regulations with proper implementation of food hygienic practices should be given to street food vendors. Government involvement might help in promoting food safety among street vendors and it should offer some type of incentives and easy license to encourage them to participate in training.

Microbial Contamination and Food Borne Illness

One of the reasons for spreading of food borne illness among the consumer is due to consumption of unhygienic food which cause hazard to their health. Poor hygienic and mishandling practices are also a cause of food borne illness. Food born bacterial pathogens commonly detected in street food are *Bacillus Cereus*, *Clostridium Prefringes, S. Aureus* and *Salmonella Spp.* Most of the people who patronize Indian street food had reported to suffer from food borne diseases like typhoid, cholera and food poisoning etc. Every year it is reported that due to consumption of contaminated street food led to food borne illness and death in few cases.

Hazard Analysis of Street Vended Food and Premises

Street foods are perceived to be major cause of public health risk due to lack of infrastructure facilities and difficulty in handling the diverse nature of various food vending operation. Beside these vendors don't have knowledge about food safety measure as well as in public health and safety issues. There are various areas and unhygienic practices which are the cause of potential hazard in the street vended food and premises are:

Table. 1: Potential hazard in street vended food and premises:

Sl. No.	Sources	Hazard	Causes
1.	Location	Microbial Contamination	Improper water disposal. Near garbage dumping area. Lack of water facilities.
2.	Storage	Microbial Contamination	Inadequate storage facilities. Contamination by other food wastage.
3.	Raw material	Microbial Contamination	Not kept separately from cooked food. Mishandling of raw material. Lack of cleaning and washing facilities for raw material.
4.	Cooking	Microbial Contamination	Cross contamination by hands. Not using gloves while cooking. Not using mask and cap while touching and cooking the food. No proper separate storage for cooked food and raw material. Insufficient cooking temperature and time.
5.	Containers/ Utensils	Microbial Contamination	Improper cleaning. Cross contamination Using same knife without in-between cleaning
6.	Services	Microbial Contamination	Bad handling practices Not using gloves, mask and cap while distributing food.

Food Safety Practices Followed by Street Food Venders

It has been reported that bacteria from hands and other sources causes contamination of food. So, to avoid the contamination, control measures and hygienic practices helps to improve street food vending.

To reduce the risk of food borne illness from street food can be contributed by focusing on:
1. Educate the food handlers.
2. Improve environmental conditions.
3. Awareness of food safety regulations.
4. Knowledge about food safety.

Table 2: Food practices followed by street food vender:

Sl. No.	Sources	Hygienic practice
1.	Location	Clean area. Away from garbage dumping area. Away from municipal drains.
2.	Storage	Proper storage facilities. Separate storage section for raw and cooked food
3.	Raw material	Good quality

		Separately storage Proper washing and cleaning of raw materials.
4.	Cooking	Cooked food should away from raw material. Proper use of gloves. Hand should be properly sanitized. Wear cap and mask while touching the food.
5.	Containers/ Utensils	Containers and utensil should be properly clean and disinfectant
6.	Services	Proper handling of food. Food handlers should always wear mask, caps and gloves while distributing food.

Training Program for Street Food Vendors

A training program should comprise of few sessions according to its intension. The session should consist of following design schedules:

1. Orientation program
2. Session for personal hygiene
3. Sessions for food hygiene.
4. Environmental hygiene
5. HACCP implementation

Each session should be allotted with approximate few hours in duration and proper guidance should be given regarding information of new norms or rules adopted by FSSAI regarding the hygienic practices for street food. Training session should consist of various training methodologies and material like posters and motivational video film and at the end of session they should demonstrate on value addition so that they can earn more money.

Conclusion

Street foods are quite popular in India. Selling food on street is a source of income for various classes of people. Preparation of food on street results in increasing risk to consumer’s health and food borne illness. To improve the food safety practices of vendors, they should be imparted interactive training time to time. Attention should be given on the knowledge regarding food safety and hygienic practices. Vendors should improve their infrastructure facilities by using standard carts. Attentions must be given on cleanliness of cutlery and disposal of waste water. Improvisation in safety of street food can be achieved by awareness programs and also by the involvement of government organization etc. As a responsible citizen and consumer, we must make an effort to improvise food safety by making vendors aware about safety and on our part, we must try to dispose the left over in dustbins accordingly.

Vertical Drainage and Biodrainage Systems

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Non-conventional drainage methods are adopted when the conventional surface drainage or subsurface drainage methods are not suitable due to technical or economic reasons. Vertical drainage using shallow or deep wells or a shallow multiple well-point system, biodrainage, pump drainage and mole drainage are some of the non-conventional drainage methods (Bhattacharya and Michael, 2003). Construction of ring bunds to protect agricultural lands from inundation by flood water (widely adopted in Kerala), washing out the dry season surface accumulated salts in the saline land by using the water from the initial monsoon rains, and reducing the depth of accumulated runoff by recharging it into groundwater are some of the other non-conventional methods (Bhattacharya and Michael, 2003). The function of the non-conventional drainage methods is to achieve the same goals as those of the conventional drainage methods, i.e., control of excess water and excess salts in agricultural lands. However, their scope, working principle and design methods are different.

Vertical Drainage System

In conventional horizontal pipe subsurface drainage systems, the flow of water through the soil profile is a combination of horizontal and radial flow. For most part of the flow domain, from the mid-spacing up to the drain, the direction of flow remains essentially horizontal. In the radial flow zone, in the vicinity of the drain, there is a vertical component of the flow velocity. The drawdown in the case of horizontal pipe subsurface drainage system is limited to a maximum of depth of the drain from the soil surface, which seldom exceeds 2 m. Consequently, the vertical flow component is small (negligible). Once the excess water is collected in the drain, its outward flow takes place at a low gradient (normally not more than 0.2%) to limit the depth of installation and to permit gravity outfall (Bhattacharya and Michael, 2003). In contrast, a tubewell dewaters the soil profile from much greater depths. The outflow through a tubewell is directed vertically upwards, and if the drawdown is large and the cone of depression is evenly spread (as in uniform coarse soils), there is a substantial component of vertical flow even within the soil profile. Therefore, drainage by tubewells is known as vertical drainage. Another case of vertical drainage is when excess accumulated surface runoff water is to be disposed by recharging it into deeper aquifers through a tubewell (i.e., recharge well), wherein the flow through the recharge well is vertically downward.

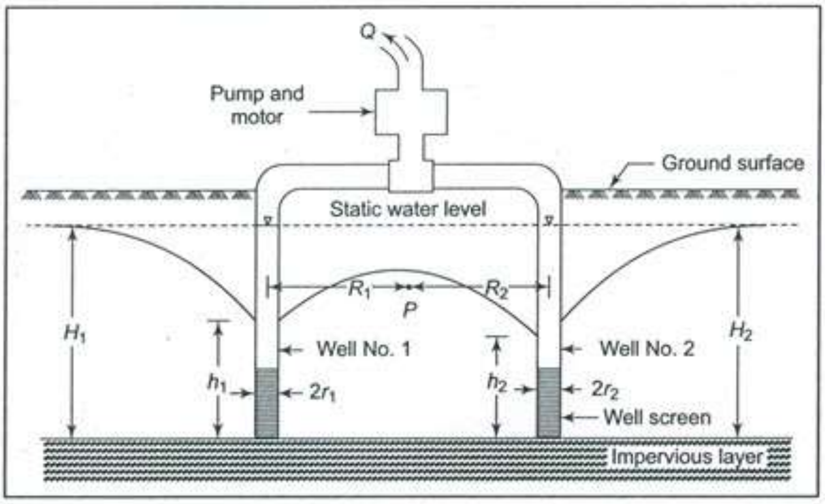


Fig.1: Schematic of tubewell drainage technique: Two wells tapping an unconfined aquifer in series. (Source: Michael et al., 2008)

Vertical Drainage Using Multiple Well-Point System

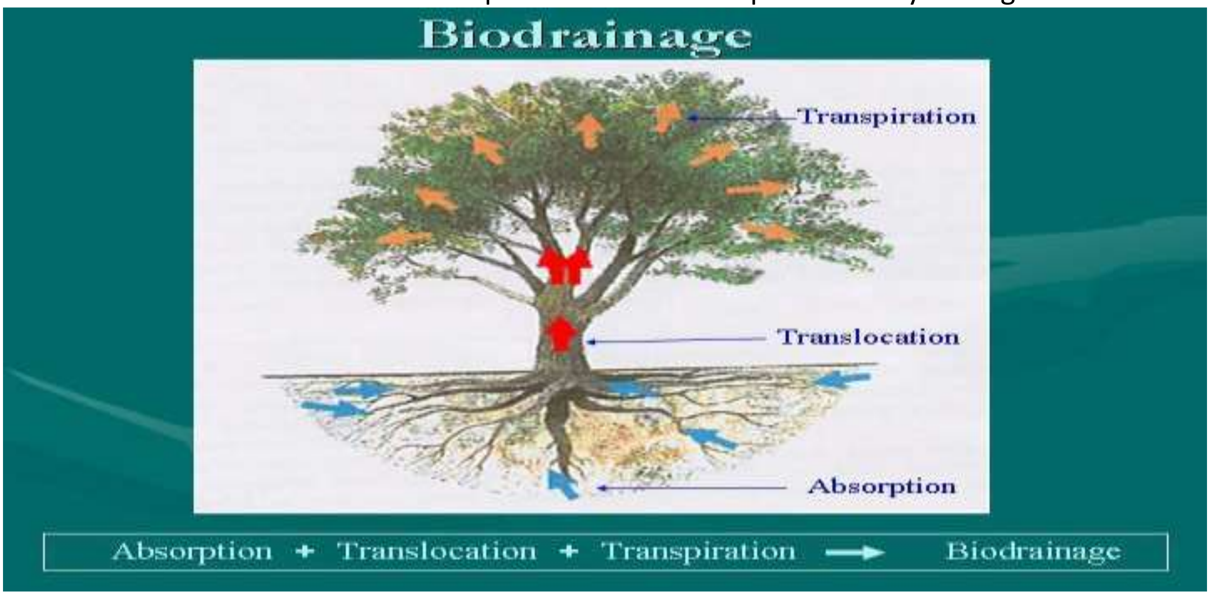
A multiple well-point system consists of a network of closely spaced shallow tube wells to dewater a waterlogged area where the water table is close to the groundwater or very close to the root zone and pumping by a single or a few scattered deeper tube wells are not adequate to lower the water table. It is also suitable when the deep well pumping or pumping at a high rate from a single tube well may be hazardous due to the presence of poor-quality water at deeper depths (Bhattacharya and Michael, 2003). Thus, a multiple well-point system of groundwater pumping is essentially a drainage method. In this system, shallow tube wells are closely spaced to produce interference effect when they are simultaneously pumped. Khepar et al. (1971) reported that a battery of two tube wells, spaced at an interval of 3 m can achieve a drawdown of 1.74 m at the mid-point due to well interference between the two, whereas the drawdown effect on the outer region was the same as if the single well were being pumped. Therefore, to cause an effective drawdown over a larger waterlogged area, there should be several tube wells located within their radii of influence. Note that well interference is not desirable for the tube wells constructed for water supply purposes.

Vertical Drainage Using Dug Well

Dug wells tap shallow unconfined aquifers. Therefore, pumping from dug wells has an immediate effect on the shallow water table. However, since the dug wells are shallow, have small discharge capacity, and have a small zone of influence, the effect of water table decline is limited to a small area surrounding the wells. Sharma (1999) studied the effect in terms of vertical drainage and improvement in crop yield by pumping from a dug well in a shallow water table farm holding in the Barna Command area of Madhya Pradesh. The crops were soybean in kharif and wheat in rabi. It was found that the temporary water table decline due to pumping from dug well and using the water for irrigation, instead of the available canal water, could give a 14.6% and 27.3% increase in yield, respectively for the kharif soybean and rabi wheat as compared to the area where the irrigation was only by canal water.

Bio-Drainage

Bio-drainage may be defined as *"pumping of excess soil water by deep-rooted plants using their bio-energy"*. The bio-drainage system consists of fast-growing tree species, which absorb water from the capillary fringe located above the ground water table. The absorbed water is translocated to different parts of plants and finally more than 98% of the absorbed water is transpired into the atmosphere mainly through the stomata.



Fast growing *Eucalyptus species* known for luxurious water consumption under excess soil moisture condition are suitable for bio-drainage. These species can be planted in blocks in the form of farm forestry or along the field boundary in the form of agro-forestry. Other suitable species for biodrainage may be *Casuarina glauca, Terminalia arjuna, Pongamia pinnata and Syzygium cuminii, etc.*

Use of plants to supplement the drainage effect of conventional drainage systems in reclaiming polders in the Netherlands has been reported by Raadsma (1974). Weed of a certain species were aerially sown over the area to be reclaimed from waterlogging, besides providing shallow trenches. Figures 1(a,b) illustrate the application of biodrainage systems in controlling waterlogging in the canal command of Indira Gandhi Nahar Project (IGNP), Rajasthan, India. Besides canal commands, the prospective sites for tree plantations for the purpose of biodrainage are government lands and fallow lands with low productivity (Bhattacharya and Michael, 2003).

Fig. 1 (a) Inundated area caused by leakage alongside IGNP main irrigation canal; (b) Trees in background are the biodrainage system that dried-up the inundated areas along the main canal. (Source: FAO, 2002)

Concept of Bio-drainage

1. All living plants transpire water. The source of the water is either irrigation water or groundwater.
2. The transpiration capacity of a plant depends on its species root depth and spread, canopy area, leaf area and leaf structure.
3. When the transpiration is met primarily by withdrawing groundwater, the process is known as biodrainage in the field of drainage engineering.
4. The total water transpired from the groundwater reservoir in a region, and hence its drainage effect (i.e., effect on water table decline) in a region is a function of plant density and other plant factors.

Merits of Biodrainage Over Conventional Drainage Systems

1. Relatively less costly to raise biodrainage plantations.
2. No operational cost, as the plants use their bio-energy in draining out the excess ground water into atmosphere.
3. Increase in worth with age instead of depreciation.
4. No need of any drainage outfall and disposal of drainage effluent.
5. No environmental problem, as the plants drain out filtered fresh water in to the atmosphere.
6. In- situ solution of the problem of waterlogging and salinity.
7. Preventive as well as curative system of long life.
8. Combined drainage- cum – disposal system.
9. Moderates the temperature of the surrounding by transpiration and a cushion for moderating frost, cold and heat wave impacts.
10. Helps in carbon sequestration and carbon credit.

Limitations of Bio Drainage

1. Decreases the land availability of area for crop raising
2. Releases toxic chemicals-leaf, stem, root, extract of Eucalyptus inhibits the germination and seedling growth
3. Good-quality water should be available for plant establishment.

Bio-drainage can be a feasible option for controlling water-logging and salinity in irrigated lands. Sewage water should safely be used for timber or fuel-wood production by the raising Eucalyptus trees instead of food and fodder crops. The Policy makers (Planning Commission, Ministry of Agriculture, Ministry of Environment and Forests and Ministry of Water Resources, Govt. of India) and Indian National Committee on Irrigation & Drainage (INCID), should issue suitable guidelines of bio-drainage for the use of sewage water and treatment of waterlogged and potentially waterlogged areas.

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Biodiversity in Different Cultivated Species in Vegetable Crops

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Summary

India is a treasure house of horticultural diversity available offers substantial genetic diversity to meet the future needs, particularly for the present scenario of climate change. Around 331 in case fruits and nuts, 215 in vegetables, 154 in plantation and tuber crops and 161 in spices and condiments. they are expected to be sources of genes conferring resistance to various biotic and abiotic stresses, and nutritional quality and are the genetic resources for future needs.

Introduction

India is considered one of the 12 "Mega-diversity centres', housing an estimated 12 percent of the world flora described so far. It contains three of the 34 biodiversity "hotspots". India has about 141 endemic genera belonging to over 47 families. As per Botanical Survey of India (BSI), India has 46,214 plants species. Of these, about 17,500 (7,000 species in north east region alone) represent flowering plants (7% of the world flora); 37 percent of them are endemic. Of the endemic species (4,950), the largest number (about 2,532) species are located in Himalayas followed by peninsular region (1,788 species) and Andaman Nicobar Islands (185 species). India is a treasure house of horticultural biodiversity both at species and intra-specific level, particularly for edible fruits and vegetables, and medicinal plants, consequently around 583 species are cultivated, of which around 417 belong to horticultural crops. Around 27 species in fruits and nuts, 23 in vegetables, 15 in plantation and tuber crops and 16 in spices and condiments are cultivated on regular basis, which has a large number of wild relatives, around 331 in case fruits and nuts, 215 in vegetables, 154 in plantation and tuber crops and 161 in spices and condiments. However, despite the availability of vast genetic diversity in the form of landraces, traditional varieties, weedy and wild relatives a very little has been used to meet future needs of genetic improvement and there are needs for greater emphasis to exploit the genetic diversity, particularly available in the wild relatives.

Future Needs of Biodiversity

The adaptability of horticulture with development of improved crop strains tolerant to high temperatures, drought, floods, expected diseases etc. and improve nutritional quality for better healthcare. Therefore, evaluation of horticulture biodiversity in search of genes and alleles to meets future needs/challenges is a priority, particularly in following areas.

Biotic Stresses

Implications on crop health from climate changes in the range of disease vectors (e.g., insect, pests) would influence crop losses, therefore there is need to identify the stable sources of resistance, particularly in wild relatives for new pests and diseases for sustainability of horticulture.

Abiotic Stresses

To mitigate the rising temperature, there is need to search for genes conferring tolerance to high temperatures, particularly in germplasm from arid and semi-arid regions. This germplasm would also be suitable for search of gene(s) conferring resistance to drought or water use efficiency. With increasing levels of oceans due to melting of glaciers, saltwater intrusion in coastal areas is expected, that would impair water supplies and agriculture in coast, therefore there is need to evaluate the germ plasm for salt tolerance. Climatic changes caused by deforestation and cropping pattern causing soil fertility problems would need search for genotypes tolerant to soil nutritional deficiencies. Once these genes are identified, they can be cloned for transfer to other crops using biotechnological approaches.

Nutritional Quality

As the horticultural crops, particularly vegetables provide important nutritional ingredients like vitamins, micro-nutrients; antioxidant etc., there is a need to search for genetic resources with better nutritional quality. In this regard use of exotic germplasm with known nutritional potential can be of value in improving the nutritional quality of the present cultivars.

Increasing Yield

Hybrid-breeding technology needs to be exploited for production of high yielding genotypes with uniform produce. Use of genetic diversity in promotion of hybrid technology has helped in Increasing productivity in crops, such as brinjal, carrot and chillies, and needs to be promoted further by exploiting wild species germ plasm in developing cytoplasmic male sterility or a breeding system promoting out-crossing, to support cheap hybrid seed production.

Diversity in Vegetable Crops

A. moschatus, A. esculentus, and A. Tetraphyilus var. Tetraphylius occur in India. Of these, only A. esculentus is cultivated. Furthermore, introduction of vegetables, such as Phaseolus vulgaris (common bean), Allium cepa (onion), Allium sativum (garlic), Brassica rapa (turnip), Brassica oleracea var. capitata (cabbage), Coriandrum sativum (coriander), Cucumis melo (sweet muskmelon), Daucus carota (carrot), Pisum sativum (pea), Syzygium aromaticum (clove) (West and Central Asia), Allium tuberosum (leek), Asparagus racemosus (satawar), Beta vulgaris (beet root), Brassica oleracea var. botrytis (cauliflower), B. oleracea var gemmifer, (Brussels sprout), B. oleracea var. gongyloides (knol-khol), Capsicum frutescens (sweet pepper), Cucurbita maxima (squash), Lactuca sativa (lettuce), Lycopersicon esculentum (tomato), Pisum sativum (sweet pea), Cucurbita moschata (pumpkin), Cucurbita pepo (summer squash) Ipomoea batatas (sweet potato), Solanum tuberosum (potato), and Phaseolus vulgaris (French bean) has made India a very important centre of diversity for a large number of vegetable crops. Intra-specific diversity is also recorded for Capsicum annuum, Coccinia cordifolia and Moringa oleifera.

For root and tuber crops, rich species and genetic diversity occur in India represented by Amorphophallus paeoniifolius, Manihot esculenta, Ipomoea batatas, Dioscorea alata, Dioscorea rotundata, Psophocarpus tetragonolobus, Dioscorea esculenta, Dioscorea bulbifera var. sativa, Colocasia esculenta, Alocasia macrorrhiza, and Xanthosoma sagittifolium. Besides these, several minor tubers crop namely, Maranta arundinacea, Solenostemon rotundifolius is found in western peninsular region. Around 30 species of Allium are found in India (Babu, 1977). The cultivated species are Allium cepa var. cepa, A. cepa var. aggregatum, A. cepa var. viviparum, A. fistulosum, A. tuberosum, A. sativum, A. ampeloprasum var. porrum. Further, 1,532 wild edible species are being used by native Indian tribes, of which 145 as roots and tubers and 521 as leafy vegetables, offering opportunities as sources for alternative food ready for commercial exploitation.

Major Thrust Areas

Wild and weedy relatives of crop species have survived in nature because of their resilience against various stresses and therefore they are expected to be sources of genes conferring resistance to various biotic and abiotic stresses, and nutritional quality and are the genetic resources for future needs. Use of wild species, in addition to providing specific desirable gene would also help in broadening the genetic base of horticultural crops that has been one of the major concerns. The pre-breeding, particularly wide hybridization exploiting wild relatives has established credentials with successful stories of overcoming challenges in many crops. In facts pioneering work in this area was started in horticulture crops, like potato (Ross, 1979) and tomato (Rick, 1979).

But a recent review reflects that though there has been a steady increase in release of cultivars containing wild species genes, there is continued emphasis on their use for a wider range of characteristics, they are gaining in importance and prevalence, but their contributions in development of new cultivars remain less than expected (Reem and Toby, 2007). Therefore, pre-breeding efforts need to be accelerated in meet the challenges of climatic change for which the present cultivars have become more vulnerable due to funneling towards a selected set of genes and narrowing down of genetic base.

Conclusion

India has about 141 endemic genera belonging to over 47 families. As per Botanical Survey of India (BSI), India has 46,214 plants species. Around 27 species in fruits and nuts, 23 in vegetables, 15 in plantation and tuber crops and 16 in spices and condiments are cultivated on regular basis, which has a large number of wild relatives, around 331 in case fruits and nuts, 215 in vegetables, 154 in plantation and tuber crops and 161 in spices and condiments. Use of wild species, in addition to providing specific desirable gene would also help in broadening the genetic base of horticultural crops that has been one of the major concerns. In addition, the recent research using molecular techniques has also indicate that the wild species are not only rich in genes for resistance to biotic and abiotic stresses, by also for yield and yield components and nutritional traits. However, it would need pre-breeding efforts for incorporation the genes conferring the unique genetic potential into primary gene pool, to facilitate its use in specific breeding programme.

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Nutritional Deficiency and Vulnerability to Covid-19: A Review

Article ID: 10498

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Abstract

COVID-19 originated in the city of Wuhan, Hubei Province, Central China and has spread quickly to 72 countries to date. COVID-19 is caused by noval coronavirus named Severe Acute Respiratory Syndrome coronavirus 2 (SARS-COV-2). At present, has caused a large number of deaths with tens of thousands of confirmed cases worldwide, posing a serious threat to public health.

However, there are no clinically approved vaccines or specific therapeutic drugs available for Covid-19. Intensive research on the newly emerged SARS-COV-2 is urgently needed to elucidate the pathogenic mechanism and epidemiological characteristics and to identify potential drug targets, which will contribute to the development of effective prevention and treatment strategies. Hence, this review will focus on nutritional deficiency and vulnerability to Covid-19.

Etiology And Pathogenesis of Covid-19

SARS-COV-2 is the seventh member of the family of COVs that infect humans. Four human COVs (HCOV-229E, HCOV-NL63, HCOV-OC43 AND HCOV-HKU1) are able to cause a wide range of upper respiratory tract infections (common cold) whereas SARS-COV and MERS-COV are responsible for atypical pneumonia.

The causes of different infection sites are likely related to the presence of dipeptidyl peptidase 4 (DPP4) and angiotensin converting enzyme 2 (ACE2) in the lower respiratory tract, which are the major human receptors for the surface spike (S) glycoprotein of MERS-COV and SARS-COV, respectively (22) (23) (24). The genetic sequence of SARS-COV-2 is > 70% similar to that SARS-COV and SARS-CoV-2 is capable of using the same cell entry receptor (ACE2) as SARS-COV to infect humans. However, there are more differences in the key S proteins that the viruses use to interact with host cells.

SARS-COV-2 spike binds to human ACE-2 with approximately 10-20-fold higher affinity than the SARS-COV spike, making it easier to spread from human to human. Upon entry into Alveolar epithelial cells, SARS-COV-2 replicates rapidly and triggers a strong immune response, resulting cytokine storm syndromes and pulmonary tissue damage.

Cytokine storm syndrome, also known as hypercytokinemia, are a group of disorders characterized by the uncontrolled production of proinflammatory cytokines and are important cause of acute respiratory distress syndrome (ARDS) and multiple organ failure. In addition, the number of total T-cells are decreased in patients with SARS-COV2 infection and surviving T-cells are functionally exhausted suggesting a decreased immune function. ARDS, decreased immune fuction and secondary infection further worsens respiratory failure.

Transmission Route of SARS-COV-2

The novel COV can be transmitted between humans via respiratory droplets. Notably, the respiratory tract is probably not the only route of transmission. Close contact is also a source of transmission of SARS-COV-2. For example, SARS-COV-2 can be transmitted through direct or indirect contact with mucous membranes in the eyes, mouth or nose.

There is also a possibility of aerosol transmission in a relatively close environment with continuous exposure to high concentrations of aerosol. Moreover, it has been reported that Covid-19 patients have some gastro-intestinal symptoms including diarrhea, nausea and vomiting.

Susceptible Population

All populations are generally susceptible to SARS-COV-2. All elderly people and people with underlying diseases or low immune function are more likely to become severe cases. In addition, pregnant women and new borne infected with SARS-COV-2 are also prone to develop severe pneumonia. Thus, these vulnerable patients should be considered as a focused in the prevention and the management of SARS-COV-2 infection.

Treatments: Suspected and confirmed cases should be treated in designated hospitals with effective isolation and protective condition. Suspected cases should be treated in a single room and isolated and confirmed cases can be treated in the same ward. Moreover, critical cases need to be admitted to the ICU as soon as possible.

General treatments: General treatment strategies include bed rest and supportive treatments, ensuring sufficient energy intake, maintaining a constant internal environment (water electrolytes and other internal environmental factors) and monitoring vital signs (heart rate, pulse, blood pressure, oxygen saturation, respiratory rate etc.).

Diet During Pre and Post Covid-19

If disease, any disease – is taxing on the body and depletes it of nutrition and immunity, then we should largely focus on replenishing these through a proper diet. This is true for COVID-19 infection, particularly because studies have shown that even mild symptoms of it can cause damage to heart, lungs and brain.

The Covid-19 pandemic is one of the largest socio-economic and health crises the world has seen. Be it fiscally or existentially there is hardly any sector or soul that has remained unblemished by the pandemic and the subsequent lockdown. A balanced diet and nutrition can act as an effective prophylactic measure against the Covid-19 injection.

Although there seems to be an onslaught of bad news in the pandemic, there has also been a silver lining i.e., a visible positive behavioral change in the nutritional habits of people around the world such a shift in eating habits especially among urban population, who generally (pre-COVID-19) tend to consume more processed fast foods and eat out more as compared to their rural counterparts as visible on social media.

According to a study conducted in the USA 8 out of 10 consumers changed their eating habits due to pandemic or the lockdown imposed to control its spread. A survey focusing on diet, eating habits and lifestyle indicated an increase in homemade recipes, cereals, legumes and a decrease in fresh fish, packaged bakery products, alcoholic intake etc.

A survey by IFIC (international food information council) around 60% of American consumers reported cooking at home more and around 20% said they were eating healthier than usual, eating more than usual and also eating more premade meals from their pantry or freezer.

India too has seen several changes in the sphere of nutrition and dietary habits, most of these being positive. The pandemic and the corresponding lockdown seem to have had a stronger than anticipated impact on the eating habits and food choices in various forms as explained below:

1. Preference of Home Cooked Food: Whether it is by choice or by compulsion, one of the biggest shifts in eating habits in India has been the reliance on home cooked food as opposed to eating out or ordering food online. Becoming self-reliant has been the mantra of late.

2. Shifting Trends Towards Healthier Eating and Food Safety: Good health and immunity along with intrinsic factors are greatly dependent on the food one consumes and lifestyle followed, a fact that came into prominence during the pandemic.

As a result, along with home remedies to improve immunity, citizens started paying attention to the food they consumed, ensuring that it was healthier.

People started consuming more fruits and vegetables and also decreasing the consumption of fried foods, sugar and salt. At the beginning of the pandemic, there was even a reduction in the consumption of animal's protein such as meat, due to fears that these animals might be potential virus carrying hosts. An emphasis was created on the importance of food safety.

There has been an increasing demand for organic produce and natural food items in India. Consumers realize the significance of including safe and nutritious food in their diets.

While increased consumption of traditional healthy food items is a welcome development, care must be taken to ensure that these items are accessible and affordable to all. Increased reliance on Ayurveda and other traditional medicine.

Nutrition

Proper nutrition and hydration are vital. People who eat a well-balanced diet tend to be healthier with stronger immune system and lower risk of chronic illnesses and infectious diseases. So, it is necessary to eat a variety of fresh and unprocessed food every day to get the vitamins, minerals, dietary fiber, protein and anti-oxidants our body needs. Drink enough water. Avoid sugar, fat, and salt to significantly lower your risk of overweight, obesity, heart disease, stroke, diabetes and certain types of cancer.

1. Eat fresh and unprocessed food everyday: Eat fruits, vegetables, legumes (example: lentils, beans) nuts and whole grains (example- unprocessed maize, millet, oats, wheat, brown rice or starchy tuber or roots such as potato, yam, taro or cassava) and foods from animal sources (example: meat, fish, eggs and milk).

Daily eat 2 cups of fruits (4 servings), 2.5 cups of vegetables (5 servings), 180 gram of grain and 160 grams of meat and beans (red meat can be eaten 1-2 times per week, and poultry 2-3 times per week). For snacks, we have to choose raw vegetables and fresh fruits rather than foods that are high in sugar, fat or salt. Overcooking of veggies and fruits should be avoided as this can lead to loss of important vitamins. When using canned or dried vegetables and fruits, choose varieties without added salt or sugar.

2. Drink enough water everyday:

a. Drinking 8-10 cups of water every day is essential as it is essential for life. It transports nutrients and compounds in blood, regulates body temperature, gets rid of waste and lubricants and cushion joints.

b. Water is the best choice, but other drinks can also be consumed like lemon juice, tea, coffee but in moderation.

3. Eat moderate amount of fat and soil:

a. We have to consume more unsaturated fats (example: found in fish, avocado, nuts, olive oil, soy, canola, sunflower and corn oils) rather than saturated fats (example- butter, coconut oil, cream, cheese, ghee, lard etc.)

b. We have to choose white meat (example- poultry) and fish, which are generally low in fat, rather than red meat.

c. Avoid processed meat as they are high in fat and salt

d. Opt for low fat or reduced fat versions of milk and dairy products.

e. Avoid industrially produced trans-fat. These are often found in processed food, fast food, snack food, fried food, frozen pizzas, pies, cookies, margarine and spreads.

4. Eat less sugar and salt: Limit the amount of salt and high sodium condiments. (soy sauce, fish sauce etc.). Choose fresh fruits instead of sweet snacks, such as cookies, cakes or chocolates.

5. Avoid eating out: Eat home cooked meals in order to avoid all types of infections like with people or infected food or any social sittings.

Conclusion

The coronavirus disease (Covid-19) is highly pathogenic viral infection caused by SARS-COV-2. It has caused global health concern. It is assumed that COVID-19 has zoonotic origin based on the large number of infected people who were exposed to the wet market in Wuhan city, China. The phylogenetic analysis has revealed that SARS-COV-2 has significant sequence similarity with Severe Acute Respiratory Syndrome (SARS-like) bat viruses, thus bats could be primary possible reservoir. The intermediate host and their subsequent transfer are not known yet, although human to human transfer is widely confirmed. The transmission of COVID-19 infection from one person to another resulted in the isolation of patients who were subsequently given a variety of treatments. To monitor the current outbreak, robust steps have been taken around the globe to reduce the transmission of Covid-19 infection.

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Disease Management in Tomato Crops

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Solanaceous crops, including tomatoes, peppers, eggplants, and potatoes, may be the most popular garden plants, but many diseases commonly affect them. Early blight and Septoria leaf spot occur each year under even the best disease management, and bacterial spot may be spread easily under rainy conditions. A combination of approaches, such as using resistant varieties, record-keeping, cultural, and chemical management, is the best practice for minimizing vegetable garden diseases.

Early Blight

Identify: This common tomato plant disease appears as bulls-eye-shaped brown spots on the lower leaves of a plant. Often the tissue around the spots will turn yellow. Eventually, infected leaves will fall off the plant. In most cases, the tomatoes will continue to ripen, even as the disease symptoms progress up the plant.

Prevent: The early blight pathogen *(Alternaria solani)* lives in the soil and once a garden has shown signs of the early blight fungus, it's there to stay because the organism easily overwinters in the soil, even in very cold climates. Fortunately, most tomatoes will continue to produce even with moderately severe cases of early blight. To prevent this tomato fungal disease, mulch plants with a layer of newspaper topped with untreated grass clippings, straw, leaf mold, or finished compost immediately after they are planted. This mulch forms a protective barrier, preventing the soil-dwelling spores from splashing up out of the soil and onto the plant.

Manage: Once the fungus strikes, organic fungicides based on Bacillus subtilis or copper can help prevent or stop the spread of this tomato plant disease. Bicarbonate fungicides are also effective (including BiCarb, GreenCure, etc).

Fusarium Wilt of Tomato

Disease symptoms often appear later in the growing season and are first noticed on the lower (older) leaves. As the disease progresses, the younger leaves will also be affected and the plant eventually dies. In many cases, only one branch or side of the plant show symptoms.

Fusarium wilt can survive for years in the soil and is spread by water, insects and garden equipment. The fungal disease develops during hot weather and is most destructive when soil temperatures approach 80˚F. Dry weather and low soil moisture encourage this plant disease.

Treatment:

1. Plant resistant varieties when available.
2. Remove stricken growth from the garden and sterilize pruning clippers (one part bleach to 4 parts water) between cuts.
3. Use Safer® Yard & Garden Insect Killer to control many garden insects, like cucumber beetles, which are known to spread the disease.
4. High nitrogen fertilizers may increase susceptibility to the disease. Test your soil and use a slow-release, organic fertilizer in the vegetable garden.
5. Hand pulls or spot treat weeds using a weed flamer or natural herbicide — many weed species host the disease pathogen.
6. Mycostop is a biological fungicide that will safely protect crops against wilt caused by Fusarium. Approved for use in organic crop production, it can be applied as a soil spray or drench (1-2 gm/ 100 sq ft) to seedlings, ornamentals and vegetables. Apply sufficient water during application to move Mycostop into the root zone.
7. If the disease persists, it is best to remove the entire plant and solarize* the soil before planting again.

To solarize the soil, you must leave a clear plastic tarp on the soil surface for 4-6 weeks during the hottest part of the year. Soil solarization will reduce or eliminate many soil inhabiting pests including nematodes, fungi, insects, weeds and weed seeds.

Late Blight of Tomato

The fungus, *(Phytophthora infestans)*, that causes late blight is aptly named: phytophthora in Latin means "plant destroyer." Infected plant tissue dies. Outbreaks spread quickly under favourable conditions (cool, wet weather) because the pathogen can produce huge numbers of wind-dispersed spores. Once a plant is infected, it must be destroyed.

Identification: The first symptoms of late blight on tomato leaves are irregularly shaped, water-soaked lesions, often with a lighter halo or ring around them; these lesions are typically found on the younger, more succulent leaves in the top portion of the plant canopy. During high humidity, white cottony growth may be visible on underside of the leaf where sporangia form. Spots are visible on both sides of the leaves. As the disease progresses, lesions enlarge causing leaves to brown, shrivel and die. Late blight can also attack tomato fruit in all stages of development. Rotted fruit are typically firm with greasy spots that eventually become leathery and chocolate brown in colour; these spots can enlarge to the point of encompassing the entire fruit.

Management:

a. Tomato varieties resistant to certain races of the late blight fungus are grown where the disease occurs regularly.
b. Remove any nearby volunteer tomato and potato plants and nightshades.
c. Check transplants to ensure they are free of late blight before planting.
d. Avoid sprinkler irrigation, if possible, because it favours the development of late blight.

e. Fungicides are generally needed only if the disease appears during a time of year when rain is likely or overhead irrigation is practiced. Mefenoxam-resistant strains of the pathogen are widespread in California and this fungicide is no longer effective.

f. Disc tomato fields in fall to eliminate a winter reservoir for the fungus.

Bacterial Wilt

Identification: The youngest leaves show signs of infection first, and begin to wilt during the hottest part of the day. This often goes unnoticed as the leaves stay green during the infection. Eventually, the wilting will become obvious, but once you notice it happening, it is likely that the entire plant has begun to wilt and will soon die. Bacterial wilt tends to occur when the weather is extremely hot and there is a high level of humidity from recent rainfall, leaving the soil wet.

Management:

a. To prevent the problem:

i. Use varieties with some resistance (Fortune Maker, Kentom, Taiwan F1).

ii. Avoid planting in lowlands, wet areas or fields with history of bacterial wilt.

iii. Stop tomato growing for 5 seasons with non-solanaceous crops like cereals, beans, sugarcane, cabbage, (but not red pepper, Irish potatoes, eggplants).

iv. Avoid movement of tools/equipment/water from contaminated soils to non- contaminated soils.

v. Disinfect pruning knifes, e.g., with bleach, before working on next plant. Wear gloves when disinfecting or immediately wash hands with water afterwards, because bleach is toxic.

vi. Avoid furrow irrigation because this soil borne disease would grow (if furrow irrigation is needed then flow water from new to old fields to minimize spread of diseases).

b. If a single infected plant is found then actions must be taken:

i. Pull out plants with roots and surrounding soil and burn everything. But do not openly carry materials through your field, because this will spread the disease. Do not re-plant tomatoes into the same spot.

ii. Chemical sprays are of little to no help because this disease is soil borne.

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Development, Maintenance and Multiplication of Female Lines of Castor (*Ricinus communis* L.,)

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Basic Sex Forms in Castor

Castor is monospecific and belongs to family Euphorbiaceae. The diploid chromosome number (2n) is 20. Castor is a sexually polymorphic species. The plant consists of several series of determinate branches each terminated by a raceme. The development of raceme along any one axis is sequential; thus, it is possible to have racemes in all stages of development. This sequential bearing has considerable bearing on sex expression. The basic sex forms in Castor are:

1. Monoecious (M): It is the most natural occurrence of annual and perennial castor. The spike has basal 1/3rd to 1/2 male flowers while the top portion has female flowers. In between these few whorls have both male and female flowers in an interspersed fashion.

2. Pistillate (P): Occurred as a rare recessive mutant with the spike having female flowers throughout the spike. It may be 100% pistillate or <100% (70 - 99%) having a few male flowers in the basal portion.

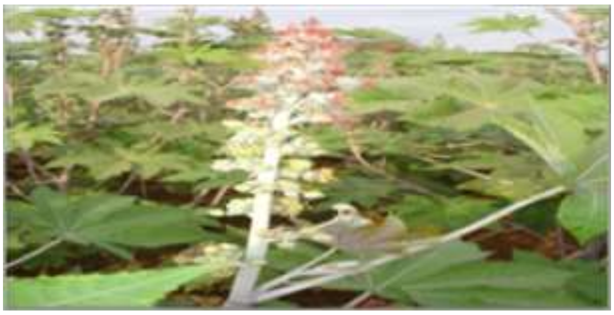

Fig. 1: Monoecious

Fig. 2: Pistillate

3. Interspersed Staminate Flower (ISF): A variant of pistillate form with male flowers interspersed, throughout the female flowers on the spike.

4. Sex revertant: It is a female that turns to monoecious at later stage.

Fig. 3: Interspersed Staminate Flower (ISF)

Fig. 4: Sex revertant

These basic sex forms are classified in different ways by different authors as the expression of sex in different locations is highly influenced by environmental conditions.

Female promoting environment (F): Winter, low temperatures (<30^{0}C), young plants, early order spikes, high nutrition, less difference between maximum and minimum temperatures promote female flowers and shift the balance towards femaleness on a spike.

Male promoting environment (M): Summer, rainy seasons, high temperatures (>32^0 C), old plants, late order spikes, low nutrition and large difference between maximum and minimum temperature promote male flowers on a spike and incline towards maleness.

Types of Pistillate Mechanism

1. N type.
2. S type.
3. NES type.

N Type

'N' type pistillate genotype was first identified by Claassen and Hoffman (1950). Katayama (1948) describes it in a backcross line that exhibited a segregation ratio of 1:1 monoecious and pistillate plants. The pistillate character is governed by a single sex switching gene f. If a plant is homozygous recessive ff for sex expression it remains as pistillate while a heterozygous recessive Ff is a monoecious plant. Thus, a female plant when crossed with a monoecious, it gives 1:1 monecious: female. In USA, N type of pistillate lines Nebraska 145-4 were used for development of castor hybrids.

Later Classen and Hoffman (1950) while working with populations studied different sex variants as:
1. Completely pistillate (100%).
2. Mostly female; pistillate lines with 70 - 99% pistillateness.
3. Interspersed.
4. Pistillate with hermaphrodite.

S Type

S type is characterized by sex revertant and environment sensitive interspersed staminate flower expression.

Sex revertant: S pistillate type was obtained by selection within sex reversal variants at the Weigmann Institute, Israel by Shifriss (1960). Sex reversals start as females and later turn to monoecism at any stage after the first raceme or after 10th raceme in case of a perennial plant. Once the change to monoecism has occurred at a given site in a plant it is ontogenetically irreversible, will not revert to female type.

a. Sex reversals are variegating type i.e.; a part of the plant may be pistillate while the other half when turns to monoecism - thus at a time a single plant may depict both pistillate type and monoecious spikes. Sex reversion is thus confined to a particular cell lineage

b. On continuous inbreeding sex revertants give a spectrum of sex reversals which may be early, late and non-reverted.

c. These sex revertants when allowed to open pollinate regress to monoecism and thus have to be maintained by continuous selection for revertant pistillate plants

d. Before turning monoecious, most of the spikes produce highly interspersed staminate flowers that may be high in male promoting environment.

e. Among the progeny of sex revertants - female, monoecious, early revertants and late revertants - late revertants are a potential source of pistillate line.

f. Early revertants on selfing give <50% pistillate population and > 50% monoecious while the pistillate in turn are early reverted

g. Late revertants on selfing give > 80 to 100 % pistillate population and very less proportion of monoecious. These pistillate lines in turn are late reverted.

h. The genetic system governing time of phenotypic reversion is unstable, but reversion as such is not associated with any serious break down in the female producing mechanism.

Non reverted female: are developed from inbred stocks of Queen 162 and Adam Mistaef and carry gene for interspersed staminate flower expression at a higher frequency. The environment determines the penetrance and expressivity of ISF. In a female promoting environment only few male flowers occur which prematurely drop due to the competition from older female flowers that were fertilized by monoecious pollen in the vicinity. This can be overcome by protecting the spikes from cross-pollination by bagging. Though the initial male flowers drop, later developed male flowers fertilize the female flowers. Shifriss (1960) developed a true breeding non-reverted female line that has the gene for environmentally sensitive ISF expression.

NES Pistillate Type

NES type is a combination of both N and S type as it carries the homozygous recessive gene for pistillateness and environment sensitive genes for ISF. A NES type line CNES 1 was developed by Zimmerman and Smith (1966) by backcrossing the N type pistillate line N 145 - 4 with a monoecious variety Cimarron and selecting for pistillate lines with a few interspersed staminate flowers. Subsequently, Kulkarni and Ankineedu (1968) also developed a pistillate line 240 that is pistillate with few male flowers. NES type is easier to operate and transfer a single recessive gene as compared to the polygenic complex both dominant and epistatic S type.

Maintenance and Multiplication of Pistillate Line

Majority of the pistillate lines available are based on the S type of pistillate mechanism and thus have a series of sex revertants available and maintained by environment sensitive ISF expression. Maintenance of pistillate lines is done either by conventional or refined method based on the pollen source.

Foundation Seed Production of Female Lines

The main principle in foundation seed production of female line is to maintain stable pistillate nature of the female line. This is done in two ways.

1. Conventional method.
2. Improved or Refined method.

Conventional Method of Foundation Seed Production of Parental Lines

Sowing season: Kharif or post rainy season

The difference between the two methods depends on the pollen source or maintainer line. In conventional method 25% monoecious plants of the female line are allowed as pollen source.

a. Primary spikes are to be observed for their sex behavior. Monoecious plants beyond 3 whorls from the base are to be removed.

b. Plants with ISF if any should be retained

c. 25% of monoecious plants should be retained in seed production plots.

d. Regular monitoring for reversion in secondary, tertiary and quaternary order racemes should be done and such plants need to be tagged.

e. On maturity seeds from female plants which are non-revertant at least up to 4th order are to be harvested and kept picking wise in separate lots.

f. Seeds harvested from monoecious and early revertants (tagged plants) are to be disposed of in the market (similar to maintainer line in other crops).

In conventional method 25% monoecious plants of the female line are allowed as pollen source.

Rouging: After 30- 40 days of sowing, morphological variants (red stem, flat leaves and double bloom) should be removed from plot very carefully. At the time of appearance of first spike about 20% desired monoecious plants were kept in the field. The remaining monoecious VP-1 plants should be removed from the plot. The plants having first spike completely pistillate are tagged with red colored thread. In the tagged plant, the second spike must be cent percent pistillate. If the second spike is reverted to monoecious, in previously tagged plants then tag (thread) should be removed and consider such plant monoecious. In the later stage, if any tagged 100%

female exhibit monoecism, such reverted spike should be nipped off. Hence VP-1 foundation plot be inspected regularly and carefully. At the time of harvesting, tagged plants should be harvested separately, threshed & stored. The untagged plants be harvested and threshed separately and seed of such plants is sold in market. The harvesting wise produce of tagged plants be packed separately, sealed and stored in a specific godowns / room.

The representative seed sample from the picking wise seed will be grown by authorized representatives of the state agency for undertaking test for genetic purity as well as physical purity in the recognized state seed testing laboratories. Based on results of GOT and Seed testing laboratory test, the substandard seed will be rejected and quality having 95% genetic purity and above 70% germination will be considered as standard seed.

Demerits of conventional method:

a. Conventional method results in 45-65% monoecious population in certified hybrid seed production, which are to be removed.
b. High cost of rouging, labor intensive.
c. Low genetic purity.

Improved or Refined or Modified Method of Seed Production

Sowing time of pistillate line: January or February

Seed production technology of VP-1 has been improved as the above system gives 45-55% monoecious plants in hybrid seed plot besides 25-30% revertants. This led to selfing in seed production plots resulting in emergence of selfed plants along with hybrid that increases chances of failure of seed production. The new improved system of seed production of VP-1 utilizes environmental sensitive interspersed staminate flowers for pollination purpose rather than monoecious and revertants, leading to high recovery of femaleness in seed production plot. This reduces cost of roguing as well as increases yield of hybrid seed and reduces selfing thereby chances of failure reduced to great extent.

The refined method is based on environmentally sensitive genes for interspersed staminate flower expression in a pistillate line. There is no maintainer line or pollinator as such in this method. This is based on the ability of a pistillate line to produce ISF in summer season or when temperature goes beyond 320 C but remain pistillate in the cool season. Thus, in refined method pistillate line has to be sown in January or February i.e., summer season while certified hybrid seed production has to be taken up in September or October so that flowering period coincides with winter.

Rouging:

a. Initially in the first 30 days prior to primary spike initiation the off types based on morphological characters are to be removed.
b. At the time of flowering, monoecious or male plants should be removed at the bud stage itself. The plants with male flowers in the first basal whorl to 100% male flowers should be considered as male and removed.
c. Plants with ISF may vary from 1-2 male flowers to > 10-15 male flowers per spike. These plants should be retained as pollen source.
d. However the primary spikes with highly ISF nature i.e., 5 -6 male flowers per each and every whorl have the tendency to revert to monoecious in the later orders which are to be closely observed.
e. Majority of the primary spikes may not set seed due to non-availability of pollen. However, the later orders or on the matured primary spikes itself interspersed male flowers appear and fertilize the female flowers.
f. Closely observe the population for revertants in any stage - secondary to pentenary stage and remove them in the bud stage itself.
g. However due to poor quality of seed - if the number of revertants is more (>30%) in 3rd or 4th order only the spikes can be removed and harvest the seed from the earlier orders and then remove the plants.

h. The proportion of late revertant female populations with interspersed male and occasional bisexual flowers increase in the population and thus can be allowed to continue in the population and supplement the pollen source from ISF.

i. However, seed should be collected from all female plants only and pick wise seed lots should be kept separately.

j. Seed from late order revertants should not be mixed with the female population.

The pollen source in refined method is interspersed staminate flowers that occur on a female plant with increasing temperatures.

Refined method / Modified method for maintenance of 'NES' type pistillate lines:

a. Refined method is based on environmentally sensitive genes for interspersed staminate flower expression in a pistillate line.

b. There is no maintainer line or pollinator line in this method.

c. This is based on the ability of a pistillate line to produce ISF in summer season or when temperature goes beyond 320 C but remain pistillate in the cool season.

d. In refined method pistillate line has to be sown in January or February i.e., summer season for maintenance while certified hybrid seed production has to be taken up in September or October.

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The Ozone Layer and its Implications on Crop Growth

Article ID: 10501

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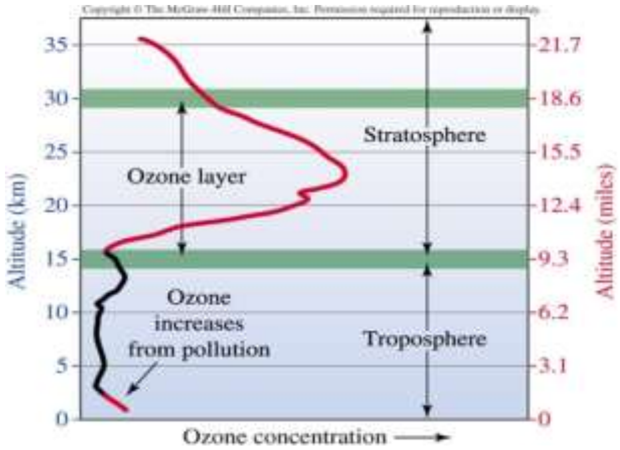
Introduction

The ozone layer is a layer in the earth's atmosphere which contains 90% atmospheric ozone (O3). The ozone layer is found in the lower portion of the stratosphere from about 20 to 30 km above earth's surface. Its thickness varies seasonally and geographically. The ozone layer is mainly found from approximately 16 to 35 kilometers above earth. Stratosphere contains about 90% of all atmospheric ozone.

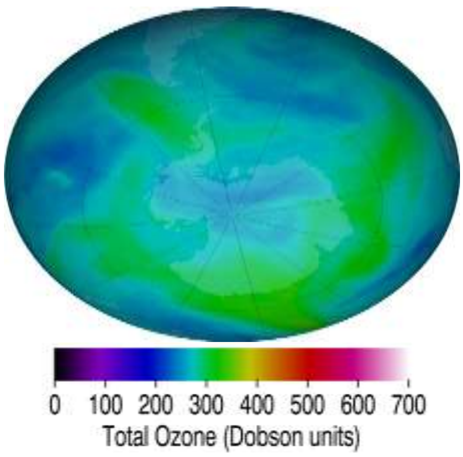
Total column ozone is the total amount of ozone in a column extending vertically from the earth's surface to the top of the atmosphere. It is measured using ground-based stations and satellites and is reported in Dobson units (DU). The ozone hole is defined in terms of reduced total column ozone—less than 220 DU.

Total column ozone: ~300 DU (1 DU = 0.3 cm thick layer at 1 atm).



The ozone hole which occurs annually over the Antarctic is one of the largest and deepest and analyses done by scientists shows that the hole has reached its maximum size. During 2020 ozone hole grew rapidly from mid-August and peaked at around 24 million square kilometres in early October and now it covers 23 million km2 and spreading over most of the Antarctic continent. (Image on 17 Feb 2021, NASA)

Ozone



Ozone (O3) is a bluish gas that is harmful to breathe is composed of three atoms of oxygen. Nearly 90% of the Earth's ozone is in the stratosphere and is referred to as the ozone layer. Ozone absorbs a band of ultraviolet radiation called UV-B. There is an increase in temperature with altitude in the stratosphere as it it is closest to the solar "heat source." It receives large amounts of UV radiation from the sun plus it has a high concentration of ozone to absorb this UV. It is the layer which contains most of the GH gases that absorb IR radiation emitted by the Earth's surface.

Formation of Ozone in Atmosphere

Ozone is the only major atmospheric constituent that absorbs significantly between 210 and 290 nm. Without its life would have remained underwater on earth. The ozone layer is a consequence of oxygen-only chemistry. It is formed once photosynthetic marine organisms (cyanobacteria) releases oxygen into the atmosphere. The process of ozone creation and destruction is called the Chapman cycle.

The Chapman Cycle

The ozone–oxygen cycle is the process by which ozone is continually regenerated in Earth's stratosphere, converting ultraviolet radiation (UV) into heat. In 1930 Sydney Chapman resolved the chemistry involved. The process is commonly called the Chapman cycle by atmospheric scientists. The Chapman Cycle explains how the ozone layer is formed and maintained. This process includes four chemical reactions:

a. Initiation: In this process, oxygen molecule is split (photolyzed) by higher frequency.

b. UV light (top end of UV-B, UV-C and above) into two oxygen atoms.

$$O_2 + \text{light} \rightarrow 2O \ (120 – 210 \text{ nm})$$

Each oxygen atom then quickly combines with an oxygen molecule to form an ozone molecule:

$$O\bullet + O_2 \rightarrow O_3$$

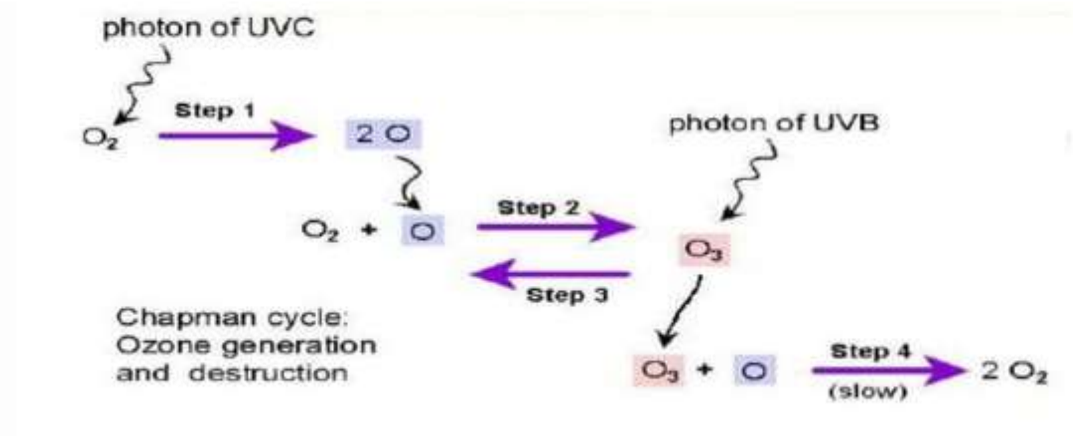
c. Propagation (cycling): The ozone molecules formed by the reaction above absorb radiation having an appropriate wavelength between UV-C and UV-B. The triatomic ozone molecule becomes diatomic molecular oxygen plus a free oxygen atom. The atomic oxygen produced quickly reacts with another oxygen molecule to reform ozone.

$$O + O_2 + M \rightarrow O_3 + M^* \ (\text{generates heat})$$

$$O_3 + \text{light} \rightarrow O_2 + O \ (220 – 320 \text{ nm})$$

d. Termination: If an oxygen atom and an ozone molecule meet, they recombine to form two oxygen molecules.

$$O_3 + O \rightarrow 2O_2$$



Functions of Ozone

The ozone layer absorbs the sun's ultraviolet radiation, it creates a source of heat and regulates the temperature of the Earth's atmosphere. If the ozone didn't filter the sun's ultraviolet radiation, most of it would reach the Earth's surface, which would be dangerous for plants and animals. Researchers conducted experiments in which

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plants, animals and humans were exposed to ultraviolet radiation, and the results showed that the radiation had harmful results. Within the ozone layer, ozone molecules are constantly formed and destroyed.

Stratospheric Ozone Layer Destruction

There are few natural phenomena that leads to ozone layer destruction which includes the influence of Sun, Volcanic eruptions and through human activities. Catalytic destruction of Ozone includes four main "families" of chemicals responsible for catalyzing ozone destruction:

1. Nitrogen oxides: NOx
- NO + NO2
2. Hydrogen oxides: HOx
- OH + HO2
3. Chlorine: ClOx
- Cl + ClO
4. Bromine: BrOx
- Br + BrO

A common type of catalytic destruction cycle (there are others)

$$Y + O_3 \rightarrow YO + O_2$$
$$YO + O \rightarrow Y + O_2$$

Where Y = NO, OH, Cl or Br.

Scientists have established normal ozone levels during natural conditions and noticed that the ozone layer is being depleted due to external factors. The main external factor that scientists are focusing on is the use of chlorofluorocarbons, or CFCs, in refrigerants, solvents and other applications. When CFCs break down, they release atomic chlorine, which can destroy over 1,00,000 ozone molecules per molecule of chlorine. Many experiments have shown that CFCs and other chemicals produce about 84 percent of the chlorine in the ozone layer.

What are CFCs? What are they Used for?

CFCs are chlorofluorocarbons; they are small molecules that contain chlorine, fluorine and carbon atoms. Usually there are only 1-2 carbon atoms. CFCs are sometimes called Freons. CFCs are referred to by a number. The most common CFCs are: CFC-11, CFC-12, CFC-113. HCFCs are CFCs that contain hydrogen. This makes them more reactive to the OH radical, decreasing their tropospheric lifetime. That means that, HCFCs ("soft CFCs") destroy less stratospheric ozone than CFCs ("hard CFCs") because a smaller fraction of HCFCs "survive" to reach the stratosphere. GM Chemist discovered Chlorofluorocarbons in 1930 (CFCs).

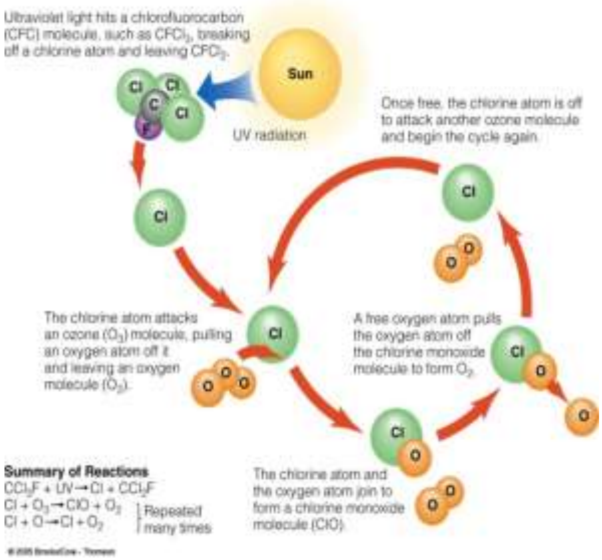

Fig: CFCs reactivity in atmosphere in destruction of ozone

It is very stable, nontoxic, non-corrosive and inexpensive. CFCs used as coolant in refrigerators and air conditioners, Propellant in aerosol sprays, Cleaner for electronics, Insulations, Air Conditioners, Refrigerators, Spray cans, Cleaners for electronic parts, Sterilizing medical instruments, Fumigants for granaries and cargo ships.

Depletion of Ozone and its Implications

Loss of the ozone layer leads to increased incidence and severity of sunburn, increase in eye cataracts, increased incidence of skin cancer, immune system suppressing, lower crop yields and decline in productivity. UV radiation might affect certain species but also insects and pests, thus counterbalancing the direct negative effects of increased UV radiation. Some long-term UV-resistant plants may prevail over more vulnerable ones. Excessive exposure to UV radiation can cause cancers in mammals, much as humans, and damage their eyesight. Experiments on food crops have shown lower yields for several key crops such as rice, soy beans and sorghum. The plants minimize their exposure to UV by limiting the surface area of foliage, which in turn impairs growth.

Wavelength Range	Name	Biological Effect
320-400 nm	UVA	It causes wrinkles, premature aging and associated sun-related skin damage; new research indicates possible skin cancer link
(290-320 nm	UVB	harmful, causes sunburn, skin cancer, and other disorders
200 - 290 nm	UVC	extremely harmful, damages DNA -- but almost completely absorbed by ozone

UV-B can Cause Cell Changes

Research to date suggests that ultraviolet light can cause changes in the molecules of plants, such as those that control growth regulation and this could mean smaller plants, different flowering times and problems for the pollination cycle. Certain crops including peas, soybean, cabbage, lettuce and squash are thought to be more affected than others by UV radiation. In humans, people with a darker skin color have more protection against burning in the sun and the same applies to plants. Some are darker in color and this makes them less susceptible to damage from the sun.

Ozone Depletion & Land Vegetation

Excessive UV-B inhibits the growth processes of almost all green plants. There is concern that ozone depletion may lead to a loss of plant species and reduce global food supply. Any change in the balance of plant species can have serious effects, since all life is interconnected. Plants form the basis of the terrestrial food web, prevent soil erosion and water loss, and are the primary producers of oxygen and a primary sink (storage site) for carbon dioxide, a greenhouse gas.

Ozone Depletion and Land Plants

The greatest risks connected with the depletion of ozone in the stratosphere are ecological. Exposure tests made in USA and Australia have showed that over one hundred species of land plant could be sensitive to increases in UV-B radiation as a result of stratospheric ozone depletion. Some research has suggested that, 25% of ozone depletion could result in a comparable reduction in total soya bean crop yield. International research has revealed that some species of rice suffer from even minor increases in UV radiation. With the help of research, as well as the efficient breeding and cultivation of strong species it will be possible to be prepared for years with a considerably decreased prevailing level of ozone.

UV-B and Land Plants

Exposure to UV-B radiation may have a dramatic effect on terrestrial plant life, although the impacts are at present poorly understood. Absorption of UV radiation varies widely from one organism to the next. In general, UV radiation deleteriously affects plant growth by reducing leaf size and limiting the area available for energy capture during photosynthesis. Plant stunting and a reduction in total dry weight are also typically seen in UV-irradiated plants, with a reduction in the nutrient content and the growth of the plants, especially in the legume and cabbage families. A reduction in quality of certain types of tomato, potato, sugar beet and soya bean has also been observed. About half of the species of conifer seedlings have been adversely affected by UV-B at a variety of levels. Although old needles are able to protect themselves by strengthening their outer wax coating and by increasing the amount of protective pigment, young growing pine needles, in contrast, suffer easily. There are some weeds are more UV-B resistant than crops. Many organisms have developed mechanisms for protecting themselves from UV-B, for example by avoiding exposure, shielding themselves with pigment. However, for many organisms these mechanisms may not be sufficient to protect against increased levels of UV-B.

Effect of Ozone Depletion on Plants

Plant life on earth is vital to both humans and animals. Without the smallest of plants, small creatures couldn't survive – and that would have major impacts on our food chain. Fears about the effects of ozone depletion has led to a variety of experiments and research being conducted but it is difficult to exactly replicate the natural situation since artificial UV light differs from UV from the sun.

Crop Sensitivity

Tests have shown that some varieties of crops are sensitive to increased UV-B exposure and it could cause a reduction in yield. However, some crops are UV-B tolerant and this provides an opportunity for scientists to genetically engineer more tolerant strains.

Long Term Exposure

Researchers also believe there is some evidence that although the effects of UV-B on some plants appears to be minimal over a short period of time, they may accumulate over a longer time span. This suggests that the effects of long-term exposure to increased solar radiation could be much worse. Fortunately, many plants have inbuilt radiation 'shields' and in most, only a small amount of solar radiation actually penetrates far into the inner tissue. Some plants also possess the ability to increase the pigment that absorbs UV radiation. In one test carried out on 200 agricultural plants, more than 50% were sensitive to increased UV-B. Even within a species, there can be differences in the way that different varieties cope with or can adapt to additional solar radiation. However, experts believe that ozone depletion of 10% or more could have a serious effect on many crops and plants.

In summary, physiological and developmental processes of plants are affected by UV-B radiation, even by the amount of UV-B in present-day sunlight. Despite mechanisms to reduce or repair these effects and a limited ability to adapt to increased levels of UV-B, plant growth can be directly affected by UV-B radiation.

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Role of Essential Oil in Poultry Nutrition

Article ID: 10502

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Abstract

Essential oils are plant-derived aromatic volatile oils and they contain bioactive compounds which have been shown to improve poultry nutrition.

Essential oils are important aromatic components of herbs and spices, and are used as natural alternatives for replacing antibiotic growth promoter in poultry feed as these have antimicrobial, antifungal, antiparasitic, and antiviral properties. Essential oils work individually and also shows synergistic effect with individual essential oils by which they enhance the effect of other feed additives.

Keywords: Essential oils, Antioxidant, Feed additives.

Introduction

Many countries are concerned and have restricted or even banned the use of antibiotics as feed additives due to its harmful effect that gets transmitted and proliferated though the food chain for a longer duration of time. The limitation on the use of antibiotic growth promoters as a feed additive have directed nutritionists and feed manufacturers to develop a safer and natural alternative for the poultry industries.

In recent years, essential oil has attracted increased attention from the swine and poultry industries. However, they are not simple compounds, rather a mixture of various compounds (mainly terpenes and terpene derivatives) which are concentrated hydrophobic liquids containing volatile aromatic compounds obtained from plants.

Essential oils are considered as a mixture of volatile compounds that are derived from the natural sources i.e., plants (flowers, leaves, buds, seeds, bark, herbs, wood, fruits and roots) and they are named by their aromatic characteristics, which is generally decided by considering their source of origination. In terms of biological activity and effects, each individual chemical constituent has its own characteristic properties.

This means that essential oils are of a complex character with rather diverse effects. Furthermore, factors such as species, ecological factors and climatic conditions, harvest time, part of plant used and method of isolation all affect the chemical composition of essential oil.

Physical Properties of Essential Oils

Essential oils could be obtained through various methods like fermentation, extraction or expression; however, steam distillation is used as the most common method for commercial purpose.

The essential oil possesses characteristic odour, and are soluble in organic solvents. Most of the oils are lighter than water with a specific gravity between 0.8-1.17. These oils are sensitive to heat and light, therefore should be stored in dark bottles and cool places. There are many properties of essential oil.

1. Antimicrobial property.
2. Antiparasitic property.
3. Antioxidant property.
4. Anti-inflammatory property.
5. Immunomodulatory property.
6. Stimulation of digestion.

Use of Essential Oils in Poultry Nutrition

The replacement of antibiotic growth promoters with other safe and natural alternatives can be an important objective for the poultry industry. There are some promising results on the use of essential oil and other natural products as performance enhancers.

Typical performance parameters for poultry rearing are body weight, growth, feed intake, feed conversion ratio and egg production.

Addition of essential oils in the diet of commercial layers during the heat stress condition was found to be favorable for the quality of egg and helped in buildup of good immune status of the birds. During excessive hot climate, birds are usually in stress condition which leads to sudden drop in egg production, a greater number of egg breakage and high mortality rate in birds. During such circumstances essential oil acts as an effective source to reduce summer/ heat stress in birds.

Broilers: The essential oils as single or mixture may be used as a growth promoter in broiler production. Many studies have shown positive effects of dietary EO on body weight gain. Supplementing the dietary essential oils would stimulate the growth performance of broilers. Broilers supplemented with a mixture of laurel, oregano, sage, citrus and anis EOs, or a mixture of EOs significantly improved feed conversion. Also, in a broiler trial that examined mixtures of oregano, cinnamon, cayenne pepper, thyme, and combination of organic acids and plant extracts in comparison to nutritive antibiotic avilamycin in broiler chickens, the birds supplemented with the plant extracts showed higher body weight gain and increased feed consumption.

Layers: In order to maintain or improve egg production and quality, optimum nutrition, environmental practices, and management are considered as the prerequisites. There are many reports examining the possible beneficial effects of garlic on egg production and quality. Plant extracts and spices as single compound or as mixed preparations can play a role in supporting both performance and health status of animals. Essential oil mixture and organic acid supplementation in commercial layer diets under heat stress is beneficial to egg weight and immune function.

Benefits of Essential Oils for Poultry

Essential oils have been claimed to offer all of the following functions:
1. Simulate digestive enzymes.
2. Improve gut histology.
3. Antibacterial.
4. Antifungal.
5. Antiviral.
6. Anti-inflammatory.
7. Antioxidant.
8. Coccidiostatic.
9. Immunomodulatory.
10. Calming.

Conclusion and Future Aspects

Many researchers have conducted their works to explore the nature and use of essential oil in the poultry nutrition with variations among the results. The essential oil and their compounds have proved their in vitro efficacy as antimicrobial, hypolipidemic, immunomodulating and anti-inflammatory agents, whereas the toxicological effects are observed only at higher inclusion levels. The antioxidant property of these oils reduces the loss in the meat processing plants. Essential oils can also act as a substitute source to antimicrobials in poultry industries; its major role is to improve the production quality in birds due to numerous nutraceutical properties.

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Sorghum Pests and their Management

Article ID: 10503

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Abstract

India ranks 3rd in sorghum area and 5th in production in the world. Estimates, Government of India for 2019-20 sorghum production estimated was 4.63 MT. Nearly 32 per cent of sorghum yield is lost due to insect pest infestation in India. Panicle feeding pest cause a yield loss of 4 to 84 per cent.

There are 5-6 major insect pests in sorghum which contributes in major yield loss to these 32 per cent. To manage these insect pests, understanding it's bioecology and damage mechanism is very important.

Sorghum Shoot Fly, *Anthrigona soccata* Rond. (Muscidae – Diptera)

Biology: The whitish grey female fly lays their eggs (at times laying in 2-3 row, each having 3-4 eggs) on the lower surface of leaf blades mostly during morning hours. The eggs hatch in 2 days into dirty white and apodous maggots. Larval period is 8 to 10 days. Life cycle completed in 17 to 21 days.

Symptoms of Damage: The maggots on hatching migrate to the upper surface of leaves, enter between the leaf sheaths and stem. They bore the stem and cut the growing points resulting "dead hearts". If plant attacked at initial stages then side tillers are produced. ETL - 10 per cent dead hearts or 1 egg/plant.

Management:

a. Early sowing.
b. Use of resistant variety CO 1, CSH-7, CSH-8, Maldandi, Hagari.
c. Use of higher seed rate as 12 kg/ha.
d. Use of fish meal trap.
e. Removal of infested plants 3-4 weeks after germination.
f. Granular application of Carbofuron 3G to the furrow at the time of sowing @2.5 kg a.i./ha.
g. Foliar spray of cypermethrin, cartap hydrochloride found effective.

Sorghum Stem Borer, *Chilo partellus* (Swinhoe) (Crambidae - Lepidoptera)

Biology: Straw coloured moth lays about 25 oval, flat eggs in batches on the under surface of leaves near the midribs.

Eggs hatch in 2-5 days and mine into the midrib. There are seven larval instars in a period of 28-35 days. Pupate within the stem for 2 to 15 days depends on climatic conditions. Total life span extends 30 to 40 days.

Symptoms of Damage: It infests the crop usually a month after sowing and causes "dead hearts". The bore holes are visible on the stem near nodes. The younger larvae crawl and feed on tender folded leaves causing typical "shot hole" symptom, affected part show internal tunnelling. ETL-10 per cent dead hearts.

Management:

a. Intercropping with lablab or cowpea.
b. Uprooting and burning the stubbles.
c. Light trapping till midnight.
d. Apply granular insecticide along with sand to the leaf whorls.
e. Spraying of carbaryl- 0.1% thrice at interval of 15 days from a month after sowing.

Earhead Bug, *Calocoris angustatus* Leth. (Miridae-Hemiptera)

Biology: Male is green and female is green with brown margin. It lays blue cigar shaped eggs under the glumes or into the middle of the florets. Eggs hatches in 7 days. Nymphal period is about 10 days and total life span is 15-17 days.

Symptoms of Damage: The nymphs and adults infest the ears as they emerge from the leaf sheet and suck the sap from the developing grain and make them chaffy, resulting in a grain loss ranging from 15- 30 per cent. Damage is severe in irrigated crops than rainfed.

Management:

a. Use of predator reduviid bug *Reduviolus* sp.
b. Two application of dust of carbaryl 10% or quinolphos 1.5% at 10 days interval synchronising with the milky stage of the crop has been found effective.

Grain / Earhead Midge, *Contarinia sorghicola* (Coq) (Cecidomyiidae-Diptera)

Biology: The female inserts the eggs singly into developing florets at the time when pollen is being shed and a female lay from 32 to 100 eggs. The life cycle from egg to adult varies from 14-19 days.

Symptoms of Damage: Maggots feeds inside the developing grains and pupates itself. It emerges between the tip of the floret leaving the white pupal case attached to the tip of floret which is a characteristic symptom.

Management:

a. Late sowing faces fewer incidences.
b. Larval parasite *Tetrastichus* spp. is effective.
c. Predator Anthocorid bug, orius, Ant *(Tepinoma indicum)*.
d. Carbaryl 10% dust @ 20 to 30 kg per hectare at 50% flowering and grain formation.
e. Malathion 5% or carbaryl 10% quinolphos 5% dust @12 kg per hectare is also effective.

Maize Leaf Aphid, *Rhopalosiphum maidis* Fitch (Aphididae- Hemiptera)

Biology: Female give birth to living young without mating and a generation can be completed in about a week. The insect is active throughout the winter.

Symptoms of Damage: Aphid colonies found feeding on leaf whorl causing yellowing of leaves. Their densities often decline as plants enter the boot and heading stage. Sooty mould also grow due to honeydew secretion.

Management:

a. Use of natural enemies such as lady bird beetle, chrysopids, hover fly larvae, parasitic wasp.
b. Dimethoate 0.03% or neem seed kernel extract 0.04% +soap.

Web Worm, *Cryptoblades gnidella* (Milliere) (Pyralidae-Lepidoptera)

Biology: A narrow light brown larva with a dark head and dark lateral lines on the body. Larva remains near the axis of inflorescence initially.

Symptoms of Damage: Larvae scrap the leaf and later on feeds on milky and hard grain. The larvae web together adjacent grain with the help of silken threads. The whole ear head is completely webbed with excreta and silken threads.

Management:

a. Remove the webbed ear heads.
b. Carbaryl 10%, malathion 5 dust @ 20- 25 kg/ha.

	
Sorghum stem borer	**Sorghum shoot fly**
	
Sorghum earhead bug	**Sorghum earhead midge**
	
Maize leaf aphid	**Sorghum web worm**

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Tree Foliage Source of Nutritious Fodder for Livestock

Article ID: 10504

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Introduction

Trees, bushes and shrubs besides serving primary purposes (fuel/timber wood, leaf meal for silk worms, flora for honey bees) also provide fodder for livestock such as; poplar, mulberry, robinia, ulmus, willow etc. The tree species which serve more than one purpose are also known as multipurpose trees (MPT). Traditionally in Kashmir, livestock are allowed to forage on lopped fodder tree branches with intact leaves during summer and on fallen leaves during autumn and winter. It is a common practice for sheep farmers to make the leaves from the small fodder trees fall, by giving it a jerk or shattering it with a long stick. The palatability, digestibility and nutritive value of these tree leaves grown under temperate conditions is higher when compared to their counterparts in tropical and sub-tropical region, because of low deposition of lignin and other less digestible fibers. Fodder trees like *Robinia pseudoacacia, Ulmus wallichiana, Salix viminalis,Poplous deltoidis*, *celtis australis* and Morus alba/*indica/multicaulis* are loped during the late summer and fed a fresh to the animals. Lopping of willow and poplar starts from late summer until early autumn. Twigs and small branches with intact leaves from willow and poplar are detached from main woody braches and made into bundles called Baache (fig 1). These bundles are tied with fist full of paddy straw and left to dry in the open. The bundles are kept upright in a slanting position around the tree trunks to prevent shattering of leaves and damage by animals. After drying these in open to required levels of moisture, the bundles are either packed on a forked tree or stored under a roof only to be used during the harsh days of the winter. In case a forked tree is not available in the proximity, a pair of wooden poles is nailed on either side horizontally at a height of seven to eight feet to two adjacent trees for storing these bundles. Bundles stored in such a way are covered with thatched straw or water proof synthetic material to avoid any damage due to rain or snow.

Except mulberry tree numbers, the available literature indicates that no survey has been under taken to estimate the number and species of fodder trees available in this region. As per the available data (Bindroo *et al.,* 2005) there are around 7.5 million mulberry trees throughout the J&K. Of these the temperate sericulture zone (Kashmir) possesses 5 million trees and the rest are in sub-tropical sericulture zone (Jammu). It is possible to obtain two leaf crops per annum under temperate conditions of the valley. The spring leaf crop is used for production of silk, while as the autumn crop is either fed afresh to animals or fallen leaves are collected and stored for winter feeding. Mulberry finds its main use in silk production; however, the leaf crop available during autumn season can be entirely used as fodder for livestock, as farmers somehow don't rear silk worms during this season. Even the leaf stalks and leftovers after feeding of silk worms, which contain around 11.5% of crude protein can still be fed to animals without any adverse effects (Singh and Makkar, 2002). Mulberry leaves are rich source of crude protein, calcium, ascorbic acid (table 1) and low in fiber. Besides vitamin B1, carotenes, folic acid and vitamin D, the leaves also contain traces of copper, zinc, boron and manganese (Singh and Makkar, 2002). The available levels of sulphur, potassium and iron are more in mulberry than are required in the diet. A full-grown mulberry tree yields on an average 20kg of leaves during spring and 30 kg during autumn. Assuming the tree number and fodder yield to remain constant, each year these trees can contribute tons of nutritious fodder for animals, which will at least help in bridging the gap between demand and supply of fodder to some extent. Intercropping of mulberry with fodder grasses can help in maximizing the use of available land resources and minimizing the demand supply disparity.

Willow (local name vir) species serve as a raw material in a number of industries including handicraft, sports, plyboard, match factories and fodder for animals. The leaves are nutritious and contain around 17% of crude protein. The leaves contain high levels of zinc and magnesium which are important for animal health (table 1). Condensed tannins and phenolics like aspirin positively impact the animal health. Much of the willow trees are used for manufacturing various sports goods and a lesser percentage is used for packaging material for various fruits. Apart from its main uses these trees yield sufficient quantities of fodder that can be immense value in mitigating the scarcity of fodder especially during winters.

Poplous (local name phras) finds its main use in construction industry. Its wood is suitable for manufacture of plywood, match, hard board and pencils. Both indigenous and exotic verities of poplars are cultivated in Kashmir. The trees are heavily lopped, which prevents damage from snow and seed setting. Baache made from lopped tree branches are dried and stored for use during winters. Poplar leaves are very nutritious; contain high levels of dry matter, minerals and trace elements. Its nutritional value is said to at par with good quality lucerne hay (table 1). It is worth to note here that animals devour dry leaves compared to fresh poplar leaves.

Robinia pseudoacacia (local name kikkar) is a leguminous woody species. The tree is mainly used for timber and fire wood. It is the main floral species for honey bees in Kashmir during spring season. it produces great amounts of nutritious forage for animals. The browse from these trees is highly preferred by small as well as large ruminants; however, it is toxic to horses (Ball *et al.,* 1996). Kikkar trees are lopped or pollarded during summer months. The lopped branches are fed a fresh to the animals, as it is difficult to make into bundles due thorns. The browse from kikkar is highly nutritious (table 1) and as per the data available goats fed kikkar leaves had similar weight gain compared to their counterparts fed alfalfa pellets (Papachristou *et al.,* 1999).

Elm (*Ulmus wallichiana)* locally knows as bren, is mainly used for timber, fuel wood and fodder. The tree can grow to a height of 30 meters. The trees are mostly planted along the banks of streams and as boarder fencing. Traditionally, bark from this treeis used for making ropes. Trees of smaller diameter are lopped for harvesting fodder, which is fed afresh or stored for winter feeding. With regard to trees of larger diameter it is a common practice to collect fallen leaves and store them for winters, as the trees are very large in size and pose a serious challenge and threat to lop them. Green leaves are highly palatable and nutritious. Leaves are good source of protein, calcium and phosphorus (table 1).

Celtis australis locally known as brimji is native to western Himalayas including Kashmir. It is mainly used for making whip handles, cups, and spoons etc. The numbers of brimji have seen a drastic reduction due to indiscriminate felling. Leaves are fed afresh or fallen leaves are collected during autumn season and stored for winter feeding. The tree provides ample supply of palatable, nutritious and tennin free fodder (table 1).

Apple plantation covers large swathes of land in Kashmir. After harvesting the fruit, farmers usually let their sheep in orchards to browse fallen leaves, which contain around six percent of crude protein. Apart from allowing sheep for browsing, apple leaves are also collected and stored for winter use. However, one should keep in mind that many pesticides used for disease control in apple may find its way in human food chain, before opting for this practice.

Summary

Scarcity of fodder is a major challenge in harnessing the potential of available livestock resources, which if addressed can do wonders in fulfilling the growing demand of protein of animal origin. Trees leaves like mulberry, salix, poplar, robinia, ulmus and celtis provide an alternate source of nutritious fodder for animals. The tree foliage if harvested and collected properly can help in mitigating the scarcity of fodder to a great extent.

Table 1: leaf chemical composition (% DM basis) adopted from Ganai et al 2009.

Species	CP	EE	CF	NFE	NDF	ADF	Ca	P	Tannins
Morus multicaulis	21.25	7.60	12.60	40.09	33.10	23.04	2.54	0.23	0.95
Poplous deltoidis	13.56	3.21	18.91	48.84	52.11	39.36	3.54	0.12	0.69
Robinia pseudoacacia	19.78	5.81	15.44	47.77	44.70	26.80	1.49	0.25	0.58

Salix viminalis	17.44	2.86	14.02	55.25	55.30	35.89	2.50	0.08	0.85
Ulmus wallichiana	20.44	4.02	17.17	46.37	55.30	44.00	1.95	0.30	0.55
Celtis australis	13.18	4.44	16.70	44.93	46.87	35.10	2.75	0.19	1.01
CP crude protein, EE ether extract, CF crude Fibre, NFE Nitrogen Free Extract, NDF Neutral Detergent Fibre, ADF Acid Detergent Fibre									

Fig 1: Poplar tree leaf bundles (Baache)

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Climate Resilience through Palmyra Cultivation

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Abstract

Palmyra is an age-old tree whose immense utilities are well described even from the ancient literature. As a tree crop, it only requires minimum amount of water for its survival hence, a perfect candidate in the era of climate change. Due to change in demographic pattern, the economic value of Palmyra was undermined and the population of trees started decreasing drastically. In the wake of climate resilient agriculture, the younger generation is to be made aware of this wonder crop to equip our self for the war against climate change. An increased awareness among the public will definitely provide market for its produce. Financial support for initiating small scale industries for value additions will improve the local economy. Thus, it is necessary to save and propagate Palmyra on a large scale in weak soils in order to conserve the ecosystem and to move towards a greener economy.

Keywords: Climate change, resilience, ecosystem.

Introduction

Palmyra tree is a traditionally grown tree, famously known as "Borassus flabellifer". The term borassus emerged from a Greek word inferring to the fruit which is covered by a leathery like material, whereas the term flabellifer refers to the fan like shape of the leaves. The tree is mainly grown in southern India which is known as "karpaka veruksham" (celestial tree) in various literatures due to its potential value. The tree is said to be a native of Asia, Africa and New-Guinea, whereas these trees are highly regarded in the south east Asia region for its economic value. Especially in countries like India and Cambodia, many values added products are being produced and marketed. The palm tree belonging to sugar palm category has been grown from Indonesia to Pakistan.

Palm trees are also one of the oldest grown tree species in Indian states like Tamil Nadu, as it can grow vigorously in adverse conditions such as, extreme drought. In the wake of unprecedented climate change and many regions within India facing monsoon failures, Palmyra is truly a able candidate as a solution to the growing problems, hence aptly known as 'wish tree' (Veilmuthu, 2018). The arid conditions of Tamil Nadu and similar regions in India are the hotspots for Palmyra cultivation. Apart from the fruits, the leaves are harvested to make brooms and also used as a roofing material for houses.

Botanical Description

Palm can reach up to a height of 30m and the root system is robust. Greyish ringed trunk with leaf scars is the peculiarity of the tree. The old leaves tend to remain in the main trunk for years and falls off completely after attaining senescence. Leaves are in the shape of a fan with an approximate length of 3m. The petiole margins of leaves are present with black teeth like projections. Palm is dioecious and less than 1m in length that are hidden under a scale like bracts within the inflorescence (Catkin). The female flowers are entirely different from male flowers, they are solitary, golf ball shaped that are placed in the axis of inflorescence. These flowers, after fertilization develops into fleshy fruits, each with one to three seeds. The fruits are usually 15-5cm in width, brownish, juicy pulp and woody endocarp enclosing each seed. Young palmyra seedlings grow slowly, producing only a few leaves each year (establishment phase), but at an as yet undetermined time, they grow rapidly, producing a substantial stem.

Significance and its Impact in Green Economy

In India, it is planted as a windbreak on the plains. It is also used as a natural shelter by birds, bats and wild animals. Once upon a time, palmyra (*Borassus flabellifer*) trees dotted the wilderness and banks of water bodies in Tamil Nadu. From root to leaves, the trees had many uses. Products from the trees were used for food, wood, shelter and even as the source of toddy. So much was the prominence of the tree in Tamil Nadu that, palmyra was declared as the state tree of Tamil Nadu. There is no need to water the seeds at regular intervals. A tree is capable of growing up to 100 feet in 10 years. A tree can last 100 years. The white kernel of the ripe palm fruit after being left for a few months is used as an offering in Lakshmi Puja in various parts of Bengal and is also eaten raw. If we consume Palm Gur or karuppatti in place of cane sugar, we will end up not only restricting the pollution of water, land and the atmosphere but also save on the consumption of water. For instance, chemical fertilisers and pesticides are used in the cultivation of sugarcane. These lead to degradation of the fertile land and pollution of water.

Moreover, palmyra trees on banks of water bodies prevent soil erosion. Palmyra trees prevent soil erosion and help recharge the water table. In India, it is planted as a windbreak on the plains. It is also used as a natural shelter by birds, bats and wild animals. It is known as 'karpaha veruksham' too as all parts of the tree is used for some purpose. According to Tamil culture, Palmyra palm trees played an important role in water management in the ancient times. The ancestors had a planned vision for the future water needs of the generations that followed, but most importantly a well-balanced ecosystem was maintained. Unlike, other trees, Palmyra palm's roots go vertically into the ground, which in turn brought the ground water to various levels along the path. It irrigated the land, played a significant role in the circulation of water in the aquifers, river beds and rivers. Since the balance is natural and the balance of consumption was well maintained. Rivers remained perennial those times and these trees had its own significance. That is why these trees are considered as 'celestial trees.' You could find all the traditional ponds or lakes they had dug with palmyra palms around like a fence (Jana and Jana, 2017).

Conclusion

Our country has 121.1 crores of population according to 2011 census. To feed the ever-increasing population of our country is a great challenge. Day by day demand of food grain is increasing; on the other hand, day by day per capita landholding is decreasing. Therefore, pressure on land to produce more obviously, deteriorating the soil quality means soil health is in alarming condition. One of the ways to these challenges is providing more emphasis on non-tradition crops cultivation (crop diversification) to produce more food (many types of foods through value-addition). In this respect, cultivation of palmyra palm is important one. The contribution of Palmyra and related livelihoods is immense in mitigating the impacts of climate change. However, certain measures are to be implemented in order to protect this industry. Awareness on the nutritional, economic and environmental benefits of Palmyra needs to be created from the school level. Policies have to be made to encourage people to plant more Palmyra trees. An increased awareness among the public will definitely provide market for its produce. Financial support for initiating small scale industries for value additions will improve the local economy. The Palmyra trees, a means to protect water resources, a friend who helps the birds and animals, a plant that can bear a severe drought and one of the pillars of the village economy, can surely be dependable in the face of climate change and the problems posed by it.

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The Old Story of Nitrate and Phosphate Cross-Talk with New Molecular Findings

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Introduction

Plants require at least 17 essential nutrients for their normal growth and development. Among these nitrogen and phosphorous are the two most required mineral nutrients for the plants and are the most widely used fertilizers in agriculture production. Nitrate and phosphate not only act as nutrients but also act as signalling molecules to regulate the gene expression and activation of nutritional responses. The plant's roots acquire N & P in the form of nitrate and phosphate, respectively. The N & P accounts for about 4% and 0.5% dry weight of the plant. As human beings, balanced nutrition is also essential for plants. For, plants maintaining a proper nutrient balance is depends on the coordinated acquisition of various mineral nutrients. The coordinated utilization of mineral nutrients by plants requires a proper ratio of supplied N and P fertilizers. The ratio of supplied N & P is critical for better plant performance and to maximize the yield. Any variations in the supplied N: P ratio significantly affects their uptake which ultimately affects crop yield. Notably, an increased N: P ratio greatly promotes the uptake of P in wetlands. Therefore, under continuously varying N & P environments plants have developed various strategies to coordinate the utilization of N and P.

Nitrate Metabolism and Signalling

The nitrate transport in plant roots is mediated by nitrate NRT transporters. So far in plants, all the available nitrate transporters are classified into two gene families. The NRT1 class gene family belongs low-affinity transporter system (LATS) that contributes to nitrate uptake at high external nitrate concentrations above 1 mM. The NRT2 gene family encodes transporters that contribute to the high-affinity transporter system (HATS). The HATS operates at µM concentrations of external nitrate concentration. The HATS is operated by a two-component NRT2/NAR2 transport system. The HATS and LATS are further classified into inducible (iLATS & iHATS) and constitutive expressing (clients & cHATS). Among the different NRT transporters, the NRT1.1B transporter in plants acts as a transcriptor. The NRT1.1 is capable of functioning as both high- and low-affinity nitrate transporter and also acts as possesses an NO_3^- sensing and signalling. The NRT1.1 has two binding sites for nitrate. Under the high external NO_3^- content it will bind to the low-affinity binding site (LA) while under the low external NO_3^- content it will bind to the high-affinity binding site (HA). The binding of NO_3^- to the NRT1.1 causes the exposure of the binding site for the SPX4 domain at the cytosolic side. The phosphorylation of Thr101 of NRT1.1B mediates the nitrate binding and signal transduction. Usually, the NO_3^- signalling pathway operated at high N content. Under low NO_3^-, SPX4 sequestrate then NIN-like protein (NLP) transcription factor in the cytosol. The NLP is involved in the activation of Nitrate-inducible Garp-type Transcriptional Repressor1 (NIGT) which is involved in the inhibition of nitrate acquisition responsible gene expression. Under high NO_3^-, NRT1.1B strongly binds to the SPX4 and subject it to the ubiquitin-mediated 26s proteasome degradation by recruiting the NRT1.1B interacting protein 1 (NBIP1). Now the NLP free from SPX4 gets transported to the nucleus and activates NIGT.

Phosphate Metabolism and Signalling

The concentration of the Pi in the plant cell (5-20mM) is usually higher than the soil solution (1-10µm). Hence, uptake of Pi from the soil to root is an energy-dependent process. The Pi uptake and transport are mediated by the various phosphate transporters (PHT & PHO1). All the available phosphate transporters in the plants are classified into four classes based on their different structure, activity, and localization. In rice so far 26 PHT genes have been identified, some of them belong to high affinity and low- affinity transporters, while others are constitutive. The 2-kb upstream region of these genes contains 237 putative cis-elements. The majority of these cis-elements are PHO-like, TATA-box-like, PHR1, or Helix–loop– helix elements, and WRKY1 and ABRE elements which are the binding sites for the transcription factors induced under various stress including Pi starvation response and other stress, suggesting gene regulation by these signals.

Among the different genes that are up-regulated by PHR1 and PHL1 in response to Pi deficiency are PHT1 genes which are preferentially expressed in roots where they directly mediated the acquisition of Pi from the soil. Later the PHO1 specifically expressed in the pericyclic mediate the xylem loading of Pi up taken by PHT1. Both PHT1 and PHO1 transporters are the direct target of PHO2 mediated proteome degradation. These are also subjected to the post-translation regulation through phosphorylation and dephosphorylating of C- terminal end of PHT1 that retains it in ER under Pi sufficiency. The Phosphate Transporter Traffic Facilitator1 (PHF1) mediates the intracellular trafficking of PHT1 from the ER to the plasma membrane, thereby controls the Pi acquisition under low Pi. In response to low Pi the PHO2 Ubiquitin-conjugating enzyme 24 (UBC24) mediate the ubiquitination at lysine residues of the PHT1 and PHO1 transporters after the post trafficking they're by targeting it to proteasome-mediated degradation. The expression of PHO2 is posting transcriptionally cleaved by miR399. The miR399, a small non-coding RNA of 20-24 nucleotide sequence is itself regulated at the transcriptional level by a low Pi responsive transcriptional factor. The PHR1 itself is regulated in response to the availability of Pi. Under the low Pi condition, PHR1 is post-translationally regulated by SIZ1, a sumo E3 ligase that adds sumoyl group by stabilizes the protein. The siz1 mutant exhibit no PSI genes in response to Pi deficiency.

Conclusion

The NRT1.1Blinked nitrate sensing and SPX4 degradation into a single regulatory module, this study adds the critical piece of information to complete the nitrate signaling pathway, from signal perception to downstream transcriptional responses. In parallel modulation of PHR2 and NLP3 by SPX4 enables the coordinated activation of both nitrate and phosphate responses.

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Microgreens: A Nutraceutical Food for the 21st Century

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Introduction

Food is essential for every living organism on the earth for growth, development, and survival. Food provides the total calories requirements of humans to nourish life. Food supplemented with minerals, vitamins, etc helps in preventing serious deficiencies and disorders. The food habitat mirrors and play an important role in human evolution.

What are Microgreens?

Microgreens are the young seedlings of the vegetable harvest on an average between 10 to 14 days. Microgreens are consisting of cotyledon, central stem, and true young leaves but not roots. All the microgreens are older than the sprouts and younger than the baby greens. The difference between sprouts, microgreens, and baby greens depends on the time of the harvest.

The use of microgreens dates back to 1980, by chefs in California. Initially, microgreens are limited to basil, arugula, and cilantro. But nowadays a variety of microgreens are grown and sold in large quantities as a potential new food product with value addition by the various seed companies, and growers across the globe. However, so far 25 commercially available microgreens have been reported.

Nutrition Composition of the Microgreens

Vitamins: Vitamins are an important and essential nutrient for the normal growth and development of the human. Vitamin K1 is also known as phylloquinone plays an important role in blood coagulation. The dark green vegetables are rich in Vitamin K1 and concentration ranges from 0.5 to 4 µg/g of fresh weight.

The red-colored microgreens contain 2.8-4.1 µg/g, while yellow microgreens contain a low concentration range from 0.7-09 µg/g. Tocopherols are Vitamin E and are rich in the microgreens of radish (87.4 mg/100g). Carotenoids are another important vitamin that is also the precursor for Vitamin A. carotenoids are rich in colored fruits and vegetables. The red cabbage has 0.044g/100g of FW of carotenes.

Minerals: Apart from vitamins, minerals are also essential nutrients for humans. Microgreens are reported to contain high mineral content. The broccoli microgreens are rich in minerals by 1.5 to 2.5-fold compared to matured greens and known to contain a variety of minerals such as potassium, phosphorus, zinc, iron, copper, sodium, and magnesium.

Polyphenols and Glucosinolates: These are the bioactive compounds known to play an important role in the prevention of several human chronic diseases such as obesity, cardiovascular disease, and cancers. The microgreens from the red cabbage contain 71.01 micromoles /g of polyphenols which is higher than the matured cabbage (50.58 micromoles /g). Glucosinolate concentration was also found to be high in the red cabbage microgreens which are about 17.5 micromoles /g.

The microgreens have greater nutritional value to human beings than the matured grains. However, the nutritional composition of the microgreen is affected by various factors such as the selection of the cultivar, growing medium, and growth condition.

Table 1. Some of the important microgreens and their nutrient composition:

Microgreens	Phytochemicals	concentration
Red cabbage	Total ascorbic acid	147.0 mg/100 g FW
	Phylloquinone	2.8 µg/g FW
	B-carotene	11.5 mg/100 g FW
	Anthocyanins	12.44 µmol/g
Broccoli	Glucoraphanin	0.67−0.85 µmol/g dry weight
	Glucobrassicin	10.13−10.81 µmol/g dry weight
Arugula	Total ascorbic acid	45.8 mg/100 g FW
	Phylloquinone	1.6 µg/g FW
	B-carotene	7.5 mg/100 g FW

Growth Conditions for Microgreens production

Seed sowing rate: 201g/m2, (varies with microgreen)

Fertilizers: soil-less growing medium like peat-like mix with calcium nitrate 2000mg/L of nitrogen (150ml/L of medium) with daily post-planting solution fertilization with 150 mg/L of nitrogen. Vermicomposting can also be used as a medium.

Light: 463 µmol photons/m2/s for a short period.

Conclusion

Microgreens are appeared to be an important and potential low caloric source of nutrients and bioactive compounds. Along with providing the added value of nutritional requirement of the human beings it also prevents the various human chronic diseases making them nutraceuticals. These nutria-rich plants are indeed promising food for the consumers' interest satisfaction.

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Australian Finger Lime Against the Control of Citrus Greening

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Introduction

Haulongbin (Citrus greening) has created havoc in the world citrus industry and served as the major cause of the citrus decline. The disease was first reported in China in the 1980s. The disease later become reported as “yellow branch disease” in South Africa in 1929 and later called “greening”, which refers to the green color of fruits (Battol et al., 2014).

Disease Causal Organism and Symptoms

The disease is caused by phloem restricted uncultivable bacterium *Candidatus Liberobacter* and 3 species are reported for the occurrence of the disease *i.e*., an Asian strain (*Candidatus Liberibacter asiaticus*), an African strain (*Candidatus Liberibacter africanus*) and a strain found only in Brazil (*Candidatus Liberibacter americanus).* This disease is graft-transmissible and was reported to transmitted by two species of citrus psyllids: Asian citrus psyllid, *Diaphorina citri* and African citrus psyllid, *Trioza erytrae*. Trees infected with HLB exhibits yellow shoots and blotchy mottle leaves resembling nutrient deficiencies and fruits on affected branches are small and lopsided, produce aborted seeds, don’t develop colour properly and drop prematurely. As the disease progresses, the tree losses productivity, and then the entire tree died. If the disease is widespread, citrus trees may live for only 5–8 years and the fruits are remaining unmarketable. Under certain conditions, symptoms are displayed in different parts of the plant. In general, the greening-affected trees show the open growth, stunting, twig dieback, sparse yellow foliage, or severe fruit drop. In some cases, green colour develops on fruit at the peduncular rather than the stylar end, as in normal case which is known as “colour inversion” or “red nose”. This disease is called “decline” in Taiwan, “dieback” in India, “leaf mottle” in the Philippines, “vein phloem degeneration” in Indonesia and “yellow branch”, “blotchy mottle” or “greening” in South Africa, based on the symptoms.

Control Strategies

Different strategies have been applied for the control of citrus greening that devastates the world citrus industry and pay dearly billions of rupees for this. Thermotherapy (heating plantlets at 48-50°C for several minutes), Chemotherapy (use of different chemicals i.e., tetracycline, penicillin, carbendazim, Imidacloprid) gave some control against citrus greening. Breeding for the production of resistant strains of citrus rootstocks, eradication and replacement of affected plants has been followed (Bist and Bista, 2020). Methods for control of vectors have an immense tactic for the control of the greening disease. The feeding and reproductive activity of D. citri also plays an important part in the dissemination of the pathogen. D. citri adults prefer young tender plant parts or emerging flushes for food, and oviposition and breeding of life cycle. Trees infected with HLB develop yellow shoots and emits a volatile methyl salicylate compound, all of which attract D. citri adults. However, since HLB-infected tissue has a comparatively low nutritional content, adult psyllids easily migrate into healthy nearby plants, a behavior that encourages the spread of the disease (Alvarez *et al*., 2016). Different biocontrol agents like *Mallada boninensis*, *Menochilus sexmaculata fabricius*, *Serangium sp*, *Geocoris sp* gave control on the population of citrus psylla (Chien and Chu, 1996).

All commercially important citrus varieties are susceptible to this disease and there is no effective way to treat the affected plant rather than discarding the plant and rooting the orchard. Chemical application of insecticides for the control of psylla and use of traditional heat-sensitive antibiotics poses threats to humans, animal health, and the environment, and resulted in resistance against insects and microbes. Recently Huang et al., 2021 from the University of California have detected a naturally occurring peptide in HLB-tolerant citrus relatives such as Australian finger lime, that not only kill the bacteria but also activate the plant's own immune system to inhibit new HLB infections. The peptide's corkscrew-like structure helix structure can quickly puncture the bacterium, causing it to leak fluid and die within half an hour, much faster than antibiotics. Greening infected plants after peptide injection survived and grew healthy shoots and the treated plants had shown very low counts of bacteria. SAMPs (Stable anti-microbial peptide) present in Australian finger lime has a distinct mode of action and appears to destroy the bacterial cell membrane by nonspecific pathways, resulting in further breeding of adult psylla. In comparison, SAMP destroys bacteria quicker than antibiotics, which decreases bacterial generations and further lowers the risk of establishing resistance. Most notably, the thermal resilience of SAMP can have a sustained and long-lasting effect in the field relative to heat-sensitive antibiotics.

Conclusion

Citrus greening is one of the major factors contributing to the citrus decline which has to be kept in control to sustain citrus cultivation. Susceptibility of different citrus cultivars to the disease and different tactics for the control of the disease and the vectors are in vain because nothing resulted in successful achievement. Almost after 40 years after the appearance of the disease, a peptide that occurred in Australian finger lime gave control on this disease. So, Further research must be needed on different strains, their occurrence, genes involved for the resistance to the disease and transfer of this genes to produce disease resistant citrus species.

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Non-Conventional Fish Feed Resources in India

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Introduction

Aquaculture, one of the fastest growing food production sectors, currently represents almost 50 percent of the world's sustenance fishery. Approximately one billion peoples worldwide depend on fish as their source of animal protein, and constitutes 17 % of total protein and 7 % of all proteins consumed globally (SOFIA, 2020). In India the current Aquaculture production reaches 13.7 million metric tonnes in 2018 which constitutes 6.5 percent of global fish production. In developing countries, the lack of animal protein intake can be addressed with the proper production of aquaculture. However, fish from aquaculture comes at a higher cost and fish feed is the costliest input for aquaculture operations. Most of the high feed costs stem from a strong reliance on protein sources such as fish meal and shrimp meal. To address the high-cost input of feed, it will be economical to use plant-based ingredients or their by-products to improve fish production. Fish nutrition is an important consideration of farmed finfish and shellfish management in fisheries health (SOFIA, 2014). For some countries the change from extensive to semi-intensive and intensive fish farming demands that the farmer should have nutritionally complete feed facility. In aquaculture practices the major cost input is going for the aqua feed (approximately 60% of total cost) because of high-cost synthetic commercial feed ingredients and use of fish meal in the aqua feed. The feed cost could be minimized by using some conventional plant-based feed resources which could be the replacement of synthetic feed ingredients. Not only the cost but use of synthetic feed ingredients cause adverse effects in fish and the consumers and also deteriorate the water quality. In India there are many non-conventional plant-based feeds resources which are cheaper in cost but hold high nutritional values and also doesn’t cause adverse effect to the consumer and neither pollute the water bodies. Non-conventional feed services are credited with not being competitive in terms of human consumption, very cheap sales of goods from agriculture, by-products and waste products from farm feed and recycling sectors and are capable of acting as a means to handle waste and improve sanitation. These include all types of feedstuffs from animal (silkworm, maggot, termite, grub, earthworm, snail, tadpoles etc.), plant wastes (jack bean, cottonseed meal, soybean meal, cajanus, chaya, duckweed, maize bran, rice bran, palm kernel cake, groundnut cake, brewers waste etc.) and wastes from animal sources and processing of food for human consumption such as animal dung, offal, visceral, feathers, fish silage, bone, blood). Unconventional fish feed can be of animal or plant source.

Animal Source

These are feed from any living thing, other than human being, that can feel and move. Examples include tadpole meal; fly larvae, earthworm meal, toad meal, shrimp waste, crab meal and animal wastes such as pig and poultry droppings and blood meal.

Tadpole Meal

At the outset of the rainy season, frogs and toads’ mate, with the first rains serving as reproductive stimulation. Eggs are laid in stagnant swimming pools or in water body, and then into bowls. Proximate composition of meals revealed that 50 per cent of crude protein was contained in the meal. In a substitution experiment on the catfish *Heterobranchus bidorsalis*, a close contrast with the fishmeal indicated that it was more cost-effective but nutritionally superior. So instead of fishmeal it can be used.

Fig 1. Tadpoles

Fig. 2. Housefly larvae

House Fly Larvae *(Musca domestica)*

Houseflies flourish where there are supplies of moist organic matter. From the third day on, the harvest of maggots could start. The fly larvas, which metamorphoses from the laid eggs, may be tracked on a continuous basis. The pulp is diluted, the larvae are collected with fine mesh sift, washed to extract the substrate thoroughly and allowed to drip out, if the volume of arrowing larvas (maggots) is sufficiently high. They can be fed whole to fish. The nutritional content study of processed larvae is 8% moisture, 45% fat, 8% ash, and 25% chitin.

Animal Wastes

Animal faeces, in particular piggery and poultry droppings, can be used to promote the development of plankton as pond organic fertilizers. Both animal droppings are nevertheless used as a direct food supply for fish. During the winter, the drops can be oven dried or sun dried and added in addition to other ingredients to the fish food. It is understood that these droppings contain almost 30 percent raw protein content. In the polyculture of local catfish and tilapia animal wastes are particularly useful.

Earthworm Meal

They are made commercially in an environment with adequate rainfall on the soil or swamps by cattle, human waste or refuges. Relevant earthworm pairs are presented. The detritus will breed them as a supply of nutrients. After six months harvesting can be harvested. It takes lumps of dirt and eventually splits them into the worms. Production requires drying the oven, smoking over the oven or smoking with a pepper grinder. The protein content in earthworm is found to be approximately 56% which is very good for aqua feed.

Fig .3 Earthworm meal

Plant Sources

Leaf protein: In tropics leaves are common and freely grown. Each contains different protein levels that can produce an inexhaustible and economical nutritional source for fish. Cassavas *(Manihot. esculenta*), pawpaws (*Caricans. papaya*), pineapple (*Ananas. comosus*), soy-beans (Glycin max) and plantains (Musa paradisica), Blackgray leaf are examples of plants with nutritionally important leaves (*Vigna mungo*).

Aquatic macrophytes: These are natural aquatic plants that grow on the surface of the water. Rooted floral plants including grasses and sedges commonly found on the banks of fresh water sources .These include rooted flowering plants with submerged leaves like Ceratophyllum, and with floating leaves like the water lilies (*Nymphaea*). Free floating plants such as Duckweed, Water lettuce, Water hyacinth and Salvinia, a water fern. Water hyacinth are so wide spread that they constitute a menace to shipping and fishing activities but can be used as feed component for fish.

Azolla pinnata (fresh water fern): *Azolla pinnata* is a potential fish feed component in the diet of *Oreochromis niloticus*. Its oven dried state is equated with palm kernel cake. Forty percent of *Azolla pinnata* can be used in Tilapia diets. The plant grows fast, so can readily meet commercial needs. The oven dried sample contains 27% crude protein.

Eichhornia crassipes: (Water hyacinth): Water hyacinth can be used in the cultivable fish species e.g., *C. niloticus, Heterotis niloticus* etc. The plant grows very fast and abounds for commercial usage. Processing can be by oven drying and protein extraction as in leaf protein.

Fig.4. *Azolla pinnata*

Fig.5. *Eichornia crassipes*

Litchi seed: litchi is a fruit mainly found in Bihar. It has a delicate whitish pulp fruit and the seed part of litchi is usually creating agricultural waste. By collecting the seeds its powdered form can be used in fish feed after proper processing including soaking and drying in hot air oven. The optimum quantity of litchi seed could be the good source of antioxidant in the aqua feed. Aqueous extract act as natural additive and enhance the safety and quality of feed by inhibiting the lipid peroxidation and adepogenesis.

Conclusion

Non-conventional fish feeds are potential feed ingredients, which have not been used in fish feed production for the reasons that: They are not well known or understood, no effective study of the method of production with a view to commercializing them. They are not readily available. They can be toxic or poisonous. They contain high quality feed ingredients that can compare favorably with conventional feed types. They are expected to be cheaper by virtue of the fact that there is no competition for human consumption.

By reducing the cost of aqua feed, we can reduce the input cost in aquaculture practice and make is more feasible for the people to encourage them for doing fish farming for their better livelihood. Fish farming and aquaculture could be a key factor in doubling the income of farmers in India. By using these non-conventional fish feed resources anyone can do fish farming, the need is to more scientific study and research over these feed resources and make them useful to all the fish/shrimp farmers.

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The Prospect of Smart Farming in Indian Agriculture

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We all know the Indian agriculture and its cultivation practices. The introduction of smart farming techniques has many challenges and benefits. What is Smart farming? A smart farming system minimizes waste, increases productivity and enable the management by remote sensing of a greater number of resources. Smart farming also called or precision farming. It includes a range of technologies, including remote sensing, Internet of Things (IoT) devices, robotics, big data analytics, and artificial intelligence, to form an integrated crop production management system on a site-specific basis to increase profits, reduce waste and keep the environmental quality. Smart farming provides the agricultural/farming industry with the advanced information that including big data, the cloud and the internet of things (IoT) for tracking, monitoring, automating and analysing operations in commercial agriculture sectors. Also called as precision agriculture, smart farming is software-managed and sensor-monitored. Smart farming is important due to the grouping of the expanding global population, the increasing demand for advanced crop yield, the need to use natural resources efficiently, the growing use and sophistication of information and communication knowledge and the increasing need for climate-smart agriculture.

Smart Farming is Key for the Future of the Agricultural Sector

Smart farming is a farming management theory using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and IoT technologies. By precisely measuring variations within a field and adapting the strategy thus, farmers can greatly increase the effectiveness of pesticides and fertilizers and use them more selectively. Similarly, using Smart farming techniques, farmers can improve monitors the needs of individual animals and adjusts their nutrition correspondingly, thereby preventing disease and enhancing herd health.

For Smart Farming, what do you need ? Knowledge and capital are necessary for any innovation. Modern farming technologies need more and more professional skills. A farmer is not only a person with a passion for agriculture, he or she is also a legal expert (to find their way during a growing maze of regulations) and a part-time data analyst, economist and accountant. Furthermore, Smart Farming needs capital. Thankfully, there is a wide range of options obtainable. From using low capital investment smartphone applications that track livestock to a capital-intensive automated combine. In principle, implementing Smart farming technologies can be updated. A smart farming technology represents the function of modern Information and Communication Technologies (ICT) into agriculture, leading to what can be called a Third Green Revolution.

Smart farming helps reduce overall costs and improve the quality and quantity of products, Increasing control over production leads to improved cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for example, helps eliminate the risk of losing yields. Also, automation boosts efficiency. With smart devices, multiple processes can be activated at the same instance, and automated services enhance product quality and volume by better controlling production processes. Plant breeding and genetics revolutions, this Third Green Revolution is taking over the agricultural world based upon the combined application of Information and communications technology (ICT) solutions such as precision equipment, the Internet of Things (IoT), sensors and actuators, geo-positioning systems, Big Data, Unmanned Aerial Vehicles

(UAVs, drones), robotics, etc. Smart Farming has a real potential to distribute an extra productive and sustainable agricultural making, based on a more precise and resource-efficient approach.

Benefits of Smart Farming

Smart farming systems often allow the demand forecast to be carefully controlled and the release of products to market just in time to minimize waste. Smart farming focuses on the organization's land supply and focuses on the right growing parameters, such as moisture, fertilizer or material quality, to produce the right crop that is in demand. Increased business efficiency through development automation. By using smart devices, you can automate multiple processes across the production cycle, e.g., irrigation, fertilizing, or pest control. Improved product quality and volumes. Achieve better control over the production practice and maintain higher standards of crop quality and growth capacity through automation.

1. High crop productivity: The introduction of smart farming, the use of better and enhanced farming technology ensures better productivity as the emphasis is on optimizing inputs and eliminating waste.

2. The decrease in the use of pesticides, fertilizers, and water: Traditionally, farmers applied water, fertilizers, and pesticides even without determining where such elements are required on the farm. However, with smart, apply water and other chemicals whenever and wherever they are needed and in the right quantities. Reduced utilize of these chemicals leads to low food prices, as the cost of farming goes down.

3. Reduce strain on the environment: Smart farming has now implemented enhanced approaches to increasing efficiency while minimizing the loss of farm-use chemicals, water, and other materials. The suggestion is that when you can use them sparingly and where they are highly needed, you do not have to expose the world to unnecessarily harmful chemicals.

Smart Farming Technologies

The Smart farm involves the use of technologies such as: Sensors for soil scanning and water, light, humidity and temperature organization. Telecommunications technologies such as advanced networking and GPS. Hardware and software for specialized applications and for enabling the Internet of Things (IoT)-based solutions, robotics, and automation. Data analytics tools for decision making and prediction. Data collection is a very important element of smart farming as the quantity of data available from crop yields, soil-mapping, climate change, weather data, fertilizer applications, machinery, and animal health continues to escalate. Satellites and drones for gathering data around the clock for a total field. This information is forwarded to IT systems for tracking and analysis.

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Chelation in Soil and its Significance

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Introduction

Chelate is the coordination or complex of compounds which consist of a central metal atom that is attached to a large molecule, called a ligand, in a definite structure. It's a chemical compound of peculiar kind which is easily dissolved and absorbed than other types of molecules and chemical compounds.

It is made up of a metal ion and a chelating agent that forms multiple soluble bonds with the ion. This chemical structure is responsible for its easy absorption in a solution. Chelates are sometimes mixed with fertilizers to enhance a plant's ability to absorb and assimilate nutrients. The term chelate was first applied in 1920 by Sir Gilbert Morgan and H.D. Drew who stated: "The adjective chelate, is suggested for the caliper like groups which function as two associating units and fasten to the central atom so as to produce heterocyclic rings."

Chelation is a type of bonding of ions and molecules to metal ions. It involves the formation or presence of two or more separate coordinate bonds between a polydentate ligand and a single central atom. These ligands are called chelants, chelators, chelating agents, or sequestering agents.

Chelation has various beneficial roles particularly in applications such as providing nutritional supplements, toxic metals elmination from body, Magnetic Resonance Imaging (MRI) scanning, manufacturing of catalysts and fertilizers. Amino acids, glutamic acid, histidine, malate, phytochelatin etc. are some of the typical type of chelators in nature.

Water soluble pigments formed by many microbial species such as pyochelin and pyoverdine produced by Pseudomonas serves the function of chelating agents by binding with iron. Enterobactin a compound produced by E.Coli is also an example of chelating agents. Some metal complexes in the environment and in nature are not found in the form of chelate ring (e.g., with a humic acid or a protein).

Thus, metal chelates play a pivotal role in the mobilization of metals in the soil, their uptake and the accumulation of metals into plants and microorganisms. In order to prevent absorbed nutrients from precipitation, cationic nutrients will immediately form chelates with organic acids such as citric acids, malonic acid, and some amino acids. Thus, due to the chelation process, the nutrients can move freely within the plants.

The Different Ways by which Chelates can Impact Our Soil are as Follows

1. Chelators in soil increase the solubility, and thus availability of certain metal micronutrients to plants. For example, in soil with high pH levels, chelating agents will bind insoluble iron, converting it into a water-soluble form that is available for plant uptake.
2. Chelating agents prevent chemical reactions that turn some nutrients into insoluble compounds that are unavailable to plants.
3. Chelates can reduce the toxicity of some metal ions to plants by returning their concentration to normal beneficial levels.
4. Chelates prevent loss of nutrients through leaching, or wash out.
5. Chelation increases the mobility of nutrients in soil. This increased mobility enhances the uptake of nutrients by plants.
6. Chelating agents reduce the growth of plant pathogens by reducing available iron.

Examples of Some Chelating Agents

Inorganic:

a. EDTA (Ethylenediaminetetraacetic acid)
b. GCG (L-5-glutamyl-L-cysteinylglycine)
c. NTTA (Nitrilotris(methylene)triphosphonic acid)
d. TMDTA (Trimethylenedinitrilotetraacetic acid)
e. DTPA (Diethylene triaminepenta acetic acid)
f. NTA (Nitrilo tri acetic acid)

Organic:

a. Formic, Succinic, Oxalic, Citric, Acetic, Humic, and Fulvic acids.
b. Glycine, Cysteine.

Conclusion

Thus, chelation is significant process taking place in a soil that increases the availability of nutrient elements which actually were not available to the plants and hence protects the plants from the deficiency symptoms which otherwise would have caused in absence of these nutrient elements.

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Tinospora Cordifolia (Giloy): One Plant, Many Roles

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Abstract

Ayurveda, natural products with medicinal value are gradually gaining importance due to their well-known property of no side effects as compared to drugs. Giloy is an herb that helps to boost immunity. It has heart-shaped leaves that resemble betel leaves.

Giloy powder, Kadha (tea) or tablets can be used for various skin problems as it helps to remove toxins from the body. Giloy is rich in nutritional and therapeutic values. It is consumed by the people in the form of decoction to cure certain ailments. The plant is well known for its phyto-chemical constituents. The stem of Giloy is considered highly effective because of its high nutritional content and the alkaloids found in it but the root and leaves also can be used. According to a shloka of Charak Samhita, Giloy is one of the main herbs with a bitter taste. It is used in various disorders and also helps to alleviate Vatt and Kapha dosha.

Keywords: Ayurveda, Climbing Herb,Giloy, Immunity plant.

Introduction

Tinospora cordifolia commonly named as "Guduchi" in Sanskrit belonging to family Menispermaceae is a genetically diverse, large, deciduous climbing shrub with greenish yellow typical flowers, found at higher altitude. A variety of active components derived from the plant like alkaloids, steroids, diterpenoid lactones, aliphatic, and glycosides have been isolated from the different parts of the plant body, including root, stem, and whole plant. Recently, the plant is of great interest to across the globe because of its reportant medicinal properties like anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritic, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, anti-malarial, hepatoprotective, immunomodulatory and anti-neoplastic activities.

Figure 1: Giloy Leaves

Tinospora cordifolia commonly known as Giloy, a Hindu mythological term is referring to the heavenly Elixir. Giloy is used in the traditional medicinal system since ages. Its stem and roots are used as herbal remedies. The plant is a large, glabrous, deciduous climbing shrub and distributed throughout sub-tropical and tropical Indian sub-continent, extending from the Himalayas down to the southern part of India. It is a best remedy for children suffering from upper respiratory tract infections. The crude extract of dry stem of Tinospora cordifolia enhanced immune responses and has anti- hyperglycemic properties.

Extensively used in Ayurvedic medicine, Giloy is often called the "root of immortality". The herb has numerous health benefits. It is a powerhouse of antioxidants, which fight free radicals and thus reduces the risk of deadly diseases like cancer. Since the onset of the corona virus pandemic, people have started using more and more ayurvedic herbs. And one of the most commonly used ayurvedic herbs to boost immunity, which is our prime concern right now, is Giloy. Giloy removes toxins from the body, purifies the blood and fights bacteria. It is especially beneficial for people with liver disease. It is antipyretic in nature, which means it can reduce fever and ease the symptoms of life-threatening fevers like dengue, swine flu and malaria.

Tinospora cordifolia is very important medicinal plant which holds a special position in Ayurvedic system of medicines for prevention and treatments of various human ailments. Because of presence of various kinds of phytochemicals in Giloy, it has found applications in pharmaceutical chemistry due to its antiosteoporetic, hepatoprotective, immunomodulatory, antihyperglycemic, anti-tumor, anti-HIV properties.

Health Benefits of Giloy

With a slightly bitter taste, the stem of the Giloy plant is said to have potent nutritional benefits. The roots and leaves also promise numerous benefits and alleviate health problems. The best benefits of consuming the wonderful herb regularly are:

1. Works as Excellent Fever Reliever: The natural way to bring fever down, look no further than Giloy. Both ayurveda and modern science support the working of Giloy in bringing down the temperature and cooling the body down, particularly in chronic, recurrent cases. Since Giloy has antipyretic and anti-inflammatory properties in it, it helps to boost immunity, act down on inflammation (which results in fever or spiked up the temperature) and reduces body heat. Ayurveda also suggests that Giloy works to remove the toxic 'Ama' in the body, which is caused by improper digestion or consumption of unsuited foreign particles. Thus, by keeping toxins away and regulating body temperature, Giloy works to keep inflammation level under control and keeps a person healthy. Drinking Giloy twice a day can help fight with fever when battling with an infection. It can also suit kids who do not like taking medicines.

Figure 2 Giloy Stems

2. For Corona-Virus Infection: Giloy can boost immunity hence it may be useful for various fevers specifically for viral fevers like corona infection. Though there is no evidence that Giloy can cure corona infection but it can raise immunity to fight against it.

3. Boosts Immunity: This herb activates the immune system of body and increase vitality in a person. Include Giloy juice or kadha in daily diet twice a day can improve immunity level. It is full of antioxidants and helps to release toxins from the body. Giloy juice also detoxifies and improves skin. Giloy is also used for liver diseases, urinary tract infections, and heart-related issues.

4. Ads Digestion: Giloy also works wonderfully to root out problems related to digestion and gut functioning. According to multiple studies and researches conducted worldwide, Giloy, with its vitalizing properties can aid digestion, prevent problems such as stomach infection, diarrhea, acidity, nausea as well as colitis, with regular intake. It also takes care of stress levels, which can also cause gut problems and indigestion.

Figure 3 Giloy Juice

5. Vitalize Heart and Body: People who are disturbed by problems of chronic fatigue and exhaustion are often advised to add supplements like Giloy to their diet plan. Giloy is wonderful for heart and works to revitalize the entire body. It reduces stress levels, fights toxins, alleviates anxiety and its soothing properties can calm the body down. Frequent consumption of powerful natural herbs like Giloy can also boost mental power, memory and cognitive functions.

6. Keeps Immune System Young and Healthy: One of the strongest reasons behind the Giloy in the modern days is the benefits it carries for one's immunity. Not only does the herb fight infections and toxins naturally, but it also contains immune modulator effects which keep the immune system in good shape, boost its power and strengthen the metabolism. A strong and healthy immune system acts as our first line of defense and keeps many illnesses and germs at bay. Consumption of Giloy and other immunity-boosting herbs should be increased after an age, or for people who are bogged by problems of frail or bad immunity.Since it vitalizes and recharges the immune system, Giloy is also used to treat certain liver, urinary tract and gut infections.

7. Treats Arthritis and Gout: Giloy contains anti-inflammatory and anti-arthritic properties which help to reduce arthritis and gout. Giloy powder with warm milk helps in joint pain.

8. Improves Eye-Sight: Giloy is very effective to improve eye-sight when applying topically. It is usually used in Panch karma. Boiling Giloy powder or Giloy leaves in water, once it cools down apply it over the eyes. Giloy herb doesn't have any side-effects. However, when taken Giloy with other diabetic medications it may lead to low blood sugar levels. According to traditional beliefs, Giloy mixed with water can be applied on eyelids, or consumed regularly to bring benefits for vision and improve eyesight.

Figure 4: Neem Giloy

9. Rich in Antioxidants, Anti-cancer Properties: Giloy also contains a strong dose of antioxidants and anti-inflammatory agents which promote healthy living. Small studies have suggested that Giloy can act as a good anti-cancer drug. Animal studies have showcased that administrating part of the Giloy root, which contains a natural chemical called Tinospora cordifolia could bring down the size of metastatic potential of melanoma cells. A pilot study done by researchers based out of AIIMS also found that certain Ayurvedic drugs, such as Giloy could be really helpful in treating cancer and improving health for patients who were administered strong chemotherapy.

Figure 5. Giloy for Health

10. Helps to Balance Blood Sugar Level: In Ayurveda, Giloy is known as a 'Madhunashini' which means 'destroyer of sugar'. It helps to enhance the production of insulin which ultimately controls the blood sugar level. Giloy is also useful for diabetes complications like ulcers and kidney problems, there is yet another benefit for people suffering from pre diabetes and related health problems. According to Ayurvedic experts, Giloy acts as a hypoglycemic agent and helps treat type 2 diabetes. Giloy juice has shown wonderful results in people with high blood sugar level. Regular consumption can also manage and prevent additional problems which may flare up with uncontrolled blood sugar- such as obesity, inflammation and may even slow down age.

11. Health Rejuvenator: This medicinal herb is a health rejuvenator which is also widely known for its effective in enhancing natural immunity to fight against a number of illnesses such as fever, jaundice, skin diseases, constipation and tuberculosis.

12. Anti-Ageing Properties: The anti-ageing properties in Giloy helps in reducing wrinkles, dark spots, fine lines and pimples resulting in flawless and glowing skin.

Ways to Include Giloy in Daily Diet

1. With Milk and Ginger: Giloy works wonder for joint pain when boiled with milk. The concoction when combined with ginger can treat rheumatism.

2. Chew Giloy Stem: The easiest way to consume Giloy is by chewing on its stem. This method works great for people suffering from asthma. Asthmatics can also try Giloy juice to ease the symptoms.

3. Apply on Eyes: Giloy extract can boost the vision. Boiling some Giloy powder and let it cool. Soak a cotton pad in it and then apply over eyelids.

4. Drink Giloy Shot: Giloy shot mixed with some Alma, ginger and black salt to boost immunity power. Blend the ingredients, along with some water and churn it well and consume the mixture.

5. Giloy Juice: Boil Giloy stems in a glass of water until the water is reduced to half of its quantity. Strain the water and consume it daily. This will help in purifying blood, remove toxins and fight the disease-causing bacteria.

The Best Way to have Giloy

Giloy is widely used and available in many forms- be it the root, powder or capsules or syrups. An individual can choose to have Giloy root in its entirety, have it as a daily supplement or use the powdered version of immunity booster. Giloy can be used daily, safely in variety of ways. While the most commonly used way is to mix Giloy powder in milk or water and consume it regularly. People also prefer having giloy juice on an empty stomach, first thing in the morning. Making a giloy kadha (concoction), in addition to other spices and herbs is a wonderful way to enrich diet with goodness.

Conclusion

Even-though, there are many herbal plants in the world, Giloy is considered to be having greater medicinal value. The pharmacological actions attributed to Tinospora cordifolia in Ayurvedic texts have evidences suggesting that this drug has immense potential in modern pharma co-therapeutics.

The crude extracts from various parts of Giloy have medicinal applications from time immemorial. Tinospora cordifolia can be a potential dietary component which can help in prevention of different diseases. The utility of Giloy leaves in diet is advisable and is highly beneficial.

Tinospora cordifolia is very important medicinal plant which holds a special position in Ayurvedic system of medicines for prevention and treatments of various human ailments. Because of presence of various kinds of phyto chemicals in Giloy, it has found applications in pharmaceutical chemistry due to its various properties.

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Water Management Options for Shallow Black Soils with Special Reference to Madhya Pradesh-A Review

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Abstract

Black soils form a major soil group of India, covering a total area of about 72.9 million hectares (22.2% of total geographical area) spread over 80 45' and 260 0' N latitudes and 680 0' and 830 45' E longitude. Soils possessing depth ranging from 30 to 50 cm are designated as shallow black soils; those having depth ranging from 50 to 120 cm as medium black soils; and those with depth in excess of 120 cm as deep black soils. Shallow black soils occupy about 7.1 percent of the total geographical area of the state of Madhya Pradesh. The soils are generally fertile and possess physical and hydraulic properties conducive to crop growth under irrigated agriculture. They suffer from the limitations of shallow depth, low moisture storage capacity of the profile, shallow root zone and proneness to erosion. Reasonably good yields can be obtained it water management practices and irrigation systems are designed with due consideration to the nature and limitations of these soils. The properties of shallow black and their implications in irrigation management have been reviewed and discussed in the present paper.

Keywords: Shallow black soils, water management, IW/CPE ratio.

Introduction

The state of Madhya Pradesh occupies about 23% of the gross area under black clay soils (Murthy et al. 1982) in the country. The area amounts to 16.7 m ha which is about 47.6% of the total geographical area (44.3 m ha) of the state. This major soil group is subdivided into deep, medium and shallow soils depending on the soil depth which according an estimate cover 3.5-, 37- and 7.1 percent of the total geographical area of the state. Thus, almost 1/3 of the area under black soils is classified under shallow black soils mainly spread over Satpura ridge comprising of districts of Seoni, Chhindwara, Betul, and parts of Nimar valley comprising of the districts of Khandwa, Khargone, Jhabua and Dhar of the state of Madhya Pradesh.

The extent of shallow black soils in the state of Madhya Pradesh therefore is quite significant. These soils represent a valuable natural resource if managed scientifically. Adoption of an integrated approach comprising of suitable soil, water and crop management practices can lead to economically viable exploitation of these soils without impairing their health. Shallow black soils, though represent a distinct class of black soils, they share the same percentage and hence resemble medium or even deep black soils in many respects, yet they differ significantly in morphological make up, depth, relief and related properties. An attempt has been made here to discuss in brief the physicochemical nature, soil water relations of shallow black soils and water management practices relevant to such soils.

Chemical Properties

The shallow black soils are rich in montmorillontic clay which imparts high cation exchange capacity (CEC). The clay content of these soils varies from 30 to 45 percent. The CEC values commonly encountered range from 25 to 45 me /100g. The soils may or may not be calcareous. Soil pH (1:2) ranges from 6.0 to 7.8. They are usually well drained and therefore do not exhibit accumulation of salts in excessive amounts. Organic carbon content is low and ranges from 0.4 to 0.5%. The soils are generally low in available nitrogen and phosphorus and high in potassium.

Physical Properties

1. Soil Texture: A typical shallow black soil (Kamalia Kheri Series) contains sand, silt and clay in the range of 18 to 20, 16 to 40 and 30 to 50 percent, respectively. The clay content tends to increase whereas silt content decreases with soil depth (Table 1)

Table 1: Physicochemical properties of shallow black soils (Kamlia Kheri Series) of Malwa (Tomar et.al 1983):

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Texture	pH2	EC2 ds m-1	O. C. (%)	CaCO3 (%)	Bulk density (g-cm-3)
Soil Profile 1: (College of Agriculture Farm, Indore, M.P.)									
0-6	18.5	37.4	44.1	Clay	7.2	0.1	1.0	2	1.15
6-17	16.9	35.9	47.2	,,	7.4	0.12	0.70	2.3	1.30
17-40	15.5	33.4	51.1	,,	7.6	0.15	0.42	2.8	1.34
40-46	19.4	32.0	48.6	,,	7.6	0.13	0.45	3.0	1.42
46+									
Soil Profile 2: Jambudi-Habsi Village of Indore district, M.P.									
0-10	17.3	38.3	44.4	Clay	7.3	0.08	0.42	2.0	0.85
10-21	16.0	39.0	45.0	,,	7.4	0.08	0.48	2.8	1.02
21-38	14.2	32.3	53.6	,,	7.6	0.06	0.39	2.0	1.16
38-45	18.5	31.2	50.3	,,	7.6	0.05	0.34	1.8	1.28
45+	51.2	16.3	33.5	Scl	7.7	0.10	0.27	2.0	-

2. Bulk density: The bulk density of the soils tends to increase with soil depth as is the case with deep black soils. The bulk density however ranges from about 1 to 1.5 gcm-3 suggesting low impedance for tillage and root penetration. The bulk density of these soils, however depends besides other factors, on prevailing soil moisture content being low under wet moisture regime.

3. Moisture retention characteristics: The moisture retention characteristics of a soil reveal the amount of water a soil can retain under a given tension or suction. The slope of a moisture content- suction curve at a given suction indicates the amount of moisture released per unit increase in suction from a known soil volume. Both the amount of water retained by a soil at a given suction and the rate of moisture release determine the plant available water which is not necessarily the difference between 1/3 bare and 15 bar percentages as commonly believed.

The moisture retention characteristics of shallow black soils may also exhibit changes with depth in view of the increasing clay content and bulk density (Table 1.) which imply the depth dependence of pore size distribution. Table.2 depicts the laboratory estimated moisture retention in soils representing a shallow black soil of Malwa (Kamalia Kheri Series). The 1/3 bar percentage considered to be the upper limit of available water ranges from about 28 to 40 cm m-1 whereas the 15-bar moisture content varies depending on soil bulk density from 20 to 30 cm m-1. The difference between 1/3 and 15 bar moisture content therefore ranges from 8.5 to 10.5 cm m-1. The actual amount of water a shallow black soil would release between 1/3 and 15 bar suction would be much less. For a soil depth of about 45 to 50 cm, it is only 4 to 5 cm.

It must be remembered that the laboratory estimates of 1/3 bar and 15 bar moisture contents of black swell-shrink type) soils are at a considerable variance from field measured values. The 1/3 bar moisture content under field conditions is less in comparison to the laboratory estimated values (Gupta et al. 1981). The soil moisture content (ϴ) suction (h) relationship of the form; h= he (ϴ/ ϴs)–b seems to describe fairly well the moisture retention characteristics of these soils. The value of 'he' is usually between 30-50, mb varies from 4.3 for the upper layers to about 6 for the lower (20-50 cm) layers (Sharma et al. 1983). 'ϴs' is the volumetric moisture content at saturation. 'h' and he are in mb.

Table 2: Laboratory estimated moisture retention cm.m-1, at different suctions (bars) of Kamaliakheri Series of soil:

Location	Soil depth (cm)	0 bar	0.33 bar	0.5 bar	5 bar	10 bar	15 bar
College of Agriculture Farm, Indore, M.P.	0-4	58.6	40.0	39.1	34.4	29.1	-
	4-8	56.5	41.0	39.7	32.6	28.7	-
	8-12	52.0	39.1	37.6	28.7	29.8	29.7
	12-16	48.0	39.2	38.2	33.1	29.7	29.7
	16-20	51.0	38.5	37.7	31.0	29.0	28.0
Jambudi Habsi village, of Indore, M.P.	0-4	49.7	35	34.3	20.1	20	19.0
	4-8	44.4	31.2	30.3	23.7	21.3	21.2
	8-12	41.4	31.4	30.6	24.4	23.1	23.0
	12-16	16	28.4	27.9	23.4	21.4	20.1
	16-20	38.4	29.2	28.7	25.2	23.9	21.7

4. Water Intake rate or Infiltration rate of water: The intake rate of a soil is a measure of its capacity to take in and absorb irrigation water applied to the soil surface during the period of application. The amount of moisture already in the soil greatly influences the rate at which water enters the soils. As the irrigation continues, the wetting from advances, the surface soil becomes saturated and the hydraulic potential gradient driving the water into the soil decreases. This results into decrease in the intake rate with time until it reaches a nearly constant value. The terminal intake rate is determined by the soil layer with the lowest transmission rate. The factors which influence intake rate of shallow black soils are given as below:

a. Surface sealing: The soils have fairly high content of swelling type clay. The swelling of the surface soil on wetting seals the shrinkage cracks. In addition, the water dispersible fraction of clay tends to form a thin layer on the ground surface. Both the processes adversely affect the intake rate. The effect is accelerated in the presence of residual sodium carbonates in the irrigation waters or where the soil contains excessive amounts of exchangeable sodium (Gupta and Verma, 1983)

b. Tillage: ploughing and cultivation prior to water application or rains promote infiltration capacity of the soil. Deep ploughing may be resorted to where an underrating layer exists within the active root zone. Coarse soil tilth favors intake rate by reducing run- off.

c. Crop rotation: The intake rate can be maintained or even increased by using a cropping system that provides for incorporating crop residues. Grasses followed by legumes or cereals intercropped with deep rooted crops like pigeon-pea or soybean which help in building up organic carbon are cropping systems that can be followed.

d. Quality of irrigation water: The quality of irrigation water has a direct effect on soil health and on growth and yield of the crop being grown. The amount and nature of soluble salts, residual sodium carbonate content and sodium adsorption ratio of irrigation water influence soil structure, amount of water dispersible clay, swelling characteristics of the soil and exert a direct influence on moisture retention characteristics, water transmission rate (Ranade and Gupta 1987, Gupta and Verma, 1985 Gupta and Verma, 1984) and water intake rate (Gupta and Verma, 1983). The irrigation waters of EC < 2000 micro mhos, RSC< 5 and SAR < 10 are considered safe when water table is fairly deep.

e. Soil erosion: Shallow black soils are quite vulnerable and prone to water erosion because of their location on a catenary sequence or on sloppy lands. Removal of fine soil fragments by flowing waters exposes coarse- textured layers, thereby reducing the moisture retention. The intake rate is increased but the irrigation efficiency is greatly reduced.

The infiltration characteristic of normal shallow black soils is good enough not to pose any serious restriction on their suitability for irrigation on this account. Gupta and Verma. (1983) observed the dependence of cumulative infiltration I (mm) on time, t (minutes) for an initially dry Iceptisol as; I = 6.1 t 0.65 at ESP-6. The alkalinity of the soil led to decrease in cumulative infiltration as; I = 5.7 t 0.5 at ESP-10, I = 5.7 t 0.36 at ESP-16, and I = 4.9 t 0.31 at ESP- 22. Terminal intake rates of 12 mm/hr or higher is not uncommon with these soils.

Determination of Intake Rate

For successful irrigation, studies to determine the intake rate must be made in all irrigated areas in order to improve design criteria and operational techniques. This is essential in view of wide intake rate variability commonly encountered in these soils. The method of determining water intake rate must be matched with the method of irrigation proposed to be used.

1. For sprinkler- irrigation, a good way to determine the intake rate is to measure the water application rate at selected points in the distribution pattern of operating sprinkler. Here the measurements should be delayed until near the end of a normal irrigation at which time the intake rate approaches the minimum value.

2. For furrow and corrugation methods, intake characteristics are usually determined by inflow into and out flow from the lower end of a furrow.

3. For border and other controlled flooding methods of irrigation intake characteristics are often estimated by using cylinder infiltrometers.

Limitations

The shallow black soils, though rich in clay and silt, the most active soil fractions, do possess certain inherent limitations impeding their productivity following conventional soil and water management practices.

1. Low available water holding capacity: As discussed earlier, though the soil has very good moisture retention capacity, the shall depth restricts the moisture retention and availability which other-wise are almost in proportion to the profile depth. A 50 cm deep soil retains about 15 to 20 cm water at field capacity. The amount left at the harvest of a crop (non-available) is of the order of 10-12 cm. Thus almost 40% of the water stored at field capacity is potentially available to a crop. In order to avoid severe adverse effect of soil moisture stress on crop yield , the water depleted by a crop must be replenished at about 50% depletion. This would mean. In essence, more frequent but shallower water applications than usually followed.

2. Shallow root penetration: Since the soil depth is limited, root penetration is restricted to the shallow depth. The crop is therefore solely dependent on relatively small nutrient and water resources. The crops grown on such soils are thus prone to prolonged dry spell and cannot be grown without supplemental irrigation.

3. Appreciable percolation losses: Since the soil couer is relatively thin and the infiltration capacity is good, fairly high aericelation losses are likely to occur during rainy season. This may cause leaching losses of applied nitrogen during kharif season.

4. Soil erosion: The soils are prone to water erosion because of their occurrence on slopy terrain unless special soil water and crop management practices are adopted. In addition to soil loss, the plant nutrients are lost. The Kharif crops grown on such soils are therefore likely to give poor yields.

Land Use

Very shallow soils should preferably be put under grasses, pastures and forestry where- as soils with 20 cm or more depth may be used for agro-forestry, agro horticulture, vegetable crops and other crops.

Irrigation Management

It is obvious that the shallow black soils cannot be subjected to traditional irrigation management. Their limitations and properties must be given due weightage. Among the soil propertied described above, the soil moisture retention and release characteristics are worthy of consideration while deciding depth and formulating schedule of irrigation.

1. Depth of irrigation: As is clear from the foregoing discussion, that even a soil with 50 cm depth cannot retain more than 20 cm water a field capacity. The allowable water depletion (which allows optimum crop yields) is usually taken to be 40 to 50 percent of plant available water which is about 8 cm. The depth of net water application therefore is about 4 cm. The shallower soil would require proportionately less water. The gross water application would be higher as no irrigation system is 100 percent efficient and not all the water during irrigation enters and is held in the root zone. Unavoidable losses are caused by unequal distribution of water over a field, by percolation below the root zone and by waste at the ends of orders and furrows. In sprinkler irrigation, additional losses are caused by evaporation from the spray and by the retention of water on plant foliage. To be sure that the net amount of moisture to be replaced at each irrigation enters and is retained in that root zone, the gross amount to be applied can be determined by as; Gross amount =Net water application / Efficiency of system.

2. Frequency of Irrigation: Irrigation frequency refers to the number of days between water applications. It depends on moisture retention and release characteristics of the soils, consumptive use rate of a crop and prevailing atmospheric conditions. For a given crop and atmospheric evaporability open shallow soils must be irrigated more often than deep soil, the irrigation system must be designed keeping in view the peak period moisture use rate of a crop. Several criteria are available for scheduling irrigation such as

a. Growth stage of the crop.
b. Moisture depletion.
c. Soil moisture suction.
d. Cumulative open pan evaporation.

The open pan-evaporation based irrigation scheduling seems to be convenient as it is simple and easy to estimate open pan evaporation in a field using locally available or low-cost open pans. Irrigation water (IW) to cumulative open pan evaporation (CPE) ratio has been reported to correlate with crop yields as it is evident form Table 3 (Anonymous, 1985).

Table 3: Influence of IW/CPE based irrigation crop yield. (kg/ha.):

IW/CPE	Sunflower	Wheat	Potato	Linseed	Gram
0.4	3100	-	-	783	2325
0.6	3300	3594	+	1250	2351
0.75		3984			
0.80	3240	-	26880	1166	2150
0.90	-	4159	-	-	-
1.0	-	-	26540	-	-
1.05	-	4372	-	-	-
1.5	-	-	31200	-	-

If the depth of irrigation has been fixed on the basis of soil properties as discussed earlier, the cumulative pan evaporation values can be computed and irrigation applied when the computed CPE has occurred. IW/CPE of 0.6 for rabi pulses and oil seeds whereas that of for cereals is usually maintained. The critical crop growth stage criteria would not suit the shallow soils as the depth of irrigation is less than 50% of what is generally used on deep soils. Further the irrigation frequency on shallow soils out numbers the critical growth stages of a crop. Hence it is suggested that IW/CPE ratio (Irrigation water depth / Cumulative pan evaporation ratio) method of scheduling irrigation should be followed.

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Soil-Tool Interaction

Article ID: 10514

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Soil Tool Interaction

Soil-tool interaction defines the process of interaction of soil and tool in tillage operation. Optimization of tillage is one of the major concerns of the soil tool-tool interactions. It is most important factor for considering the designing the various tillage tools. The various factors affect the soil-tool interaction, i.e., soil condition, tool shape, and tool speed. The true shape of the soil failure profile occurring in front of the tool is important in developing soil-tool interaction models useful for the design of implements and tools. The tilth of agricultural soils consists of various structural elements arranged in some hierarchical order (Dexter, 1988). The Soil tool interaction deals with the forces acting on the tool and soil reaction acting upon it. The intra-aggregate structure is characterized by a relatively strong cohesion and a relatively uniform pores size distribution. The reaction of soil to a tillage tool can be quantitively described only by a mechanics. Energy required to force a tillage tool through the soil and to cause displacement of soil. The soil-tool interactions and the field performance of various implements have been extensively studied considering the initial soil condition, tool shape, tool speed and the movement of drawn and power take-off (PTO) driven implements (Perdok and Kouwenhoven, 1994). The true shape of the soil failure profile occurring in front of the tool is important in developing soil–tool interaction models useful for the design of implement and tools (H.P.W. Jayasuriya; V.M. Salokhe).

Factors Affecting the Soil Tool Interaction

The various factors affecting the soil tool interaction as follow below:

1. Tool size.
2. Tool shape.
3. Width of operation.
4. Depth of operation.
5. Speed of operation.
6. Soil conditions.

Initial Soil Condition

The tilt of agricultural soils consists of various structural elements arranged in some hierarchical order (Dexter, 1988). The intra-aggregate structure is characterized by a relatively strong cohesion and a relatively uniform pore size distribution. This is in comparison with the next higher element or clod, constructed on the basis of the smaller aggregates considered. The associated inter-aggregate holes and pores are larger, and accordingly the number of contact points, bridges and binding forces become smaller compared with the intra-aggregate situation.

Soil Consistency

Soil bulk density and moisture content will vary during the agricultural production cycle. When the soil is dry, it produces hard and coarse clods and requires more energy compared with the optimal moisture range. If soil is compacted and kneaded under wet conditions, it displays a plastic behaviour during ‘steady cutting’ under actually wet conditions. High adhering soil-metal forces and degradation of the remaining aggregates in the structure less, wet furrow slice cause an unworkable situation. Drying and shrinkage of the above structure less soil matrix results in a very cohesive rigid soil body.

Tool Movement and Speed

Soil engaging tools and implements are drawn by humans, animals or the tractor drawbar. This generates a straight and steady movement of the implement frame and the tools directly connected to it. The faster the forward speed, the more intensive the tool action. In practice however, speed is limited to 2-3 m/ s.

Soil Moisture

Soil moisture influences soil behavior and the soil condition produced by a tillage tool. For many soils, the coefficient of fiction increases with an increase in soi1moisture up to an intermediate value and then decreases.

1. Angle of interna1 friction of soil(Φ): The sum of the total energy required to overcome interlocking of particles, their sliding and rolling in the soil mass constitutes total frictional energy and is expressed by (⍰), the angle of internal fiction. Angle of internal fiction (⍰) is affected by soil porosity, moisture content, normal stress, and grain size distribution.

2. Cohesion (CS): The nature of soil cohesion is not fully understood. It may be considered as the strength of the soil that does not depend on the applied force. Based on cohesional properties, clay soils are termed "cohesive" soils and soils like sand and grave1 are considered frictional or "non-cohesive" soils.

3. Adhesion: Adhesion is the tension force required at the mutual contact surface of two rigid bodies to separate them. It is the result of bonding forces between the soi1 and other materials. Adhesion decreases with increasing speed and increases with moisture content for clay soil (Staffbrd and Tanner, 1983). Adhesion of the soil to tillage tools causes a normal force on the contact surface. Since the frictional force is a function of the normal load, adhesion increases the frictional force.

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Bacterial Endophytes as Biocontrol Agents

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Endophytes

Endophytes are microbial symbionts residing within the plant for the bulk of their life cycle with none detrimental impact to the host plant. The use of those natural symbionts offers a chance to maximize crop productivity while reducing the environmental impacts of agriculture. Endophytes promote plant growth through organic process, phytohormone production, nutrient acquisition, and by conferring tolerance to abiotic and biotic stresses.

They are found across many phyla, including the *Proteobacteria, Actinobacteria, Firmicutes* and *Bacteroidetes.* Common characteristics of endophytes include the facility to synthesize plant hormones like indole-3-acetic acid, solubilize phosphate, secrete siderophores, and confer plant tolerance to biotic and abiotic stresses. Bacterial endophytes in several genera such as *Azoarcus, Burkholderia, Gluconobacter, Herbaspirillum, Klebsiella, Pantoea,* and *Rahnella* were found in many various plants, facilitating the expansion of the host plant in nutrient poor conditions.

Bacterial endophytes reside within the internal plant tissues which can be a favourable environment for N-fixation that minimizes competition with other microbes in the rhizosphere also as possibly providing a micro aerobic environment that is necessary for nitrogenase activity.

Endophytes colonize all plant parts (in between the spaces of the cell walls and vascular bundles of plant roots, stems and leaves, tissues or flowers, fruits and seeds). Population dynamics of endophyte bacteria may vary from 100 to 9 x10^9 bacteria/g of plant tissue.

Generally, the highest endophytic populations are found in below ground parts in comparison to above ground tissues, the Apo plastic movement of endophytic bacteria from roots to rice leaves has been showed.

Production of Phytohormone

Bacterial endophyte strains promote plant growth by synthesizing phytohormone including indole3-acetic acid (IAA), cytokinins and gibberellins or through regulating internal hormone levels within the plant body. IAA produced by endophytes within plants increases the quantity of lateral and adventitious roots, facilitating access to nutrients, and improving root exudation, offering more resources for soil microbes to interact with roots. Growth enhancement by increasing plant height and/or biomass.

Siderophore Production

Siderophore are organic compounds secreted by microorganisms and plants in iron limited conditions enabling them to chelate iron from the environment for microbial and plant cells to uptake. Some bacteria produce hydroxamate type siderophore, while others produce catecholate types.

Phosphorus-Solubilisation

Phosphorus-solubilizing bacteria can solubilize immobile phosphorus in soil, which is potentially available for plants to absorb, a crucial trait for plant growth promotion.

Enhancing Resistance or Tolerance to the Host Plant

Bacterial endophytes can confer resistance or tolerance to the host plant from biotic and abiotic stresses by releasing antimicrobial compounds, producing siderophore, competing for space and nutrients, and modulating the plant resistance response. Some bacterial strains can relieve plant stress by blocking the pathway of ethylene synthesis in plants. These bacteria utilize 1- aminocyclopropane-1-carboxylate deaminase, which helps to scale back ethylene concentrations accumulated in response to different stresses in plants, otherwise lethal to plant health.

Attachment of Bacterial Endophytes to the Host Plant Surface

Bacteria within the vicinity of the plant roots presumably swim towards the roots, using chemotactic affinities for root exudates. followed by attachment to the basis surface, which is probably going important in getting access to potential entry sites at lateral root emergence areas or other openings caused by wounds or mechanical injuries.

The exopolysaccharides (EPS) synthesized by bacterial cells may facilitate the attachment of bacterial cells onto the idea surface and will be important within the first stages of endophytic colonization. The EPS produced by endophytic bacterium *Gluconacetobacter diazotrophicus* Pal5 was reported as a crucial factor for rice root surface attachment and colonization.

Entry of Bacterial Endophytes into the Host Plant

Openings within the roots where root hairs or lateral roots emerge, also as stomata, wounds and hydathodes within the shoots are considered the foremost entry points that endophytes use to enter the host plant. some bacterial endophytes may modify the plant cell membrane by secreting cell membrane cellulolytic enzymes like cellulases, xylanases, pectinases, and endoglucanases, which facilitate bacterial entry and spread within the plant tissues. natural cracks at the lateral root emergence site are the foremost common entry sites for endophytic bacteria.

Bacterial Niches inside the Host Plant

Bacterial endophytes most frequently occupy intercellular spaces within the plant, presumably because these areas have an abundance of carbohydrates, amino acids, and inorganic nutrients. They likely exclusively colonize the intercellular spaces of varied plant parts including roots, leaves, stems, flowers, and seeds.

In maize plants, bacterial endophytic colonization was stronger within the lower stem compared to the stem closer to the shoot apex. Using green fluorescent protein (GFP) labelling and glucuronidase (GUS) staining, *Burkholderia* sp. strain PsJN was observed in xylem and substomatal chambers of inoculated leaves of grape vine plants.

Colonization of Bacterial Endophytes in the Host Plant

The colonization pattern and growth promoting characteristics of bacterial endophytes in several plant species is different. Some bacterial endophytes also colonize flowers and seeds, and presumably get transferred vertically from the maternal endophyte community into the offspring. The “alien endophytes” can colonize various plant parts and incorporate new functional traits to the phytobiome through horizontal gene transfer with other microorganisms and also eventually end in the loss of traits which cannot be useful to the plant.

Interaction with Pathogens

Endophytes are known to supply various sorts of protections to their host plant, viz., endurance to grow in hot springs, deter herbivores by producing toxic alkaloids. In grasses and provide protection from pests. Endophytes interact with the pathogen in several ways in several hosts, and resultantly, altered physiology may suppress the expansion of the pathogen, alter nutrient balance in favour of endophyte or stimulate the plant’s defence mechanism.

Endophytic species produce antibiotics and antifungal compounds and provide protection against pathogen with reduced severity. In case of banana, endophytic bacteria (*Bacillus amyloliquefaciens, B. subtilis subsp subtilis* and *B. thuringiensis*) provide protection against fungal (*Fusarium oxysporum f. sp cubense* and *Colletotrichum guaranicola*) pathogens.

Endophytes are gaining importance due to their role in plant growth stimulation, protection against biotic and abiotic stresses and pests via modulation of somatotropin signalling, higher seed yield and plant growth hormones.

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Aquifer Mapping and Management for River Revival

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Abstract
Recent evidence shows that monsoon flows in Indian rivers are almost unaffected, but the non-monsoon flows show a declining trend. Ground water (GW) is regarded as a reliable water source in India and continues to be used on a large scale for agriculture, drinking water supply in rural areas and in the industrial sector. This preference has resulted in over exploitation of GW. While near normal GW replenishment is generally attained in the monsoon, lack of proportionate recharge mechanisms and excess exploitation of GW in the Rabi season has led to drying up of wells, tube wells and ponds. As a result, contribution by tributaries to major rivers has decreased leading to decreased flow of major rivers. It is important to understand the relation between water table and non-monsoon flow of rivers and initiate the flow revival movement through combined efforts by the government and the community. The real challenge for river revival is maintaining the continuous discharge of GW into the river. We know that in non-monsoon season, the river flows only because GW is discharged in the river. Discharge takes place only because the lowest point of the regional water table is above the river's bed (which is the lowest point of the area). The moment it drops below river bed level, the discharge stops and therefore flow in the river ceases. Therefore, the challenge of a perennial river is to keep water table above the bed level till next monsoon.

Keywords: Ground water, Replenishment, Aquifer Mapping, Discharge.

Introduction
Artificial underground reservoirs have changed the hydrological cycle from its natural condition. This modification may trigger a series of negative environmental effects both at the local and regional levels. Groundwater environmental impacts are most evident in groundwater level and flow patterns. The diversion of surface water for groundwater recharge results in a reduction of downstream flow.

For flow revival, it is necessary to determine following components:
1. Natural indicators.
2. Average annual rainfall run-off.
3. Monsoon recharge.
4. Non-monsoon flow in the river and its relation with decline of water table.
5. Factors responsible for decline of water table and their quantification.
6. Quantity of water required, its duration and source of availability.
7. Proportionate recharge (During rain and after rainy season).

Study Area
Geomorphology: Jabalpur district can broadly be divided in to three physiographic units:
a. The Vindhyan Tract
b. The South eastern plateaus of the Satpura
c. The Bhitright Range & the associated hill area.

The Bhander & Kaimur ranges of Vindhyan System attains & altitude of 530 mamsl & form the western boundary of the district. The Bhander range is in the form of ery abrupt & step scarp & at the foot of this escarpment flows the Hiran river. The south eastern plateans of satpura are cut across by the Namada its south of Jabalpur & Deccan carps farming flat topped hills cover the whole area of satpuras in south east. The general height of

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table land is 460 mamgl south of Narmada & about 535 mamgl east of Jabalpur. The Bhitrigarh range & associated hill area run across the northern part of the district from south west to north east. It consists of metamorphic rocks & meets the spur of satpuras at almost right angle. These have general elevation of 460 to 550 mamgl. The range forms the watershed between the catchments of Hiran in the south & Katni in the north. Between the high lands of vindhyans in the west & Satpuras in east is low lying alluvial plain farmed due to Narmada & Hiran rivers & is called as the 'Haveli'.

Hydrogeology: District Jabalpur is a home of geology since formations ranging from lower proterozoic to Pleistocene age are exposed in the area different types of aquifers are formed by these rocks in the area main geological units of the area are Archaens, Gondwana, Lameta, Deccan Trap and Narmada alluvium. Occurrence & movement of ground water in hard rocks is mainly controlled by secondary porosity through Joints & fractures. Primary porosity in Gondwana sand stone & vesicular basalts in Deccan Traps play are important role in ground water movement. Lameta are also forming potential aquifers made up of relatively loose & friable shale & sand stone. Ground water in general occursunder unconfined; Semi confined & confined conditions.

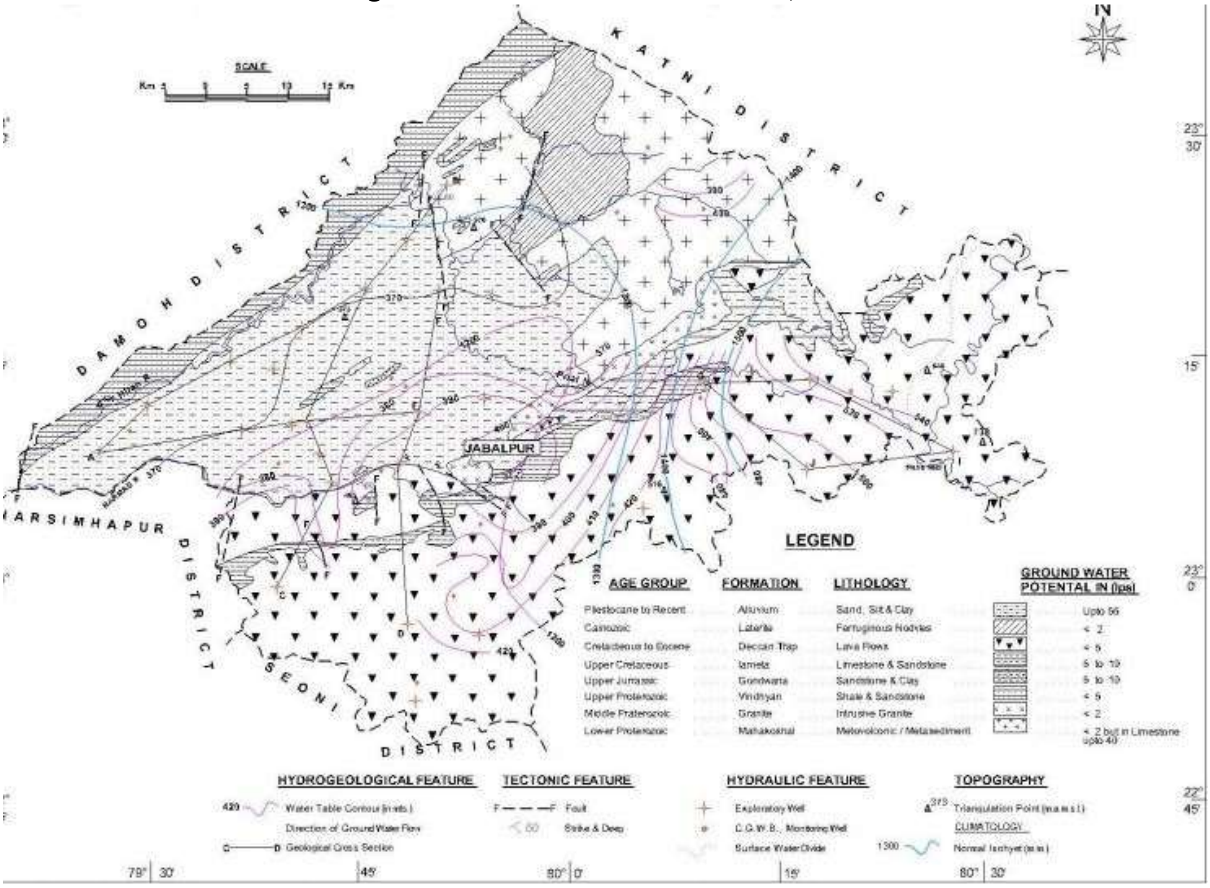

Fig 1: Hydrogeology of the area

What Kind of Maps are Ideal for this Purpose?

1. Basin map of Central Water Commission - These maps are very useful for location of dams and flood forecasting. Can be used when need arises.
2. Maps of Central Ground Water Board - These maps are very useful for Hydrological project. Not useful for revival of flow.
3. Maps of National Watershed Atlas - Map of the fifth unit (Watershed- average area one lakh hectare) of National Watershed Atlas meets the requirement. It may therefore be accepted as an ideal unit. For better planning, execution and management, it should be further sub divided into smaller units.
4. Milli-watersheds (sub-unit of WS) Average Area 5000 to 10,000 hectares.
5. Micro-watersheds (sub-unit of MWS) Average Area 500 to 1,000 hectares.
6. Aquifer Characteristics map

Status of Ground Water Development

Ground water is main source for drinking and Irrigation in the Jabalpur district. About 37.44% of irrigation in the district is from ground water sources. The level of irrigation in the district is 40% with the net sown area. There are 8832 tube wells and 8010 dug wells for irrigation in the district. Depth of dug wells in the district ranges from 5 to 20m. Yield of bore wells vary from 19.3 to 76.4 cum/hour depending upon the hydrogological situations in the area. High yielding tube wells have been encountered which were drilled in the alluvium, Lameta & Gondwana sand stone and their highest discharge was observed 33.30 lpm at Udna (alluvium) 528 lpm at Bijna. Apart from private sources, hand pumps are main source of rural water supply in the district.

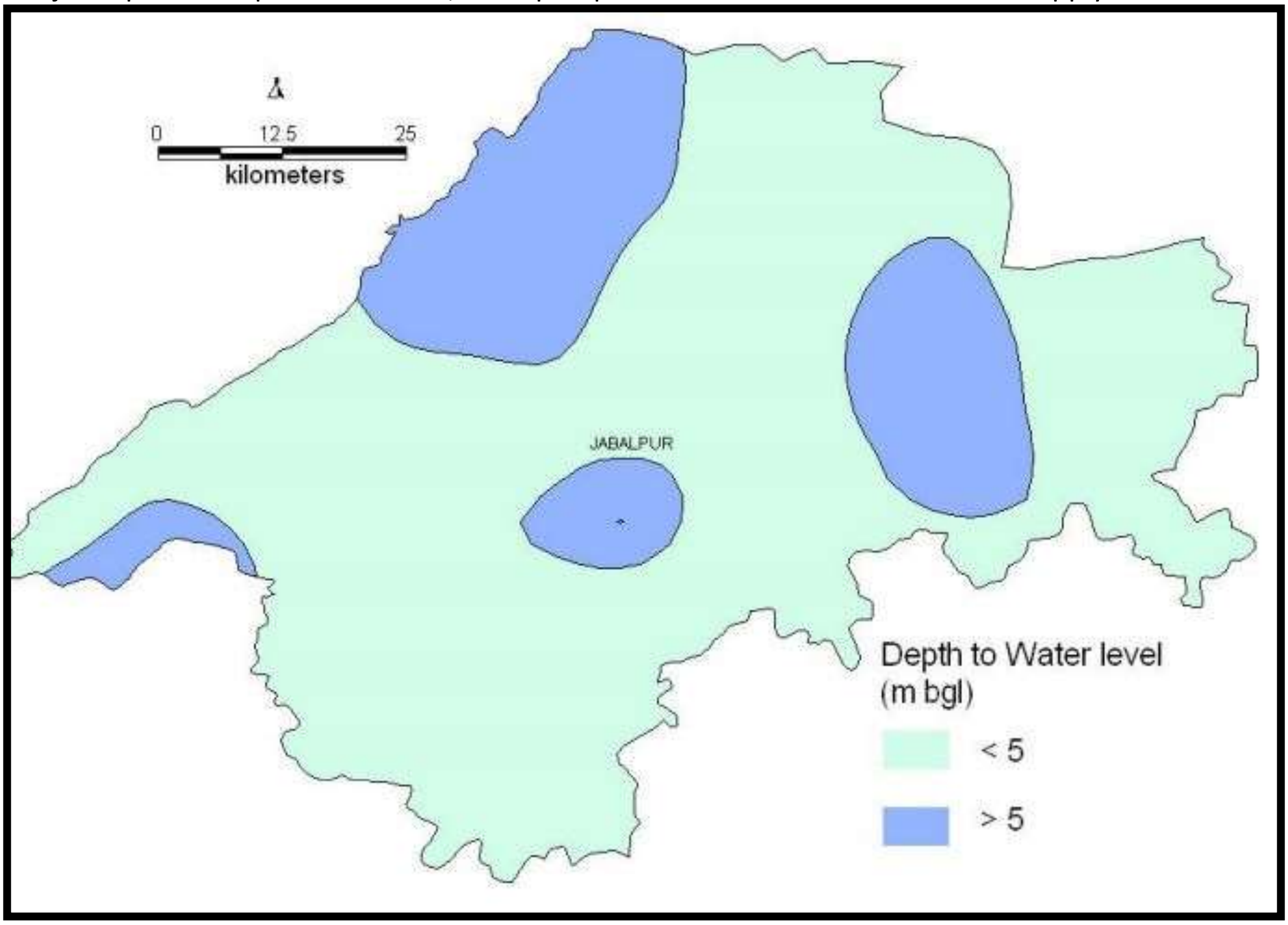

Fig 2 : Depth to water level

Aquifer Management Strategy

Resource Estimation: As per Ground water resource estimation of Jabalpur district for the year 2018/19, the available ground water resources & gross ground water drafts are 556.79 MCM & 251.40 MCM respectively, making stage of ground water development 51% as a whole for the district. Thus, there is arable scope for future development of ground water resources in the district. All the seven blocks namely, Bargi, Kundam, Sihora, Panagar, Majholi, Shahpur & Patan are falling under safe categories. Decadal water level trend analysis reveals mixed of water level during pre & post monsoon reasons.

Water Conservation & Artificial Recharge

Considering hydrogeology situation of the area, there is tremendous scope for artificial recharge work, especially, in ground water depleting areas of Shahpura, Patan Shihora, Majholi & Bargi blocks. At present stage of ground water development in the district is only 32% in command area and 55.71 in non-command area. The declining trend of water levels is also observed in small Catcher. However, with ever increasing demand for ground water, it is important to not mly safeguard it also.

Hydrogeologically, the district has been broadly grounded in to hard rock area & falling mostly in panager, Jabalpur, Kundan, Sihora & Majholi blocks & the alluvial areas falling in Patan & Shahpura blocks.

In hilly & hard rock areas plan may be adopted using hill to valley approach in a watershed at origin of streams structure like gully plugs & contour trenches may be constructed to arrest surface water runoff. Gabion structures may be constricted at down streams of these structures, across the stream using local boulders & wire mesh to check the velocity of flowing water & to store water in upstream side of their strictures. Percolation tanks are most important structures from ground water recharge point of view. Percolation tanks are recommended in second & third order streams on porous & permeable formations.

Foundation of these structures should not rest on hard & compact or on impermeable formations & water should be allowed to seep below stream bed to recharge ground water body at subsurface. It is quite possible that in due course of time infiltration of water from percolation tank is reduced due to silt deposition inside the structures to over-come this problem, recharge shaft may be constricted inside percolation tanks to allow continuous Seepage of water from the structure to ground water system of the area. Recharge shafts can be constructed using Hume pipes of the diameter from 1 to 3 m structures.

Recharge shafts can also be contracted in those places where impervious formations are occurring of surface & at shallow. Depths porous & permeable rocks are found. Properly designed tube wells also act as recharge shorts to recharge deeper aquifers. Sub-surface dykes are water conservation structures constructed at suitable hydrogological locations across the river beds at end of water shed to check sub-surface flow of water along stream beds. Dug wells recharge is also applicable in rural areas. In this system water from fields is diverted in to recharge well passing through de-salutation chamber & filter media. In alluvial areas, recharge shafts are appropriate. Other structures like contour trenches, gabion structures & nalla bunds etc can be constructed in the entire area.

Conclusion

Under present conditions, it is very difficult to revive non-monsoon flows and ensure its sustainability only through technical interventions. It is therefore desirable to manage it with community support and maintain:

1. Balance between demand and supply
2. Sustain environmental flows
3. Encourage wise use

It is important to ensure:

a. Conjunctive use of Surface Water (SW) and Groundwater (GW) – balance in use.
b. Use designs that fulfil natural responsibilities of a river vis-à-vis meet requirements.
c. Focus on Organic/traditional/natural agriculture.
d. Develop properties that enhance moisture retention in the soil.
e. Develop and use indigenous seeds whose water requirement is low and yield is adequate.
f. Focus on water efficiency.
g. Sprinkler irrigation.
h. Focus on efforts to maintain good water quality.

Expected Benefits

1. Reduction in stage of pollution.
2. Improvement in water availability. Jal Swaraj.
3. Availability of environmental flow.
4. Revival of biodiversity.
5. Revival of naturally self-cleaning capabilities of the river.
6. Reduction in water borne diseases and having healthy communities.
7. Employment generation for river dependent communities.

8. Development of balanced and safe model.
9. Improved water availability in ponds, wells and tube wells.
10. Reduction in water scarcity and migration.
11. Reduction in pressure on metros for meeting basic amenities and employment of rural population.
12. Many other direct and indirect benefits.

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Trichoderma as a Potential Biocontrol Agent - A Review

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Abstract

Trichoderma is widely used as biocontrol agent against different kinds of plant pathogens. Trichoderma spp. is asexual fungi that are present in all types of agricultural soils and also in decaying wood. The hostile activity of Trichoderma species showed that it is parasitic on many soil-borne and foliar plant pathogens. Recent studies showed that this fungus not only acts as biocontrol agent but also stimulates plant resistance, plant growth and development resulting in an increase in crop production. The antagonistic activity involves mycoparasitism, antibiotics, competition for nutrients and also induces systemic resistance in plants. Currently, Trichoderma spp. is being used to control plant diseases in sustainable disease management system. This paper reviews the already published information on Trichoderma as biocontrol agent, its biocontrol activity and its commercial production and application in plant disease management programs.

Keywords: Biocontrol, Nutrient, Trichoderma, Soil.

Introduction

Bio control refers to the reduction in plant pest population by naturally occurring organisms that are part of integrated disease management. Bio control agent of plant pathogens known as antagonist inspires development and research work in many fields to meet the needs of rising human population by managing the pest. These antagonistic microorganisms belong to various groups of fungi and bacteria while plant pests include plant pathogens, weeds, and insects. Trichoderma attacked other plant pathogenic fungi and promotes plant and root growth. It uses different mechanisms for the control of plant pathogenic pathogens including antibiosis, mycoparasitism, the induced resistance of host cell and competition for nutrient and space. Species of Trichoderma can control and antagonize broad range of economically important postharvest phytopathogenic fungal pathogens and plant-pathogenic fungi as well as also control bacteria and viruses (Harman, 2006). Significant information on nutrition of Trichoderma is available in literature but very little is well-known about specific carbon and nitrogen nutrients on mass production of Trichoderma antagonists (Rajput *et al.,* 2014). Trichoderma spp. not only controlled pathogens, they also enhance plant growth and root development (biofertilizer) and stimulate plant defence mechanisms (Harman *et al.,* 2004). Some Trichoderma strains have been shown to penetrate the epidermis and establish robust and long-lasting colonization of root surfaces. Trichoderma spp. has been shown to improve growth of lettuce, tomato, and pepper plants (Vinale *et al.,* 2008). Trichoderma spp. also produced gluconic and citric acids, decreased the soil pH, and enhanced the solubilization of phosphates, micronutrients, and mineral components such as iron, magnesium, and manganese (Vinale *et al.,* 2008). Some species of Trichoderma such as *T. asperllum, T. atroviridae, T. virens, T. harzianum* are widely used as biological control agents of plant pathogens. Table 1 shows the various controlled by Trichoderma species as Biocontrol agent.

Table: 1. Various diseases controlled by *Trichoderma* spp:

Crop	Disease	Pathogen	References
Apple	Ring rot White root rot	*Botryosphaeria beregeriana f.sp.* piricola *Dematophora necatrix*	Kexiang et al., 2002
Beans	web blight of beans	*Sclerotinia sclerotiorum*	Amin et al., 2010

Chickpea	Wilt, wilt complex Root rot	*Fusarium, Sclerotium, Rhizoctonia* *Rhizoctonia solani*	Gupta et al., 2005
Chilli	Dry root rot	*Rhizoctonia solani*	Bunker and Mathur (2001)
Guava	Die back	*Lasiodiplodia theobromae*	Yadav and Majumdar (2005)
Pigeon pea	Wilt	*Fusarium udum*	Chaudhary and Prajapati (2004)
Potato	Black Scurf Bacterial brown rot	*Rhizoctonia solani* *Fusarium and Phoma spp.*	Gogoi et al., 2007
Rice	Sheath blight Bakanae	*Rhizoctonia solani* *Fusarium moniliforme*	Biswas and Datta (2013) Ng et al., 2015
Tomato	Fusarium wilt Crown, stem and root rot diseases Collar rot of Tomato	*Fusarium oxysporum f.sp. lycopersici* *Rhizoctonia solani, Sclerotinia spp. and Pythium* *Sclerotium rolfsii*	Komy et al., 2015 Marzano et al.,2013 Amin et al., 2010
Wheat	Leaf blight Loose smut	*Alternaria triticina* *Ustilago segetum*	Parveen and Kumar (2004) Singh (2004)

Conclusion

Biological control gives the impression of an alternative to chemical-based pesticides for disease suppression and control. Scientists and their research have proved that Trichoderma is non-pathogenic to plants and need to be formulated in a way that favors the activity and survival of microbes. Moreover, the novel concept of bio control needs a space outside the laboratory to see its fruits in present production systems. The novel technologies in all areas of agriculture have improved agricultural production, but some modern practices affect the environment. The recent challenge faced by advanced farming is to achieve higher yields in an environment-friendly manner. Thus, there is an immediate need to find eco-friendly solutions. Among various types of species being used as biocontrol agents, Trichoderma is widely used as biocontrol agent against different kinds of plant pathogens.

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Post-Harvest Handling in Turmeric

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Turmeric is a product of *Curcuma longa*, a rhizomatous herbaceous perennial plant belonging to the family Zingiberaceae, which is native to tropical South Asia. Turmeric is known as haldi, gelbwurzel, safran des Indes, dilau, and curcuma acafrao, yellow or golden ginger. The rhizomes of this plant, when dried and ground provide a yellow and flavourful powder, used for centuries as a natural colouring agent in food, cosmetics and textiles, as a flavouring compound and also as insect repellent and as an Indian medicine.

Composition

More than 100 components have been isolated from turmeric. The main component of the root is a volatile oil, containing turmerone, and there are other colouring agents called curcuminoids in turmeric. Curcuminoids consist of curcumin demethoxycurcumin, 5'-methoxycurcumin, and dihydrocurcumin, which are found to be natural antioxidants curcumin (5–6.6%), extraneous matter (<0.5% by weight), mould (<3%), and volatile oils (<3.5%). Volatile oils include d-α-phellandrene, d-sabinene, cinol, borneol, zingiberene, and sesquiterpenes.

Nutritional analysis showed that 100 g of turmeric contains 390 kcalof carbohydrates, 10 g total fat, 3 g saturated fat, 0 mg cholesterol, 0.2 g calcium, 0.26 g phosphorous, 10 mg sodium, 2500 mg potassium, 47.5 mg iron, 0.9 mg thiamine, 0.19 mg riboflavin, 4.8 mg niacin, 50 mg ascorbic acid, 69.9 g total carbohydrates, 21 g dietary fibre, 3 g sugars, and 8 g protein (Balakrishnan 2007).

Post-Harvest Handling

Harvesting: Turmeric readiness for harvest is indicated by the drying of the plant and stem, approximately 7 to 10 months after planting, depending on cultivar, soil and growing conditions. The rhizome bunches are carefully dug out manually with a spade, or the soil is first loosening with a small digger, and clumps manually lifted. It is better to cut the leaves before lifting the rhizomes. Rhizomes are cleaned from adhering soil by soaking in water, and long roots are removed as well as leaf scales. Rhizomes are then further cured and processed, or stored for the next year's planting. Rhizomes for seed purposes must be stored in well-ventilated rooms to minimize rot, but covered with the plant dry leaves to prevent dehydration. They can also be stored in pits covered with sawdust, sand, or panal (Glycosmis pentaphylla) leaves that may act as insect repellent. (Anandaraj et al.,2001) The Indian Institute of Spice Research recommends the following fungicides as a pre-storage dip treatment for rhizome seeds quinalphos at 0.075%, and mancozeb at 0.3%.

Curing: Turmeric rhizomes are cured before drying. Curing involves boiling the rhizomes until soft. It is performed to gelatinize the starch for a more uniform drying, and to remove the fresh earthy odor. During this process, the coloring material is diffused uniformly through the rhizome. The Indian Institute of Spice Research, Calicut, Kerala, and the Agricultural Technology Information Centre simply recommend boiling in water for 45 min to one hour, until froth appears at the surface and the typical turmeric aroma is released. They report the color deteriorates as a result of over-cooking, but that the rhizome becomes brittle when undercooked. Optimum cooking is attained when the rhizome yields to finger pressure and can be perforated by a blunt piece of wood. Boiling in alkaline water by adding 0.05% to 1% sodium carbonate, or lime, may improve the color. For the curing process, it is important to boil batches of equal size rhizomes since different size material would require different cooking times. Practically, fingers and bulbs are cured in separate batches, and bulbs are cut in halves. Cooking may vary from one to four or six hours, depending on the batch size. Curing is more uniform when done with small batches at a time.

It is recommended to use perforated containers that allow smaller batches of 50 to 75 kg, which are immersed in the boiling water; by using this method, the same water may be used for cooking several batches. Curing should be done two or three days after harvest, and should not be delayed to avoid rhizome spoilage. The quality of cured rhizomes is negatively affected for material with higher initial moisture content.

Drying: Cooked fingers or bulbs are dried to a moisture level of 5% to 10%. Sun drying may take 10 to 15 days, and the rhizomes should be spread in 5-7 cm thick layers to minimize direct sunlight that results in surface discoloration. Turmeric is one of the spices for which it is more advantageous to use mechanical driers because of the sensitivity to light. Those can be drums, trays, or continuous parallel or cross-flow hot air tunnels. Like with ginger rhizomes, the optimum drying temperature is 60 ºC.

Grading, packing and storage: Quality specifications are imposed by the importing country, and pertain to cleanliness specifications rather than quality of the spice (see cleanliness specifications in 1.5.1). Proper care must be taken to meet minimum requirements, otherwise a lot may be rejected and need further cleaning and/or disinfection with ethylene oxide or irradiation. Bulk rhizomes are graded into fingers, bulbs and splits.

Storage: Turmeric pigment is highly unstable as compared to the yellow synthetic colorant, tartrazine. However, if protected from light and humidity, the curcuminoid pigments in turmeric powder and oleoresin are stable. Therefore, turmeric rhizomes and powder should be stored away from light and in a very dry environment. Additionally, all water or ethanol solvent should be removed from the oleoresin to assure pigment stability.

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Insect Pests of Kiwi and their Management

Article ID: 10519

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The Kiwi, Actinidia deliciosa, belongs to the family Actinidiaceae and it is originated from China. It is commonly known as Chinese miracle fruit, Chinese gooseberry, Horticultural wonder of New Zealand. Kiwi fruit are rich in protein dissolving enzyme Actidin, it also digests milk protein easily so it is not advised to serve with milks in desert as like papaya and pineapple latex. The kiwi fruit contain high amount of vitamin C and makes it an effective immunity booster. It has been grown commercially in New Zealand, Italy, USA, Japan, Australia, France, Chile and Spain. In India, the highest kiwi cultivation area is in Himachal Pradesh. Whereas, the highest production is in Arunachal Pradesh (National Horticulture Board). Recently, the cultivation of kiwi gaining importance in India. Heavy attack of insect pests results in reduction of fruit quality in kiwi crop cultivating area. The insect pests cause 20% yield losses to the crop (Mckenna et al., 2009).

Brown Headed Caterpillar- *Ctenopseustis obliquana* (Torticidae: Lepidoptera)

The caterpillar webs and feeds on leaves. It also feed on fruits which wither away. Adults are brown to brownish grey with a variable wing pattern. Most individuals have several dark markings along the costa, including a remnant of the median fascia. Hind wings are mottled in both males and females. The total life cycle occupies 60-70 days. The female moth oviposits on leaves in masses and lays up to 150 individual eggs. The egg period is about 9 days. The larvae are green with a dark central stripe and two side stripes with brown colour head. The larval period for male is 32 and female is 36 days. Pupation occurs in the larval nest. Pupal period is about male 16.4 and female 13.8 days. Follow proper training and pruning in the vineyards. The infested leaves should be removed and burned to destroy the eggs and caterpillars. Periodical release of its parasitoids such as *Trigonospila brevifacies, Dolichogenidea tasmanica*, *Braconid wasp*, *Goniozus jacintae* may be useful. Spray application of 0.05% Dichlorvas or Fenitrothion affords protection.

	
Larva	**Adult moth**

Green Headed Leaf Roller- *Planotortrix excessana* (Torticidae: Lepidoptera)

The caterpillar feed on leaves and sometimes on fruits as well. The forewings are pale orange brown to dark reddish brown. The female moth lays eggs on leaves in groups and have on opaque coating on the surface of eggs. The larval head is transparent light brown to green and may have faint brown mottling. The prothoracic shield is pale green with no lateral shading. Pupation takes place within the webbed foliage. The total life cycle occupies 90-110 days, the eggs, larval and pupal periods respectively being 11, 40-54 and 18 days. Management practices similar to that of brown headed caterpillar.

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Larva	**Adult**

Greedy Scale: *Hemiberlasia rapax* (Diaspididae: Hemiptera)

The scale is deep yellow with dark 'V' shape on posterior pygidium. The eggs are generally yellow in colour and laid under the armor of the female. Both nymphs and adults suck the cell sap from the bark and fruit. Sometimes it becomes serious affecting the vigor of the plant considerably and sooty mould development on fruit, causing it to be off grade. Use propagative material that is free of scales. Adequate plant spacing is important because armored scales seldom spread from plant to plant unless the crowns of the plants are in contact. Scraping and scrubbing to remove scales from plants are effective. The green lacewings, minute pirate bugs and ladybird beetle [*Chilocorus bipustulatus, Chilocorus infernalis* and *Chilocorus cacti*] is predaceous on the scale insect. Two sprays of 0.05% Chlorfenvinphos or quinalphos at 7 days interval during scale insect growing season. Periodical spray application of Neem oil @ 2-3 litres per 100 litres of water is very effective.

	
Nymphs and adults of greedy scale	**Nymphs and adults suck the sap from bark**

Passion Vine Hopper: *Scolypopa australi* (Ricaniidae: Hemiptera)

The nymph is greenish with a fluffy tail – visible. The hoppers found abundance during October. The eggs are inserted in plant stems, with relatively soft, dead or dying stems seem to be preferred. Both nymph and adult suck the sap from succulent shoots and the result is distortion of fruit and leaves. Plants will get stunted, wilted and dieback overall. The honey dew excreted by them afford conditions for development of sooty mould on fruits and it was unfit for consumption. The adults are about 5-6 mm long and have broad triangular forewings that are clear with a mottled dark brown-black pattern. The head, thorax (middle part of body) and abdomen are pale brown. They jump if disturbed as well as being able to fly. On the underside of the head the rostrum extends between their legs. Adults take two weeks to mature. The nymph stage lasts about three months. Collect and destroy the damage plant parts along with nymphs and adults. Heavy winter pruning of egg laying sites. Growing companion plants such as geranium and petunia, coriander, marjorams, yarrow and chamomile in and around the leaf.

	
Adult	**Nymphal stages congregates on the bark**

Thrips: *Heliothrips* sp (Thripidae: Thysanoptera)

The larvae and adults infest tender leaves and feed on the causing pale yellow blotches on leaves and later turns into brown. The insect reproduces sexually as well as parthenogenetically. Adults are 1.3 - 1.7 mm in length. Blackish-brown body with lighter posterior abdominal segments and white legs. The female thrips insert the eggs into the leaves. The larvae are whitish in colour with red eyes and later turns into yellow colour but retained red eyes. The larval abdomen is up-turned and has a dot of excrement on it. The excrement can cause spotting on the leaves. Pre-pupa and pupa are whitish to slightly yellow. Larvae resemble adults, but wingless. Periodic release of larval parasitoids- *Thripobius semiluteus* and predators like Predatory mite, predatory thrips, hover fly, mirid bug etc., is very effective. Sprinkling water during nursery stages reduces the multiplication of pest.

Thrips feeding on leaves

Two Spotted Mite: *Tetranychus urticae* (Aracinidea: Tetranychidae)

The adults are oval shaped and red brown in colour. Each female *T. urticae* mite lays 10-20 eggs per day. These eggs are spherical round, white coloured and laid at the bottom of the leaf. The six-legged larvae hatch after 3-15 days. They molt three times within 4-5 days, towards protonymph, then deuteronymph and at last adult. All the instars have eight legs. Life cycle is completed in 1-2 weeks. It is generally found on the lower surface of the leaves. The mite punctures the leaf tissue and the oozing plant sap is sucked. The removal of plant sap with chlorophyll and other plant pigments results in the whitish or silvery-transparent appearance. Predatory mites are *Amblyseius, Metaseiulus*, and Phytoseiulus; ladybird beetles, *Stethorus*; the minute pirate bugs, *Orius*; the thrips, *Leptothrips*; and the lacewing larvae, *Chrysopa. Scolothrips sexmaculatus, Phytoseiulus persimilis* are released to suppress the mite population. Dicofol @ 2.5 ml/l has been found effective in controlling mite's population.

Mites feeding on leaves

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Salient Features and Importance of APMC's In Indian Markets

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Introduction

The concept of an agriculture produce market regulation programme in India dates back to the British Raj: raw cotton was the first farm produce to attract the attention of the Government due to the anxiety of British rulers to make available the supplies of pure cotton at reasonable prices to the textile mills of Manchester (UK). Consequently, India's first regulated market (Karanja) was established in 1886 under the Hyderabad Residency Order, with the first legislation being the Berar Cotton and Grain Market Act of 1887, which empowered British residents to declare any place in the assigned district a market for sale and purchase of agricultural produce and constitute a committee to supervise the regulated markets. This Act became the model for enactment in other parts of the country.

An important landmark in the agricultural marketing scene in the country has been the recommendation of the 1928 Royal Commission on Agriculture for regulation of marketing practices and establishment of regulated markets.[3] One of the measures taken to improve the situation was to regulate the trade practices and to establish market yards in the countryside. In pursuance, Government of India prepared a Model Bill in 1938 and circulated it to all states; however, not much headway was made until India's independence.

During the 1960s and 1970s, most of the states enacted and enforced Agricultural Produce Markets Regulation (APMR) Acts. All primary wholesale assembling markets were brought under the ambit of these Acts. Well laid out market yards and sub-yards were constructed and, for each market area, an Agricultural Produce Market Committee (APMC) was constituted to frame the rules and enforce them. Thus, the organized agricultural marketing came into existence through regulated markets.

In 2015, the year's Union Budget proposed to create a United National Agriculture Market (eNAM) with the help of state governments and NITI Ayog.

The policies, programmes and actions of the government in its efforts to develop and modernize the marketing system for rural area are mainly in three directions:

1. Institutionalizing of agricultural marketing by facilitating the formation of Cooperative marketing societies.
2. Regulation of markets for various agricultural products designed to minimize or eliminate unfair trade practices and
3. Direct involvement of the State in the marketing of certain agricultural products

In order to improve the marketing system along these three lines, certain steps have been taken as encouraging cooperative marketing, establishment of regulated markets, and grading, storage and warehousing. In this connection the role of Agricultural Produce Marketing Committee (APMC) is pivotal in promoting the agricultural marketing.

Agricultural Produce Marketing Committee (APMC)

Agricultural Markets in most parts of the country are established and regulated under the State APMC Acts. The whole geographical area in the State is divided and declared as a market area wherein the markets are managed by the Market Committees constituted by the State Governments. Once a particular area is declared a market area and falls under the jurisdiction of a Market Committee, no person or agency is allowed freely to carry on wholesale marketing activities. The monopoly of Government regulated wholesale markets has prevented development of a competitive marketing system in the country. The agricultural produce marketing committee is a marketing board established by the state governments of India. In order to facilitate farmers, the state government to sale their produce and get reasonable price and constituted APMC in many towns. Most of APMC have market yard where traders and other marketing agents are provided godowns and shops for purchase of agriculture produce from formers. Formers can sail their produce to agents or traders under supervision of APMC.

The Major Role/Functions of the APMC are

1. Grant, renew, refuse, suspend or cancel license.
2. Provide the necessary facilities.
3. Regulate and supervise the auctions.
4. Maintain and manage the markets.
5. Regulate the sales, promote and organize grading and standardization of the agricultural produce and ware housing facilities in the market area.

The APMC Generates Many Benefits to the Farmer Community

1. Farmers get fair price; correct weighing for agricultural produces;
2. Maintenance of daily list of prices of commodities for the benefits of formers and
3. Immediate payment after disposal of the produce (within 24 hrs).

As on 31-3- 2010 the markets covered under regulation is 7177 in India. In addition, there are 27924 rural periodical markets or hats, about 15 percent of these in markets have been brought under the ambit of the regulation.

Some of the Salient Features of the APMC'S

1. Facilitating contract farming model.
2. Special market for perishables
3. Allowing farmers and private persons to set up their own market.
4. Relaxation of licensing norms.
5. Single market fee
6. APMC revenue to be used for improving market infrastructure.

Agricultural Produce Market Committee (APMC) is a statutory market committee constituted by a State Government in respect of trade in certain notified agricultural or horticultural or livestock products, under the Agricultural Produce Market Committee Act issued by that state government.

APMCs are Intended to be Responsible for

1. Ensuring transparency in pricing system and transactions taking place in market area.
2. Providing market-led extension services to farmers.
3. Ensuring payment for agricultural produce sold by farmers on the same day.
4. Promoting agricultural processing including activities for value addition in agricultural produce.
5. Publicizing data on arrivals and rates of agricultural produce brought into the market area for sale.
6. Setup and promote public private partnership in the management of agricultural markets.

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Short Review on Host Pathogen Relationships

Article ID: 10521

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Introduction

Pathogen – A living organism which caused disease in the host.

Parasite – An Organisms that depend on another organism or lives on/in another organism for nutrition.

Plant Parasite – An Organism that becomes intimately associated with the plant and multiplies/grows at the expense of the plant.

Host- A plant those affected by the pathogen and getting suffered or diseased is called host.

Parasitism is a type of symbiotic relationship, or long-term relationship between two species, where one is the parasite and another is host, parasite who gets benefited from the host plant for complete their life cycle and nutrition's. The word parasite comes from the Latin form of the Greek word 'parasitos' meaning "one who eats at the table of another". or

Parasitism is an association or a situation in which two different types of organisms of different characteristics or nature who live together where one enjoys all kind of benefits from another organism. The benefited organism is called the parasite and another organism shelter the parasite is called the host.

Both the factors (Host and Pathogen) are responsible for Host -Pathogen relationship. In the host pathogen relationship pathogen attacks on the host. When pathogen attacks on the host it doesn't mean that disease will be appear on the host because another one factor is also responsible for disease. There are three factors which are responsible to causing a disease. First is Pathogen, second is Host and third is Environment. These three factors cause disease triangle, there are three conditions for disease triangle 1) the pathogen should be virulent, 2) the host should be susceptible and 3) environment should be favorable. These three types of factors and their required condition will be in same manner in that case host plant get suffered or diseased, this condition is called disease triangle.

Hosts are not hospitable to parasites. Instead of that they ponder parasites as foreign bodies or external bodies and want to exterminate or defeat them by producing antibodies by host cell. Parasites to avoid host's reaction for their presence develop many specialties like increased fecundity, polyembryony, safe-habitat, production of special enzymes, a good deal of transmission etc.

Parasitology has been broadly defined as "a study of symbiosis or literally called "existing together". Naturally parasitology is defined as the scientific study about the parasites. A parasite is defined by as "an animal who depend on plant or on another organism and getting its food or nutrition from the host".

Knowledge of the host-parasite relationship between economic plants and microorganisms is phytopathology, so far, the process of getting the knowledge has been slow and difficult, which is indicative of the complex nature of this relationship. Much of this study has been aimed at the description of the resistance mechanism in the host rather than the metabolism and nutritional requirements of the parasite. An exclusion has been the recent passion of interest and detailed investigation into the nutrition of the rust fungi.

The study of the nutrition of fungi parasitic on other fungi is called mycoparasites has to a large extent paralleled that of similar studies of parasites on higher plants, except that it has been more recent and more limited. Parasites that can be cultivated easily on common laboratory media have received major consideration. Only in recent years has the relatively young science of fungus physiology matured to the extent that it could serve as a firm foundation for the more specialized nutritional studies of the parasites recognize to require living hosts for their survival. The success that has been achieved in determining the special nutritional requirements for some of these parasitic fungi is not based so much on improved techniques as on a better understanding of their general basic nutritional needs.

The use of mycoparasites in studies aimed at details of basic principles of parasitism has certain benefits over the use of parasites on higher plants; (a) there is a saving of time and space; (b) the environment can be in strictly controlled environmental conditions; (c) the host nutrition can be under control.

Most of the fungi have been seen growing on other fungi in natural conditions but most of these fungi must be considered simply as fungicolous fungi until a nutritional relationship has been present in the ecosystem.

Host–parasite relationships are the ‘unseen’ part of the natural community posseses, as do predator–prey relationships and inter-specific competition, distribution of species and sufficiency and social connections also. The Parasites and their hosts are always part of ecological communities, and simply as they can’t be pondered in remove from each other they cannot be separated from the communities of which they form a part. No one can understand about Host–parasite relationships or their ecological communities outside the ecological system in reference between which both factors are lives together.

We can think about the Host–parasite relationships as being embedded. The Hosts have always different parasites or pathogens, competitors and predators and each parasite have other hosts or vectors, carriers etc. Hosts are always linked to other species and non-living organism and continues their cycle.

The meaning of the word symbiosis has become controversial among Scientists. Whereas some Scientists believe symbiosis should refer to relationships that are profitable to both factors (mutualistic relationships), others believe it should apply to any type of persistent biological interactions. Consequently, four different types of symbiotic relationships have emerged namely:

1. Parasitism.
2. Mutualism.
3. Commensalism.
4. Phoresis.

Host and Parasite: A Mutual Relation

In the course of time a mutual adjustment or connection or tolerance repeatedly develops between the two which favors them to live together as a sort of compound combination without very serious effect or harm to either.

The virulent types try to eradicate the hosts. But it is necessary to keep the host alive and not to kill it by causing a high degree of pathogenicity. By killing the host, it will finally lead to death of itself also. In that manner Natural Selection leads to the elimination of most virulent species and maintains the less virulent ones.

Effects of Parasites on Hosts

The effects of parasitism on the hosts are intimately associated to the effect of host on the parasites. These impacts depend on various factors, like as—age, diet, genetic factors, susceptibility of the hosts, the size, number and virulence of the parasites, their mortality, migration, and method of feeding.

Parasitism

Parasitism represents a symbiotic relationship in which one member of the association advantages at the expense of the other. Both parasites and pathogens loss the host; however, the pathogen causes a disease, whereas the parasite usually does not. Commensalism happen when one member profits without affecting the other.

Although parasites may avenge harm on their hosts, it is not in the best interest of the parasite to kill its host. A parasite which kills its host has invariably committed “suicide”. Some of the way’s parasites avenge harm on their hosts.

Parasitism usually results from a long history of evolutionary symbiosis between the parasites and the hosts in which both parties are fully conditioned. It is no surprised certainly why incidental parasitism is deadly for both host and the parasites because neither of the two parties is adapted for the co-existence.

Types of Parasitism

1. Ectoparasites: The Parasite may live on the external surface of the host they take nutrients from epidermal and mesophyll cells. Example – *Erisiphe poligony.*

2. Endoparasite: The parasite may grow inside the host cell (intracellular) or in between the cell (intercellular) of the host plant and draw nutrition. Example – *Leveillula Taurica.* They grow in the subcuticular cell's parenchyma tissues or in vascular tissues.

3. Destructive Parasites: Those which get nutrition from the host and often destroy or kill the host. Example – Root rot, wilt causing pathogens.

4. Balanced Parasite: Those which get nutrition without killing the host.

5. Facultative Parasite: These are the organisms which are generally saprophytic in their mode of life but under certain conditions they became parasites. Example – *Pythium* sp. *Rhizopus* sp. *Fusarium* sp. Etc.

6. Facultative Saprophyte: These are the organism which are usually parasites in their mode of life but under certain condition they became saprophytes. Example – Smut fungi, *Phytophthora* sp., *Mucor* sp., *Venturia* sp.

Plant Parasites and Pathogen

The production of enough good quality crops is necessary to human existence. Plant diseases have destroyed crops bringing prevalent famine. Many plant pathogens are fungi that cause tissue deterioration and finally death of the host. In addition to destroying plant tissue directly, some plant pathogens spoil crops by producing humming toxins. Fungi are also responsible for food deterioration and the rotting of stored crops. For example, the fungus Cleviceps purpurea causes ergot, a disease of cereal crops specially in rye. Although the fungus decreases the yield of cereals, the effect of the ergot's alkaline toxins on humans and animals are of much greater importance.

In cattle's, the disease is known as ergotism. The most common sign and symptoms are convulsions, hallucination, gangrene and loss of milk in cattle. The active ingredient of ergot is lysergic acid, which is precursor of the drug LSD. Smuts, rusts and powdery mildew or downy mildew are other examples of common fungal pathogens that affect crops.

Summary

Host parasite relationships become as a outcome of prolonged progressive associations between organisms i.e. organisms evolutive or living with each other in the same atmosphere for a long duration. The limit of association judges the type of relationship which may result. Fungi establish parasitic relationships with plants and animals. Fungal diseases can destroy crops and spoil food during storage. Compounds produced by fungi can be toxic to humans and other animals. Mycoses are infections caused by fungi. Superficial mycoses affect the skin, whereas systemic mycoses spread by the body. Fungal infections are difficult to cure.

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Role of State Agriculture University in Agriculture Development

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Introduction

In India, the first SAU was established in 1960 at Pantnagar in Uttar Pradesh. The SAU's were autonomous organizations with state-wide responsibility for agricultural research, education and training or extension education. These universities became the branches of research under the ICAR and became the partners of the National Agricultural Research System (NARS). The green revolution, with its impressive social and economic impact, witnessed significant contributions from the SAUs, both in terms of trained, scientific work force and the generation of new technologies.

Historical Development of the SAUs in India

In its early phases, the Indian agricultural education system was in the domain of public funded general universities. Agricultural research and education received major support in the first decade of the 20th century when Lord Curzon was the Viceroy of India. By 1905, only six agricultural colleges had been established in Pune (Maharashtra), Kanpur (Uttar Pradesh), Sabour (Bihar), Nagpur (Maharashtra), Faisalabad (now in Pakistan) and Coimbatore (Tamil Nadu) with annual funding of Rs. 2 million by the government of India. These colleges were adequately equipped with staff and laboratories and mandated with research and teaching initiatives. In 1926, the Royal Commission placed emphasis on the importance of a strong research base for agricultural development in India.

The most significant milestone was the establishment of the Imperial (now Indian) Agricultural Research Institute (IARI) at Pusa (Bihar) in 1905. Due to an earthquake in 1934, the Pusa institute was shifted to New Delhi in 1936. The Royal Commission established the autonomous Imperial (now Indian) Council of Agricultural Research (ICAR) in 1929.

It was mandated to promote, guide and coordinate agricultural research with a non-lapsing fund of Rs. 5 million. The establishment of the ICAR empowered agricultural research in India. However, the ICAR had no administrative control on research institutions in the provinces.

The SAUs are headed by a Vice-Chancellor, governed by a board and advised by an advisory committee. The governing boards of the SAUs have representatives from government, farmers and agri-business. Being autonomous organizations, they are able to effectively integrate research and education and carry out their mandate.

The SAUs receive core funds for research and education from the state governments and substantial grants from the national agricultural research council or national institutes. The second National Education Commission (1964-66), at that time headed by the University Grant Commission Chairman, Dr. D. S. Kothari, recommended the establishment of at least one agricultural university in each Indian state. These universities imparted education on all aspects of agriculture on the same residential campus and integrated teaching with research and extension.

Subsequently, implementation of the recommendations of the Education Commission (1964-1966) and Review Committee of Agricultural Universities (1977-1978) streamlined their functioning, and all matters related to agricultural research in the states were transferred to the universities. According to Review Committee of Agricultural Universities (1978), an essential feature of the agricultural university system is the acceptance of the philosophy of service to agriculture and to rural communities with the following mandates:

1. State-wide responsibility for teaching, research and extension education.
2. Integration of teaching, research and extension at all levels of the university administration.
3. Multi-disciplinary teamwork in the development programs of education, research and extension.
4. Acceptance by all concerned in the university of a philosophy of service to agriculture and the rural community and emphasis on programs that are directly and immediately related to solving social and economic problems of the countryside.
5. Quick communication of new knowledge to students in classrooms, to extension personnel and to farmers.
6. Programs giving specialized training to the rural youth and adult men and women who are not candidates for degrees, through departments involved in responsibility for the subject matter being taught.

The ICAR as an apex body coordinates research and promotes inter-institutional research linkages. Since the ICAR supports SAUs through regular grants, it has direct participation in the management of the SAUs. In addition, regional committees were formed in 1975 to assess the status of research, extension and education in the ICAR institutes and the SAUs in the eight regions of the country.

These committees also make recommendations to undertake research on immediate problems of a region. Officials from the ICAR, ICAR institutes, SAUs, State Line Department, Non-Governmental Organizations (NGOs), members of parliament and farmers' representatives are members of these committees. Another informal but effective link between various research institutions is the cross-nomination of members in various committees and scientific panels.

These committees and scientific panels have a major say in the planning and management of research. Efforts are made to ensure effective use of research resources and to avoid duplication of research efforts. Research collaboration with the Consultative Group on International Agricultural Research (CGIAR) System, NARS and research foundations overseas, etc. is operationalized by the ICAR through the Department of Agricultural Research and Education (DARE).

However, SAUs can also directly collaborate with these international organizations. Linkages with the national and private research organizations are direct. Public research institutions extend support by activities such as supplying germplasm and training facilities to the private sector. Over a period of time, agricultural universities in India have grown and to-date the list of SAUs (64), total KVKs (713), national bureaus (6), deemed-to-be universities (4) and central universities (4).

Financial Resources for the Sau

The SAUs are autonomous institutions for meeting the educational and research needs of the states and these are managed by the board of management and academic council. All the states have at least one SAU. The SAUs are largely funded by state governments, but they also get regular grants from the ICAR. In the past, the research and extension system has achieved much success.

It is believed that compared to other alternatives, the investment in agricultural research and extension is much more productive in accelerating the pace of development. Considerable empirical evidence indicates high rates of return from agricultural research and development investments, making agricultural research a cost-effective way for governments to accelerate agricultural development (Evenson, et. al., 1999).

It has been shown empirically that the investment in agricultural research and extension is the main source of growth in agricultural total-factor productivity in India, and the rates of return are impressive (Evenson and McKinsey, 1991; Rosegrant and Evenson, 1992; Kumar and Rosegrant, 1994).

The Union Government of India supports the ICAR, the apex body of agricultural research, extension and education in the country. In addition to financing the ICAR institutes and research centers, a part of the fund is allotted to the SAUs in the form of research programs and annual grants (ICAR Budget Book, 2005-2006). The SAUs are supported by the respective state governments.

The central government's effort to strengthen and empower the decentralized research and education system is one of the prime reasons for its increased investment in research and education in the country.

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Insect and Pest Management in Potato Crop

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Introduction

The potato (*Solanumtuberosum* 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: *Myzuspersicae:* 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 Ahidiusparasitoids and ladybird beetles and syrphid predators.

Aphid

2. Epilachna Beetle: ***Epilachnaviginatioctopunctata:*** 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. Thesebeetle 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., Pediobiusfoveolatus, Pleunotrogrusfaveolatus and Tetrastichus spp.

c. Application Of neem, mahua, groundnut cakes are efficient 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 percentCarbaryl (Sevin) dust at the rate of 30 kg per hectare may also control the pest.

Epilachna beetle

3. Potato Cutworms: ***Agrotisypsilon*****:** 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: *Phthorimaeaoperculella*: 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 color which measures about 12 mm long. Full grown caterpillars are pinkish white or pale greenish in color 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.

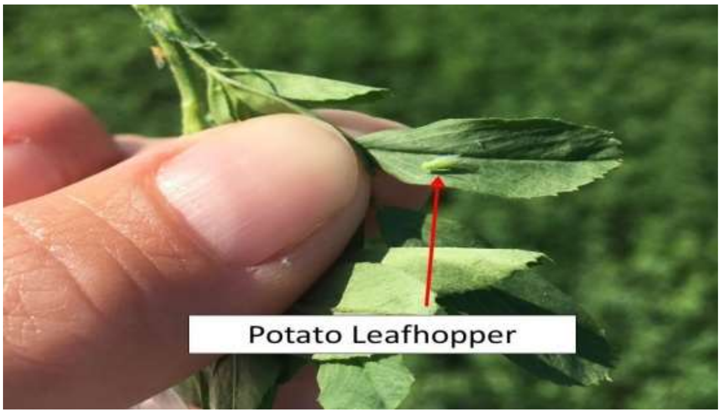
Tubermoth

5. Leaf Hopper: *Empoascafabae*: 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 liters of water

b. Spray the crop with 300 ml of Rogor 30 EC or metasystox 25 EC (methyldemeton) 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 dries 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 30 kg per haectare at the time of sowing and mix it properly.

Whitegrub

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Forcing of Specialty Cut Flowers Crop

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Tulip

Standard forced tulips can be utilized either as potted or growing plants or cut flowers. When tulips are harvested, the apical meristem is vegetative, and to force the bulb requires that they are given a series of warm -cool-warm temperature flower initiation and organogenesis is controlled by the post-harvest warm temperature. The precise temperature used depend on whether the bulbs are forced early, medium, or late in the season.

For early forcing ,the bulb is harvested in mid to late June and given 1 week at 93 degree ˚F. The bulbs are then transferred to 63 to 68˚ F for acceleration of flower initiation and organogenesis. When the flower reaches stage G in mid to late August, the bulbs are placed at 44.5˚ to 48˚ F for 6 weeks of regular precooling prior to planting. When planting tulips in pots. Place the flat side facing the outside. When this is done, the large bottom leaf faces outward .

For late forcing the bulbs are harvested in July and stored at 73-degree F to September 1, followed by 68-degree F to October 1, and then 63˚F. Cut tulips are planted in late October or early November and pot tulip in mid-October to mid-November.

Hyacinth

Hyacinth are primarily used as pot plants . However ,the flowers can be cut ,and if desired ,the individual floret can be used in corsages. In addition ,they can be forced on water using special forcing glasses. Bulb size from 15 to 16 cm to 18 to 19 cm are used for forcing. The apical meristem of hyacinth is vegetative when the bulb is harvested, and to force them requires a series of warm -cool-warm temperature. The specific temperature requirements are 10 to degree F higher than those of the tulip. The flowering season extend from mid -December to April, and to control the development throughout the period, two types of bulb are available: prepared and regular

Prepared bulbs, which are used for December and January flowering ,are harvested in mid-June and then placed at 86-degree F fir 2 weeks, 78˚ F for 3 weeks, followed by 73˚F until the uppermost floret reaches stage A2. The bulb is then held at 63 degree ˚F until planted in September. After planting, prepared bulbs need only 10-12 weeks of rooting and cooling at 48˚F before being placed in a 73 degree˚ F greenhouse. When the florets begin to show colour, the temperature should be dropped to 68˚F. If desired, some dark stretching can be used for 4 to 5 days immediately after the plants are plants are placed in the greenhouse.

For medium ad late forcing, the bulb is harvested in late June and early July and stored at 78-degree F until planted. Planting will be in late September to mid-November depending on the desired flowering date and cultivar. For late forcing the plants are rooted at 48˚ F, the temperature should be lowered to 41˚F. When the shoots reach 1 inch ,the temperature must be lowered to 32˚ to 35˚ F. The minimum cold -week requirement is 13 weeks, and up to 23 cold weeks can be used. These plants can be forced in 59˚ to 63˚F green houses and do not require dark stretching.

Daffodlis

Standard forced Narcissus are used either as pot plants or cut flowers.

For early forcing the bulbs are harvested in July and given 1 week at 93 ˚ F. They are then held at 63˚ F until precooled in August at 48˚ F. The handling of cut and pot daffodils after planting in early October is different. Cut daffodils are rooted and cooled continuously at 48 ˚ F, which a total of 15 to 16 cold weeks has been accumulated, the bulb is forced in 55 degree˚ to 59˚ F greenhouse.

For medium and late forcing, bulb is harvested in late July or early August and stored at 63 to 68˚ F until planted. The bulb is planted in order to provide 17 to 18 cold weeks for cut daffodils and 14 to 16 cold weeks for pot daffodils. They are rooted at 48˚ F and then cooled at 41˚ F or 35˚ F. Shoot growth should not exceed 4 inch in the rooting room. The pot and cut daffodils are forced in the greenhouse at 60 to 63˚ F or 55 to 59˚ F respectively.

Specialty Bulbs

Iris danfordiae which can be forced for Christmas ,the *Muscari armeniacum* which can be forced as late as April and Allium Karataviense which is forced for late April and May. Crocus can also be forced on water using special forcing glasses. Bulb size used for forcing are *A. karataviense* 12 and up cm, Crocus 10 and up cm. Dward Iris 6 and Muscari 9 to 19 cm. When harvested in June or July, the apical meristem of these bulb is vegetative. They require a warm -cool-warm temperature.

For early forcing Crocus and Muscari are given 1 week at 93˚F followed by 63˚ to 68˚F until precooled at 48-degree F in late August. The bulb is planted at 48˚F early October. As soon as they are fully rooted ,the temperature must be dropped to 41-degree F and after to 32˚F to 35˚F. They require 15 to 16 cold weeks.

For medium forcing, Corcus and Muscari are stored at 63 to 68 degree˚ F until planting. Iris reticultata bulbs are again stored at 73 degree˚ F to August 1, and then at 63 to 68 ˚ F. After planting , they are rooted at 48˚ F, and then the temperature held at 41˚ F followed by 32 to 35˚ F.

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Organic Cultivation of Chilli Crop

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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, Tamil Nadu, 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

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.

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.

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.

Varieties

The important varieties of chilli which are cultivated all over India for long pungent types are: PusaSadabahar, PusaJwala, Pant C-1, NP46A,ArkaBasant, Bhagyalakshmi& K2, and for the sweet pepper group the important varieties are: California Wonder, Yolo Wonder, ArkaMohini& King of North.

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 *Trichodermaand Psuedomonas* sp. @ 10 g per kg of seed to prevent incidence of seedling rot in the nursery.

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 *Trichodermaare* 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.

Organic Manuring in Chilli Crop

The organic manures for chilli crops are farmyard manure, green manure, compost prepared from crop resides 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.

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 weeding/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 weeding may be taken up. Weeds which attract pests should be allowed to grow in the field to act as trap and removed before flowering. Earthling up is carried out as and when necessary.

Irrigation

In India the major area under chillies is 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.

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 Beauvariabassiana 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 *(Meliaazadirach)* along with Bichoo Grass *(Urticadioica)* 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 Colletotrichumcapsici 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.

Organic Farming: The Present Need of Era

Article ID: 10526

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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.

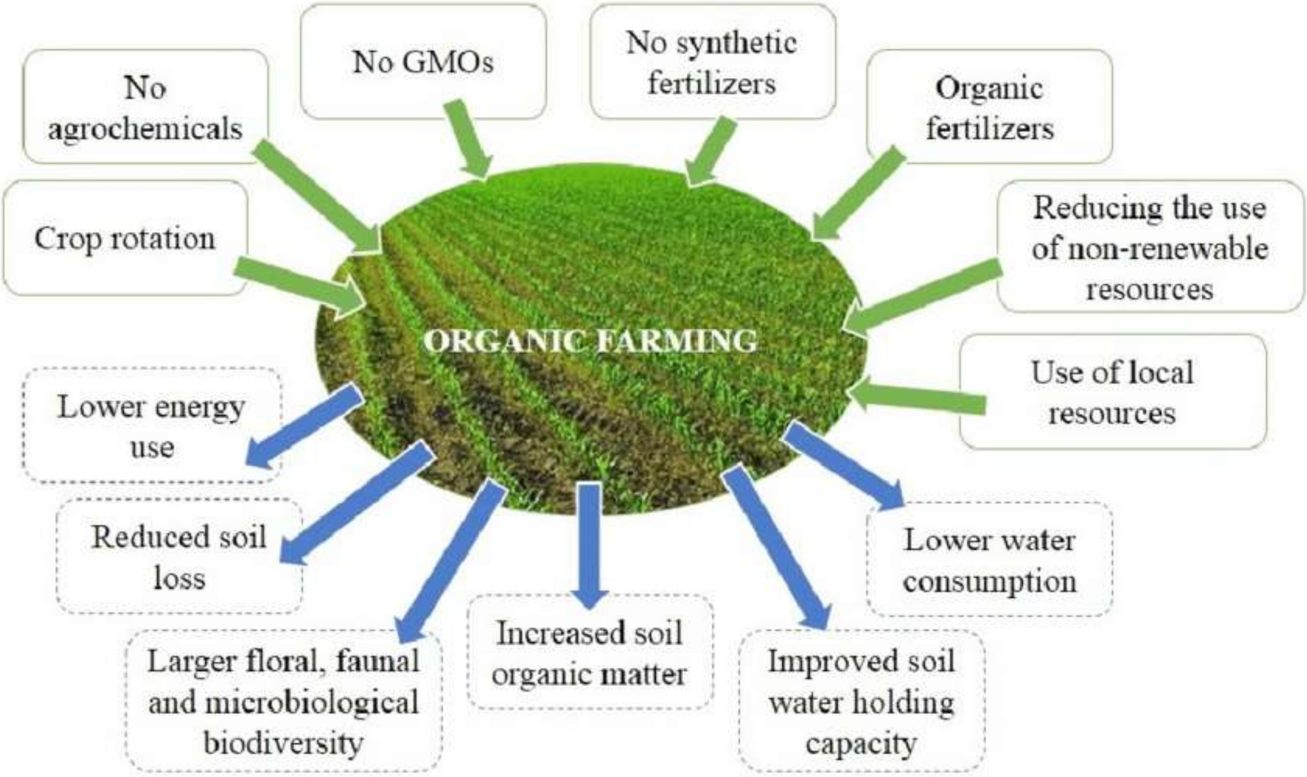
Modern crop production technology has considerably raised output but has created problems of land degradation, pesticide residues in farm produce, gene erosion, atmospheric and water pollution and all this is due to the indiscriminate use of synthetic fertilizers, pesticides and antibiotics etc., hence 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 (bio fertilizers) 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:

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.

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

Biological pest control: With this method, we use living organisms to control pests with or without the use of chemicals.

Compost: Highly rich in nutrients, it is a recycled organic matter used as a fertilizer in the agricultural farms.

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.

Mulching: It is a process of covering the soil and making more favourable condition for the growth, development of the plant.

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 millennial 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.

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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Micronutrients Deficiency in Context to Climate Change

Article ID: 10527

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Introduction

Micronutrients are essential to sustain life and for optimal physiological function. Widespread global micronutrient deficiencies (MNDs) exist, with pregnant women and their children under 5 years at the highest risk. Iron, iodine, folate, vitamin A, and zinc deficiencies are the most widespread MNDs, and all these MNDs are common contributors to poor growth, intellectual impairments, perinatal complications, and increased risk of morbidity and mortality.

The long-term consequences of MNDs are not only seen at the individual level but also have deleterious impacts on the economic development and human capital at the country level. Perhaps of greatest concern is the cycle of MNDs that persists over generations and the intergenerational consequences of MNDs that we are only beginning to understand. Prevention of MNDs is critical and traditionally has been accomplished through supplementation, fortification, and food-based approaches including diversification.

An Overview of Climate Changes as a Global Problem

1. The climatic conditions in which our food-producing systems depend on have been shifting quickly and are projected to continue their current pathways unless significant interventions are made.

2. The main cause of climate change is the release of anthropogenic greenhouse gases to the atmosphere, which have intensely increased since the pre-industrial era, determined largely by economic and population growth, and are now higher than ever.

3. Overall, 1.0°C increase in global warming since the preindustrial era has been observed, and is expected to reach 1.5°C by 2050 if increases at the current rate are maintained.

4. Moreover, it is expected that almost two billion people will be affected by almost complete water deficiency over the course of this century, and that close to 65% of the human population will be affected by circumstances of partial water insufficiency.

Effects of Climate Change on Micronutrients

1. Human population is growing at a fast pace, with a 33% increase expected to happen in the next 30 years, reaching 9.6 billion by 2050. Consequently, global demands for food will continue to rise throughout this century.

2. Crop yields and nutritional security are extremely dependent on the climatic conditions projected for the future, and consequently, most of the food produced for human consumption is under its menace.

3. Micronutrient deficiencies are a substantial public health problem, presenting serious health and nutritional consequences. A great deal of emphasis has been given in recent decades to zinc (Zn) and iron (Fe) nutritional deficiencies, particularly in developing countries where a considerable proportion of people depend on grains and legumes as main food sources of these elements.

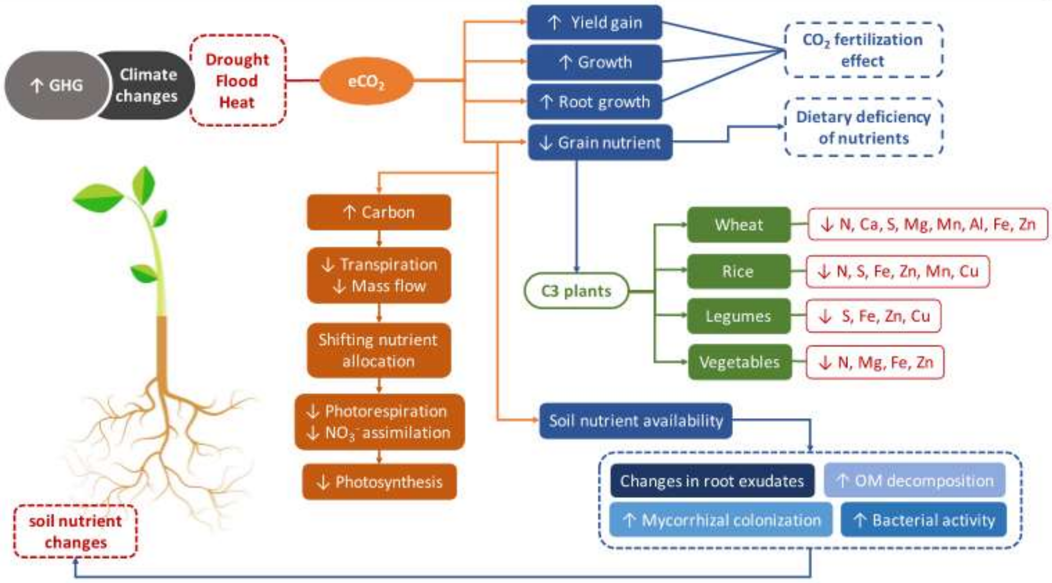
4. Micronutrient limitation has also an impact on the susceptibility of plants to biotic and abiotic stresses. However, the response largely depends on plant genotype and each mineral element has complex interactions with several changing climate variables.

The Influence of eCO_2 on Mineral Accumulation

1. The atmospheric CO_2 levels have been progressing from the 280 ppm preindustrial reference levels to current global levels which are now above 400 ppm.

2. Although the increasing concentration of atmosphericCO_2 is the main driver of harmful anthropogenic climate changes, it can also improve crop performance by increasing rates of photosynthesis and water-use efficiency, particularly in C3 plants.

3. Nowadays, there is strong evidence that Zn deficiency is a significant global health problem affecting 17% of the world's population, and that increasing CO_2 levels lower the concentration of Zn in significant food crops.



The Effects of Other Climate Change Factors on Nutrient Accumulation

1. A permanent state of equilibrium in nutrient concentration is a decisive regulatory factor in maintaining nutritional quality and determining the ability of plants to withstand the impact of climate changes.

2. Several studies have shown that several climatic changes may disturb the nutrient accumulation in major crops. Climate changes are also characterized by soil related waterlogging complications due to natural factors or by human activities such as excessive irrigation and low drainage. Waterlogging leads to a decreased O_2 availability in the soil with possible accumulation of phytotoxins, leaf chlorosis, stomatal closure and restricted crop performance by decreasing soil mineral nutrient accessibility.

Impacts of Climate Change on Food Systems and Food and Nutrition Security

The pathways through which climate change may impact food security, food safety and nutrition are complex and comprise biological, physical and socio-economic systems which are also affected by climate change. These pathways include:

1. Increased frequency and intensity of extreme climatic events such as heat waves, droughts, storms, cyclones, hurricanes, and floods.
2. Decrease of fresh water resources.
3. Sea-level rise and flooding of coastal lands, leading to salination and contamination of water, agricultural lands and food.
4. Water and food hygiene and sanitation problems.

5. Impacts of temperature increase and water scarcity on plant or animal physiology.
6. Beneficial effects to crop production through CO_2 ‘‘fertilization”. Influence on plant and livestock diseases and pest species and livestock diseases.
7. Damage to forestry, livestock, fisheries and aquaculture. Impaired sustainability.

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Chekurmanis *(Sauropus androgynous)* - A Less Explored Multivitamin Green Leafy Vegetable

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Introduction

The plant is native of India and Burma region. It is found in Sikkim, Himslayas, Khasi and Akra hills at 1200m elevations and in the Western ghats of Kerala from Wynad northwards at an attitude of 300- 1200m. It is reported to be introduced in Kerala from Malaysia in 1953 and is known in malayam as 'Madura keera'. The leaves of chekurmanis are commonly consumed in Malaysia. Consumption of chekurmanis, however, is not very common in India, being restricted to certain parts of Southern India. Due to high nutritive value, it is commonly called 'Multivitamin Greens' Chekurmanis, occupying prominent place in almost household kitchen gardens of Kerala, has not been cultivated on a large scale for commercial purpose. Hence, no data on area and production of this vegetables are available.

Scientific Name	*Sauropus androgynous*
Family	Euphorbiaceae
Common Name	*Chekurmanis,* Multi vitamin plant
Propagation	Stem cuttings
Longevity	Perennial
Description	This is a medium size shrub which has leaves high in vitamins. Tender shoots can be eaten raw. Leaves can be used as leafy vegetable. Native to India.

Nutritional and Medicinal Usage

1. The leaves of chekurmanis are highly nutritious, being a very rich source of β-carotene, vitamin E, vitamin C, thiamine, riboflavin, calcium, iron, zinc and protein. Thus, chekurmanis is an unusual green leafy vegetable having maximum number of nutrients being a rich source of several vitamins, minerals and protein.

2. Chekurmanis leaves have been reported to possess strong antioxidant properties, probably owing to the vitamin C and E contents. In view of its rich nutrient composition, this shrub can be explored for the development of health beneficial food products, which can also help in the prevention of micronutrient deficiencies.

3. Chekurmanis leaf, however, is reported to contain the alkaloid papaverine in considerable amounts. Excessive consumption of the leaves especially in raw form has been reported to cause drowsiness and respiratory disorders attributable to this alkaloid.

4. In view of the widespread micronutrient deficiencies in India, it is desirable to explore natural sources of micronutrients that can be easily grown and used in households. Chekurmanis is a perennial shrub which grows wildly and which is a very rich source of vitamins, minerals, as well as protein as compared to other green leafy vegetables.

5. As a result of the high concentration of vitamin C and E, chekurmanis may also have antioxidant properties, which merits its inclusion in health foods.

6. In the Southern parts of India, the leaves of chekurmanis are usually consumed either in the cooked form as a vegetable, or in the form of a powder incorporated with spice powder.

7. *S. androgynous* (chekurmanis) is the medicinal plant that contains a fairly high number of bioactive antioxidants.

8. These antioxidants, including phenolic compounds, carotenoids, anthocyanins, some volatile compounds, and other phytochemicals have high free radical scavenging activities, thus inhibit oxidative stress.

9. Inhibition of oxidative stress by these antioxidants can prevent inflammation and the onset of several chronic diseases.

10. The bioactives from *S. androgynous* (chekurmanis) leaves also possess antimicrobial and anticancer effects. These bioactives may somehow pose adverse health effect to the human body because some of the compounds are toxic.

Conclusion

This easily available plant can therefore be exploited for use in the development of nutritious food products, at a low cost, after ascertaining its safety. Intake of fresh leaves of S. androgynous (chekurmanis) for the potential health benefits is not advisable as the past evidences reveal several outbreaks of bronchiolitis obliterans. Therefore, proper preparation of the leaves is needed prior to consumption for any purposes.

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Impact of COVID-19 on Livelihoods

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Livelihoods are a vital means of making a living. It encompasses people's capabilities, assets and activities required to secure the necessities of life. The shocks and stresses of the COVID-19 crisis worldwide, although primarily considered a public health crisis, have a much broader impact on the global economy predictably for a long term, leading to worldwide socio- economic disruptions and will not only diminished the well-being and livelihoods of people, but also undermined the social nets, markets and food security on which life depends. Both lives and livelihoods are at risk from this pandemic.

The COVID-19 pandemic has led to a dramatic loss of human life worldwide and presents an unprecedented challenge to public health, food systems and the world of work. The economic and social disruption caused by the pandemic is devastating: tens of millions of people are at risk of falling into extreme poverty, while the number of undernourished people, currently estimated at nearly 690 million, could increase by up to 132 million by the end of the year.

Millions of enterprises face an existential threat. Nearly half of the world's 3.3 billion global workforce are at risk of losing their livelihoods. Informal economy workers are particularly vulnerable because the majority lack social protection and access to quality health care and have lost access to productive assets. Without the means to earn an income during lockdowns, many are unable to feed themselves and their families. For most, no income means no food, or, at best, less food and less nutritious food.

Impact on Rural Livelihoods

Immediate impacts	Medium/Long-term Impacts
Agriculture production: Seasonality of production cycle: due to movement restrictions and markets closure 1) planting season may be disrupted limit farms access to essential inputs such as seeds, fertilizers or pesticides; 2)	Farmers incapacity to maintain their activity due to loss of incomes: lower sales, lower incomes and increase in prices, might put at risk farming as it become more difficult for farmers to buy seeds and cultivate their crops for the next harvest season.

seasonal workers may lose job opportunities and so incomes for their families. Incomes losses farmers at risk of losing their main incomes source as they cannot sell their products and have no capacity to storage or process production into new products.	Reduction on the production due to reduced size of fields Increase competition for agricultural jobs with people returning from urban Reduced resources for livelihoods as increase the expenditures on health care
Livestock: Increase pressure on natural resources (water and pasture) in the areas where they are blocked that impact grazing areas capacity to regenerate and leads to animal food shortage Loss of incomes due to livestock markets closure, restriction of gathering and reduction of meat consumption as families reduce their incomes	Possible damaging coping strategies: - Altering food consumption to reduce costs to levels with consequences for health - Increase consumption of wild food - Selling assets that are irrecoverable like animals or land - New unaffordable debts - Migration - Abandon of fields
Fishing: Limited capacity of fish processing and impossibly of selling highly perishable fishing products due to market closure and movement restrictions leads to cessation of fishing activities and consequent loss of jobs and incomes. Health impact leads to income loss as it is a skill specific labour that is difficult to be replaced by another member of the household.	

Impact on Urban Livelihoods

Immediate impacts	Medium/Long-term Impacts
Loss of jobs (employees) and self-employment (micro and small businesses) in e.g., Services, Industry, Tourism and no Social Protection will make people highly dependent on humanitarian assistance.	In urban contexts, the households are completely dependent on incomes from labour or self-employment and markets to cover all their needs, while the cost of living is higher in urban than rural areas mainly due to housing costs.
Informal activities to continue with high risk of exposure to contamination for themselves and their families as there are no safety nets or social protection or alternative incomes.	Less job opportunities, formal and informal: increased competition, including skilled labours in non-skilled jobs. Impact on the quality of work conditions: reduction on wages, restriction of social insurance and benefits, abusive hours, etc. Increase unemployment among women and youth (the groups with higher rate of unemployment). Increase cost of transport that affects mobility and incomes for transport businesses (taxi drivers, moto drivers, etc.).

Impact on Food and Nutrition Security

The context: 2020 already started with an increase in food insecurity due to conflicts, drought, locust invasion and other climate change effects, with over 800 million people facing chronic undernourishment and over 100 million people in need of lifesaving food assistance, previous to COVID-19 crisis.

Availability

1. Supply chain disrupted that leads to limited availability of essential food products in the markets.
2. Panic buying that leads to basic needs products shortage and increase in prices.

Access

1. Movement restrictions limits the physical access to the markets.
2. Reduced purchase power due to drop on households' incomes.
3. Increase of prices of staple cereal due to the outbreak in Asia has started to impact prices in local markets countries dependant on import.

Utilisation

1. Prioritisation of poor nutrition quality products that are more affordable
2. Reduce meals as increase pressure of family members returning when left without incomes e.g., urban workers returning to the villages; or elderly to meet the basic needs of youth.

The COVID-19 virus has proved especially deadly for those who are elderly or whose health is already compromised. This likely includes people suffering from malnourishment:

a. Malnourished individuals are at higher risk of becoming ill, long term recovery, and greater risk of death (Existing evidence from other infectious disease outbreaks)

b. School feeding programmes for many children accounts for nearly 50% of their daily calories, with schools shutting down, this critical lifeline of food is gone

c. Nutrition linked activities in current programmes have stopped because of gathering bans and movement restrictions (community nutrition awareness session, mass screening, referrals and home visits from care workers, etc.) putting at risk of cases being neglected.

d. Reduction in access to fresh food and high nutritional value essential to boost immune system of population at risk.

e. Increased mortality rate among malnourished people that have developed the disease.

f. Increased caseload of malnourished individuals among those that can't ensure proper food intake due to illness and loss of incomes

g. Increase vulnerability to other diseases and malnutrition for those recovering from COVID-19 due to long term duration of recovery.

h. More than 6 months of inappropriate nutrition intakes can impact intellectual and physical development of children.

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Tribal Foods - Exploring the Unexploited Food Realm

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Introduction

Indian subcontinent consists of wealth with indigenous folk knowledge pertaining to the areas of natural resources, agriculture, astrology, food and medicine. Ethno-botanic wealth recognized and utilized by ethnic people are used in numerous traditional health medicines and diet to treat ailments including headache, skin disorders, fever, cough, snake bite, rheumatoid arthritis, dysentery, diabetes and respiratory disorders since time immemorial portrays the significance of food as medicine.

Ancient people understanding the emotional, physiological and cultural interconnection of food/diet did not separate the concept of diet and medicine and rather acknowledged them as continuum of health through utilizing seasonal and indigenous ethnobotanicity of that geographical area.

Anishi

To prepare this Naga tribes food, mature leaves of edible *Colacassia* species must be staked one above other and wrapped in banana leaves. The wrapped packs should be kept aside for a week to let the *Colacassia* leaves turn yellow in colour. The yellow-coloured leaves will then be made into paste (if needed ginger, chilly and salt can be added). Dry the paste cakes and it can be added during pork cooking.

Courtesy: The Morung Express

Fermented Bamboo Sheet

Tender bamboo shoot sheaths are sliced and placed in bamboo basket (basket inner wall is covered with banana leaves). At the bottom of the basket a small hole, just enough to insert bamboo stick, is made. The basket is closed with banana leaves and hung with bamboo stick draping down from bottom of basket.

The bamboo stick is twisted once in a while to drain the juice during fermentation process. The process takes two weeks for completion. The juice is stored and consumed as fermented beverage while the fermented shoot can be cooked either as such or after drying.

Courtesy: 7 Sisters Kitchen

Pickles

Galgal, *lingri* and *aaroo* pickles are native to Himachal Pradesh. Pickle is by fermenting the ingredients for about 25 days after drying in sunlight for 1 to 2 days and adding spices and oils.

Mushrooms

Kani tribe of Tamil Nadu consume around 10 (taxa) varieties of wild mushrooms (*Pleurotus roseus, Pleurotus ostreatus, Pleurotus sajor caju, Termitomyces microcarpus, Termitomyces heimii, Auricularia auricula, Volvariella volvacea, Lentinus squarrosuhus, Lentinus tuberegium* and *Grifola frondosa*) in their culinary preparations. A research conducted showed that the mushrooms possessed essential nutrients in appreciable amounts. Fresh mushrooms were rich in fibre (alpha glucans) and minerals and exhibited hypocholesterolemic effect.

Conclusion

Food is a combination of various ingredients that is prepared with different methods. Unexploited foods with uncommon ingredients are utilized by tribes around the world, while only very few are listed in this article. Exploring these culinary systems would open up a new type cuisine and processing method in food sectors. Furthermore, studies to discover their culinary system, therapeutic effect of diet and arenas to improve the nutritional and economical status of tribes must be boosted to conserve the ethnicity.

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Speed Breeding: The Future of Cereals Breeding

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With the large surge in population in the world, Global food availability is one of the prime concerned at the time. As time passes the demand for food increases day by day, so it is very important at this stage of human evaluation to make changes in Breeding and production techniques so that we can be able to complete the food requirement of all the human beings living throughout the world.

Now a technique named Speed Breeding came into existence which enables the crop plant to complete their life cycle in a very short time. It has been reported that through the speed breeding procedure crop complete 6 generations in a year. Lee T. Hickey and Amy Watson founded the idea of speed breeding while working in collaboration with the University of Sydney and the John Innes Centre. They reported that Wheat, Barley, Chickpea, and Pea plants can complete the 6 generations while canola can complete 4 generations. Speed breeding performs in a fully enclosed, controlled growth environment which helps to accelerate plant development. Continuous supply of light in a controlled environment allows rapid generation cycling through single seed descent (SSD) and it also showed the adaptation to larger-scale crop improvement potential programs.

Importance of Speeding Up the Breeding Cycle

The prime importance of speeding up the breeding cycle of crop to tackle the proportion of population surging day by day. If we follow the traditional breeding cycles which is high time consuming the result is obtained not always in proportion, the effort we are making. Now we are limiting with the resources, so we need to evolve the method of breeding we are following.

The climate change is an important phenomenon happening in current scenario. It is now very important to develop the climate resilient cultivar which are able to give sufficient produce in the same proportion that of efforts we are making. For which we need to extensive testing over generation under different climatic regimes to develop stable cultivar. So those kinds of variable environmental condition can be easily created and modified under the speed breeding protocol.

It is reported that incorporating Genomic selection with a Speed breeding program would result in a higher rate of genetic gain in comparison to traditional selection breeding programs, which is due to the additional number of generations produced per year. This approach advances genetic gain and variety development in a very short span of time.

Development of the Concept of Speeding Up Plant Selection with Speed Breeding

The Speed breeding concept was inspired by NASA's work to grow crops in space, using an enclosed chamber and an extended photoperiod. They recognize this as an opportunity to produce the wheat and barley more rapidly which favours the faster selection and population development. The approach has also been adapted for high-density plant production systems for single seed descent (SSD) programs.

In Speed breeding, plants are grown in controlled environments with continuous light for 22 h per day at an optimal temperature. For inducing the flowering best results were observed with sowing at 1 000 plants/m², 22h of LED light at 22°C, 2h of night at 17°C, and the light spectrum displayed on the left, the fastest seed-to-flowering time was 24 days, for Spring Barley.

In addition to generation time acceleration, a near-simultaneous flowering is obtained, even between genotypes of different earliness. A higher temperature should be maintained during the photoperiod, while a fall in temperature during the dark period can aid in stress recovery. After (the seeds have set in the plant), either increase the temperature or withhold water from the plant to hasten seed ripening." Ghosh, et al (2018).

Combining Genomic selection and Speed breeding should allow for more intense and more frequent selection stages and contribute to higher genetic gain per year. Generally, it is reported that breeding schemes that involved more speed breeding rounds have significantly higher genetic gains for different traits compared to schemes that used Genomic selection only, and they both (GS and Speed breeding combined Genomic selection schemes) outperformed conventional plant selection in almost all condition for all the traits.

Keywords: Crops, Genomic Selection, Selection, Speed Breeding.

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Nutrient Recovery and Vermicompost Production from Livestock Waste and Earthworm

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Introduction

Organic manure in the form of vermicompost obtained from the earthworm is one way to overcome the problems of low productivity. The production of compost from any organic waste (agriculture and homestead) using earthworms is called vermicomposting. Earthworms feeds the organic waste materials and passes it through their digestive system (digested by microbes present in the guts of worms) and gives out in a granular form (cocoons) which is known as vermicompost. Vermicomposting made from mix of dung, crop residues and kitchen wastes along with earthworms are rich in terms of nutrient availability compared to farm yard manure (FYM) which is from mere decomposition of dung.

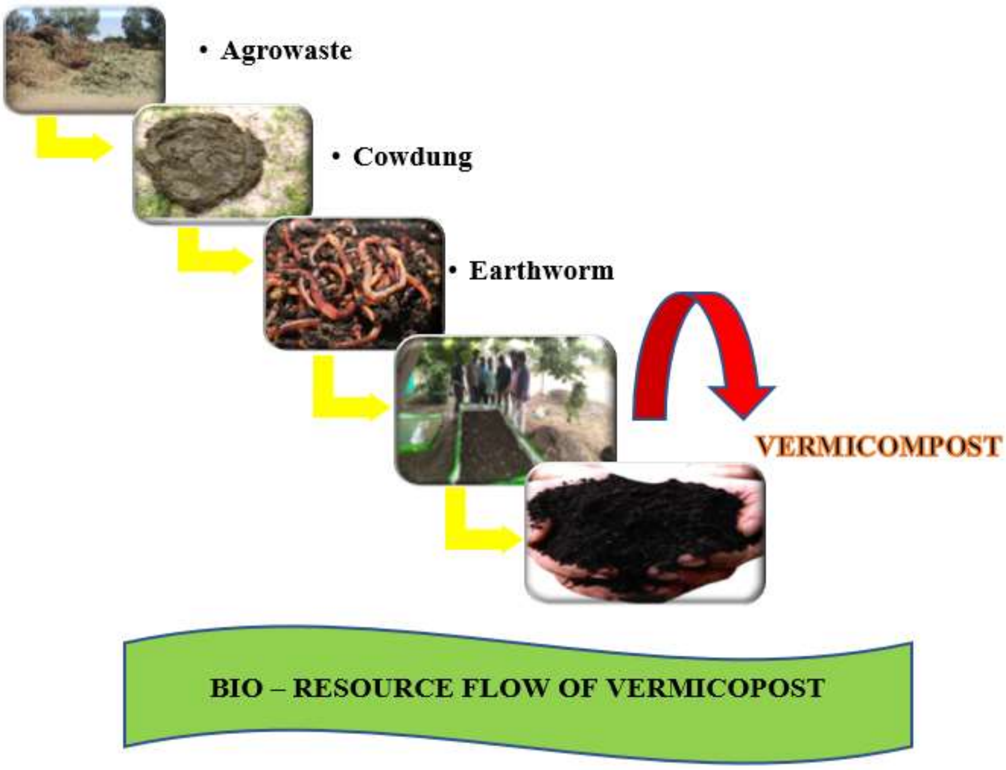
Requirements for Vermicomposting

The following are the four major requirements for vermicomposting:
1. Suitable organic wastes.
2. Multiplication of earth worms.
3. Structure for composting.

Vermicomposting Materials

Decomposable organic wastes such as animal excreta, kitchen waste, farm residues and forest litter are commonly used as composting materials. In general, animal dung mostly cow dung and dried chopped crop residues are the key raw materials. Mixture of leguminous and non- leguminous crop residues enriches the quality of vermicomposting.

Types of Earthworms



There are different species of earthworm's viz. Red earthworm, night crawler. Red earthworm is preferred because of its high multiplication rate and thereby coverts the organic matter into vermicomposting within 45 – 50 days. Since it is a surface feeder it converts organic materials into vermicomposting from top.

Commonly Faced Problem in Vermicomposting

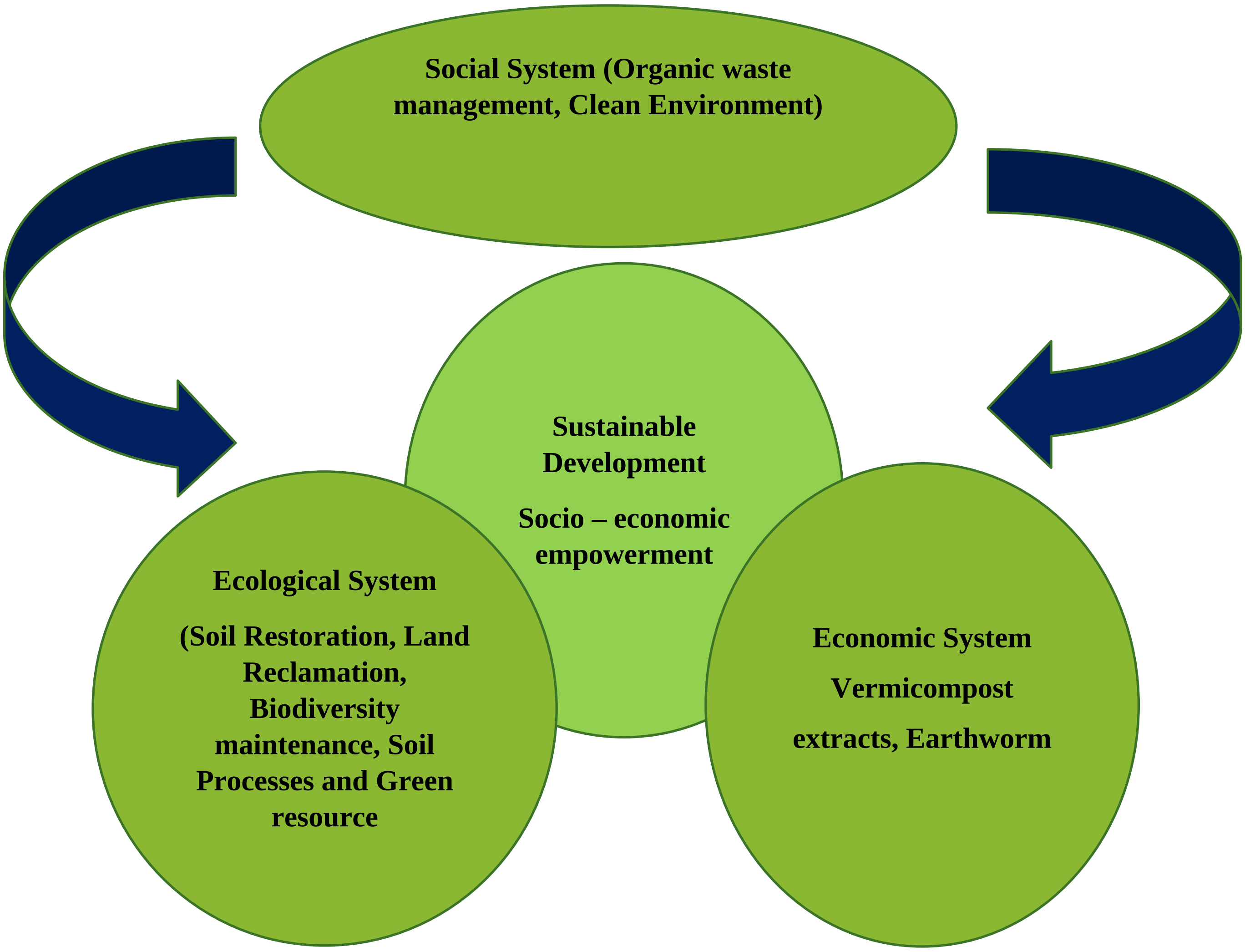
Vermicomposting is more sensitive than other composting methods and may induce to the following problems:

1. Extreme weather condition: Vermicomposting is susceptible to extreme weather conditions such as frost, heavy rainfall, and drought and overheating.

2. Putrefication: Anaerobic conditions (due to compaction and lack of oxygen) can quickly lead to putrefication.

Advantages of Vermicompost

1. Vermicompost is rich in all essential plant nutrients.
2. Provides excellent effect on overall plant growth, encourages the growth of new
3. Shoots / leaves and improves the quality and shelf life of the produce.
4. Vermicompost is free flowing, easy to apply, handle and store and does not have bad odour.
5. It improves soil structure, texture, aeration, and water holding capacity and prevents
6. Soil erosion.
7. Vermicompost is rich in beneficial micro flora such as a fixer, P- solubilizers.
8. Cellulose decomposing micro-flora etc in addition to improve soil environment.
9. Vermicompost contains earthworm cocoons and increases the population and
10. Activity of earthworm in the soil.



11. It neutralizes the soil protection.
12. It prevents nutrient losses and increases the use efficiency of chemical fertilizers.
13. Vermicompost is free from pathogens, toxic elements, weed seeds etc.
14. Vermicompost minimizes the incidence of pest and diseases.
15. It enhances the decomposition of organic matter in soil.
16. It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.

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Insect Pests of Kiwi and their Management

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The Kiwi, *Actinidia deliciosa*, belongs to the family Actinidiaceae and it is originated from China. It is commonly known as Chinese miracle fruit, Chinese gooseberry, Horticultural wonder of New Zealand. Kiwi fruit are rich in protein dissolving enzyme Actidin, it also digests milk protein easily so it is not advised to serve with milks in desert as like papaya and pineapple latex. The kiwi fruit contain high amount of vitamin C and makes it an effective immunity booster. It has been grown commercially in New Zealand, Italy, USA, Japan, Australia, France, Chile and Spain. In India, the highest kiwi cultivation area is in Himachal Pradesh. Whereas, the highest production is in Arunachal Pradesh (National Horticulture Board). Recently, the cultivation of kiwi gaining importance in India. Heavy attack of insect pests results in reduction of fruit quality in kiwi crop cultivating area. The insect pests cause 20% yield losses to the crop (Mckenna et al., 2009).

Brown Headed Caterpillar - *Ctenopseustis obliquana* (Torticidae: Lepidoptera)

The caterpillar webs and feeds on leaves. It also feed on fruits which wither away. Adults are brown to brownish grey with a variable wing pattern. Most individuals have several dark markings along the costa, including a remnant of the median fascia. Hind wings are mottled in both males and females. The total life cycle occupies 60-70 days. The female moth oviposits on leaves in masses and lays up to 150 individual eggs. The egg period is about 9 days. The larvae are green with a dark central stripe and two side stripes with brown colour head. The larval period for male is 32 and female is 36 days. Pupation occurs in the larval nest. Pupal period is about male 16.4 and female 13.8 days. Follow proper training and pruning in the vineyards. The infested leaves should be removed and burned to destroy the eggs and caterpillars. Periodical release of its parasitoids such as *Trigonospila brevifacies, Dolichogenidea tasmanica, Braconid wasp, Goniozus jacintae* may be useful. Spray application of 0.05% Dichlorvas or Fenitrothion affords protection.

	
Larva	**Adult moth**

Green Headed Leaf Roller - *Planotortrix excessana* (Torticidae: Lepidoptera)

The caterpillar feed on leaves and sometimes on fruits as well. The forewings are pale orange brown to dark reddish brown. The female moth lays eggs on leaves in groups and have on opaque coating on the surface of eggs. The larval head is transparent light brown to green and may have faint brown mottling. The prothoracic shield is pale green with no lateral shading. Pupation takes place within the webbed foliage. The total life cycle occupies 90-110 days, the eggs, larval and pupal periods respectively being 11, 40-54 and 18 days. Management practices similar to that of brown headed caterpillar.

	
Larva	**Adult**

Greedy Scale: *Hemiberlasia rapax* (Diaspididae: Hemiptera)

The scale is deep yellow with dark 'V' shape on posterior pygidium. The eggs are generally yellow in colour and laid under the armor of the female. Both nymphs and adults suck the cell sap from the bark and fruit. Sometimes it becomes serious affecting the vigor of the plant considerably and sooty mould development on fruit, causing it to be off grade. Use propagative material that is free of scales. Adequate plant spacing is important because armored scales seldom spread from plant to plant unless the crowns of the plants are in contact. Scraping and scrubbing to remove scales from plants are effective. The green lacewings, minute pirate bugs and ladybird beetle [*Chilocorus bipustulatus, Chilocorus infernalis* and *Chilocorus cacti*] is predaceous on the scale insect. Two sprays of 0.05% Chlorfenvinphos or quinalphos at 7 days interval during scale insect growing season. Periodical spray application of Neem oil @ 2-3 litres per 100 litres of water is very effective.

	
Nymphs and adults of greedy scale	**Nymphs and adults suck the sap from bark**

Passion Vine Hopper: *Scolypopa australi* (Ricaniidae: Hemiptera)

The nymph is greenish with a fluffy tail – visible. The hoppers found abundance during October. The eggs are inserted in plant stems, with relatively soft, dead or dying stems seem to be preferred. Both nymph and adult suck the sap from succulent shoots and the result is distortion of fruit and leaves. Plants will get stunted, wilted and dieback overall. The honey dew excreted by them afford conditions for development of sooty mould on fruits and it was unfit for consumption. The adults are about 5-6 mm long and have broad triangular forewings that are clear with a mottled dark brown-black pattern. The head, thorax (middle part of body) and abdomen are pale brown. They jump if disturbed as well as being able to fly. On the underside of the head the rostrum extends between their legs. Adults take two weeks to mature. The nymph stage lasts about three months. Collect and destroy the damage plant parts along with nymphs and adults. Heavy winter pruning of egg laying sites. Growing companion plants such as geranium and petunia, coriander, marjorams, yarrow and chamomile in and around the leaf.

	
Adult	**Nymphal stages congregates on the bark**

Thrips: *Heliothrips* Spp. (Thripidae: Thysanoptera)

The larvae and adults infest tender leaves and feed on the causing pale yellow blotches on leaves and later turns into brown. The insect reproduces sexually as well as parthenogenetically. Adults are 1.3 - 1.7 mm in length. Blackish-brown body with lighter posterior abdominal segments and white legs. The female thrips insert the eggs into the leaves. The larvae are whitish in colour with red eyes and later turns into yellow colour but retained red eyes. The larval abdomen is up-turned and has a dot of excrement on it. The excrement can cause spotting on the leaves. Pre-pupa and pupa are whitish to slightly yellow. Larvae resemble adults, but wingless. Periodic release of larval parasitoids- *Thripobius semiluteus* and predators like Predatory mite, predatory thrips, hover fly, mirid bug etc., is very effective. Sprinkling water during nursery stages reduces the multiplication of pest.

Thrips feeding on leaves

Two Spotted Mite - *Tetranychus urticae* (Aracinidea: Tetranychidae)

The adults are oval shaped and red brown in colour. Each female *T. urticae* mite lays 10-20 eggs per day. These eggs are spherical round, white coloured and laid at the bottom of the leaf. The six-legged larvae hatch after 3-15 days. They molt three times within 4-5 days, towards protonymph, then deuteronymph and at last adult. All the instars have eight legs. Life cycle is completed in 1-2 weeks. It is generally found on the lower surface of the leaves. The mite punctures the leaf tissue and the oozing plant sap is sucked. The removal of plant sap with chlorophyll and other plant pigments results in the whitish or silvery-transparent appearance. Predatory mites are *Amblyseius, Metaseiulus*, and *Phytoseiulus*; ladybird beetles, Stethorus; the minute pirate bugs, Orius; the thrips, Leptothrips; and the lacewing larvae, Chrysopa. *Scolothrips sexmaculatus*, *Phytoseiulus persimilis* are released to suppress the mite population. Dicofol @ 2.5 ml/l has been found effective in controlling mite's population.

Mites feeding on leaves

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Production of Fruit & Cole Vegetables in Hydroponic Techniques

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Soil-less culture mainly refers to the techniques of Hydroponics and Aeroponics. The term Hydroponics was derived from the Greek words' hydro' means water and ponos' means labour (Beibel, 1960). It is a method of growing plants using mineral nutrient solutions, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or mineral wool. Hydroponics is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution (Maharana and Koul; 2011). This system helps to face the challenges of climate change and also helps in production system management for efficient utilization of natural resources and mitigating malnutrition (Butler and Oebker; 2006).

Classify the Techniques

Techniques of hydroponics; It is also known as Liquid Hydroponics method. Plants grown in solution culture have their roots suspended directly in a nutrient solution.

It can Further be Classified Into

1. Circulating methods (closed system)/ Continuous flow solution culture:

a. Nutrient film technique (NFT).
b. Deep flow technique (DFT).

2. Non-circulating method (open systems)/ Static solution culture:

a. Root dipping technique.
b. Floating technique.
c. Capillary action technique.

Media Culture for Hydroponic Techniques

The media culture method has a solid medium for the roots and is named for the type of inert medium, e.g. sand culture, gravel culture or rock wool culture. There are two main variations for each medium, sub-irrigation and top-irrigation. However, it is classified as follows;

1. Hanging bag technique
2. Grow bag technique
3. Trench or trough technique
4. Pot technique

Table 1.0 List of Vegetables that can be grown In Soil-Less culture:

Sn.	Fruits Vegetables	Sn.	Cole Vegetables
1.	Lycopersicon esculentum	1.	Brassica oleracea var. capitata
2.	Capsicum frutescens	2.	Brassica oleracea var. botrytis
3.	Solanum melongena		
4.	Capsicum annum		

Supply of Nutrients to the Plants

In hydroponics, because of limited nutrient-buffering capacity of the system and the ability to make rapid changes, careful monitoring of the system in necessary (Singh and Singh, 2012). Two aspects of nutrition need to be considered: the supply of nutrients from the nutrient delivery system and the plant nutrient response. For most common crop plants critical levels for most nutrients have been determined. Sources of nutrient elements with their characteristics are given in table 2.0.

Table 2.0 Sources of nutrient elements for Vegetables:

Sl. No.	Source	Element	Characteristics
1.	Potassium nitrate KNO3	N, K	Very soluble salt
2.	Potassium phosphate monobasic KH_2PO_4	P, K	Corrects phosphorus deficiency
3.	Magnesium sulphate $MgSO_4$	S, Mg	Cheap, highly soluble, pure salt
4.	Iron Chelate	Fe Cit	Best sources of iron
5.	Boric acid H_3BO_3	B	Best source of boron
6.	Calcium nitrate $Ca(NO_3)_2$	N, Ca	Very soluble salt

Desirable pH Range of Nutrient Solutions

In hydroponic systems, pH is constantly changing as the plant grows. Changes in pH of less than 0.1 units are not significant. Thus, pH control is a necessity in hydroponic solutions. The pH range of 5.5 to 6.5 is optimal for the availability of nutrients from most nutrient solutions for most species, but species differ significantly and several can grow well outside of this range (De Kreij and Voogt, 1999).

Control of Contaminants in Hydroponic Techniques

Maintenance of sterile root-zone environment is essential to have good plant vigour under soil-less culture. It is extremely difficult to achieve and critical to minimize population of plant pathogens in the root zone (Raviv et, al., 1998). Commonly encountered disease in hydroponic solution is wilt, caused by Fusarium and Verticillum. Species of Pythium and Phytophthora destroys all but the main roots. No effective fungicides are there which can be safely used in hydroponics (Savvas, 2002). Only Metalaxyl has been found highly effective for control of Pythium on vegetable crops, but it is not registered for the use. Heat treatment of nutrient solution has also been found effective in keeping the root-zone free of pathogens (Raviv et, al., 1998). Root death of tomatoes by Pythium was overcome by heating nutrient solutions at 20- 22oC. In aeroponic system with heated nutrient solution, the roots of ginger plants matured faster and produced slightly higher fresh rhizome yields than plants in the same medium without bottom heat (Singh and Singh, 2012).

Advantages of Hydroponic Techniques

There are many advantages of growing plants under soil-less culture over soil-based culture (Savvas, 2002). These gardens produce the healthiest crops with high yields and are consistently reliable; gardening is clean and extremely easy, requiring very little effort (Silber bush and Ben, 2001). 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 (Silber bush and Ben, 2001). 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 (Sonneveld, 2000).

Prospectus of Hydroponic Techniques

Hydroponics is the fastest growing sector of agriculture, and it could very well dominate food production in the future (Butler and Oebker; 2006). As population increases and arable land declines due to poor land management, people will turn to new technologies like hydroponics and aeroponics to create additional channels of crop production (Maharana and Koul; 2011). To get a glimpse of the future of hydroponics, we need only to examine some of the early adopters of this science (Singh and Singh, 2012). In Tokyo, land is extremely valuable due to the surging population. To feed the citizens while preserving valuable land mass, the country has turned to hydroponic rice production (De Kreij and Voogt, 1999). The rice is harvested in underground vaults without the use of soil. Because the environment is perfectly controlled, four cycles of harvest can be performed annually, instead of the traditional single harvest. Hydroponics also will be important to the future of the space program. NASA has extensive hydroponics research plans in place, which will benefit current space exploration, as well as future, long-term colonization of Mars or the Moon (Van et al; 2002). As we haven't yet found soil that can support life in space, and the logistics of transporting soil via the space shuttles seems impractical, hydroponics could be key to the future of space exploration (Van et al, 2002). The benefits of hydroponics in space are two-fold: It offers the potential for a larger variety of food, and it provides a biological aspect, called a bio-regenerative life support system. This simply means that as the plants grow, they will absorb carbon-di-oxide and stale air and provide renewed oxygen through the plant's natural growing process. This is important for long-range habitation of both the space stations and other planets (Singh and Singh, 2012).

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Nuclear Techniques in Soil Fertility and Plant Nutrition

Article ID: 10535

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Introduction

Nuclear technology that involves the nuclear reactions of atomic nuclei. Among the notable nuclear technologies are nuclear reactors, nuclear medicine and nuclear weapons. It is also used, among other things, in smoke detectors and gun sights. Nuclear techniques are normally complementary to conventional or classical techniques in agricultural experimentation. Nuclear techniques, which include the usage of radioactive and stable isotopes, had been used in soil fertility, plant nutrition, plant breeding, plant protection and food preservation research works.

Radiation and Isotope methods have proved to be very useful in agricultural research and in increasing world food production to the level at which it is today. These methods are being used routinely in fields like plant nutrition and soil fertility, plant breeding, animal production and health, insect pest control, food preservation and pesticide residue studies. With continuous improvements of isotope and radiation methods there is the need to update at regular intervals information used for the training of agricultural scientists in these fields.

Radioisotopes and Isotopes are variants of a given chemical element that have nuclei with the same number of protons, but different numbers of neutrons. The attributes of naturally decaying atoms, known as 'radioisotopes.' In general, it is possible to separate the nuclear techniques used in soil fertility and plant nutrition into to 2 groups:

1. The first group is the use of radioactive and stable isotopes as a tracer in order to find out the optimum fertilization rate of plants precisely.
2. The second group is the use of neutron probe in determining the soil moisture at different periods of the growing season and at various soil depths precisely without any difficulty.

Isotopes - Meaning and Types

Types of Isotopes:

Stable isotopes: Do not undergo radioactive decay. eg; 14N, 15N, 31P, 18O, 12C etc.

Unstable isotopes: Ionizing radiation. Unstable atoms have an excess of energy or mass or both. eg; 10N, 32P, 11C etc…

Applications of Isotopes

1. Medicine.
2. Archaeology.
3. Industrial uses.
4. Energy- Radioisotope thermoelectric generators (RTGs).
5. Agricultural uses.

Application in Agriculture

1. Techniques that include the use of chemicals or compounds that are tagged with stable or radioisotopes.
2. Techniques that include the use of irradiation of the plants, seeds or food with different type of radiation x-rays, a-alpha, p-beta and 8-gamma for obtaining improved varieties of plants, for preserving and increasing the shelf life of food.
3. Techniques for improving soil water management practices using neutron probe.

4. Soil fertility and Plant nutrition.
5. Water management.
6. Insect pest control.
7. Livestock production.
8. Pollution studies.

Application in Soil Fertility and Plant Nutrition

1. Genotypic difference in nutrient uptake and use.
2. Recovery of nutrient from crop residues.
3. Nitrogen gaseous losses (volatilization and denitrification).
4. Degradation of nutrient among plant parts.
5. Tolerance of plant for salinity and drought.
6. Time and placement of fertilizer.
7. Per cent nutrient derived from fertilizer by crop.
8. Residual effect of fertilizer.

Principal Isotopes Used in Soil-Plant Studies

Element	Stable Isotope	Radioisotope
Carbon	^{12}C	^{14}C
hydrogen	^{1}H	^{3}H
Oxygen	^{18}O, ^{16}O	^{15}O, ^{13}O
Potassium	^{39}K	^{42}K
Magnesium	^{24}Mg	^{28}Mg
Sulphur	^{32}S	^{35}S
Iron	^{56}Fe	^{59}Fe
Chlorine	^{35}Cl	^{36}Cl, ^{37}Cl
Boron	^{11}B, ^{10}B	^{12}B
Molybdenum	^{96}Mo	^{99}Mo

Measurement of Fertilizer use Efficiency

1. The classical or conventional method based on yield.
2. Methods based on nutrient uptake: Indirect method.
3. Isotopic method: Direct measurement of uptake from the applied fertilizer through the use of isotopes.

By labelling of fertilizer with isotope ^{15}N and radioactive isotopes ^{32}P or ^{33}P.

Advantages

1. With the help of radio isotope, we can easily locate the presence of a single atom and molecule and their movement.
2. Very small quantities of labelled nutrients can be accurately measured in presence of large quantities of other nutrients.
3. Tracer technique enables one in tracing those elements taken by the plants accurately and precisely.
4. It also helps to study accurately the interaction among the mineral nutrients.
5. You can label specific atoms (say carbon-1 in glucose) to follow where each one goes.

Disadvantages

1. Radioisotopes are rather expensive.
2. Radio isotopes are dangerous and they pose disposal hazard.

3. Some radioisotopes (like P-32 and I-125) have short half-lives, so have to be used quickly.

Conclusion

Stable isotope ^{15}N serve as a powerful tool for measuring the nutrient uptake from various sources, for studying the processes that influence the efficiency of the applied fertilizer, investigating N use efficiency by crops grown in different cropping systems to minimize losses of nutrients and water from the agro-ecosystem.

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The Role of Nano Fertiliser in Agriculture

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Introduction

Agriculture, including horticultural crops, is a major economic sector related to the production and provision of a wide range of specialty crops for food, feed, and ornamental purposes and it currently represents a worldwide multitrillion dollar industry. Limited resources and the rapidly-increasing human population, which is predicted to reach 9.6 billion by 2050, pushes the sector forward demanding the development of a very efficient agriculture while allowing reduction of worldwide poverty and hunger. Chemical fertilizers provide plants with nutrients for optimal growth and productivity; however, current production practices cannot fulfil the growing demand of food without reliance on the extensive use of fertilizers. Given the limited amount of additional arable lands and scarce water resources globally, the use of more efficient mineral fertilizers is a necessary approach to fulfil the increase in food production required to feed this increasing population and support economic development. Furthermore, intensive application of conventional fertilizers over extended periods of time has caused serious environmental constraints worldwide including ground water pollution, water eutrophication, soil quality degradation, and air pollution. Limited nutrient use efficiency and environmental constraints associated with the use of chemical fertilizers remain a major problem and a hindrance for achieving reasonable sustainability in agriculture. Additionally, cost increases resulting from over-application of chemical fertilizers reduce profit margins for growers. Low nutrient use efficiencies are typically the result of high release rates of conventional fertilizers overwhelming the actual nutrient absorption rate by plants, and/or the transformation of fertilizers/nutrients to forms that are not bioavailable to crops. As such, there is a great interest towards the development of new innovative fertilizer sources in order to increase the fertilizer use efficiency.

Strategies have been proposed to increase fertilizer use efficiency, such as the use of precision fertilization, split or localized application, fertigation, and the use of nano fertilizers.

Application of nanotechnology for the development of new types of fertilizers is regarded as one of the potentially promising options for significantly boosting global horticultural production to meet the growing food demands of population with the added benefits of sustainability under the current scenario of climate change. A correct application of nano fertilizers can feed plants gradually in a controlled manner along with the benefits of increasing the fertilizer use efficiency, minimizing volatilization and leaching, and lessening environmental hazards.

Nanotechnology Application

Nanotechnology is the manipulation or self-assembly of individual atoms, molecules, or molecular clusters into structures to create materials and devices with new or vastly different properties. The emergence of nanotechnology and the development of new nanodevices and nanomaterials open up potential novel applications in agriculture. Nanotechnology is defined as “the understanding and control of matter at dimensions of roughly 1-100 nm, where unique properties make novel applications possible”.

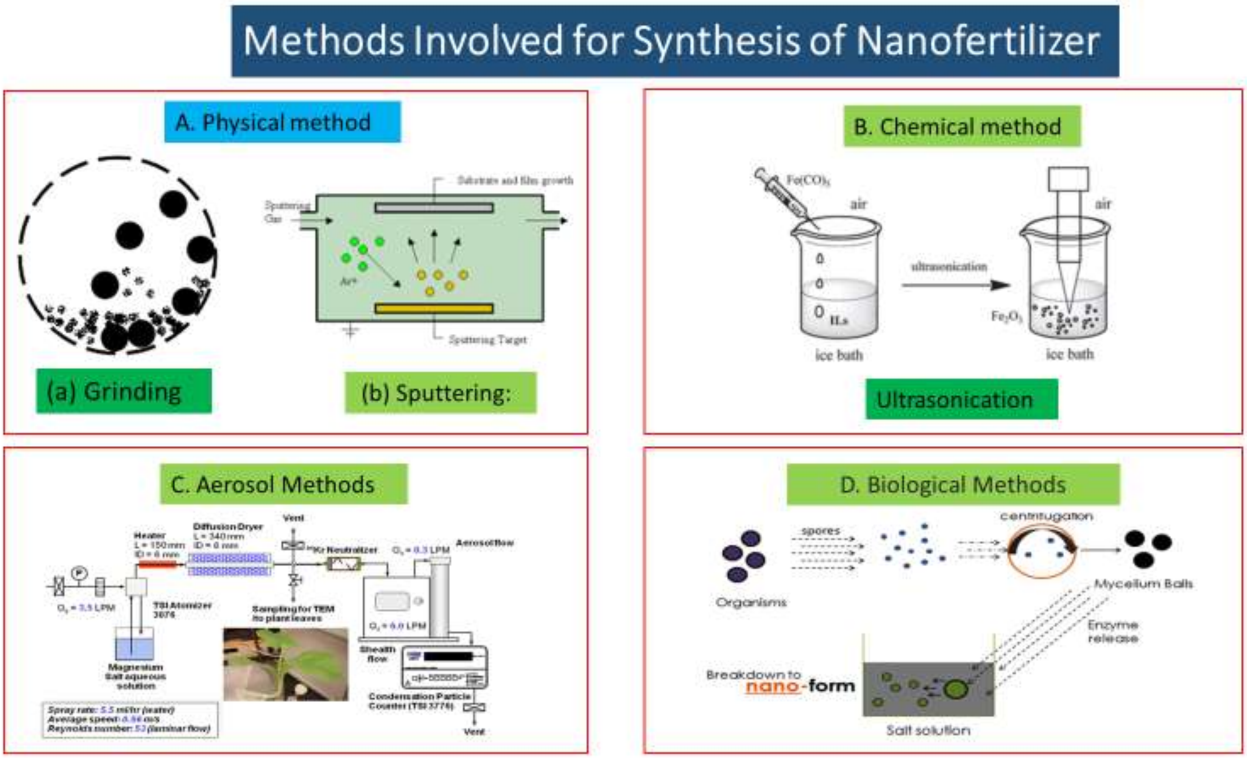
Advantages of Nano Fertilizers

There is a growing pressure on the agriculture sector to fulfil the continuously increasing demands of the consistently growing human population. Chemical fertilizers are thought to be indispensable for improving crop productivity and are extensively applied through different methods. However, crop usage is generally less than half of the applied amount of fertilizer, and the remaining amount of minerals intended to reach the targeted site may leach down, so that they become fixed in soil or contribute to water pollution.

1. Application of nano fertilizers reduce the water pollution.
2. Enhances fertilizer use efficiency and increased yield.
3. Control and slow delivery of one or more nutrients in order to satisfy the imperative nutrient requirements of plants.
4. The interaction of nanomaterials and fertilizers, due to the high reactivity of nanomaterials, results in an increased and effective absorption of nutritional elements and essential compounds for plants.
5. Increase crop production, quality and also enhance the sustainability.
6. Nano fertilizers increase the bioavailability of nutrients through their high specific surface area, miniature size and high reactivity.
7. Providing balanced nutrition, nano fertilizers enable the plant to combat various biotic and abiotic stresses,
8. Nano fertilizers provide the opportunity to the growers for supplying adequate amounts of nutrients.
9. Nano fertilizers is that they can be synthesized according to the nutrient requirements of intended crops.
10. Nano fertilizers reduce the need for transportation and application costs
11. Using small quantities is that the soil does not get loaded with salts that usually are prone to over-application using conventional fertilizers on a short- or long-term basis.

Nanotechnology Applications in Agriculture

1. Nanotechnology has the potential to revolutionize the agricultural and food industry with new tools for the molecular treatment of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients etc.
2. In the near future nanostructured catalysts will be available which will increase the efficiency of pesticides and herbicides, allowing lower doses to be used.
3. Nanotechnology will also protect the environment indirectly through the use of alternative (renewable) energy supplies, and filters or catalysts to reduce pollution and clean-up the existing pollutants.
4. In the future, nanoscale devices with novel properties could be used to make agricultural systems “smart”. For example, devices could be used to identify plant health issues before these become visible to the farmer. Such devices may be capable of responding to different situations by taking appropriate remedial action.



Nanoparticles are made from organic and inorganic nanomaterials. Additionally, their synthesis also varies in terms of physical or chemical methods employed. The inorganic nanomaterials include the metal oxides such as ZnO, TiO2, MgO and AgO, and others. On the other hand, the organic nanomaterials include lipids, polymers and carbon nanotubules.

The nano fertilizers are classified on the basis of the nutrient categorization. Hence, there are classically two types of nano fertilizers, i.e., micronutrient nano fertilizers and macronutrient nano fertilizers. Furthermore, nano biofertilizers are also emerging as an additional approach.

Macronutrient Nano Fertilizers

Macronutrients (e.g., nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), sulphur (S) and calcium (Ca) have been combined with nanomaterials for the purpose to deliver an accurate amount of nutrients to the crops and minimize their bulk requirements with extra benefits of decreasing purchasing and transportation costs.

As a nitrogen source, urea-modified zeolites, hydroxyapatite and mesoporous silica nanomaterials have been investigated as slow/control release nano fertilizers showing promising results. Biosafe nano fertilizer was developed as a source of P that is a nanostructured water-phosphorite suspension (particle size of 60–120 nm).

Micronutrient Nano-Fertilizers

Micronutrients are those elements that are required by the plant in trace/low quantities, but are essential to maintain vital metabolic processes in plants. This micronutrient is also involved in the synthesis of carbohydrates, protein metabolism, and the regulation of auxins, and provides defence to plants against harmful pathogens. For example, Zn nanoparticles as a nutrient source in rice, maize, wheat, potato, sugarcane and sunflower, stabilized maghemite nanoparticles applied through irrigation in solution form in soil as a nano fertilizer improved the growth rate and chlorophyll contents.

Nano Biofertilizers

Biofertilizers are formulations or preparations containing one or more microorganisms enhancing soil productivity, by fixing atmospheric nitrogen, solubilizing phosphorus or stimulating plant growth through synthesis of growth-promoting substances. Therefore, nano biofertilizers could be defined as the integration of biofertilizers with nanostructures or nanoparticles in order to improve the growth of plants. Use of nano formulations can be helpful to enhance the stability of biofertilizers with respect to desiccation, heat, and UV inactivation. For example, polymeric nanoparticle coatings can be used to develop formulations resistant to desiccation and consequentially improve the useful life of these products.

Limitation of Nano Fertilizers

1. In the context of sustainable agriculture, recent progress is undoubtedly witnessing the successful use of some nano fertilizers for achieving enhanced crop productivity. However, the deliberate introduction of this technology in agricultural activities could result in many unintended non-reversible outcomes.

2. Nanomaterial phytotoxicity is also an issue in this regard since different plants respond differently to various nanomaterials in a dose-dependent manner.

3. Nanomaterials are very reactive because of their minute size with enhanced surface area. Reactivity and variability of these materials are also a concern. This raises safety concerns for farm workers who may become exposed to xenobiotics during their application.

Conclusion

Under the current climate change scenario, Nano fertilizers have a significant impact in the agriculture sector for achieving enhanced productivity and resistance to abiotic stresses. The promising applications of Nano fertilizers in the Agri-food biotechnology and horticulture sectors. Even, the potential benefits of Nano fertilizers have stimulated a great interest to increase the production potential of agricultural crops.

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Innovation for Cleaner Air

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Introduction

It was in 2015 when nations across the globe met in Paris, and 197 signatory countries have promised to own up and to limit the increase to no more than 1.5 degrees over the pre-industrial levels by 2030. India is one of them. India has promised to cut its emission intensity by 33-35% by the year 2030, as compared to 2015 levels. It looks like this is desirable and achievable. But India is facing big challenges like, Most of India's emissions come from energy (largely coal-based) production (68%), industry (20%), agriculture, food and land use (10%) and even agriculture, land use and water resources, these too contribute to climate change with continuous supply of free 24-hour electric power supply and taking up water-intensive crops are led to increased air pollution. hence there is need for continuous monitoring of air pollution for better present and healthy future.

Over the Past Decade, India has Made Significant Progress in Monitoring Air Pollution

1. There are more than 250 continuous ambient air quality monitoring stations and more than 800 ambient air quality monitoring stations operating across the country.
2. It is owing to these that we are able to understand the magnitude of the challenge of air pollution.
3. There has been a tremendous effort in improving awareness of citizens through campaigns around air pollution and its adverse impact on health and environment.
4. However, while these efforts need to amplify, it is equally important to have systemic changes at the policy and strategy levels.

Welcoming Policy Interventions

1. Public policy is already responding positively.
2. The budget allocation for air pollution increased substantially in 2020-21 from what it was in 2018-19 to ensure cleaner air in cities having populations above one million.
3. The establishment of the Commission for Air Quality Management with penal provisions against polluters in the NCR and adjoining areas is a welcome move.
4. India has jumped from BSIV to BSVI vehicles. There is an increased focus on e-mobility.
5. Through the Pradhan Mantri Ujjwala Yojana, there has been an effort to reduce indoor air pollution in rural areas by increasing LPG coverage.
6. While these measures will have a major impact in the long term, India needs innovations to deliver on the promise of cleaner air in the immediate future.
7. There are many institutions involved in developing solutions. Such as:
    a. Drip irrigation (as Israel has done), aerobic cultivation (a water- saving agronomic practice, and researching on improving specific traits that lead to better roots that go down to deeper levels in the ground, as initiated by the University of Agricultural Sciences, Bengaluru),
    b. Stubble burning, which lead to enhanced air pollution in Delhi and Haryana is addressed by, The Indian Agricultural Research Institute's PUSA Bio Decomposer, which turns crop residue into manure in 15-20 days, could become a cost-effective alternative to tackle stubble burning.

8. UNDP is also promoting start-up led innovations such as a filter-less retrofit device for cutting particulate matter at source in industries and vehicles, and a nature-based solution to amplify air purification through breathing roots technology for improving indoor air quality.

9. Air pollution in India has numerous sources that are spread across vast geographies, which is a challenge for environmental regulators with limited capacity and manpower.

10. In such conditions, it is imperative to leverage advance digital technologies, such as geospatial technology and Artificial intelligence (AI), to upgrade our capacities to identify, monitor, regulate and mitigate air pollution hotspots.

11. For instance, the Geo-AI platform for brick kilns, developed by UNDP in partnership with the University of Nottingham, is supporting environment regulators to identify non-complaint brick kilns from space.

12. The platform has already mapped over 37,000 brick manufacturing units across the Indo-Gangetic plains.

13. Given the complexity and magnitude of air pollution, India needs context-specific innovations not only in the technological but also in the economic, social, legal, educational, political and institutional domains. It is important for it to develop a single window online platform for showcasing innovations with the potential to mitigate the challenges of air pollution.

What more should be Done?

1. The need of the hour is to provide an enabling ecosystem for innovations to address context-specific air pollution challenges.

2. There needs to be significant government support for enterprises to come up with scalable pollution abatement technologies.

3. Resources need to be allocated to support testing, certifying and scaling of innovative solutions and also to extend support for intellectual property rights protection.

4. It is equally important to mobilise private sector participation.

5. Businesses and enterprises need to innovate their operations and functioning, building in emission and pollution controls and reducing institutional carbon footprint to the lowest possible levels.

6. The private sector has strong potential to develop commercially viable products to combat air pollution and boost the innovation ecosystem.

7. Also, if one quantifies the impact of interventions that reduce air pollution with healthcare cost, disability-adjusted life years, or economic cost, it could lead to diversification of funding sources for that intervention.

Conclusion

The strategies and implementation of various programmes for prevention and control of air pollution of air pollution has, definitely, been paying dividends in terms of either improvement in air quality or at least preventing further deterioration. But still, there is a long way to go and the goal to have a cleaner environment can be achieved through continuous dedicated efforts of the pollution control agencies, commitment of the polluters and participation of public.

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Be the Solution to Soil Pollution

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Introduction

Increasing anthropogenic activities, such as mining, smelting, irrigation using waste water, application of sewage sludge and atmospheric deposition, have caused severe heavy metal contamination around the world. Soil can act as a source as well a sink for heavy metals. Accumulation of heavy metals in soils and subsequently in the food chain is a potential threat to human health. Moreover, heavy metal uptake by crops is one of the major pathways for food-chain contamination and human exposure.

During recent decades, different remediation techniques have been developed to reduce total or bioavailable concentrations of heavy metals in soils and thus minimize their accumulation in the food chain. Among various techniques heavy metal immobilization using soil amendments has been promoted as a rapid, cost-effective and low disruption technique.

What are Heavy Metals?

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Density criteria range from above 3.5 g/cm^3 to above 7 g/cm^3.

Sources of Heavy Metal Contamination

1. Fertilizers - Historically, agriculture was the first major human influence on the soil. To grow and complete the lifecycle, plants must acquire not only macronutrients (N, P, K, S, Ca, and Mg), but also essential micronutrients. Some soils are deficient in the heavy metals (such as Co, Cu, Fe, Mn, Mo, Ni, and Zn) that are essential for healthy plant growth but application of certain phosphatic fertilizers inadvertently adds Cd and other potentially toxic elements to the soil, including F, Hg, and Pb.

2. Pesticides - Several common pesticides used fairly extensively in agriculture and horticulture, indiscriminate application of pesticides such as copper-containing fungicidal sprays such as Bordeaux mixture (copper sulphate) and copper oxychloride can cause heavy metal contamination.

3. Biosolids and Manures - The application of numerous biosolids (e.g., livestock manures, composts, and municipal sewage sludge) to land inadvertently leads to the accumulation of heavy metals such as As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Mo, Zn, Tl, Sb.

4. Wastewater - The application of municipal and industrial wastewater and related effluents to land causes contamination.

5. Metal Mining and Milling Processes and Industrial Wastes - Mining and milling of metal ores coupled with industries are cause of metal contaminants in soil. Extensive Pb and zinc Zn ore mining and smelting have resulted in contamination of soil that poses risk to human and ecological health.

6. Air-Borne Sources - Airborne sources of metals include stack or duct emissions of air, gas, or vapor streams, and fugitive emissions such as dust from storage areas or waste piles.

Immobilization Techniques

Immobilization techniques, resulting in the stabilization of trace elements, can be applied to contaminated soil either ex situ or in situ.

1. Ex situ remediation.

2. In situ remediation.

Ex situ remediation - Techniques are often applied, in which soil is removed from its place of origin.

Advantages

1. Fast and easy to apply.
2. Relatively low cost.

Disadvantages

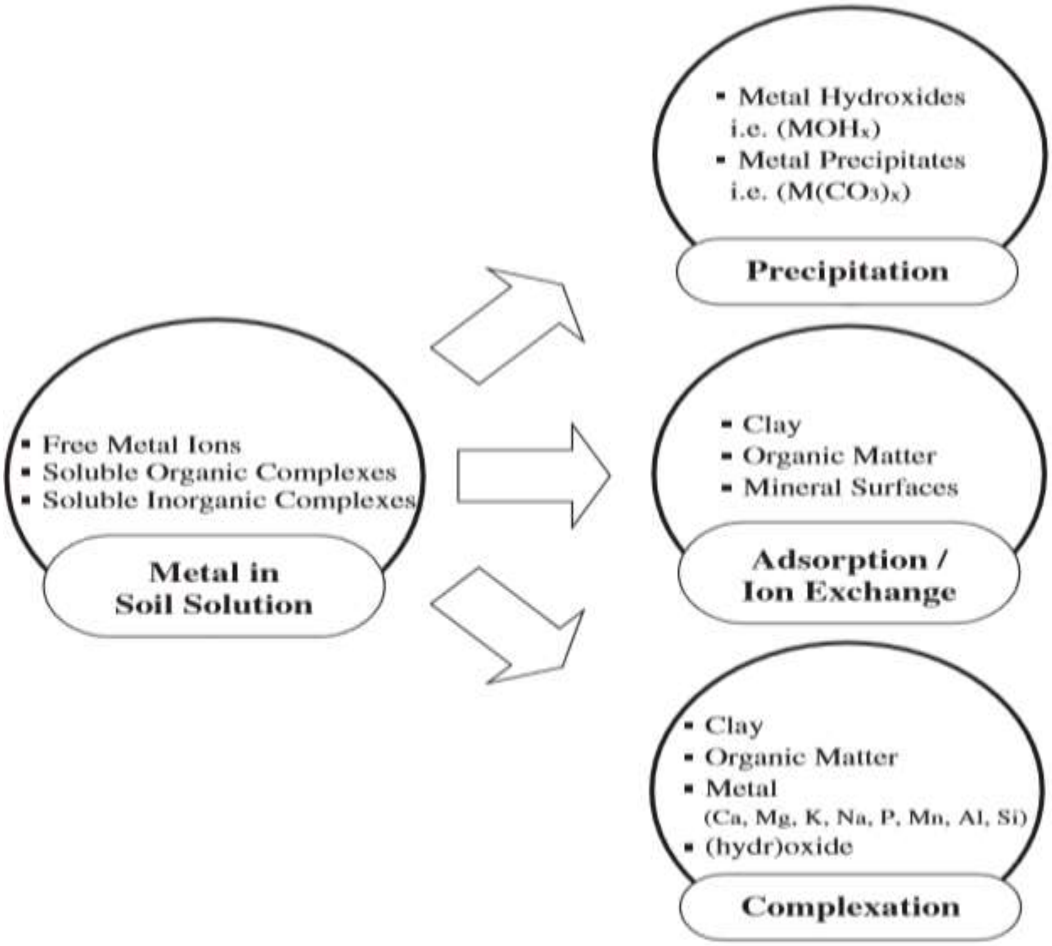
1. Generates significant volumes of by-products.
2. Highly environmentally invasive.
3. Permanent control is required for stored wastes.
4. Release of additional contaminants.

In Situ Immobilization

Advantages:

1. Low site disturbance.
2. Simplicity and rapidity.
3. Relatively lower costs compared to other remedial options.
4. Introduction of nutrients to the contaminated area.
5. High public acceptability.
6. Applicable to a broad spectrum of inorganic pollutants.
7. Reduced risk of spreading contamination.

Mechanisms of Soil Amendments Induced Metal Immobilisation



Common Immobilizing Agents

When selecting an appropriate immobilizing agent, both the amendment immobilization efficiency and its impacts on soil quality should be considered. Recently, many immobilizing agents including bio-absorbent by-products and synthetics compounds were routinely used for soil remediation based solely on their fixation efficiency and cost.

Organic Soil Amendments

1. Organic soil amendments have been widely used to immobilize soil Heavy metals by changing speciation from initially highly bioavailable forms (i.e, free metals) to the much less bioavailable fractions associated with Organic Matter (OM), metal oxides or carbonates.
2. The most commonly used organic soil amendments are biosolids, bark and wood chips, composts of different origins, manures, saw dust, sewage-sludge and wood ash.
3. Target metals - Cd/Cu/Zn/Pb/Cr/Ni.
4. Mechanism - Adsorption and Complexation.

Immobilizing agents- Manures, composts & biochar.

Liming Material

Liming is primarily aimed at ameliorating soil acidity, and has increasingly been used as a management tool for reducing heavy metal toxicity in soils.

A wide range of liming materials are commonly available including $CaCO_3$, CaO, $Ca(OH)_2$ and $CaMg(CO_3)_2$.
1. Target metal - Cd/Pb/Zn/Cu.
2. Mechanism - Complexation, Precipitation.

Immobilizing agent - Dolomite, Limestone, Slacked-lime, Burnt lime.

Gypsum ($CaSO_4$)

Both naturally occurring (mined gypsum) and industrially manufactured gypsum-like by-products have been widely applied for many years as ameliorants to counter heavy metal contamination in soils.

As a calcium enriched material, gypsum can act as a bridge between negatively charged DOC and soil particles, assists DOC coagulation.

Phosphorus Amendments

Phosphorus-containing amendments have commonly been used for the in-situ remediation of metal-contaminated soils. At present, many different types of phosphorus amendments exist including both synthetic and natural apatite, hydroxyl apatite, rock phosphate (PR), phosphate-based salts, di-ammonium phosphate (DAP) and phosphoric acid.

Industrial Waste By-Products

Over the last decade, as industries focus more on recycling and value adding to their ubiquitous waste streams, several industrial wastes by-products have been screened for their ability to immobilize heavy metals including fly ash, paper mill sludge, red mud, and slag.

Conclusion

Application of various organic and inorganic soil amendments to contaminated soil for immobilisation of heavy metals resulting in an overall decrease in soil metal bioavailability and improve soil physical, chemical and biological properties by immobilisation mechanisms like metal complexation, precipitation, redox reaction and adsorption.

Due to lower labour, energy requirements and higher efficiency, immobilization technologies are largely practiced.

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A Touch of New Technologies for Amending Salt Affected Soils

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Introduction

In India, out of 329 million hectares of total geographical area, the arid and semi-arid occupy more than one third of the area (127.4 m ha). The salt affected soils occurring in these zones occupy 12 m ha spread over 15 states of the country. These salts affected soil zones comprise of 4.12 m ha of alkali soil, 3.26 m ha of saline soil and 4.62 m ha of saline alkali soils. Soil salinity is one of the most devastating among all kinds that causes land degradation. Salt-affected soils (SAS) are soils on which the growth of most crop plants is limited due to excess of soluble and insoluble salts. an increase from 5 to 11 per cent of total net sown area of the country (141 million ha) and it may turn large areas of cultivable land to completely barren. The cost of inaction could be beyond repairable to the natural resources base in the country. Typical challenges of SAS management are that some soils (alkali or sodic soil) can be reclaimed by specific amendment and managed thereafter, but others (coastal salt affected soils, black soils) cannot be fully reclaimed, needs continuous soil & water management practices for its productive uses. Salinity problem in agriculture is becoming more and more serious because of poor quality water, lack of adequate knowledge about soils and poor management practices. The amelioration of these salt affected soils is not only expensive but also time consuming and laborious. Hence there is urgent need to explore the possibilities of new technology in soil reclamation and to improve soil health.

Salt-Affected Soils

1. Salt-affected soils are soils with high concentrations of dissolved mineral salts in their profiles, such that these dissolved salts adversely affect crop production and soil health.
2. The salts are primarily composed of chlorides, sulphates, carbonates and bicarbonates of calcium (Ca^{2+}), magnesium (Mg^{2+}) and sodium (Na^{+}).
3. These salts affected soils have originated due to different natural cycles.

The Sources of Salts

Primary salinization:

a. Weathering of rocks.
b. Capillary rise from shallow groundwater.
c. Intrusion of sea water along the coast.
d. Salt laden sand blown by sea winds.

Secondary salinization:

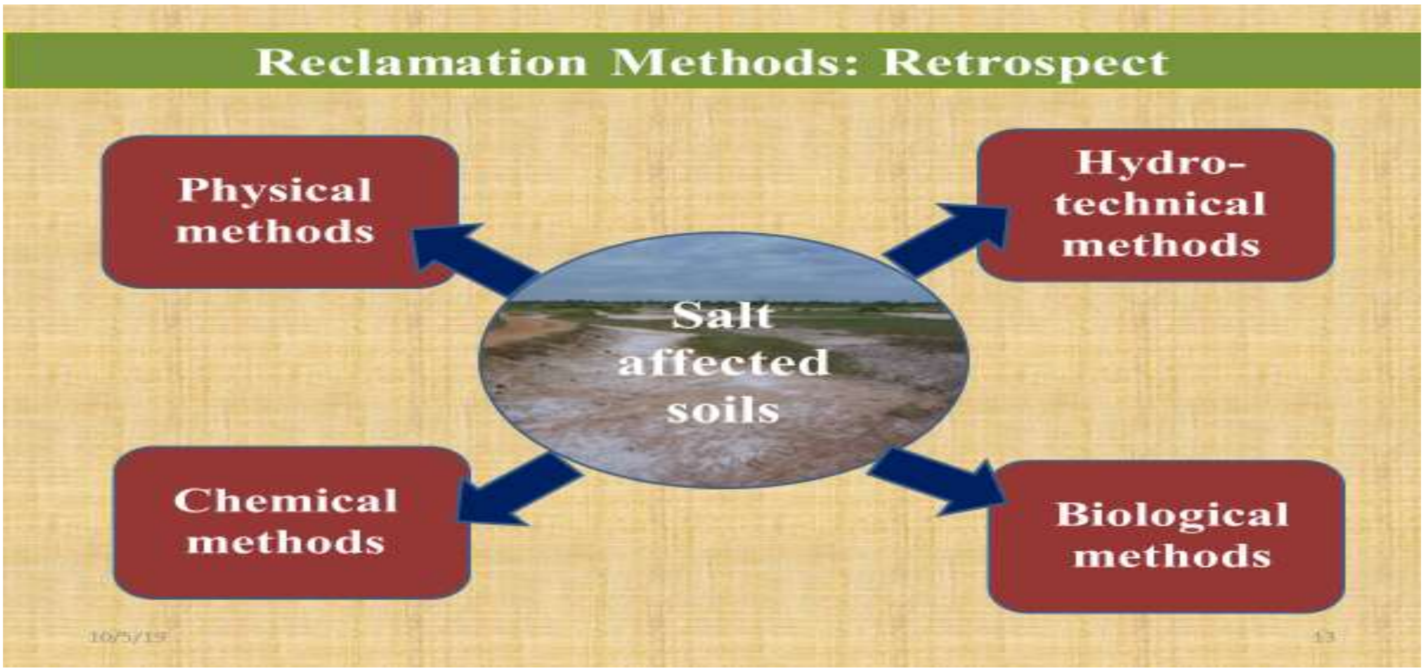
a. Irrigation water.
b. Industrial effluents.
c. Overuse of basic fertilizers.
d. Flooding with salt rich water.
e. Improper planning of developmental works.

Salt stress in soil:

a. Osmotic stress – lead to physiological drought.
b. Toxicity of Na and Cl ions to cells – lead to reduced cell metabolism.
c. High uptake of Na ions – causes nutrient imbalance in plants.
d. Dispersion of soil colloids – lead to poor aeration and drainage.

Altogether it will reduce the yield of crops.

Reclamation of Salt Affected Soils



1. Physical methods:

a. Deep ploughing.
b. Scrapping of surface salts.
c. Sanding and subsoiling.

2. Hydrotechnical methods: Leaching and Drainage.

3. Chemical methods:

a. Use of soluble salt of calcium – Gypsum, $CaCl_2$
b. Use of sparingly soluble salts of calcium – $CaCo_3$
c. Use of acid or acid formers – Sulphur and $H2So_4$

Advances for Reclamation

1. Raw distillery spent wash: Distillery spent wash finds its access to open drains, it may pose serious threats to water as well as soil quality. Therefore, as it is a good source of nutrients and organic matter, it can be used as a potential amendment in reclaiming sodic soils. Distillery spent wash is usually of high acidity and contains fair amount of Ca and Mg. Therefore, distillery spent wash can be used as an organic amendment in improving physical and chemical properties of soil.

2. Biochar manure compost and pyroligeneous solution: Biochar (BC) is a carbon-rich material produced via pyrolysis of biomass with limited oxygen. Combined amendment Biochar manure compost and pyroligeneous solution significantly improved both the physical and chemical conditions of the salt-stressed soil and thus increasing yield through a decline in soil salinity.

3. Use of nanotechnology: Traditionally, gypsum is recommended for the reclamation of sodic soils but ability to reclaim the soil depends on the quality (fineness and solubility) and quantity of gypsum used. With an idea to explore the possibilities of nanotechnology, nano gypsum prepared is more effective in reclamation od sodic soils.

4. Municipal solid waste compost: Municipal solid waste compost represents a nutrient source that can enhance soil fertility and thus contributes to ameliorating the salt-affected soils, this could even reduce the problems of waste disposal.

Conclusion

The continued worldwide expansion of salt-affected lands has created need for alternate source and technology to reclamation of salt affected soils by which salt affected soil are reclaimed at least cost and efficient manner and even the problems of waste disposal, environmental pollution are addressed effectively and make agricultural lands suitable for reuse.

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Mushroom: Power Pack of Nutrients

Article ID: 10540

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Meeting the food demand for the growing population from the limited land resource is a big challenge for developing country like India in this vulnerable climate change era. In addition to this, wide spread malnutrition and associated diseases are more common among the economically poor population.

This compels us to search for cheap alternative quality nutritional sources for our huge population. Mushroom farming is one among the appropriate ways to meet this challenge because mushroom grow on wastes without requiring additional land besides its exceptional nutraceutical properties.

The most cultivated edible mushroom worldwide is *Agaricus bisporus* (common mushroom) followed by *Lentinus edodes* (shiitake mushroom), *Pleurotus* spp. (in particular oyster mushroom), and *Flammulina velutipes* (enoki mushroom).

Nutritional Aspects

Indian diet is primarily based on cereals (wheat, rice and maize), which is deficient in protein. Supplementation of mushroom recipe in Indian diet will bridge protein gap and improve the general health of socio-economically backward communities.

Earlier mushrooms were considered as an expensive vegetable and were preferred by affluent peoples for culinary purposes. Currently common populace also considers mushroom as a quality food due to its health benefits.

Mushrooms are consumed for their delicacies flavour, palatability and nutritional value. Mushroom is considered to be a complete, health food and suitable for all age groups, child to aged people. Nutritive values of different mushroom are given in Table 1.

Table 1- Mean nutrient content of raw mushrooms per 100 g edible portion(Source- USDA)

Nutrient	Common mushroom	Shiitake mushroom	Oyster mushroom	Enoki mushroom
Moisture (g/100 g)	92.45	89.74	89.18	88.34
Protein (g/100 g)	3.09	2.24	3.31	2.66
Fat (g/100 g)	0.34	0.49	0.41	0.29
Ash(g/100g)	0.85	0.73	1.01	0.91
Carbohydrate(g/100g)	3.26	6.79	6.09	7.81
Dietary fiber(g/100g)	1.0	2.5	2.3	2.7
Calcium (mg/100g)	3	2	3	0
Copper (mg/100g)	0.32	0.14	0.24	0.11
Iron (mg/100g)	0.5	0.41	1.33	1.15
Magnesium (mg/100g)	9	20	18	16
Manganese(mg/100g)	0.05	0.23	0.11	0.08
Phosphorus (mg/100g)	86	112	120	105
Pottasium (mg/100g)	318	304	420	359
Sodium (mg/100g)	5	9	18	3
Zinc (mg/100g)	0.52	1.03	0.77	0.65
Thiamin (mg/100g)	0.081	0.015	0.125	0.225

Medicinal Aspects

Due to the alkaline ash, high potassium, sodium ratio and high fibre content, they are also suitable for the people with hypertension, hyper acidity, and constipation. It has been found that various edible mushrooms (cultivated or wild) show anti-bacterial, anti-fungal, anti-protozoal and anti-viral effects. In addition to this anti-tumor, anticholesterol and anti-thromobic effects of mushrooms, shiitake mushrooms can help in preventing high blood pressure, diabetes, causes recession of some kinds of cancer and inhibits the growth of some viruses like influenza (Edwards, 1975). Oyster mushroom *(P. ostreatus)* lowers blood pressure and cholesterol. They have been reported to possess significant anti-cancer and blood cholesterol reducing properties. Shiitake mushrooms have antimicrobial effects along with lipid lowering effects. It has been shown to improve liver function in individuals with hepatitis. It can lower the blood pressure of high blood pressure patient.

Conclusion

Mushroom with regard to their good medico-nutritional and high digestibility values are gaining importance in today's human diet. Even in this century of vegetarian consciousness and healthy eating, the mushroom is, in fact, providing to be an excellent meat substitute (Singh et al., 1995). Development of appropriate storage and preservation technology in order to extent their marketability and availability to consumption in fresh as well processed form is of great significance.

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Role of Mobile Based Advisory System for Transfer of Technology - An Overview

Article ID: 10541

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Introduction

The mobile phone introduced in India 1995, it has been gradual and drastic changes in the use of the mobile phones' users in India. It is reported that the India's telecommunication market is the second largest in the globe. Nowadays the mobile phones are available to the people right from the age of 10 years. The current scenario of mobile phone technology is brought into closer in the world. It provides the greater communication tool among the peoples by way of either calling or texting in the transfer of technology. Now, the mobile phones are growing up with the plenty of facets starts from e mail, surfing, recreations, internet access, education and social networking sites and the overall majority of the mobile phone users in the age group of 18 - 25. Even though the mobile phone provides the many merits, whereas, it is also providing some harmful effects in the mobile users but mobile phones play pivotal role in agriculture in order to transfer of technology dissemination and communication to the farmers. The farmers can access the information by sitting place like market price, available fertilizer stock, subsidy scheme, seed stock position, weather advisory, organic products, crop insurance, line departments officers, Farmer Producer Organization product, pest and disease monitoring, Agricultural Technology Management Agency training, demonstration, agricultural news etc.

Importance of Mobile Phone

Mobile phones have established itself in the rural areas and are becoming quite popular both with farmer and farm women. These powerful electronic machines that was a farmer's dream earlier have become a reality as the farmers can immediately make use of them to address their field problems and other farm difficulties. The Government gifted Kisan Call Centres (KCC) are functioning the all over India which give answers to the farmer queries in local languages to this toll-free number 1800-180-1551. Grameen Phone is a commercial operation providing cellular services in both urban and rural areas of India, with approximately 40,000 customers. Mobile advisory system has been developed and utilized for transfer of agricultural technologies for sustainable development across the world. The findings of the different mobile based studies conducted across the world have reviewed and presented for replicating the suitable models in similar situation for effective dissemination of the technologies. It is concluded that mobile platform is only tool to reach the last mile connectivity especially in rural areas for delivering need-based technologies in time.

Abdul Razaque Chhachhar (2019) reported that 97.30 percentage of the respondents own their personal mobile phone and 64.50 percentage of the respondents call to the market directly for seeking crop information and farmers make use of mobile phones to keep current with the market, contact buyers and very limited 7.90 percentage of the respondents get weather information, communication technology disseminates information rapidly around the world to the benefit of many communities.

Radhakrishnan (2020) reported that more than 75.00 percentage of rural youths using the internet to access the Twitter, Face book, WhatsApp and Instagram. Accessing the social media is one of the foremost significant phenomena for rural youths to access the internet. In fact, many youths accessing the internet for the first time, social media was the prime and peculiar reason. Across India there are 143 million users of social media. Urban areas witnessed a growth of 35.00 percentage with 118 million users as of April 2015. On the other side, the number rural areas 25 million. WhatsApp and Instagram emerged the leading social media tools with 96.00 percentage of urban users assessing it, followed by face book (80.00 percentage), Twitter (62.00 percentage) Instagram (43.00 percentage) and LinkedIn (25.00 percentage). The largest segment of users was college going students (34.00 percentage) followed by young men (27.00 percentage) and school children constitute (12.00 percentage).

Potential Information of Mobile Phone in Agriculture (PIMPA)

The farmers can access the following information by home and farm field conditions. The details are given in figure 1. (Source: e-Governance in Tamil Nadu:2018).

Merits of Mobile Phone for Transfer of Technology

1. Sharing and receiving the knowledge: Mobile phone plays a vital role in transfer of technology dissemination in agriculture and allied departments. The farmers, extension officers, line department officers, other officials and public peoples are getting benefits or exchanging their knowledge or information through mobile phone and it will their save time, cost, transport and others activities

2. Skipping the middle man: Olden days the peasants are want to sell their produce and buy the commodities in market, really it will be typical task because of the middle man interference but nowadays the farmers having handy information wherever the commodities which are available in the market they can access and buy it easily without any traders / commission agent activities.

3. Identify the pest and disease: The farmer's crop is affected by pest and diseases in field condition, immediately the farmers can take a snap and send it to the respective subject matter specialist (Scientist) in various field of specialization. The scientist is recommending the inputs or advice to the farmers promptly.

4. Better accessibility: Because of the mobile phone the peoples or farmers are receiving the timely information based on the need basis from various field of specialization scientist respectively.

5. Reduce the financial transaction: The famers are facing the plenty of financial problems to sell their produce in market and other places by using the public transport and separate vehicle but once the farmers can used to access the daily market information and the details are available in mobile phones it will save the financial problems and very useful tool to their produce in remunerative price at market level. The farmers are having various contact / network nowadays and getting the benefits.

6. Obtaining the functional expert advice: The farmers are getting the multi benefits from the various research station, krishi vigyan kendra, agricultural colleges etc., by getting the different type of trainings, field exposure visits, demonstrations, farmers tours, agricultural / horticultural index and cultivation best practices. With this, the functional expert is giving the inputs in field conditions either on campus - off campus of various aspect of advices in different crops. Farmers can get those kinds of advices / benefits from the concerned scientist, it will solve the field problems because of the mobile phone.

7. Market price for agricultural product: All the agricultural commodities of the farmers to sell their produce in remunerative price, the mobile phone is essential by accessing the information or updating the market price in field condition and home itself. The Uzhavan application is more useful tool for them. It will provide the local market price, whole sale market and market demand in different commodity in various districts.

8. Weather advisory services: Due to the natural calamity the farmers can assess the weather advisory services easily by using the mobile phones during the rabi and kharif season respectively. Based on the weather report in a day the farmers can devise to have sowing the seeds in different crops and readily available information in mobile phone.

Demerits of Mobile Phone for Transfer of Technology

Even though there is plenty of merits in mobile phones but there might be a greater number of demerits by usage of mobile phones among the public and farmers. Mobile phone creates high level of electronic wastage and problems, social disruptive, cause many accident while riding two wheelers and driving the four wheelers, some of the android mobile phones are very expensive, mobile phone technologies can create addictive tendencies among the public peoples, health problems, cheating, technical error while using the mobile phone, battery powers keeps running out and dangerous, vicarious living of others, mobile phone can create significant distraction for people and crime etc.

Conclusion

This study has been provided the potential of mobile phone in agricultural sectors. The implementation of mobile phone also poses a plenty of challenges in Indian farmers due to lack of mobile friendly and locally relevant digital content, rural mobile infrastructure limitations including networks, electrical and signal problems, illiteracy and a greater number of local languages.

Mobile based applications need to be integrated with ongoing agricultural extension programmes and various training methods. The mobile agro advisory services for farmers will be encouraged from various international agencies ad collaboration with private agricultural sectors.

Despite of that, the farmers need assessment, location and farmer specific information need to be generated in various multimedia content format for technology dissemination among the farm families but mobile phone penetration throughout India continuous to increase among the farming community and information services continue to adapt and proliferate, sufficient potential information exists for a much deeper rural productivity and impact in future agriculture.

The benefits of mobile phone such as portability, flexible content of message delivery of information, two-way communication and deliver low cost but highly customized solutions. Information and Communication Technology might be play as important role in building the competency and self-confidence required to influence the adoption of new mindsets and actions by small farmers.

Increase the public and private investments will be necessary to bridge the critical infrastructure to identify the gaps, the policy changes may also need to encourage the better access to high quality of inputs and credits for small and marginal farmers, increased extension services and training and development efforts can complement information dissemination by using mobile phone services to accelerate to adoption of new techniques.

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Waste Utilization of Used Tyres

Article ID: 10542

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What is Waste?

Waste is anything which is thrown or of non-use or discarded after primary use. A by- product by contrast is a join product of relatively more economic value. Waste are therefore all those things which are of no direct use and is of no monetary value. There are two types of waste biodegradable and non-biodegradable and tyre is non-biodegradable which cannot be decomposed or need thousands of years to decomposed.

Example- plastic, rubber etc.

About Waste Management?

Waste management means the techniques or activities which are for the purpose of the reducing pollution, minimising disposed issue, extracting more values from thrown away staffs. It includes collection, transport, treatment disposal of waste and regulation of the waste management process. This would eventually solve the issues like environmental hazard and manage the cost needed for disposal and string the waste.

Tyre – A Potential Waste Hazard

Nowadays there are many things which we use once and throw into the environment. But these wastes are hazardous to our nature one of such waste is tyre. Tyre are used in our bike truck and many more automobiles. Tyres are manly made up of following things.

When nature tries to decompose tyre. Its chemical has ill effect on soil such as lime increase the pH soil thus reduce the acidity and increase alkalinity of soil. ZnO reduce the root and shoot biomass by 80% and ionic Zn causes 25% reduction. Thus, it has phytotoxic effect. Oil found in tyre also effect soil as pore space might be logged which could reduce soil aeration and water infiltration and increase bulk density, subsequently affect plant growth. Thus, directly or indirectly it affects the growth of plants.

Table 1: Composition of tyres:

The material of construction	Weight Percent
RHC	48%
Carbon black and silica	22%
Metal reinforcement	15%
Oil, wax, and stearic acid	8%
Fabric	5%
Zinc oxide	1%
Curing agent	1%
Total	**100%**

Our Work on Waste Management

A small endeavour was made by us to reuse the waste which cannot be used again. In this project we take three used tyres which is non- biodegradable waste. We arranged or managed tyres in such a way that. It looks like butterfly in these three tyres are painted with elastic colour. And in this tyre, we planted small seasonal flower like Salvia, Petunia, Dianthus. This makes it more beautiful and attractive. This eventually improved the aesthetic value of the entire area. For this we ensured that the land which of no use for anyone. We had used waste plastic from which we made two wings shapes and also butterfly face. Where we put these things together, we got a beautiful sculpture which look alike portrait as a butterfly. In this we portraited maximum use of waste material. This shows the waste management. This not only ensured proper utilization of waste but also served an example the society towards systematic reuse of waste material.

Our Future Plans

1. Designing of innovative structure by using left over plastic bottle and tyres.
2. Using left over plastic material for designing other aesthetic products.
3. Use left over water bottle to grow small plants and evolve.
4. To create a unique structure out of thrown away plastics.

Conclusion

We reach to the conclusion that waste is very hazardous to our nature, and waste management is very important and effective way to reuse waste product. All should take important decision to manage or reuse waste product and make earth free from hazardous waste. Make earth clean and hygienic to sustain life.

Boron and Zinc Disorders in Fruit Crops

Article ID: 10543

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Boron Disorders in Fruit Crops

1.	Mango	Black tip, Internal necrosis
2.	Pomegranate	Fruit cracking
3.	Grapes	Chicken and hen, Millerandae or shoot berries, colvere
4.	Aonla	Fruit necrosis
5.	Apple	Hardy corky tissue, fruit cracking, blossom blast, water core, burknott formation
6.	Pear	Fruit cracking, calyx end rot

Zinc Disorders of Fruit Crop

1.	Guava	Bronzing
2.	Apple	Rossette leaves, Blind bud, Little leaf
3.	Litchi	Little leaf +leaf bronzing
4.	Citrus	Leaf motting / frenching
5.	Cheery	Abnormal reduction in fruit size

Phosphorus Rich Organic Manure Production Technology

Article ID: 10544

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Introduction

Phosphorus is one among the most important nutrients for plant growth along with nitrogen and potash. It is required by all plants but is limited in soil, creating a problem in agriculture. In many areas' phosphorus must be added to soil for the extensive plant growth that is desired for crop production. The most important ore of phosphorus is rock phosphate (also called phosphate rock) which is a complex phosphate of calcium. Manufacture of synthetic phosphatic fertilizers (such as triple superphosphate, ammonium phosphate, etc.) demands production of elemental phosphorus or phosphoric acid from phosphate rock, which, by itself, is an energy intensive process. The world consumes around 140 million tons of high-grade rock phosphate mineral today, 90% of which goes into the production of di-ammonium phosphate (DAP). Excess application of chemical fertilizers in fact reduces the agricultural production as chemicals destroy natural soil flora and fauna. Because the amount of these fertilizer utilized by plant up to 30% only. The remaining amount of these fertilizers accumulated in the soil and constantly increases the soil pH. This is a serious concern for agriculture. When DAP or SSP is applied to the soil only about 30% of the phosphorus is used by the plants, while the rest is converted to forms which cannot be used by the crops a phenomenon which is known as phosphate fixation. Thus Bio-fertilizer which is produced is named as PROM (Phosphate Rich Organic Manure) since it is synthesized by blending finely ground phosphate rock with an organic manure. The most recommended sources of organic manure are vermicompost and the sludge discarded from units that manufacture biogas by the anaerobic digestion of animal wastes (cow dung, night soil, poultry litter, piggery waste) or plant wastes (garden debris, agriculture residues). Though PROM has completed many successful field trials, PROM can thus act as a viable substitute to otherwise expensive synthetic phosphatic fertilizers. (Sekhar and Arey, 2005).

Phosphorus Rich Organic Manure

Phosphorus rich organic manure is a type of fertilizer used as an alternative to di-ammonium phosphate and single super phosphate. It is produced by co-composting high-grade (32% P_2O_5+ 2%) rock phosphate in very fine size (say 80% finer than 54 microns). Hence, it is a value-added product produced by co-compositing high-grade rock phosphate in fine size with organic matter collected from various sources such as FYM, straw of paddy or wheat, pressmud, karanj cake or waste from fruit industries and distillery etc. Phosphate Solubilizing Bacteria (PSB) and nitrogen fixing bacteria are added to improve the efficiency. Production of phosphorus rich organic manure (PROM) by composting of pressmud and distillery waste with rock phosphate into a value-added product standardized to contain 18% P2O5 with 22% moisture is a highly promising, natural, better and cheaper substitute of di-ammonium phosphate (DAP). PROM is manufactured and marketed in India by different agro Industries. The efficiency of PROM is totally depended on the particle size of rock phosphate. More the fine of rock phosphate, more the efficiency of PROM. Rock phosphate is soluble phosphate and it is effective in both acidic and alkaline soil. Ministry of agriculture and cooperation has now proved to PROM as bio-fertilizer in 2012 under fertilizer control order.

Manufacturing Process of Phosphorus Rich Organic Manure

1. PROM is produced by the biochemical conversion of phosphate rock into soluble phosphates.

2. Feedstock: Pulverized refined phosphate rock (free from silica) of uniform size of around 75 microns blended with well-ground ADS (Anaerobic Digestor sludge) or vermicompost in the ratio 1:2.

3. Average particle size of the blend is less than 1 mm.

4. The vermicompost used is that obtained by composting plant wastes and agricultural residues. The compost is dried in a tray dryer, finely powdered in a hammer mill and then blended with the pulverized rock phosphate ore.

5. For sample-II, ADS is collected from the biogas generator that employs anaerobic digestion of animal wastes (cow dung, night soil, poultry litter). The sample of discharged slurry is dewatered, dried in a tray dryer, finely ground in a ball mill and then mixed with the well-ground ore of phosphate rock in the ratio specified above. Both the ore and the organic manure (vermicompost, ADS) are screened through a set of Indian standard screens in a sieve shaker to as-certain the uniformity of size.

6. Substrate: An aqueous suspension of above blend in water. The water: solids ratio maintained is 7:3. Small amount of salt petre and gypsum are also added to make up nutrient deficiency and promote bacterial growth.

7. Bioreactor: Agitated stirred tank (slurry reactor), Operating temperature (optimum): 30°C - 35°C, Operating temperature (maximum): 60°C, pH (optimum): 7.0, Operating pressure: 1 atm, Microbial culture: Bacillus megatherium var phosphaticum (phosphorus solubilizing bacteria), Size of inoculum: 3% - 5%.

8. The process is conducted in two stages. During the first stage, the substrate slurry is added continuously to the bioreactor and is constantly agitated. The suspension is allowed to ferment for about 7 - 10 days (thermophillic stage). Since the consistency of suspension is maintained at (7/3), the pH of the medium remains at around 7.0.

9. The operating temperature is maintained more or less constant and it seldom exceeds 60°C. At the end of the thermophillic stage, the bioreactor is seeded with an inoculum of phosphate solubilizing bacteria (mentioned above) and the agitation is continued. Though the process is aerobic, since the reactor is kept open, atmospheric air/ oxygen diffuses into the substrate and transfer and dissolution of oxygen is further facilitated by agitation of the slurry. No air compressors are required to be employed. At the end of this aerobic stage, it is desirable to employ an additional stage during which the bioreactor is seeded with an inoculum of nitrogen fixing microbes such as Azotobacter and permit an additional residence time of about 5-10 days. This stage is, however, optional. We have employed all the three stages in our study.

10. Downstream processing: The product solution is filtered to separate the solid bio-fertilizer which is then dried, ground to the desired size, labeled and packaged. The bio-fertilizer (PROM) so obtained has been found to have the composition: Phosphorus content: 16.5% (as soluble P_2O_5) C: N ratio: 19:1.

11. It is fit for direct use in the agricultural field. The composition of PROM has been analyzed by the standard procedure with the help of spectrophotometer.

12. As is the case with most biochemical processes, bio-conversion of phosphate rock is also a slow process and thus demands a large residence time for the bioreactor. For a given capacity, the reactor volume required could be significantly large. It is, therefore, recommended to use two to three bioreactors with parallel feeding of substrate slurry. (Narayanan, 2006).

The Specific Advantages of PROM in Agriculture

The process of production of PROM is highly cost-effective as it is a low energy process that does not demand high temperature or high pressure (operates at ordinary temperature and pressure), needs no chemical catalyst and does not consume any valuable chemicals. It is a sustainable conversion of bio digested sludge in to the phosphate rich organic manure. The raw rock phosphate ore, since is biochemically converted to soluble phosphates, can be fed directly to plants. The yield of crops, grams, vegetables, flowering plant and orchard plants obtained with PROM is very much comparable with and often superior to that obtained when synthetic phosphatic fertilizer (SSP, DAP) are being employed in soil. PROM is associated with 100% cow dung waste.

Organic acid secreted by cow dung convert rock phosphate into soluble form. The phosphorus content in PROM is around 16.5% (as soluble P2O5) and is directly assimilable by plants. Acts as alternative to DAP and makes soil soft and enriched with nutrients for long time. Provides micro-nutrients like cobalt, copper, zinc along with primary nutrients. PROM is very effective as phosphatic fertilizer even in saline soils where DAP completely failed. It improves soil fertility in terms of chemical, physical and biological property which ultimately sustain health of soil. Reduce the cost of fertilization to the farmers and will also result into the conservation of phosphate mineral, an on renewable resource due to the high residual effect.

Conclusion

PROM (Phosphate rich organic manure) is a value-added product produced by co-composting with high grade of rock phosphate in fine size with organic manure. It is a very good source of Phosphate which is acts as alternate to synthetic fertilizers and improves the physical, chemical and biological properties of the soil, increases crop production and sustain soil health. It has been found to be an excellent, less expensive, substitute to synthetic phosphatic fertilizers, ultimately reduce the cost of fertilization to the farmers and will also result into the conservation of phosphate mineral, an on renewable resource due to the high residual effect.

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Biofortification – Improving Nutrition for Reducing Malnutrition

Article ID: 10545

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Introduction

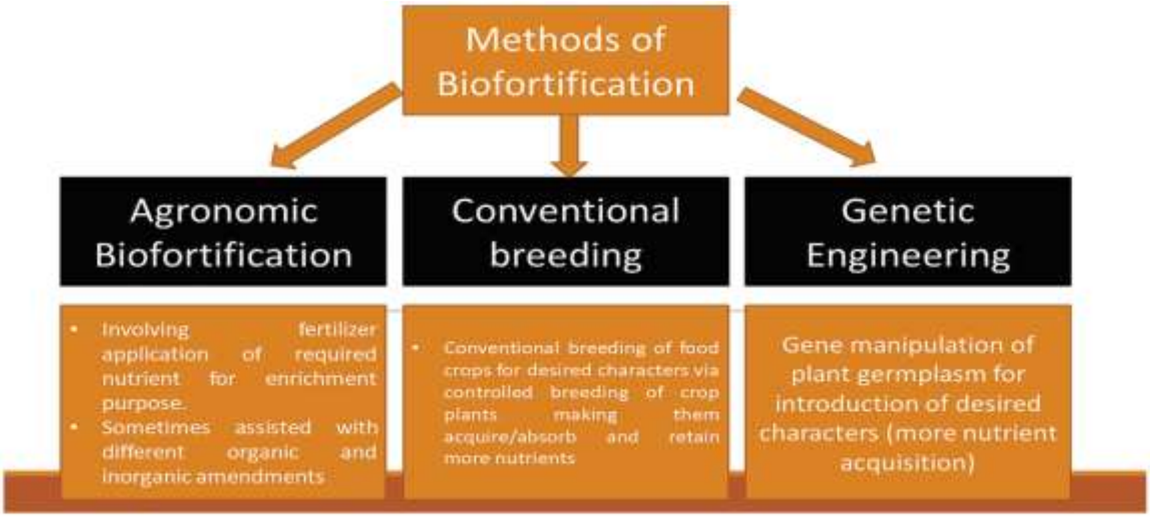
Increasing the bio-available concentrations of micronutrients in edible portions of plants through crop management and genotype improvement is known as biofortification.

Biofortification is a realistic and cost-effective source of conveying micronutrients to those populations who have limited access to different diets and other micronutrient interventions.

Since the beginning of the 21st century, mankind has witnessed the rise of terrorism, economic inflation, and climate change as the major threats to a healthy and peaceful life. But very few are aware of an even bigger problem of 'hidden hunger' lurking in the background. About half of the world's population faces a deficiency of micronutrients, proteins, and vitamins and other essential elements in their diet.

According to the statistics of the World Health Organization (WHO), a staggering 2 billion people worldwide are suffering from anemia and is mainly due to the deficiency of iron in their diet. This kind of deficiency has multiple detrimental effects on the population like increased risks of diseases, reduced lifespan, reduced mental abilities, etc.

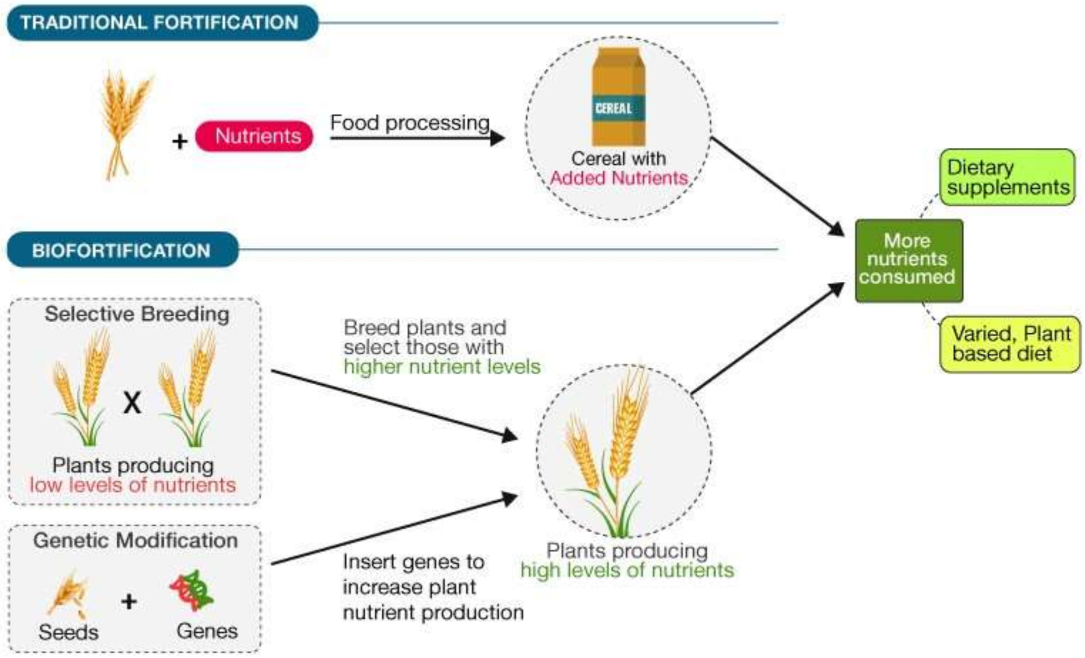
Methods of Biofortification



The Methodology of Biofortification Involves Two Principal Methods

1. Selective breeding: This is the conventional method that requires crops that have naturally occurring high nutritious value -to be crossbred with high-yielding varieties. The development of the hybrid varieties must be monitored by nutritionists to check whether the improved levels of nutrients can be used by the consumers and how these levels are affected by the storage, processing, and cooking of the food crop.

2. Genetic modification: Altering the genetic makeup of a crop by introducing foreign genes from the wild crop of the same species or other species that code for the increased production of certain nutrients or disease resistance could make the host crop rich in nutrients and increase its quality. Alternatively, different genes which code for different nutrients can also be stacked in a crop to make it rich in a wide variety of nutrients. One of the most glorious examples is that of golden rice which has been enriched with beta-carotene, a precursor of Vitamin A.



Micronutrients Deficiency in Indian soil

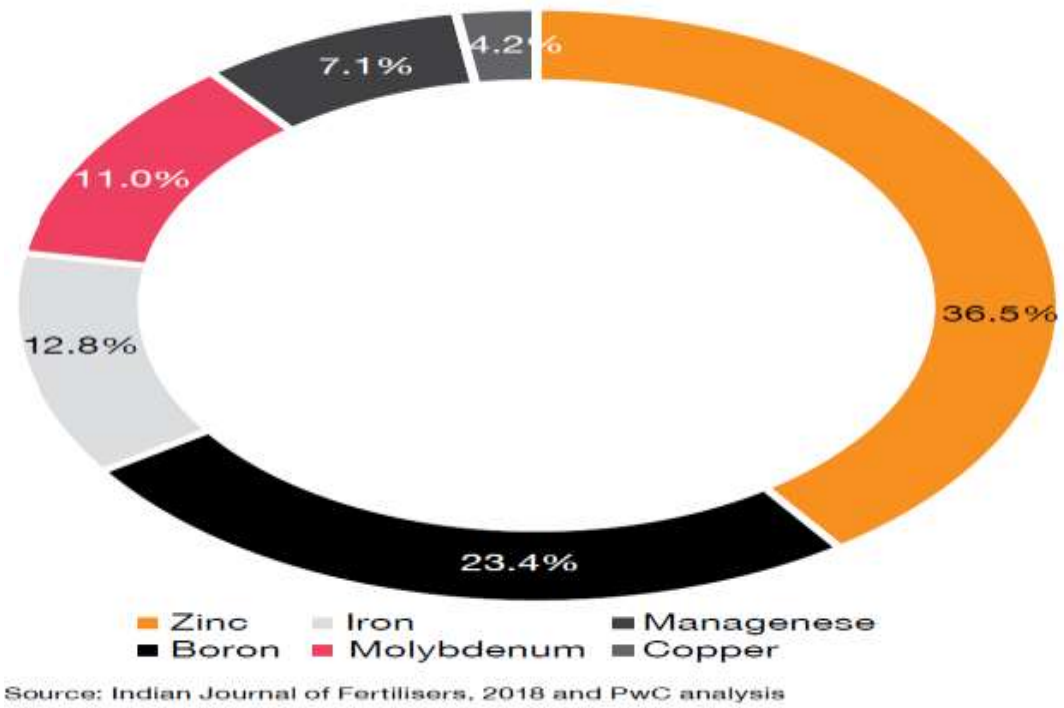


Table 1: Effect of different treatments on Fe and Zn content (mg kg-1) in rice grain:

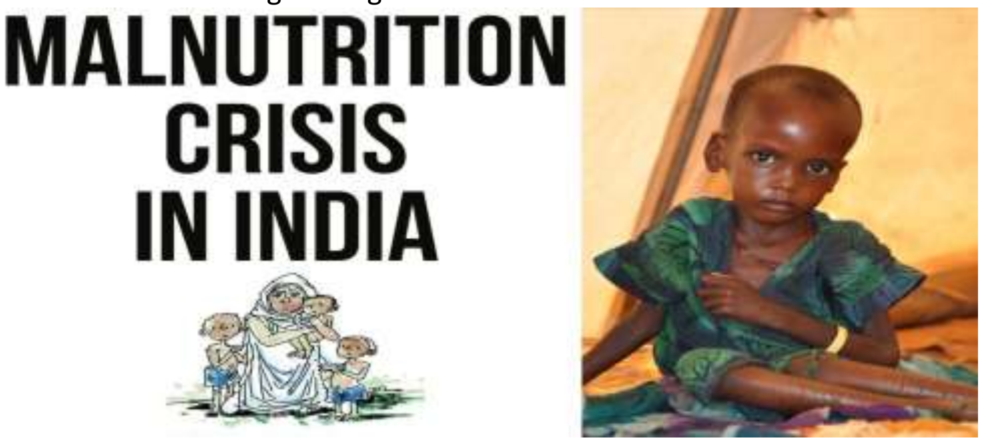
Treatments	Fe	Zn
Mo: Control	99.0	43.0
M1: 2.50 mg Fe kg-1	111.2	47.4
M2: 5.00 mg Fe kg-1	138.0	51.5
M3: 7.50 mg Fe kg-1	147.6	53.5

M4: 10.0 mg Fe kg-1	147.2	53.4
M5: 1.25 mg Zn kg-1	111.5	52.1
M6: 2.50 mg Zn kg-1	119.6	64.0
M7: 3.17 mg Zn kg-1	125.0	72.9
M8: 5.00 mg Zn kg-1	129.0	84.0
M9: Grade 5 @ 12.0 mg kg-1	122.9	59.5
C. D. @ 5%	10.31	4.35

Navsari (Gujarat) **Gohil et al. (2018)**

Conclusion

Micronutrient malnutrition is known to affect more than half of the world's population and considered to be among the most serious global challenges to humankind. Micronutrient malnutrition or the hidden hunger is very common among women and preschool children caused mainly by low dietary intake of micronutrients, especially Zn and Fe. Biofortification, the process of increasing the bioavailable concentrations of essential elements in edible portions of crop plants through agronomic intervention or genetic selection, may be the solution to malnutrition or hidden hunger mitigation.



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Focus on better food, not only more food,
The expected rewards are high.

Importance of Waste Decomposer in Agriculture

Article ID: 10546

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Introduction

The use of food and insect killing poisons in agriculture sector has increased greatly, which has led to increase in our production, but there are many negative effects that have also been felt in our lives. The use of heavy metals in the plants, the worsening of the natural environment, water borne problems, changes in the soil properties and also many diseases in human and cattle. To avoid this, many agricultural experts recommending the technology of using waste decomposer which not only we can rid of chemical foods and poisonous sprays in short time but also makes the soil soft and rich in nutrients. Waste decomposer is a consortium of few beneficial microorganisms which works as biofertilizer, bio-control and as well as the soil health reviver. It can also be used in various ways such as quick composting of bio wastes, foliar spray as bio pesticides and seed treatment in all types of agricultural and horticultural crops.

Preparation of Waste Decomposer

1. Take 2kg of jaggery and mix it in a plastic drum containing 200 liters of water.
2. Now take one bottle of waste decomposer and pour all its contents in a plastic drum
3. Mix it properly with a wooden stick for a uniform distribution of waste decomposer in drum.
4. Cover the drum with a cardboard and stir it every day twice.
5. After five days the solution of drums turns in creamy color.

Effect of Waste Decomposer on Soil

1. Waste decomposer application changes the biological and physicochemical properties of soil, there by soil becomes favorable for plant growth. The biological properties of the soils seemed to change tremendously in terms of increase in beneficial microorganisms. The texture and structure of the soil are changed in tune with supporting plant growth.

2. Waste decomposer application can also change the salinity and alkalinity problems by producing a wide range of lysing enzymes, to degrade substrates and possess high resistance to microbial inhibitors antagonizes phytopathogens by competing for nutrients space, by producing antibiotics as well as by inducing systemic resistance of plants, it also stimulates plant growth and development by means of the production of plant growth promoting molecules.

Uses of Waste Decomposer in Crop Production

1. Seed treatment with waste decomposer in an advance technique of seed treatment that involves the application of beneficial microrganisms on seed surface followed by hydration. Waste Decomposer seed treatments help to control soil borne diseases and also enhances plant growth and yield as it got the ability to alleviate biotic stress and abiotic stress.

2. Seed treatment with waste decomposer shows 98 percent early and uniform germination.

3. It can be used as biopesticide the mass multiplied liquid waste decomposer culture is diluted in the ratio of 1:3 ratio with water and applied as foliar spray to control pest and diseases. It can control all types of soil borne pests and diseases.

4. It can also apply to soil by drip irrigation method.

5. Waste decomposer application is a promising tool for good quality and higher yields of crops.

6. All Biodegradable materials like agro waste, animal waste, kitchen waste, city waste decomposes by spraying waste decomposer in 40 days.

Disadvantages

1. They will destroy the diversity of beneficial microbes in soil because waste decomposer contains only 2 or 4 microbes.
2. There is a chance of decomposition of seeds.
3. In dryland agriculture use of waste decomposer will fastly decompose of mulching materials like dry leaves, bio-wastes by this no conservation of water occurs.

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CRISPR/Cas Genome Editing and Its Applications in Crop Improvement

Article ID: 10547

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Introduction

Improved crop production using innovative breeding approaches is urgently required to enhance access to quality foods worldwide. Current progresses in CRISPR/Cas genome editing facilitate effective targeted modification in most crop plants, therefore promising to hasten crop improvement. Genome editing is defined as a collection of advanced molecular biology techniques that facilitate precise, efficient, and targeted modifications at genomic loci.

There are mainly three tools of genome editing which are generally used for this purpose, namely,
1. Zinc-Finger Nucleases (ZFNs).
2. Transcription Activator-Like Effector Nucleases (TALENs).
3. Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas systems.

CRISPR/Cas system of genome editing is discussed in this article.

CRISPR/Cas is a Clustered Regularly Interspaced Short Palindromic Repeats of genetic information that was found in some bacterial species as an adaptive immune system. It represents a family of DNA repeats in the majority of archaeal (~90%) and bacterial (~40%) genomes provide acquired immunity against invading foreign DNA such as viruses and phages. The size of CRISPR repeats and spacers varies between 23-47 base pair and 21-72 base pair, respectively. Generally, CRISPR repeat sequences are highly conserved within a given CRISPR locus.

Components of CRISPR-Cas System

1. crRNA (CRISPR RNA): It comprises the guide RNA to detect the correct sequence of the host DNA along with a region that binds to tracrRNA.

2. tracrRNA (trans activating crRNA): It binds to crRNA to make an active complex.

3. sgRNA: It is a combination of tracrRNA and crRNA.

4. Cas9: It is a protein associated with CRISPR loci having endonuclease activity thus able to cause double stranded break at targeted site.

5. Repair template: It is a DNA that guides the cellular repair mechanisms allowing insertion of a specific DNA sequence.

Classification of CRISPR-Cas System

All CRISPR-Cas systems are divided into two distinct classes, on the basis of the design principles of the effector modules.
1. Class 1 systems: The multi-subunit effector complexes comprising several Cas proteins. Eg. Type I, III and IV CRISPR-Cas system.
2. Class 2 systems: The effector is a single, large, multidomain protein. Eg. Type II, V and VI CRISPR-Cas system.

Table 1: Different Cas proteins, their distribution and functions:

Protein	Distribution	Function
Cas1	Universal	Spacer acquisition

Cas2	Universal	Spacer acquisition
Cas3	Type I signature	Target interference
Cas4	Type I, II	Spacer acquisition
Cas5	Type I	crRNA expression
Cas6	Type I, III	crRNA expression
Cas7	Type I	crRNA expression
Cas8	Type I	crRNA expression
Cas9	Type II signature	Target interference
Cas10	Type III signature	crRNA expression and interference

Table 2: Applications of CRISPR/Cas in improvement of crops:

Crop species	Target gene	DNA repair type	Trait improved	Reference
1. Crop yield improvement strategies:				
Rice	LAZY1	NHEJ	Tiller-spreading	Miao et al., 2013
Rice	Gn1a, GS3, DEP1, IPA1	NHEJ	Enhanced grain number, larger grain size, panicle architecture, plant architecture	Li et al., 2016
Wheat	GW2	NHEJ	Increased grain weight and protein content	Zhang et al., 2018
Tomato	SP5G & SlAGL6	NHEJ	Earlier harvest time & Parthenocarpy	Soyk et al., 2017 Klap et al., 2017
2. Quality traits improvement:				
Camelina sativa	FAD2	NHEJ	Decreased polyunsaturated fatty acids	Jiang et al., 2017 & Morineau et al., 2017
Rice	SBEII	NHEJ	High amylose content	Wagh et al., 2016, Sun et al., 2017 & Zhang et al., 2018
Maize & Potato	Wx1	NHEJ	High amylopectin content	Wang et al., 2017
3. Disease resistance:				
Wheat	1.EDR1 2. TaMLO-A1, TaMLO-B1, TaMLOD1	NHEJ	Powdery mildew resistance	1.Zhang et al., 2017 2. Wang et al., 2014
Rice	1.OsERF922 2.OsSWEET1	NHEJ	1.Enhanced rice blast resistance, 2.Bacterial blight resistance &	1.Wang et al., 2016 2. Zhou et al., 2015
Tomato	SlMLO1 & SlJAZ2	NHEJ	Powdery mildew resistance & Bacterial speck resistance	Nekrasov et al., 2017 & Ortigosa et al., 2018
cotton		NHEJ	leaf curl disease-resistant	Iqbal et al., 2016
Cucumber	eIF4E	NHEJ	Virus resistance	Chandrasekaran et al.,2016
Mushroom	PPO	NHEJ	Anti-browning phenotype	Waltz et al., 2016
Cotton	GhERF-IIb3		Bacterial blight	Cacas et al. 2017
4. Herbicide resistance				
Rice	ALS	HR	Herbicide resistance	Butt et al., 2017
Rice	EPSPS	NHEJ	Herbicide resistance	Li et al., 2016

Soybean	ALS	HR	Herbicide resistance	Li et al., 2015
Maize	ALS	HR	Herbicide resistance	Svitashev et al., 2015
Potato	ALS	HR	Herbicide resistance	Butler et al., 2016
Flax	EPSPS	HR	Herbicide resistance	Sauer et al., 2016
Cassava	EPSPS	HR	Herbicide resistance	Hummel et al., 2018
5. Abiotic stress resistance				
Wheat	TaDREB2 and TaERF3		Abiotic stress response	Kim et al., 2018
Maize	ARGOS8		Increased grain yield under drought stress	Shi et al., 2017
Tomato	SlMAPK3		Drought tolerance	Wang et al., 2017
Rice	OsPIN5b (a panicle length gene), GS3 (a grain size gene) and OsMYB30 (a cold tolerance gene)		Yield and Cold tolerance	Zeng et al., 2020
Cotton	GhPIN1–3, GhPIN2 GhRDL1		Drought resistance	1. He et al., 2017 2. Dass et al., 2017
Sugarcane	ScNsLTP		Drought and Chilling resistance	Chen et al., 2017
6. Other traits to fasten breeding process				
Rice	OsMATL		Induction of haploid plants	Yao et al., 2018
Rice	1.TMS5 2. OgTPR1		male sterile lines Interspecific hybrid male sterility	Zhou et al., 2016 Xie et al., 2017
Maize	ZmTMS5		Thermosensitive male-sterile	Li et al., 2017
Wheat	3 homologous of Ms45		male sterile lines	Singh et al., 2018
Wheat	TaWaxy and TaMTL		Induction of haploid plants	Liu et al., 2019
Tomato	SP, SP5G, SlCLV3 and SlWUS, SlGGP1		Rapid domestication	Li et al., 2018
Rice	SF3B1		Directed evolution	Butt et al., 2019

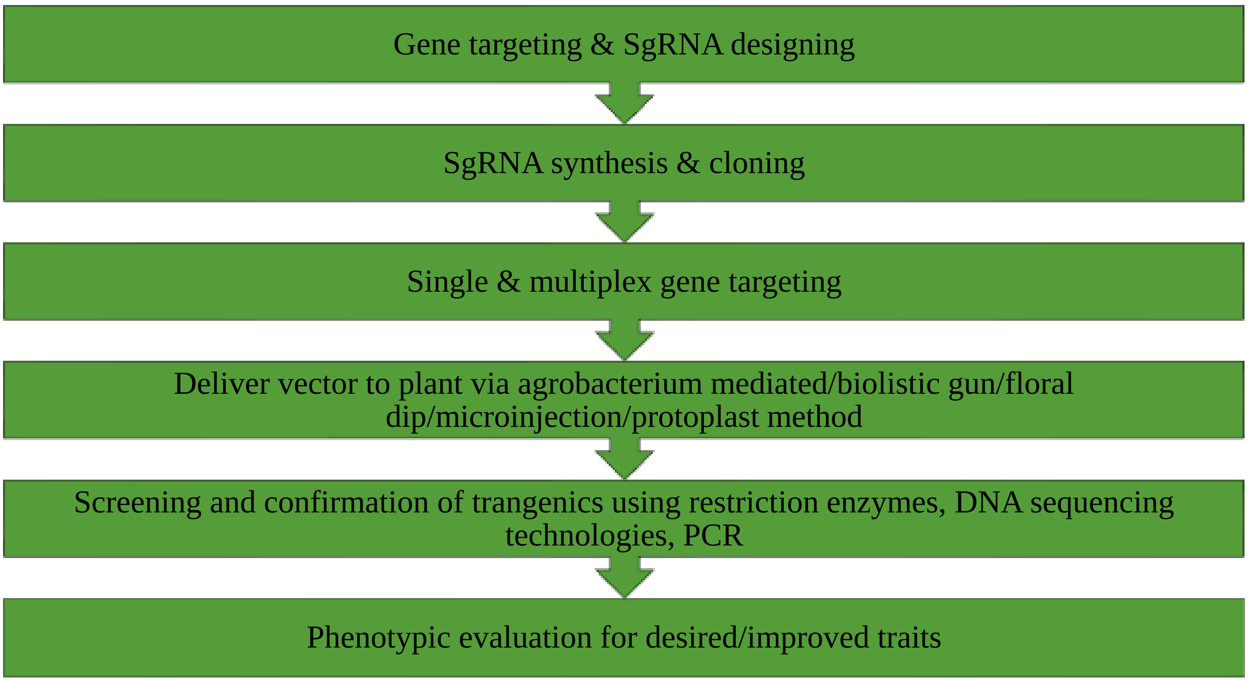

Fig: Flow chart of CRISPR/Cas based genome editing in plants

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Need for PGR Conservation

Article ID: 10548

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Summary

Man's interest in agriculture started about 10,000 years ago and during this long period, transition from 'gathering' to 'growing' of plants occurred. In this process, a wide array of crop variability got generated by natural means and through both conscious or unconscious selection. Gradually, a new wealth of variability also got generated/adapted and diversified by crop introductions in the exotic environment or through migration of human population. Associated with this process was the keenness of human mind to explore the rich global diversity of plant wealth in general so as to judiciously tap the potential of useful flora. Historically, mankind has used only about 5,000 plant species worldwide to meet food and other needs.

Introduction

Conservation of plant genetic resources Plant breeders manipulate variability in various ways – for example, they assemble, recombine, select, and discard. The preferential use of certain elite genetic stock in breeding programs has narrowed the overall genetic base of modern cultivars. As already noted, pedigree analysis indicates that many cultivars of certain major crops of world importance have common ancestry, making the industry vulnerable to disasters (e.g., disease epidemics, climate changes). National and international efforts have been mobilized to conserve plant genetic resources.

Seed Company

Need for PGR Conservation

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As already noted, pedigree analysis indicates that many cultivars of certain major crops of world importance have common ancestry, making the industry vulnerable to disasters (e.g., disease epidemics, climate changes). National and international efforts have been mobilized to conserve plant genetic resources.

Why Conserve Plant Genetic Resources?

There are several reasons why plant genetic resources should be conserved:

1. Plant germplasm is exploited for food, fiber, feed, fuel, and medicines by agriculture, industry, and forestry.

2. As a natural resource, germplasm is a depletable resource.
3. Without genetic diversity, plant breeding cannot be conducted.
4. Genetic diversity determines the boundaries of crop productivity and survival.
5. As previously indicated, variability is the life blood of plant breeding. As society evolves, its needs will keep changing. Similarly, new environmental challenges might arise (e.g., new diseases, abiotic stresses) for which new variability might be needed for plant improvement. When a genotype is unable to respond fully to the cultural environment, as well as to resist unfavorable conditions thereof, crop productivity diminishes.

Plant breeders may use germplasm collections in one of two basic ways:

a. As sources of cultivars.
b. As sources of specific genes.

A breeding collection contains alleles for specific traits that breeders can transfer into adapted genotypes using appropriate breeding methods. Accessions must be properly documented to facilitate the search by users. This means, there should be accurate passport and descriptor information for all accessions. Unfortunately, this is not the case for many accessions.

The redundancy in germplasm banks is viewed by some breeders as unacceptable. A study showed that of the 250,000 accessions of barley at that time in repositories, only about 50,000 were unique. Such discrepancy leads to false estimation of the true extent of diversity in the world collection. A large number of the accessions are also obsolete and have little use to modern plant breeding programs.

The major uses of germplasm enhancement may be summarized as follows:

a. Preventions of genetic uniformity and the consequences of genetic vulnerability.
b. Potential crop yield augmentation. History teaches us that some of the dramatic yield increases in major world food crops, such as rice, wheat, and sorghum, were accomplished through introgression of unadapted genes (e.g., dwarf genes).
c. Introduction of new quality traits (e.g., starch, protein).
d. Introduction of disease- and insect-resistance genes.
e. Introduction of environment-resistance genes (e.g., drought resistance).

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Natural Farming: Star Promoter of Andhra Pradesh Community Natural Farming (APCNF)

Article ID: 10549

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Introduction

Alternative low-input farming practices have emerged in India and across the world likely to reduce input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Instead, natural farming in Andhra Pradesh, renamed APCNF in 2020 (Andhra Pradesh Community-managed Natural Farming, especially with women Self-Help Groups), consists in creating 'a mosaic of local agro ecosystems stimulating in diversified ways biological synergies between several vegetal and animal species above and below the soil, from microorganisms to livestock' (Tripathi et al., 2018). It furthers the farmers' autonomy, self-reliance and economic empowerment by encouraging them to grow diversified and healthy food while protecting the soil and other natural resources and services.

Why Andhra Pradesh Community Natural Farming (APCNF)?

Rising cost of Inputs. High labor wages. Volatile market price. Fragile ecosystem – Unpredicted monsoon extremes. Large suicide of farmers. Rising Environmental concerns. Change in Consumers preference towards safety food.

Scope of Andhra Pradesh Community Natural Farming (APCNF)

Andhra Pradesh Community Natural Farming (APCNF) has been emerged as a farming model for small and marginal farmers to overcome the farming distress and sustaining the livelihood and keeping the health of family on top priority. It reduces farmers' costs through eliminating external inputs and utilizing in-situ resources to rejuvenate the soil, simultaneously increasing incomes, restoring ecosystem/soil health and climate resilience through diverse, multi-layered cropping systems. As the importance of natural farming is reiterated in the budget, it gained wide popularity. This is a very good step in the current circumstance.

Uniqueness of Andhra Pradesh Community Natural Farming (APCNF)

An approach towards sustainability. Expense-free farming. Farming up to 30 acres with one native cow. Farming with minimum electricity and water consumption. Producing quality, poison-free food. Agriculture without external input. Techniques of multi-crop cultivation for higher net income. Reducing external labour requirement.

Four-Wheels (Chakras) of Andhra Pradesh Community Natural Farming (APCNF)

In 2015, the Government of Andhra Pradesh (GoAP) instituted the Rythu Sadhikara Samstha (RySS), a state-owned, non-profit organisation to introduce ZBNF practices to all farmers in the Indian state of Andhra Pradesh (AP). The implementation of the project in the field was started in 2016-17 and in 2017-18, around 1,63,000 farmers in 972 villages across all 13 districts of the state have adopted ZBNF practices. To ensure the programme reaches every farmer in the state, the GoAP and RySS have used a decentralised cluster model to identify, mobilise, and train forthcoming and early-adopting farmers to institute a unique community-based dissemination methodology for ZBNF through numerous NGOs. Various NGOs promote APCNF methods through their programs, or support individual farmers.

Four Wheels of APCNF	Benefit
Beejamrutham: a microbial coating for seeds, based on cow dung, urine, and lime	Protects young roots from fungus and seed borne or soil borne diseases
Jeevamrutham: 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
Mulching (Acchadana): Covering the top soil with cover crops and crop residues	Produces humus, conserves top soil, increases water retention, encourages soil fauna, prevents weeds
Whapahasa: Soil aeration, a result of jivamrita and acchadana- represents the changes in water management brought about by improved soil structure and humus content	Increase water availability, water use efficiency, increase resilience to drought

(APZBNF, 2018)

Identification of New Dravanam in Kadapa, Andhra Pradesh

A new dravanam was identified by an NGO (NON- Governmental Organisation) named K. Nageswar Reddy having a Non-profit Voluntary Organisation called People's Action in Development (PAID), Kadapa, Andhra Pradesh. He was also a farmer and fascinated in performing new natural farming methods in his work by assisting the natural farming methods to the farmers of different areas at low cost. One such method he found, while he was performing in his own field, he controlled pest attack in his groundnut field from the initial stage onwards by using natural farming method entitled "Matti Dravanam".

Preparation of Matti Dravanam

"Matti Dravanam" is a powerful method which helps to manage the pest, increase soil fertility, growth promoter and increase the crop yield. First collect two types of leaves such as 2kg Neem leaves and 2kg Calotropis leaves. Then grind these leaves in the mixer and filter the extract by cloth and retain the solution aside. After that fetch 1m depth of 25kg forest soil and then mix it in 200lt drum or barrel of water. Next take the solution and pour it in the drum and rotate the solution in the clockwise direction with a stick. After one hour spray it on plants of pest. It has to be done three times beginning with five days interval. Then after 15 days interval it has to be continued. After three times spraying in the field, there is a clear visualization of good condition of the yield.

NGO & Farmer K. Nageswar Reddy in his sprayed "Matti Dravanam"

Groundnut pods in sprayed "Matti Dravanam" Groundnut Field

Feedback from an APCNF Farmer Followed the Matti Dravanam

In Takkoli cluster of Sidhout Mandal, Kadapa, S.H.G Member-Ganga Maheswari, a Farmer in her one-acre field of groundnut crop, there is pest attack. After the guidance of NGO- K. Nageswar Reddy of People's Action in Development (PAID) and with the assistance of PAID Staff: Agricultural Technical Officer- K. Sowndarya, CA- R. Adi Narayana Reddy, CRP-Lakshmi and ICRP-Naveena, she prepared "Matti Dravanam" in her own field. Then she sprayed in her groundnut field with intercrop Citrus and Sesbania. After few days she observed that her field condition and appearance was good.

Words from Ganga Maheswari

In APCNF our expenses are very low. It doesn't matter what the yield is, I still make a profit because my costs are negligible. Plus, I've added intercrops to this, so I get income from many crops, not just one. Yield is not an important concept for us.

1. Neem leaves and Calotrophis leaves.

2. After grinding of leaves in a mixer

3. 25kg Forest soil mixed in 200lt drum of water

4. PAID Staff with farmer Ganga Maheswari

Conclusion

The farmers in Andhra Pradesh have expressed that transition to Andhra Pradesh Community Natural Farming (APCNF) from chemical agriculture has paid them good dividends. All the practitioners were claimed high yield at low cost with possibly no decline in future, because of enhancement in soil fertility by continuous incorporation of natural farming residues. The new system of farming has assisted the farmers to escape from the debt trap and has given them a new level of confidence to consider farming as an economically viable venture. As the importance of natural farming is reiterated, it gained wide popularity.

Future Prospects

Monitoring and collecting data from the APCNF field for continuous 4-5 years can give more precise idea regarding the increase in yield, soil fertility, water requirement etc.

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Recent Advancement in Tissue Culture of Horticulture Crops

Article ID: 10550

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Introduction

Plant tissue culture broadly refers to the in vitro cultivation of plants, seeds, and plant parts (tissues, organs, embryos, single cells, protoplasts) on nutrient media under closely controlled and aseptic conditions. Plant tissue culture systems are often used as "model" systems in the study of various physiological, biochemical, genetic, and structural problems related to plants. Plant tissue culture techniques also have great potential as a means of vegetative propagating economically important crops and crops of potential on a commercial basis (Brown et al., 1984).

Although the term plant tissue culture is commonly used to include all types of aseptic plant culture, it is sometimes preferable to use the following more specific terms to distinguish the various types of culture:
1. Plant culture- culture of seedlings or larger plants.
2. Embryo culture- culture of isolated mature or immature embryos.
3. Organ culture- culture of isolated plant organs.
4. Tissue or callus culture- culture of tissue arising from explants of plant organs.
5. Suspension culture and cell culture- culture of isolated cells or very small cell aggregates remaining dispersed in liquid medium.
6. Protoplast culture- culture of plant protoplasts, i.e., cells devoid of their retaining walls.
7. Anther or haploid culture- culture of anthers and/or immature pollen grain in an effort to obtain a haploid cell or callus line.

Future Prospect of Tissue Culture in Fruit Crop Breeding

The past decades of plant cell biotechnology have evolved as a new era in the field of biotechnology, focusing on the production of a large number of secondary plant products. During the second half of the last century the development of genetic engineering and molecular biology techniques allowed the appearance of improved and new agricultural products which have occupied an increasing demand in the productive systems of several countries worldwide (Navarrvo 2007).

Nowadays, one of the most promising methods of producing proteins and other medicinal substances, such as antibodies and vaccines, is the use of transgenic plants (Ferrante 2001).

Transgenic plants represent an economical alternative to fermentation-based production systems. Plant-made vaccines or antibodies (plant bodies) are especially striking, as plants are free of human diseases, thus reducing screening costs for viruses and bacterial toxins.

Advantage of Tissue Culture in Fruit Crop Breeding

1. In present scenario, where the growers face the problem of shortage of disease-free planting material, the tissue culture is a potential means to tackle this problem.
2. Inoculation of AMF or other beneficial microbes during weaning.
3. Expanding the existing genetic resource in fruit crops.
4. Conservation of wild species.

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Landscape Design for Industrial Areas

Article ID: 10551

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Summary

Urban landscape is basically formed of open and green spaces within an urban environment. However, it is not totally independent from the surrounding buildings and structures. Altogether, they form the character and identity of a city, and sense of place. It contributes to the cityscape by means of aesthetics and function. It also supports urban ecology. It is dynamic and constantly evolving. According to von Borcke (2003) it is not an add-on but rather forms the basis for creating places. Urban landscape elements function as separator and/or connector agents between different land uses. They can form a buffer zone between conflicting uses (e.g., between industrial and housing areas) while they can facilitate movement of citizens throughout the city (e.g., greenways). They have the flexibility to serve for multiple uses and for different group of users in the community (Anonymous, 2009).

Introduction - Urban landscape also contributes to the cityscape in terms of visual quality. Within dense built environments, it creates a sense of openness and more attractive places to live. Urban landscape helps to balance human-scale in city centers where vertical effect of buildings and structures dominates. It softens the "hardness" of buildings and structures. Well designed and managed urban landscape can improve citizens' quality of life in many other ways as well.

Objectives

The chief objectives of landscaping industrial areas are:

1. To reduce the wind velocity by using tall evergreen trees.
2. To reduce pollution caused by hazardous gases.
3. To reduce noise.
4. To improve microclimate.
5. To improve aesthetic values.

Industries may be broadly categorized into two groups. The first group comprises comparatively neat factories such as a plywood factory or a fruit processing plant which emit less dust and other polluting materials. The second group consists of factories such as cement, steel, fertilizer, etc. which emit a lot of dust, smoke, and harmful chemicals.

The primary aim in a factory garden will be to plant trees to arrest the drifting dust and smoke and to cut down noise. Another important aim is to provide ample shade and coolness so that the workers get a respite under the coolness of trees from the hostile hot interior of the factory. Moreover, the trees bring down the temperature in the factory premises to a considerable extent. The places where garden can be laid in the factory area are canteen, rest-shed, hospital, administrative building, etc.

Planning

For planning a well-designed industrial landscape, the following parameters are to be taken into account:
1. Weather parameters of that location.
2. Type of soil, pH, depth, problems of drainage and soil erosion.
3. Water source, quality and availability.
4. Native plant species.
5. Nature of bird and animal habitat.

Principles

The following fundamental principles are to be followed for a good industrial landscape:
1. Simplicity in design should be the key note and undue complexity is to be avoided.
2. Variety in a garden gives pleasure. But attempting too much in a small space is not desirable.
3. The ground should be so designed that the entire garden is not visible at a glance. It should be full of surprises, with each turn of the path revealing fresh vistas, or disclosing new interests.
4. Long and straight garden paths should be avoided.
5. Judicious employment of a greater number of plants of different varieties is desirable.
6. Color and contrast in the garden are very much desirable which would help in creating a relaxing environment for the tired employees.

Basic Components

The basic components of industrial landscape designs such as concrete benches, steps, wooden decks and stone lanterns should be mostly from the plant material as they serve definite functions. For instance, proper care should be taken while choosing and planting a specimen tree or a shrub as it is a vital component of the whole garden with regard to its position and beauty. It is also equally important to cover or conceal undesirable features in the landscape using a live hedge. Lawns need proper maintenance such as fertilizing, weeding, watering and mowing. So, when planning for a lawn, the cost and efforts required to maintain it are to be considered.

Desirable Characteristics of Trees for an Industrial Landscape

1. Broad leaves with rough surface.
2. Pubescence.
3. Large number of stomata.
4. Efficient in tapping dust and other particles.

Trees Suitable for Landscaping Industrial Areas

1. Trees tolerant to SO_2:

a. Casuarina.
b. Albizzia.
c. Acacia nilotica.
d. Delonix regia.
e. Moringa oleifera.

2. Trees tolerant to Fluoride:

a. Ailanthus excelsa.
b. Cassia fistula.

c. Eucalyptus.
d. Ficus sp.
e. Thuja compacta.

3. Trees for thermal power and cement factories:

a. Ficus spp.
b. Azadirachta indica.
c. Tamarindus indica.
d. Butea monosperma.

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Pesticide Residues in Food

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Weeds, worms and insects are mainly responsible for damaging the agriculture crops. Further, pest infestation still remains one of the major problems for the stored grains. Hence, pesticides are used against these pests that destroys crop. Several variants of pesticides such as insecticides, fungicides, herbicides, rodenticides, bactericides, nematicides and others are used to exterminate insects, fungus, weeds, rodents and other pests for increasing the crop production and ultimately to uplift the economic state of farmer by reducing their loss.

However, indiscriminate use of pesticide has resulted in various problems due to their high persistence or existence in the environment. Pesticide degradation occurs by the biotic and abiotic factors such as microbes and sunlight. Pesticides which do not quickly decay remain in the environment and enter the food chain. A large part of population gets exposed to pesticides either directly or indirectly. Direct exposure occurs by inhalation during pesticides spray in field, accidental ingestion, dermal contact or ocular contact and indirectly by contaminated food derived from plants and animals (Sethi et al., 2017).

Pesticides Residues in Food Products

The highest levels of pesticide residues are recorded in Maharashtra (74%), followed by Gujrat (70%), Andhra Pradesh (57%), Himachal Pradesh (56%) and Punjab (51%). Vegetables samples have been tested positive for pesticide residues in Kolar district of Karnataka (Gowda and Somashekar 2012). The pesticides prevalent in oil rich food such as butter and ghee obtain from bovine milk cause bioaccumulation of pesticide in the animal body (Gill et al., 2020, Bedi et al., 2016, Kumari et al., 2005). Moreover, honey which is a good source of antioxidants has also been reported to be contaminated with pesticide (Choudhary et al., 2008). A study conducted in Ludhiana on chicken muscles and eggs has revealed the presence of organochloride pesticides residues suggesting presence of pesticide residues in the bird feed (Aulakh et al., 2006). Pesticide such as Hexachlorocyclohexane (HCH) has contaminated the ground and surface water in Bhopal, India (Bhat and Padmaja 2014). Moreover, pesticides ill effects on aquatic life have also been observed in several studies establishing presence of pyrethroides and organochlorides in the weeds and fishes of Thamirabarani River in South India (Arisekar et al., 2019). Moreover, the intensity of this problem can be better understood from the fact that pesticide residues has been detected in human breast milk (Bedi et al., 2013).

Even though pesticides are developed in such a way that these do not intend to affect the human health, but available data have shown that prolong exposure to pesticides results in serious health problems such as immune suppression, hormone disruption, reproductive problems, kidney problems, liver problems and cancer (Ali et al., 2021). We have previously reported that long term dietary exposures of various classes of pesticides result damage to the non-target organs like lung at cellular and molecular level (Pandit et al., 2016, Pandit et al., 2019, Verma and Sethi, 2020 and Shaikh and Sethi, 2020). Taken together, pesticides residues can be considered as an emerging problem for the health.

What can be the Solution?

A solution is required for all the above mention problems. We need proper management of pesticides to increases the crop yield without affecting the environment or the human health. Biopesticides obtain from microbes and plants can be the alternate to pesticides to kill the harmful pests and weeds in the agricultural field. Further, awareness camps should be set up to educate the farmers about the harmful effects of pesticides and its management. Pesticides should be spayed after consultation with the agricultural experts. There should be strict monitor of the sale of pesticides to prevent indiscriminate use of pesticides.

Conclusion

It can be concluded from above discussion that pesticides have contaminated a large proportion of food products and affected environment as well as the organisms and monitored use of pesticides will help to minimize the ill effects of pesticides.

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Bacterial Lipopolysaccharides

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Summary

Bacterial lipopolysaccharides (LPS), are the major cell wall components characteristic of Gram-negative bacteria. They are essential for protection from hostile environments and in the case of pathogens, they play a direct role in interactions with eukaryotic host cells.

Introduction

The cell envelope is the first line of defense between a bacterium and the world-at-large. Gram-negative bacteria are characterized by an envelope that contains two membranes: an inner membrane (IM) that surrounds cytoplasmic components, and an outer membrane (OM) that separates the cell from its environment.

These two membranes surround an aqueous cellular compartment termed the periplasm, which contains the peptidoglycan cell wall (Silhavy et al., 2010). Thus, in Gram-negative bacteria, the OM serves as the first line of defense against environmental threats; it is a highly asymmetric bilayer that contains phospholipids in the inner leaflet and lipopolysaccharide molecules in the outer leaflet.

Lipopolysaccharide (LPS), is one of the most studied bacterial surface molecules. It creates a permeability barrier at the cell surface and is a main contributor to the innate resistance that Gram-negative bacteria display against many antimicrobials, allowing bacterial growth in unfavorable environments such as those that may be encountered within or on the host.

LPS can also play a crucial role in bacteria-host interactions by modulating responses by the host immune system. LPS-defective mutants show increased in vitro sensitivity to antibiotics and antimicrobial peptides and the numbers of viable bacteria often decline very rapidly upon introduction into plants.

Structure of LPS

LPS is a large glycolipid composed of three structural domains: lipid A, the core oligosaccharide, and the O antigen (Raetz and Whitfield, 2002) (Fig 1). Lipid A, the hydrophobic portion of the molecule, is an acylated β-1‘-6-linked glucosamine disaccharide that forms the outer leaflet of the outer membrane.

Lipid A is the biologically active part of the LPS molecule. The acyl chain length and number of acyl groups may vary between bacterial species but are relatively conserved within a species; however, it can undergo regulated modifications in response to environmental conditions.

The core oligosaccharide is a non-repeating oligosaccharide that is linked to the glucosamines of lipid A. The core structure usually contains 3-deoxy-D-manno-oct-2-ulosonic acid (Kdo) residues, heptoses, and various hexoses, which can be modified with phosphates and other substituents such as phosphoethanolamine. The core oligosaccharides vary among species and even between some strains of one species.

The most diverse component of LPS is the O antigen. Not only can the structure and composition of the O antigen differ within a species at the strain level, but, in addition, some Gram-negative bacteria do not synthesize this component of LPS. In such cases, molecules composed of only lipid A and the core oligosaccharide are typically referred to as lipooligosaccharides.

In the vast majority of LPS structures, the O-specific chain is characterized by extremely high structural variability even within a given bacterial species, which constitutes the chemical basis for the serological classification of individual wild-type bacterial strains according to their O-antigenic determinants.

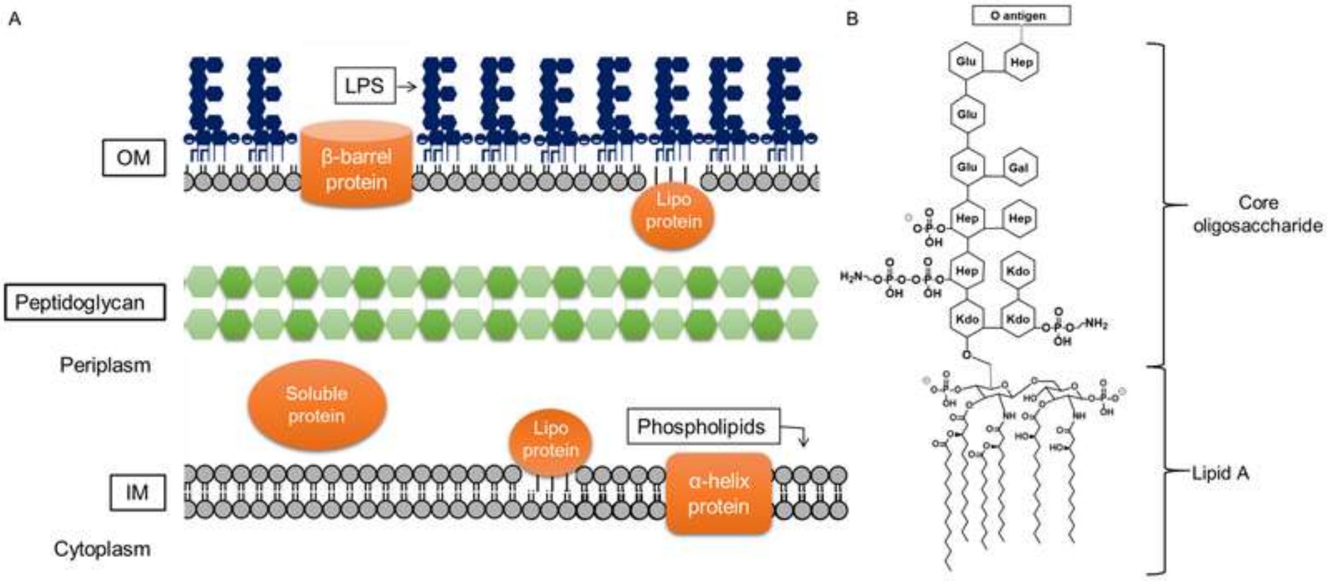

Fig. 1. Structure of Lipopolysaccharide

The barrier function of LPS stems in part from its strong amphipathic nature. As in other lipid bilayers, the acyl portion of lipid A provides hydrophobic character that inhibits the passage of hydrophilic molecules through the OM. However, in contrast to other bilayers, the core oligosaccharide and O antigen additionally provide extensive hydrophilic character to LPS that makes the OM particularly impermeable to hydrophobic compounds as well.

LPS and Plant Diseases

A role for LPS in a number of plant diseases has been suggested by the study of bacterial mutants which are defective in both LPS and extracellular polysaccharide biosynthesis or in LPS biosynthesis alone. These mutants, which have been described in all the major genera of Gram-negative phytopathogens, have been found to have reduced virulence.

As a major constituent of the outer membrane, LPS is thought to contribute to the restrictive membrane permeability properties of the outer membrane, allowing bacterial growth and survival in harsh environments which may include niches within eukaryotic hosts. In the context of plant pathogenesis, this may involve the exclusion of preformed or induced antimicrobial substances of plant origin.

In contrast to this role in promoting plant disease, there are a number of reports detailing the effects of LPS on the induction of basal plant defenses, consistent with its designation as a MAMP (Newman et al., 2007). LPS preparations from a number of bacteria induced NO synthesis in suspension cultures and leaves of Arabidopsis thaliana (Zeidler et al., 2004).

LPS also has effects on cell wall alterations such as callose deposition (Keshavarzi et al., 2004) and on PR gene induction. LPS can modulate the triggering of the HR in a number of plants. Also, LPS from various bacteria have been found to induce programmed cell death in rice cells PCD (Desaki et al., 2006)

Conclusion

Lipopolysaccharide, besides being the most important cell wall component of Gram-negative bacteria, also serves critical roles in host interactions by promoting biofilm formation, attachment, and colonization. This allows the bacteria to grow and survive in hostile environments on and within hosts, modulate the host defense responses and alter the host range.

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Concept of Lactose Intolerance in Fermented Dairy Products-Kefir

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Introduction

The kefir is derived from the word keyif, its meaning is “feeling good” after its ingestion (Lopitz-Otsoa et al., 2006; Tamime, 2006). The kefir is originated from the Caucasus Mountains, a traditional product which is highly consumed in Eastern Europe, Russia and Southwest Asia (Tamime, 2006). Recently, an increase in kefir consumption in many countries has been reported, due to its unique sensory, chemical properties and also associated with beneficial effects on human health (Farnworth, 2005; Otles and Cagindi, 2003; Tamime, 2006). Kefir is considered as a best beverage due to its distinct flavour, typical of yeast, and also an effervescent effect felt in the mouth (Lopitz-Otsoa et al., 2006; Rattray and O’Connel, 2011). The main products of kefir fermentation are lactic acid (LA), ethanol and CO2, which confer this beverage acidity, viscosity, and low content of alcohol. Minor components also be found such as acetaldehyde, diacetyl, ethyl and amino acids for contributing the flavour (Rattray and O’Connel, 2011). This beverage differs from other fermented dairy products because, it is not the result of the metabolic activity of a single or a few microbial species (Farnworth and Mainville, 2008). Lactose sugar is found in breast milk, and almost everyone is born with the ability to digest lactose. But it is very rare to see lactose intolerance in children under the age of five. For people with lactose intolerance, a yogurt-like drink called kefir is the best dairy in their diet. Kefir is an obscure, slightly more expensive to milk, developed centuries ago and credited with many health-promoting properties.

Production of Kefir

Historically, kefir has been prepared by using different cattle breeds milk such as cow, sheep and goats, while other plant milk like soy milk kefirs is now commercially available. Like yogurt, which is made from fermented milk, kefir also contains a lot of bacteria that aid lactose digestion.

Composition

Kefir contain various nutrients such as dietary minerals, vitamins, essential amino acids, and conjugated linoleic acid but it is negligible to significant, (Guzel-Seydim et al., 2011). Its pH range was found 4.2 - 4.6 (Odet, 1995). Kefir is composed mostly of water and by-products of the fermentation process like carbon dioxide and ethanol (Ahmed et al., 2013). Several dietary minerals are also found in kefir, such as calcium, iron, sodium, potassium, copper, phosphorus, magnesium, molybdenum, manganese, and zinc (Ahmed et al., 2013). It contains vitamins in variable amounts, such as fat-soluble vitamin A, vitamin D, vitamin E and water-soluble vitamin B1, vitamin B2, vitamin B3, vitamin B6, vitamin B9, vitamin B12 and vitamin C (Ahmed et al., 2013). Essential amino acids also found in kefir such as methionine, cysteine, tryptophan, phenylalanine, isoleucine, threonine, lysine, tyrosine, leucine and valine (Ahmed et al., 2013) as compared to milk (USDA, 2014).

Kefir Grains

Kefir grains plays a major role in starter culture during kefir production and are it is recovered after the fermentation process by milk straining (Rattray and O’Connel, 2011). Kefir grains are made up of microorganisms immobilized on a polysaccharide and protein, where several bacteria and yeast in symbiotic association (Farnworth and Mainville, 2008; Garrote et al., 2010). In this ecosystem there is a relatively stable microorganism population, which interrelates with and also influences other members of the community. It provides the synthesis of bioactive metabolites are important for grain growth and microorganism inhibition as food pathogens and food contaminants (Garrote et al., 2010). Kefir grains vary in size, and their colour also varies from white to yellowish white. The kefir grains are forms elastic, viscous body and firm texture (Farnworth and Mainville, 2008; Magalhães et al., 2011; Rea et al., 1996).

Microbiological Aspects

In production of kefir, lactic acid bacteria (LAB) are mainly responsible for the conversion of lactose present in milk into lactic acid, which results in a decrease the pH. Lactose-fermenting yeasts is the other kefir microbial constituents that produce ethanol and CO2. After fermentation the grains increase in around 5-7% of their biomass. During their growth in milk, the microorganism proportions in the grains differ from those present in the final product (Rattray andO'Connel,2011; Tamime,2006). The fermentation process conditions depends on various factors like fermentation time, temperature, degree of agitation, type of milk, grain/milk inoculum ratio and microorganism distribution (Rattray and O'Connel, 2011; Simova et al., 2002; Tamime, 2006).

Lactose and Lactose Intolerance

Lactose is a major carbohydrate in cow and buffalo milk. Lactose is a disaccharide; it consists of two units of sugars. It is made up of one unit each of the simple sugar glucose and galactose. The lactase enzyme is to break lactose into glucose and galactose, which can be absorbed into the bloodstream and also used for energy. Lactose intolerance is a digestive disorder, it is caused by the inability to digest lactose, the main carbohydrate in milk. It can cause many symptoms like bloating, diarrhea and abdominal cramps. Without sufficient lactase, lactose moves through gut undigested and causes digestive symptoms. The ability to decrease lactose concentrations and the presence of β-galactosidase activity in fermented milk products make them suitable for consumption by people suffers with lactose intolerant (Farnworth and Mainville, 2008; Sarkar, 2007). It has been observed that some kefir grains show β-galactosidase enzyme activity, which are active when consumed, and kefir contains fewer lactose than milk (Farnworth, 2005; Sarkar, 2007). A commercial kefir showed to be as effective as compared to yoghurt in reducing expired hydrogen and flatulence in lactose intolerant adults when compared to the digestion of milk (Hertzler and Clancy, 2003). Some of researcher reported that few or no symptoms of gas producing after eating of kefir as compared with drinking of milk. It had lower breath hydrogen levels after drinking of kefir. Kefir might be a better option than other fermented product as yogurt for some lactose-intolerant people.

Conclusion

Presently kefir consumption in many countries has been reported, due to its unique sensory and chemical properties and also associated with beneficial effects on human health. Kefir doesn't produce symptoms of lactose intolerance because Lactic acid bacteria help digest the lactose. Kefir is considered as a best beverage due to its distinct flavor, typical of yeast, and also an effervescent effect felt in the mouth. However, Kefir is the best beverage for the lactose intolerance people as compared to milk.

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Role of Conservation Agriculture in Indian Farming

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Conservation Agriculture

Conservation Agriculture (CA) conserves natural resources such as land, water and environment without adversely affecting crop productivity. Conservation farming reduces soil erosion and water loss. Less soil mulching on the soil surface reduces weeds' germination, microorganisms are safe in the soil, organic matter is produced more, chemical fertilizers are less needed and increasing yield per hectare increases farmer income is. Conservation agriculture must have at least 30 % residue above the soil surface. Conservation farming is being done on more than 125 million hectares of land in the world. A brief description of the CA is given in this article. CA centers on three main principles: reduced soil tillage, permanent soil protection by organic residues, and diversification of crop rotations. It has real advantages in terms of maintaining soil fertility and cutting production costs, but requires often complex changes in farm management and production organization strategies.

Purpose of CA Farming

The objective of conservation farming is to use the combined resources of soil, water, and biological resources and natural resources through the integrated system, to promote and build capabilities. The main objective of this method is to minimize the soil of the farm, to minimize its plowing, to minimize the use of heavy machinery and to keep the soil surface covered with crop residues or any other vegetation cover at all times. Other crops that cover green manure or soil should be adopted in the crop cycle. By doing this, many benefits have been found, including increasing the yield of crops as well as the quality of resources such as water, land, nutrients, crop products and environment, which is very important for the continued good progress of agriculture.

Need for CA

In the present scenario, conservation agriculture has become necessary due to the following reasons:

1. Hardening of the lower surface and land due to excessive use of heavy agricultural machinery and machines in farming.
2. Changes in soil structure and reduction in soil organic matter due to excessive tillage in cultivation.
3. Lack of essential nutrients in the land.
4. Rapid increase of global warming by burning of crop residues.
5. Reduction in number of beneficial microorganisms of soil and adverse effect on their activity.
6. Continuous increase in the number of weeds in farming.
7. Increase in production cost per unit in farming.
8. Increasing soil and water pollution due to use of unbalanced chemicals and fertilizers.
9. More water requirement in farming.
10. Deteriorating soil flatness due to overuse of machines.

Specifically, Conservation Agriculture Increases the Productivity

1. Land: CA is improving soil structure and protects the soil against erosion and nutrient losses by maintaining a soil cover and minimizing soil disturbance. Furthermore, CA practices enhance soil organic matter levels and nutrient by utilizing the previous crop residues or growing green manure/ cover crops and keeping these residues as surface mulch rather than burning. Thus, land under CA is more productive for much longer periods of time.

2. Labour: Because land is not cleared before planting and involves less weeding and pest problems are following the establishment of permanent soil cover/crop rotations. Much of the reduced labour comes from the absence of tillage operations under CA, which use up valuable labour days during the planting season.

3. Water: CA requires significantly less water use due to increased infiltration and enhanced water holding capacity from crop residues left on the soil surface. Mulches also protect the soil surface from extreme temperatures and greatly reduce surface evaporation, which is particularly important in tropical and sub-tropical climates.

4. Nutrients: Soil nutrient supplies and cycling are enhanced by the biochemical decomposition of organic crop residues at the soil surface that are also vital for feeding the soil microbes. While much of the nitrogen needs of primary food crops can be achieved by planting nitrogen-fixing species, other plant essential nutrients often must be supplemented by additional chemical or organic fertilizer inputs.

5. Economic benefits: Farmers using CA technologies typically report higher yields (30-35% higher) with fewer water, fertilizer and labor inputs, thereby resulting in higher overall farm profits.

6. Environmental benefits: CA represents an environmentally-friendly set of technologies. Because it uses resources more efficiently than conventional agriculture, these resources become available for other uses, including conserving them for future generations. The significant reduction in fossil fuel use under no-till agriculture results in fewer greenhouse gases being emitted into the atmosphere and cleaner air in general. Reduced applications of agro-chemicals under CA also significantly less pollution levels in air, soil and water.

CA Machinery

All pre-sowing mechanical operations are called tillage to make proper conditions in the soil for growing the crop. Preparing the field for the next crop is called conservation tillage, by maintaining the surface of the land naturally and leaving the residuals of the first crop on the ground surface. Conservation is a method of tillage ploughing in which fields are ploughed at least in such a way that the residuals of the previous crops cover at least one-third of the soil area. This method saves energy, reduces soil degradation and also increases fertility of soil.

1. Zero Tillage: Sowing seeds directly in soil without ploughing the field is called zero tillage. Sowing of wheat, paddy, maize, lentils, gram can be done by this technique. In this technique, after sowing, crop residues are spread on the soil surface, which become humus by rotting, and composting, which increases soil fertility.

2. Happy Turbo Seeder: Happy Turbo Sowing Machine is also driven by the PTO shaft of the tractor, which is run at around 1500 RPM and sown from the back furrow-opener. This machine saves useful natural resources (energy, labor, diesel etc.), and requires 5-6 hours of time to sow a hectare.

3. Strip till Drill: This machine is used for wheat after paddy without preparing the field. It helps in increasing the yield due to timely sowing of the crop. This machine is a thin strip 6-10 cm. The field is ploughed directly and sown directly.

4. Inclined Plate Planter: A six-line tractor powered inclined plate planter is suitable for sowing peanuts, pigeonpea, soyabean, maize, etc. The distance between the queues can be controlled in this device and sowing of different seeds in different queues is also possible. The effective efficiency of the machine is 0.45 to 0.65 ha per hour.

5. Preimergence Herbicide Applicator: This helps control weeds that grow near crop lines, which is not possible by mechanical weeding. With this machine, spraying of medicine and sowing of seeds can be done simultaneously. The working capacity of the machine is 0.45 to 0.50 ha per hour.

Benefits of CA Protection Farming

1. In traditional farming, crop residues are mixed in the soil by ploughing. In conservation farming, having a layer of crop residues on the soil surface increases the ability to bind soil particles, reducing the intensity of water and air erosion.
2. Conservation Cultivation continuously enhances the physical, chemical and biological quality of the soil by minimizing mechanical manipulation of the soil, covering the soil surface with organic mulches and adopting crop rotation.
3. Conservation Farming leads to good growth of roots by improving soil structure, soil particle size and durability, and air circulation.
4. Conservation farming also reduces soil alkalinity and salinity problems.
5. Conservation In agriculture, the organic mulch of crop residues on the soil surface increases the leakage of rain water into the soil and reduces the evaporation of ground water.
6. Due to the decomposition of the crop residues by not taking them out of the field or keeping them on the soil surface, they are slowly getting nutrients in the soil by decomposition.
7. Conservation In agriculture, direct sowing of crops saves labor, fuel and time and requires less equipment.
8. In conservation farming, adopting crop cycle reduces the outbreak of pests and diseases.
9. Make ridges around the field so that the seeds of weeds with rain water do not come into the field.

10. Weeds can be reduced gradually through proper use of cultivation, use of biological weed control methods etc.
11. In conservation farming, increasing the soil quality, longer availability of moisture and less effect of drought, timely sowing, etc., increase in yield and decrease in production cost increases the benefit of Kissan.

Conclusion

Soil erosion, organic matter decline, compaction and salinization that frequently degrade good agricultural land. Applying the principles of CA can have a positive impact on the first three and possibly the fourth soil erosion rates are hugely increased by agricultural activities. Soil structures are especially compromised by cultivation, in particular by mold board ploughing, which rips apart the soil and also reduces earthworm populations. Crop residues may be effective to some extent in suppressing weed growth thus reducing use of herbicides. In-depth long-term studies on no tillage are conducted to see the effect on soil compaction, carbon sequestration, soil erosion, temperature of soil due to soil mulch cover, water infiltration etc. and their effect on reduction in global warming.

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Role of Mobile Based Advisory System for Transfer of Technology - An Overview

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Introduction

The mobile phone introduced in India 1995, it has been gradual and drastic changes in the use of the mobile phones' users in India. It is reported that the India's telecommunication market is the second largest in the globe. Nowadays the mobile phones are available to the people right from the age of 10 years. The current scenario of mobile phone technology is brought into closer in the world. It provides the greater communication tool among the peoples by way of either calling or texting in the transfer of technology. Now, the mobile phones are growing up with the plenty of facets starts from e mail, surfing, recreations, internet access, education and social networking sites and the overall majority of the mobile phone users in the age group of 18 - 25. Even though the mobile phone provides the many merits, whereas, it is also providing some harmful effects in the mobile users but mobile phones play pivotal role in agriculture in order to transfer of technology dissemination and communication to the farmers. The farmers can access the information by sitting place like market price, available fertilizer stock, subsidy scheme, seed stock position, weather advisory, organic products, crop insurance, line departments officers, Farmer Producer Organization product, pest and disease monitoring, Agricultural Technology Management Agency training, demonstration, agricultural news etc.

Importance of Mobile Phone

Mobile phones have established itself in the rural areas and are becoming quite popular both with farmer and farm women. These powerful electronic machines that was a farmer's dream earlier have become a reality as the farmers can immediately make use of them to address their field problems and other farm difficulties. The Government gifted Kisan Call Centres (KCC) are functioning the all over India which give answers to the farmer queries in local languages to this toll-free number 1800-180-1551. Grameen Phone is a commercial operation providing cellular services in both urban and rural areas of India, with approximately 40,000 customers. Mobile advisory system has been developed and utilized for transfer of agricultural technologies for sustainable development across the world. The findings of the different mobile based studies conducted across the world have reviewed and presented for replicating the suitable models in similar situation for effective dissemination of the technologies. It is concluded that mobile platform is only tool to reach the last mile connectivity especially in rural areas for delivering need-based technologies in time.

Abdul Razaque Chhachhar (2019) reported that 97.30 percentage of the respondents own their personal mobile phone and 64.50 percentage of the respondents call to the market directly for seeking crop information and farmers make use of mobile phones to keep current with the market, contact buyers and very limited 7.90 percentage of the respondents get weather information, communication technology disseminates information rapidly around the world to the benefit of many communities.

Radhakrishnan (2020) reported that more than 75.00 percentage of rural youths using the internet to access the Twitter, Face book, Whatsapp and Instagram. Accessing the social media is one of the foremost significant phenomena for rural youths to access the internet. In fact, many youths accessing the internet for the first time, social media was the prime and peculiar reason. Across India there are 143 million users of social media. Urban areas witnessed a growth of 35.00 percentage with 118 million users as of April 2015. On the other side, the number rural areas 25 million. WhatsApp and Instagram emerged the leading social media tools with 96.00 percentage of urban users assessing it, followed by face book (80.00 percentage), Twitter (62.00 percentage) Instagram (43.00 percentage) and LinkedIn (25.00 percentage). The largest segment of users was college going students (34.00 percentage) followed by young men (27.00 percentage) and school children constitute (12.00 percentage).

Potential Information of Mobile Phone in Agriculture (PIMPA)

The farmers can access the following information by home and farm field conditions. The details are given in figure 1. (Source: e-Governance in Tamil Nadu:2018).

Merits of Mobile Phone for Transfer of Technology

1. Sharing and receiving the knowledge: Mobile phone plays a vital role in transfer of technology dissemination in agriculture and allied departments. The farmers, extension officers, line department officers, other officials and public peoples are getting benefits or exchanging their knowledge or information through mobile phone and it will their save time, cost, transport and others activities

2. Skipping the middle man: Olden days the peasants are want to sell their produce and buy the commodities in market, really it will be typical task because of the middle man interference but nowadays the farmers having handy information wherever the commodities which are available in the market they can access and buy it easily without any traders / commission agent activities.

3. Identify the pest and disease: The farmer’s crop is affected by pest and diseases in field condition, immediately the farmers can take a snap and send it to the respective subject matter specialist (Scientist) in various field of specialization. The scientist is recommending the inputs or advice to the farmers promptly.

4. Better accessibility: Because of the mobile phone the peoples or farmers are receiving the timely information based on the need basis from various field of specialization scientist respectively.

5. Reduce the financial transaction: The famers are facing the plenty of financial problems to sell their produce in market and other places by using the public transport and separate vehicle but once the farmers can used to access the daily market information and the details are available in mobile phones it will save the financial problems and very useful tool to their produce in remunerative price at market level. The farmers are having various contact / network nowadays and getting the benefits.

6. Obtaining the functional expert advice: The farmers are getting the multi benefits from the various research station, krishi vigyan kendra, agricultural colleges etc., by getting the different type of trainings, field exposure visits, demonstrations, farmers tours, agricultural / horticultural index and cultivation best practices. With this, the functional expert is giving the inputs in field conditions either on campus - off campus of various aspect of advices in different crops. Farmers can get those kinds of advices / benefits from the concerned scientist, it will solve the field problems because of the mobile phone.

7. Market price for agricultural product: All the agricultural commodities of the farmers to sell their produce in remunerative price, the mobile phone is essential by accessing the information or updating the market price in field condition and home itself. The Uzhavan application is more useful tool for them. It will provide the local market price, whole sale market and market demand in different commodity in various districts.

8. Weather advisory services: Due to the natural calamity the farmers can assess the weather advisory services easily by using the mobile phones during the rabi and kharif season respectively. Based on the weather report in a day the farmers can devise to have sowing the seeds in different crops and readily available information in mobile phone.

Demerits of Mobile Phone for Transfer of Technology

Even though there is plenty of merits in mobile phones but there might be a greater number of demerits by usage of mobile phones among the public and farmers. Mobile phone creates high level of electronic wastage and problems, social disruptive, cause many accident while riding two wheelers and driving the four wheelers, some of the android mobile phones are very expensive, mobile phone technologies can create addictive tendencies among the public peoples, health problems, cheating, technical error while using the mobile phone, battery powers keeps running out and dangerous, vicarious living of others, mobile phone can create significant distraction for people and crime etc.

Conclusion

This study has been provided the potential of mobile phone in agricultural sectors. The implementation of mobile phone also poses a plenty of challenges in Indian farmers due to lack of mobile friendly and locally relevant digital content, rural mobile infrastructure limitations including networks, electrical and signal problems, illiteracy and a greater number of local languages.

Mobile based applications need to be integrated with ongoing agricultural extension programmers and various training methods. The mobile agro advisory services for farmers will be encouraged from various international agencies ad collaboration with private agricultural sectors. Despite of that, the farmers need assessment, location and farmer specific information need to be generated in various multimedia content format for technology dissemination among the farm families but mobile phone penetration throughout India continuous to increase among the farming community and information services continue to adapt and proliferate, sufficient potential information exists for a much deeper rural productivity and impact in future agriculture.

The benefits of mobile phone such as portability, flexible content of message delivery of information, two-way communication and deliver low cost but highly customized solutions. Information and Communication Technology might be play as important role in building the competency and self-confidence required to influence the adoption of new mindsets and actions by small farmers.

Increase the public and private investments will be necessary to bridge the critical infrastructure to identify the gaps, the policy changes may also need to encourage the better access to high quality of inputs and credits for small and marginal farmers, increased extension services and training and development efforts can complement information dissemination by using mobile phone services to accelerate to adoption of new techniques.

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Automation of Irrigation Using Machine Learning

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Introduction

Optimum plant growth depends upon the availability of adequate soil moisture throughout the growing period. But water scarcity frequently occurs in actual field conditions. Irrigation is applied to ensure adequate water availability to plants during the growing season. Several types of irrigation methods are used all over the globe. Irrigation methods can be broadly categorized into the conventional method and modern method. The conventional irrigation techniques include border irrigation, check basin irrigation, and furrow irrigation methods. These techniques need high manpower for their operation and are very inefficient (Munoth et al. 2016). To overcome the shortcomings of traditional systems modern irrigation systems came into the picture. Modern systems include drip irrigation and sprinkler irrigation methods. These methods are very less labor intensive and highly efficient but require a high initial investment and technical knowledge to operate.

The existing modern irrigation system cannot sense the actual amount of water needed by the crop, which leads to under irrigation or over-irrigation. Under-irrigation will lead to soil moisture deficit and over-irrigation will lead to waterlogging and salinity problems. Thus, the existing modern irrigation system needs enhancement to eradicate these problems. Nowadays, the irrigation process is being automated using techniques like machine learning (Liakos et al. 2018), big data (Piette, 2018), wireless sensor network (Viani et al. 2017), internet of things (Gupta et al. 2016) and cloud computing (Radadiya et al. 2016). These technologies help in the efficient application of water and improve yield significantly. The enhanced irrigation technique is termed as an automated irrigation system.

Types of Automatic Irrigation System

The minimization of manual labor involvement is the primary objective of automated irrigation system. Automation of Irrigation is mostly appropriate where a large area is subdivided into small blocks and blocks are irrigated in sequence to match the discharge available from the water source. There are six types of automatic systems, which are described below.

1. Time Based System: Irrigation timers play an essential role in automation of irrigation system. Timers are important device used to irrigate appropriate amount of water at the proper time. These devices can apply improper irrigation if they are not appropriately programmed or the water quantity is calculated incorrectly. Time of irrigation (hrs/day) is estimated as per the water requirement of crop (litres/day) needed and the average water application rate (litres/hr). Timer automatically initiates and terminates the irrigation process (Rajakumar et al. 2008).

2. Volume Based System: The system employs automatic volume controlled metering valves to apply required quantity of water automatically (Rajakumar et al. 2008). Zella et al. (2008) appropriately elaborates how such irrigation system operates.

3. Open Loop Systems: In the open loop system, operator programs the controller such that proper quantity of irrigation water is applied at appropriate timing. These systems use either fixed duration or fixed volume irrigation for control purposes. Open loop controllers typically accompanied by a timer that initiates the irrigation process. Stoppage of the irrigation process depends on the fixed time or volume of water advancing across the flow meter (Boman et al. 2006).

4. Closed Loop Systems: A control strategy is developed by the operator in a closed loop system. The strategy determines the timing and the amount of the water to be irrigated. The complete system is based on sensor. The irrigation process is carried out based on the data obtained from these sensors (Boman et al. 2006). Closed loop controllers need meteorological data along with system parameters for their operation.

5. Real Time Feedback System: With this application irrigation is based on actual dynamic demands of the plant itself; the plant root zone is effectively reflecting all environmental factors acting on the plant. Operating within controlled parameters, the plant itself determines the degree of irrigation required. Various sensors, tensiometers, relative humidity sensors, rain sensors, temperature sensors etc. control the irrigation scheduling. These sensors provide feedback to the controller to control its operation (Rajakumar et al. 2008).

6. Computer Based Irrigation Control Systems: The irrigation and fertigation operations are supervised by hardware and software in a computer-based control system. Generally, the computer-based control systems used to manage irrigation systems can be divided into two categories: interactive systems and fully automatic systems. Read more about it in Rajakumar et al. (2008).

Advantages and Disadvantages of Automatic Irrigation System

The primary merits and demerits of the automated irrigation system are discussed below.

1. Merits:

a. The manual operation of valves is not necessary

b. Alteration in the frequency of irrigation and fertigation to optimize the application is possible

c. The system uses advanced technologies for complex cropping systems which are difficult to operate manually

d. Use of water from different sources and increased fertilizer use efficiency.

e. Evaporation loss can be reduced by employing the system at night.

f. Energy consumption can be minimized by accurately timing the start irrigation process.

2. Demerits:

a. The system is very costly.

b. Compatibility for Self-help is very minimal with large scale systems.

c. Electricity is must for automated irrigation systems.

Machine Learning in the Automation of Irrigation System

The machine learning technique is vital in the smart irrigation system. It uses a computational method to learn agriculture data. In Machine learning, the focus of the learning process is to learn from training data to perform a given task. Set of examples in data that is described by a set of features. That feature can be numeric, binary, or nominal. Automated Irrigation systems employ machine learning for water management, soil management, and plant growth. Also, in agriculture, it is used for crop management, weed detection, disease detection, yield prediction, species recognition, and crop quality (Liakos et al. 2018).

Conclusion

Application of machine learning in agriculture it enhances the irrigation system. It helps to use water efficiently and reduces water wastage. This integration process of automated data analysis, data recording, and decision making with the machine learning implementation is a completely knowledge-based system. It increases the production level and quality of crops. This survey may help to provide prior knowledge for the farmers to adopt the machine learning techniques with the irrigation system based on their requirements and improves productivity (Morellos et al. 2016).

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Downscaling: A Tool for Predicting Future Climate

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Introduction

Decision makers are increasingly demanding climate information at the national to local scale in order to address the risk posed by projected climate changes and their anticipated impacts. Readily available climate change projections are provided at global and continental spatial scales for the end of the 21st century (Intergovernmental Panel on Climate Change [IPCC], 2007). These projections, however, do not fit the needs of sub-national adaptation planning that requires regional and/or local projections of likely conditions five to 10 years from now. Moreover, decision makers are interested in understanding the impacts of climate change on specific sectors, e.g., agricultural production, food security, disease prevalence, and population vulnerability. In response to this demand, numerous impact and vulnerability assessments produced at different scales, from global to local, provide climate change impact results at spatial scales much finer than those at which projections are initially made. To produce such results, combinations of methods and indicators are often used, each with its own assumptions, advantages, and disadvantages. In reports, these essential factors may not be adequately communicated to the reader, thus leaving him/her without the ability to understand potential discrepancies between different reports. Often, global or continental-scale information is directly used to produce local-scale impact maps, which is not appropriate since this large-scale information does not account for differences at the local scale. In order to derive climate projections at scales that decision makers desire, a process termed downscaling has been developed. Downscaling consists of a variety of methods, each with their own merits and limitations. International organizations or national governments currently provide no official guidance that assists researchers, practitioners, and decision makers in determining climate projection parameters, downscaling methods, and data sources that best meet their needs.

General Circulation Models (GCMs)

General or global circulation models (GCMs) simulate the Earth’s climate via mathematical equations that describe atmospheric, oceanic, and biotic processes, interactions, and feedbacks. They are the primary tools that provide reasonably accurate global-, hemispheric-, and continental-scale climate information and are used to understand present climate and future climate scenarios under increased greenhouse gas concentrations. A GCM is composed of many grid cells that represent horizontal and vertical areas on the Earth’s surface in each of the cells, GCMs compute the following: water vapor and cloud atmospheric interactions, direct and indirect effects of aerosols on radiation and precipitation, changes in snow cover and sea ice, the storage of heat in soils and oceans, surfaces fluxes of heat and moisture, and large-scale transport of heat and water by the atmosphere and oceans (Wilby et al., 2009). The spatial resolution of GCMs is generally quite coarse, with a grid size of about 100–500 kilometres. Each modelled grid cell is homogenous, (i.e., within the cell there is one value for a given variable). Moreover, they are usually dependable at temporal scales of monthly means and longer. In summary, GCMs provide quantitative estimates of future climate change that are valid at the global and continental scale and over long periods.

Downscaling

Although GCMs are valuable predictive tools, they cannot account for fine-scale heterogeneity of climate variability and change due to their coarse resolution. Numerous landscape features such as mountains, water bodies, infrastructure, land-cover characteristics, and components of the climate system such as convective clouds and coastal breezes, have scales that are much finer than 100–500 kilometers. Such heterogeneities are important for decision makers who require information on potential impacts on crop production, hydrology, species distribution, etc. at scales of 10–50 kilometers. Various methods have been developed to bridge the gap between what GCMs can deliver and what society/businesses/stakeholders require for decision making. The derivation of fine-scale climate information is based on the assumption that the local climate is conditioned by interactions between large-scale atmospheric characteristics (circulation, temperature, moisture, etc.) and local features (water bodies, mountain ranges, land surface properties, etc.). It is possible to model these interactions and establish relationships between present-day local climate and atmospheric conditions through the downscaling process. It is important to understand that the downscaling process adds information to the course GCM output so that information is more realistic at a finer scale, capturing sub-grid scale contrasts and inhomogeneities. Downscaling can be performed on spatial and temporal aspects of climate projections. Spatial downscaling refers to the methods used to derive finer-resolution spatial climate information from coarser-resolution GCM output, e.g., 500 kilometers grid cell GCM output to a 20 kilometers resolution, or even a specific location. Temporal downscaling refers to the derivation of fine-scale temporal information from coarser-scale temporal GCM output (e.g., daily rainfall sequences from monthly or seasonal rainfall amounts). Both approaches detailed below can be used to downscale monthly GCM output to localized daily information.

Dynamical Downscaling

Dynamical downscaling relies on the use of a regional climate model (RCM), similar to a GCM in its principles but with high resolution. RCMs take the large-scale atmospheric information supplied by GCM output at the lateral boundaries and incorporate more complex topography, the land-sea contrast, surface heterogeneities, and detailed descriptions of physical processes in order to generate realistic climate information at a spatial resolution of approximately 20–50 kilometers. Since the RCM is nested in a GCM, the overall quality of dynamically downscaled RCM output is tied to the accuracy of the large-scale forcing of the GCM and its biases (Seaby et al., 2013). Despite recovering important regional-scale features that are underestimated in coarse-resolution GCMs, RCM outputs are still subject to systematic errors and therefore often require a bias correction as well as further downscaling to a higher resolution.

Statistical Downscaling

Statistical downscaling involves the establishment of empirical relationships between historical and/or current large-scale atmospheric and local climate variables. Once a relationship has been determined and validated, future atmospheric variables that GCMs project are used to predict future local climate variables. Statistical downscaling can produce site-specific climate projections, which RCMs cannot provide since they are computationally limited to a 20–50 kilometers spatial resolution. However, this approach relies on the critical assumption that the relationship between present largescale circulation and local climate remains valid under different forcing conditions of possible future climates (Zorita and von Storch, 1999). It is unknown whether present-day statistical relationships between large- and regional-scale variables will be upheld in the future climate system.

Oftentimes, dynamical and statistical approaches are used in conjunction. Dynamical-statistical downscaling involves the use of an RCM to downscale GCM output before statistical equations are used to further downscale RCM output to a finer resolution. Dynamical downscaling improves specific aspects of regional climate modeling and provides better predictors for further statistical downscaling to higher-resolution output (Guyennon et al., 2013). Statistical-dynamical downscaling is a somewhat more complex approach but is less computationally demanding in comparison to dynamical downscaling. This method statistically pre-filters GCM outputs into a few characteristic states that are further used in RCM simulations.

Uncertainty

Confidence in global-scale GCM projections is based on well-understood physical processes and laws, the ability of GCMs to accurately simulate past climate, and the agreement in results across models (Daniels et al., 2012).

Multiple model comparisons unanimously project warming of globally averaged near-surface temperature over the next two decades in response to increased greenhouse gas emissions. However, the magnitude of this increase varies from one model to another. Additionally, in certain regions, different models project opposite changes in rainfall amount, which highlights the uncertainty of future climate change projections even when sophisticated state-of-the art GCM tools are used.

There are four main sources of uncertainty in climate projections:

1. Uncertainty in future levels of anthropogenic emissions and natural forcing (e.g., volcanic eruptions).
2. Uncertainty linked to imperfect model representation of climate processes.
3. Imperfect knowledge of current climate conditions that serve as a starting point for projections.
4. Difficulty in representing interannual and decadal variability in long-term projections.

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Environmental Flow

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Introduction

Rivers have been integral to human development and welfare since historical times because many of us are dependent on them for water, which is essential for life. Rivers provide numerous benefits to the mankind including water for drinking, agriculture, food (fish), energy (hydropower, cooling of thermal stations), means of transportation, fertile sediments, and many other products. Rivers have also acquired a central place in the social, cultural and religious activities in certain civilizations, such as India. Different groups of people perceive rivers in different ways. For hydrologists, rivers are channels to transport water and sediments. For energy planners, these are sources of hydro-power generation and for land planners these are essential components of landscape. Rivers provide water to farmers to irrigate crops. For religious leaders, river water has spiritual value. But the river water is not always favourable. Along with the beneficial uses, rivers can also be hazardous when they are in flood.

With the growth in population and consequent rise in water use, humans began to progressively manage rivers and to draw and divert more water, in many cases this resulted in almost no flow in some of the rivers in dry season. This was found to be highly detrimental to the river and its ecosystems (Vörösmarty et al., 2010). With time a realization came that survival of rivers is of utmost importance to the human society in view of many eco-system services provided by the river water. Although freshwater ecosystems contain only 0.01% of the Earth's water and cover a small fraction of the planet's surface, rivers, lakes and wetlands harbor a disproportionately high fraction of the Earth's biodiversity. Discussions gradually expanded to consider a range of issues such as geomorphology, sediment movement, freshwater habitats and requirement of species other than fish and gradually the concept of environmental flows began to take shape.

The principle governing environmental flows recognizes that these flows are necessary to maintain downstream ecosystems and the communities that depend on them. There are many definitions of environmental flows. According to the widely quoted Brisbane Declaration (2007), "environmental flows (EFs) are the quantity, timing, duration, frequency and quality of flows required to sustain freshwater, estuarine, and near shore ecosystems and the human livelihoods and well-being that depend on them" (Arthington, 2012). The term "environmental flows" is confusing to many people but it is so widely used that replacement is likely to cause more confusion. Thus, while retaining this term, there is a need to clarify that EFlows are meant to provide healthy river systems and consequently benefits to the entire society.

Typical Stages of an EF

Assessment A typical EFA process can be divided in five stages:

Stage 1: Define the issue: what is the key reason for changes in the river that means in no longer reaches expectations or is perceived to be degraded or changed? These could be abstraction (surface or ground water), impoundment, diversion of water for generation of hydropower, upstream land-use land cover changes, etc.

Stage 2: Define the scope and objective of setting EF. This requires an agreement on the type of river required and the present-day condition; it is best done with participation of stakeholders.

Stage 3: Decide the sites along the river where EFs are to be estimated. These maybe based on classification of the river based on morphology or biology, or at strategic points related to degradation and restoration issues.

Stage 4: Collect hydrological and ecological data. EFAs require the integration of information from a range of scientific disciplines: hydrology, ecology, geomorphology and hydrogeology. In some cases, this integration includes information from the economic and social sciences.

Typical data requirements are:

a. Hydrological data: time series of river flow depth and discharge, channel crosssection properties, and sediment transport. Locations selected for EFA are rarely close to existing gauging sites. For such ungauged locations, flow time series needs to be estimated.
b. Ecological data: e.g., fish species/abundance, invertebrates, riparian vegetation
c. Economic data: e.g., economic value of fisheries or recreation 5
d. Social data: e.g., degree of cultural connection with the river
e. In parallel, preliminary processing of collected data is carried out.

Stage 5: Data analysis and consultations: Dependencies between flow events, channel hydraulics and ecological/social components are established. A suitable method is applied and EFs are computed. Adequacy for different ecosystem components for different months/seasons is checked through consultation with various experts and stakeholders.

Stage 6: Implement, monitor, and feedback. Depending upon the purpose of study and available resources, additional stages may be added. For example, in important studies, field measurements may have to be carried out to obtain the missing data. In parallel a whole range of other activities may be required, such as revision of the laws on water rights, establishment of new institutions such as a river basin authority, training of specialist to undertake EFs, awareness raising amongst local people to the idea and benefits of EFs.

Approach Based Classification of Methodologies

Based on approach adopted to estimate environmental flow requirements, the methods can be divided into three broad categories (from complex to simple):

1. Hydro-biology Methodologies: these methods use hydrologic, hydraulic, and biological data. Examples are Holistic Approach, Instream Flow Incremental Methodologies (IFIM), Downstream Response to Imposed Flow Transformation (DRIFT), and Ecological Limits of Hydrological Abstractions (ELOHA).

2. Hydrology and Hydraulics Based Methodologies: These are sort of mid-way between hydraulics and biology, for example, the wetted perimeter method.

3. Hydrological Methods: These are the earliest developed methods which make use of only hydrologic data, such as Look-up tables, Range of Variability Approach (RVA), Flow Duration Curve (FDC) based approach, etc.

Future Challenges

Water from many rivers is being used for various uses. It is not possible to undo the developments and return to the conditions that existed, say, 100 years ago. Hence, the attempt should be developed flow regimes that is feasible and provides desired benefits. The science of environmental flows has advanced considerably in the last 25 years from little knowledge and awareness to a focus on individual aquatic species to a broader concern about ecosystem protection or restoration these days. At the same time, there have been considerable advances in basic scientific understanding and the development of EFA techniques. However, many of these advances in knowledge are limited to regions (mostly in developed countries) where the scientific studies have been undertaken. The same kind of understanding of ecological responses is not present in many other areas where EFAs are being applied and the knowledge is not directly transportable.

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An Overview of Irrigation Approaches

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Introduction

Irrigation is the artificial process of applying controlled amounts of water to land to assist in production of crops. Irrigation helps to grow agricultural crops, maintain landscapes, and revegetate disturbed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection, suppressing weed growth in grain fields and preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed. Irrigation systems are also used for cooling livestock, dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the removal of surface and sub-surface water from a given location. Irrigation canal in Osmaniye, Turkey Sprinkler irrigation of blueberries in Plainville, New York, United States Irrigation has been a central feature of agriculture for over 5,000 years and is the product of many cultures. Historically, it was the basis for economies and societies across the globe, from Asia to the Southwestern United States.

History of Irrigation

Archaeological investigation has found evidence of irrigation in areas lacking sufficient natural rainfall to support crops for rainfed agriculture. The earliest known use of the technology dates to the 6th millennium BCE in Khuzistan in the south-west of present-day Iran. Irrigation was used as a means of manipulation of water in the alluvial plains of the Indus valley civilization, the application of it is estimated to have begun around 4500 BC and drastically increased the size and prosperity of their agricultural settlements. The Indus Valley Civilization developed sophisticated irrigation and water-storage systems, including artificial reservoirs at Girnar dated to 3000 BCE, and an early canal irrigation system from c. 2600 BCE. Large-scale agriculture was practiced, with an extensive network of canals used for the purpose of irrigation.

Evidence of terrace irrigation occurs in pre-Columbian America, early Syria, India, and China. In the Zana Valley of the Andes Mountains in Peru, archaeologists have found remains of three irrigation canals radiocarbon-dated from the 4th millennium BCE, the 3rd millennium BCE and the 9th century CE. These canals provide the earliest record of irrigation in the New World. Traces of a canal possibly dating from the 5th millennium BCE were found under the 4th-millennium canal. Ancient Persia (modern day Iran) used irrigation as far back as the 6th millennium BCE to grow barley in areas with insufficient natural rainfall. The Qanats, developed in ancient Persia about 800 BCE, are among the oldest known irrigation methods still in use today. They are now found in Asia, the Middle East and North Africa. The system comprises a network of vertical wells and gently sloping tunnels driven into the sides of cliffs and of steep hills to tap groundwater. The noria, a water wheel with clay pots around the rim powered by the flow of the stream (or by animals where the water source was still), first came into use at about this time among Roman settlers in North Africa. By 150 BCE the pots were fitted with valves to allow smoother filling as they were forced into the water.

Present Extent of Irrigation

Share of agricultural land which is irrigated (2015) In year 2000, the total fertile land was 2,788,000 km2 (689 million acres) and it was equipped with irrigation infrastructure worldwide. About 68% of this area is in Asia, 17% in the Americas, 9% in Europe, 5% in Africa and 1% in Oceania. The largest contiguous areas of high irrigation density are found: In Northern India and Pakistan along the Ganges and Indus rivers In the Hai He, Huang He and Yangtze basins in China Along the Nile river in Egypt and Sudan In the Mississippi-Missouri river basin, the Southern Great Plains, and in parts of California Smaller irrigation areas are spread across almost all populated parts of the world. Water gardens in Sigiriya by 2012, the area of irrigated land had increased to an estimated total of 3,242,917 km2 (801 million acres), which is nearly the size of India. The irrigation of 20% of farming land accounts for the production of 40% of food production.

Types of Irrigation

There are several methods of irrigation. They vary in how the water is supplied to the plants. The goal is to apply the water to the plants as uniformly as possible, so that each plant has the amount of water it needs, neither too much nor too little. Irrigation can also be understood whether it is supplementary to rainfall as happens in many parts of the world, or whether it is 'full irrigation' whereby crops rarely depend on any contribution from rainfall. Full irrigation is less common and only happens in arid landscapes experiencing very low rainfall or when crops are grown in semi-arid areas outside of any rainy seasons.

Surface Irrigation

Surface irrigation, also known as gravity irrigation, is the oldest form of irrigation and has been in use for thousands of years. In surface (furrow, flood, or level basin) irrigation systems, water moves across the surface of an agricultural lands, in order to wet it and infiltrate into the soil. Water moves by following gravity or the slope of the land. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding or near flooding of the cultivated land. Historically, surface irrigation has been the most common method of irrigating agricultural land and is still used in most parts of the world. Where water levels from the irrigation source permit, the levels are controlled by dikes, usually plugged by soil. This is often seen in terraced rice fields (rice paddies), where the method is used to flood or control the level of water in each distinct field. In some cases, the water is pumped, or lifted by human or animal power to the level of the land. The water application efficiency of surface irrigation is typically lower than other forms of irrigation. Residential flood irrigation in Phoenix, Arizona Surface irrigation is even used to water landscapes in certain areas, for example, in and around Phoenix, Arizona. The irrigated area is surrounded by a berm and the water is delivered according to a schedule set by a local irrigation district.

Micro-Irrigation

Micro-irrigation, sometimes called localized irrigation, low volume irrigation, or trickle irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Traditional drip irrigation uses individual emitters, subsurface drip irrigation (SDI), micro-spray or micro-sprinklers, and mini-bubbler irrigation all belong to this category of irrigation methods.

Drip Irrigation

Drip (or micro) irrigation, also known as trickle irrigation, functions as its name suggests. In this system water falls drop by drop just at the position of roots. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation, if managed properly, evaporation and runoff are minimized. The field water efficiency of drip irrigation is typically in the range of 80 to 90 percent when managed correctly. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and is also the means of delivery of fertilizer. The process is known as fertigation. Deep percolation, where water moves below the root zone, can occur if a drip system is operated for too long or if the delivery rate is too high. Drip irrigation methods range from very high-tech and computerized to low-tech and labor-intensive. Lower water pressures are usually needed than for most other types of systems, with the exception of low energy center pivot systems and surface irrigation systems, and the system can be designed for uniformity throughout a field or for precise water delivery to individual plants in a landscape containing a mix of plant species. Although it is difficult to regulate pressure on steep slopes, pressure compensating emitters are available, so the field does not have to be level. High-tech solutions involve precisely calibrated emitters located along lines of tubing that extend from a computerized set of valves.

Sprinkler Irrigation

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system using sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 275 to 900 kPa (40 to 130 psi) and flows of 3 to 76 L/s (50 to 1200 US gal/min), usually with nozzle diameters in the range of 10 to 50 mm (0.5 to 1.9 in). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging. Sprinklers can also be mounted on moving platforms connected to the water source by a hose. Automatically moving wheeled systems known as traveling sprinklers may irrigate areas such as small farms, sports fields, parks, pastures, and cemeteries unattended. Most of these use a length of polyethylene tubing wound on a steel drum. As the tubing is wound on the drum powered by the irrigation water or a small gas engine, the sprinkler is pulled across the field. When the sprinkler arrives back at the reel the system shuts off. This type of system is known to most people as a "water-reel" traveling irrigation sprinkler and they are used extensively for dust suppression, irrigation, and land application of waste water.

Irrigation Efficiency

Modern irrigation methods are efficient enough to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little. Until 1960s, water was not recognized as a scarce resource. At that time, there were fewer than half the current number of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for water resources is much more intense. This is because there are now more than seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanization and biofuel crops. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities find ways to use water more efficiently.

Impact on Society

A 2016 study found that countries whose agriculture depended on irrigation are more likely to be autocratic than other countries. The authors of the study "argue that the effect has historical origins: irrigation allowed landed elites in arid areas to monopolize water and arable land. This made elites more powerful and better able to oppose democratization."

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Water Footprint

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Introduction

A water footprint shows the extent of water use in relation to consumption by people. The water footprint of an individual, community or business is defined as the total volume of fresh water used to produce the goods and services consumed by the individual or community or produced by the business. Water use is measured in water volume consumed (evaporated) and/or polluted per unit of time. A water footprint can be calculated for any well-defined group of consumers (e.g., an individual, family, village, city, province, state or nation) or producers (e.g., a public organization, private enterprise or economic sector), for a single process (such as growing rice) or for any product or service. Traditionally, water use has been approached from the production side, by quantifying the following three columns of water use: water withdrawals in the agricultural, industrial, and domestic sector. While this does provide valuable data, it is a limited way of looking at water use in a globalized world, in which products are not always consumed in their country of origin. International trade of agricultural and industrial products in effect creates a global flow of virtual water, or embodied water (akin to the concept of embodied energy). In 2002, the water footprint concept was introduced in order to have a consumption-based indicator of water use, that could provide useful information in addition to the traditional production-sector-based indicators of water use. It is analogous to the ecological footprint concept introduced in the 1990s. The water footprint is a geographically explicit indicator, not only showing volumes of water use and pollution, but also the locations. Thus, it gives a grasp on how economic choices and processes influence the availability of adequate water resources and other ecological realities across the globe (and vice versa).

Blue Water Footprint

A blue water footprint is the volume of water that has been sourced from surface or groundwater resources (lakes, rivers, wetlands and aquifers) and has either evaporated (for example while irrigating crops), or been incorporated into a product or taken from one body of water and returned to another, or returned at a different time. Irrigated agriculture, industry and domestic water use can each have a blue water footprint.

Green Water Footprint

A green water footprint is the amount of water from precipitation that, after having been stored in the root zone of the soil (green water), is either lost by evapotranspiration or incorporated by plants. It is particularly relevant for agricultural, horticultural and forestry products.

Grey Water Footprint

A grey water footprint is the volume of water that is required to dilute pollutants (industrial discharges, seepage from tailing ponds at mining operations, untreated municipal wastewater, or nonpoint source pollution such as agricultural runoff or urban runoff) to such an extent that the quality of the water meets agreed water quality standards. It is calculated as:

$$\text{grey water footprint} = \frac{L}{c_{max} - c_{nat}}$$

where L is the pollutant load (as mass flux), cmax the maximum allowable concentration and cnat the natural concentration of the pollutant in the receiving water body (both expressed in mass/volume).

Calculation for Different Actors

The water footprint of a process is expressed as volumetric flow rate of water. That of a product is the whole footprint (sum) of processes in its complete supply chain divided by the number of product units. For consumers, businesses and geographic area, water footprint is indicated as volume of water per time, in particular:

1. That of a consumer is the sum of footprint of all consumed products.
2. That of a community or a nation is the sum for all of its members resp. inhabitants.
3. That of a business is the footprint of all produced goods.
4. That of a geographically delineated area is the footprint of all processes undertaken in this area. The virtual water balance of an area is the net import of virtual water, net, defined as the difference of the gross import of virtual water from its gross export. The water footprint of national consumption results from this as the sum of the water footprint of national area and its virtual water balance.

Water Availability

Globally, about 4 percent of precipitation falling on land each year (about 117,000 km3 (28,000 cu mi), is used by rain-fed agriculture and about half is subject to evaporation and transpiration in forests and other natural or quasi-natural landscapes. The remainder, which goes to groundwater replenishment and surface runoff, is sometimes called “total actual renewable freshwater resources”. Its magnitude was in 2012 estimated at 52,579 km3 (12,614 cu mi)/year. It represents water that can be used either in-stream or after withdrawal from surface and groundwater sources. Of this remainder, about 3,918 km3 (940 cu mi) were withdrawn in 2007, of which 2,722 km3 (653 cu mi), or 69 percent, were used by agriculture, and 734 km3 (176 cu mi), or 19 percent, by other industry. Most agricultural use of withdrawn water is for irrigation, which uses about 5.1 percent of total actual renewable freshwater resources. World water use has been growing rapidly in the last hundred years.

Water Footprint of Products (Agricultural Sector)

The water footprint of a product is the total volume of freshwater used to produce the product, summed over the various steps of the production chain. The water footprint of a product refers not only to the total volume of water used; it also refers to where and when the water is used. The Water Footprint Network maintains a global database on the water footprint of products: WaterStat. Nearly over 70% of the water supply worldwide is used in the agricultural sector. The water footprints involved in various diets vary greatly, and much of the variation tends to be associated with levels of meat consumption.

Water Footprint of Nations

The water footprint of a nation is the amount of water used to produce the goods and services consumed by the inhabitants of that nation. Analysis of the water footprint of nations illustrates the global dimension of water consumption and pollution, by showing that several countries rely heavily on foreign water resources and that (consumption patterns in) many countries significantly and in various ways impact how, and how much, water is being consumed and polluted elsewhere on Earth. International water dependencies are substantial and are likely to increase with continued global trade liberalization. The largest share (76%) of the virtual water flows between countries is related to international trade in crops and derived crop products. Trade in animal products and industrial products contributed 12% each to the global virtual water flows. The four major direct factors determining the water footprint of a country are: volume of consumption (related to the gross national income); consumption pattern (e.g., high versus low meat consumption); climate (growth conditions); and agricultural practice (water use efficiency).

Environmental Water Use

Although agriculture's water use includes provision of important terrestrial environmental values (as discussed in the “Water footprint of products” section above), and much “green water’ is used in maintaining forests and wild lands, there is also direct environmental use (e.g., of surface water) that may be allocated by governments. For example, in California, where water use issues are sometimes severe because of drought, about 48 percent of “dedicated water use” in an average water year is for the environment (somewhat more than for agriculture).

Such environmental water use is for keeping streams flowing, maintaining aquatic and riparian habitats, keeping wetlands wet, etc.

Sustainable Water Use

Sustainable water use involves the rigorous assessment of all source of clean water to establish the current and future rates of use, the impacts of that use both downstream and in the wider area where the water may be used and the impact of contaminated water streams on the environment and economic well-being of the area. It also involves the implementation of social policies such as water pricing in order to manage water demand. In some localities, water may also have spiritual relevance and the use of such water may need to take account of such interests.

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Rainwater Harvesting: An Overview

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Water is one of the most important natural resources. Water forms the basis of our existence i.e., if there would be no water, there would be no life on the Earth. Water is required for almost every important activity starting from agriculture to industrial activity. We can lead our life without elements like gold, iron, etc., but without water, life is unimaginable. Whole world receives plenty of water during the rainy season and is ultimately lost due to mismanagement resulted from inadequate methodology or technique to store surplus water for future references. Such inefficiency in long term brings most of the places over the world to face water shortage problem.

In order to cope under such circumstances and in cheapest possible way is to ensure the availability of water throughout the years through adaptation of rainwater harvesting technique. There can be many factors that may influences individual to install a rainwater harvesting system such as unpredictable weather patterns, inadequate water availability, and due to explosion in water consumption, etc. In the present scenario, most of the homes and businesses are looking forward to adopt green practices to become efficient and self-dependant. In such case, harvesting rainwater is the best choice as it is the quickest and easiest method to replenish water that has been consumed and thus provides adequate time to natural water sources (i.e., groundwater) to recharge and helps to reduce the burden from the environment. It also helps individuals through significant reduction in water bills.

Rainwater harvesting is a novel approach used to collect rainwater from roofs and other surfaces and store it for future use. Water can be collected from roofs, rivers or other surfaces and diverted to a deep well, a reservoir with percolation or aquifer. Its utilities include water for irrigation, gardens, domestic use, livestock with appropriate treatment, etc. The collected water can also be used as longer-term storage, drinking water, groundwater recharge, etc.

Benefits of Rainwater Harvesting

Rainwater harvesting is a beneficial technique to reduce burden from the natural groundwater sources and collected water can be used for daily use purposes. Some of the important benefits are enlisted below:

1. Backup source of water: Water supply systems fail many times due to several unexpected reasons. This failure of the supply system leads to the inadequacy of water in homes. Thus, the installation of a rainwater harvesting system can save us from such unwanted events.

2. Ecological benefit: One of the major benefits resulted due to installation of rainwater harvesting is to render the impact caused due to utilization of water for different human activities which has affected the ecological system associated to that region. Minor activities like flushing the toilet consist of about 35% of daily water usage at home. In hotel and restaurant etc. accommodation and lodging require a significant amount of water and in that condition rainwater harvesting can help a lot to fill the gap.

3. Easy maintenance: Rainwater harvesting systems are easy to maintain as these are not used for cooking, drinking or other sensitive uses that require purification. Thus, the system eliminates the necessity of very expensive purification systems.

4. Reduces erosion and flooding around buildings: Most buildings that use rainwater harvesting systems have a built-in catchment area on top of the roof, which is capable of collecting vast amounts of water in case of rainstorms. It helps to reduce soil erosion by reducing its runoff velocity by capturing rain water, which can also prevent urban flooding. If the water were not collected efficiently, it could have resulted in severe soil erosion and flooding around the house.

5. Requires low upfront capital investment: Installation of a rainwater harvesting system is not that expensive, plus it provides feasibility of one-time installation. It only requires routine maintenance while cleaning out the tank. An expert technician needs to be hired to install the system. The technician helps in selecting the best system as per the requirement depending upon rooftop size and storing capabilities required. The overall cost of installing the system is minor and thus manageable through ascertaining losses.

New Approaches to Rainwater Harvesting

The Rain Saucer, which has a shape of an upside-down umbrella, can collect rain directly from the sky, is being used in the place of the roof to collect rainwater. The device reduces the probability of contamination and makes rain saucer a great device for potable water harvesting in developing countries. Other uses of the portable rainwater collection methods are small-plot farming and sustainable gardening. A Dutch invention known as the Groasis Waterboxx is useful for growing trees to harvest and store rainwater and dew.

Conventionally, detention basins were solely used for storm water management. The new detention basins constructed with enhanced real-time control of the outflow from the basin are much more effective at retaining total suspended load and the contaminants, like heavy metals, as compared to traditional basins. The enhanced real-time control allows the infrastructure to handle double the quantity of rainwater harvested as compared to the conventional basin, without compromising the existing detention capacity. The new basin can increase the water quality of water released and decrease the amount of water released during combined sewer overflow events.

Typically, check dams are built across the streams to magnify the entry of surface water into the soil. The water infiltration in the ponding region of the check dams can be increased by loosening the subsoil. Thus, in the dry seasons, local aquifers can be recharged rapidly using the available surface water.

Rainwater harvesting can be accomplished by growing freshwater-flooded without any economic loss that would have been possible from the utilization of the land. The primary purpose of the rainwater harvesting is to use the locally available rainwater to meet water requirements throughout the year without the need for huge capital expenditure. The method would ensure the availability of uncontaminated water for industrial, domestic and irrigation needs.

Metropolitan cities are facing a shortage of good quality water sources nearby and water is becoming scarce and costly day by day. Water is an abundant renewable resource like solar and wind energy. Every year a large area of the world is covered by solar panels. Rainwater falling on these panels can be collected and stored for the future. The collected water is of high quality; thus, it can be used for the production of value-added products like bottled drinking water.

System Setup

Rainwater harvesting systems can be of a simple type that requires very minimum skill for installation or it can be of a complex type that requires advanced skill for installation. The basic rainwater harvesting system is a very simple task as it requires no technical knowledge. In the basic system, all the portions of the building that receive rainwater are connected through a pipeline to an underground tank that stores water.

The systems are typically designed to meet the water requirement throughout the dry season hence it must be large enough to meet daily water requirements. Especially, the rainfall capturing portion of a building such as a roof must be big enough to maintain a reasonable amount of water flow. The storage tank should be large enough to store water for a season.

Before constructing a rainwater harvesting system it is essential to use digital tools to detect a region that has a high potential for rainwater harvesting, which can save time and money significantly.

Conclusion

Rapid utilization of groundwater sources has resulted in steep decline in the groundwater table in the country. This has led to drying up large number of wells, low well productivity, deteriorating groundwater quality, and also salinity ingress in many areas. Shallow wells are running dry and the depth of tube wells is increasing every year. Estimates indicate rate of groundwater withdrawal in India is twice the recharge rate (International Water Management Institute 2002). Under such adverse condition rainwater harvesting offers a critical and promising solution to replenish and recharge the groundwater. Thus, help in mitigating the impact through stabilizing water availability. There is urgent need for strong policies and programmers to promote rainwater harvesting and that to in target areas which are water scarce, and highly dependent on groundwater, and where rapid declines in groundwater levels are taking place. Rainwater harvesting through comprehensive policy approach would lead to more inclusive and sustainable water resource development and management in water scarce areas.

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Advances in Production Technology of Asparagus

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Introduction

In India, *Asparagus sprengeri* comprises the major portion of the cut foliage trade and widely used as indoor plants and fillers. Asparagus fern is a rounded herbaceous perennial that is used in the landscape as a border plant, ground cover, indoor plant, hanging baskets, landscape borders and entry point ornamental for its attractive, fine-textured foliage. The structures that are most referred as leaves are actually leaf-like branchlets called cladophylls. These tiny cladophylls are linear, flattened structures that are bright green in color. This attractive plant can be used in the landscape. Plants have ornamental feathery foliage which is commonly used in flower arrangement. It is originated in Southern Africa. It's a main constituent member of liliaceae family. They require partial-shade.

Most common asparagus is *Asparagus setacea*. They are commonly known as the lace fern, climbing asparagus or ferny asparagus. It is the climbing plant in the genus asparagus. Despite its common name the plant is not a true fern, but has leaves that resemble one.

Important Species

1. *Asparagus setacea kunth*
2. *Asparagus springeri*
3. *Asparagus pulmosus baker*
4. *Protasparagus plumosus (baker) oherm*
5. *Asparagus iujae de wild*
6. *Asparagus zunzibaricus baker*

Importance

They are commercially important because they may be grown and sold a food for other organisms. They retain water and humidity in their habit are ecologically important in addition they make soil fertile. Another economical use of ferns is the treatment ad dressing of wounds.

Soil and pH

Asparagus prefers slightly acidic soils. Soil with a range of pH between 6.0 to 6.8 works well for asparagus planting.

Propagation

Tuberous root: Propagation from cuttings is a relatively simple process for plants that have the capability to grow roots from stems, leaves or buds. It develops from tuberous roots that grow just below the surface of the soil, so cutting taken from the plant will not root. It is also easily propagated by dividing and replacing the tubers.

Manures and fertilizer: The objectives of the study were to determine the response of asparagus to different rate and source of organic and inorganic fertilizer. Annual amendments were applied to provide total of 80 kg ha/1. One half of each year recommended rate of phosphorous pentaoxide, B at 2.4 and 7.2 kg ha/1, Mg at 54 and 162 kg ha/1, fresh beef manure and aged beef manure is also used.

Spacing and planting: Asparagus should be planted in 8-inch-deep furrows. Space plants 12 inches apart in the row, with rows 3-4 feet apart.

Cover it with 2 inches of soil add additional soil to the furrows cultivation during the year but do not burry those furrows already established.

Irrigation: It is a very deep rooted and draws water from a large volume of soil. This allows the crop to withstand considerably more dry weather that other shallow rooted crops. It can be irrigated by 3methods:

Sprinkler: Wets the foliage and can results in more disease problem due to soil splash. It should be maintained the level of soil splash. it should be maintained the level of soil moisture in the top foot of 70% of field capacity.

Drip irrigation: The drip rate may be laid out as sub surface system using low flow 15 mil drip tape buried 12 to 15 inches deep under the plant row prior to planting seeds.

Furrow irrigation: It is used only in certain situations but field slope and soil type are critical for making system work. It has low irrigation efficiency and required more water than other type of irrigation.

Weed Control: During the soil preparation phase prior to planting, of perennial weeds should be controlled, perennial weeds such as Bermuda grass, Johnson grass etc, must be controlled prior to establishing an asparagus planting. It can be controlled by post emergence herbicides, cover crops, cultivation and selection of site with few or no perennial weeds.

Pest Management

Insect Cutworms: Among early season pests, cutworm especially the variegated black worm causes sporadic but occasionally severe damage. It can be characterized by spears cut partially or completely at the soil. It can be managed by applying bavisto the field before the spears emerge especially where cutworms have caused previous damage.

Asparagus beetle: Common asparagus beetles appear early to mid – April and feed on spears tips both adult and larvae eat shoots and leaves but they are particularly devasting when they chew the tip of the spears causing them to scar and turn brown. Many beneficial insects reduce asparagus beetle population through predation and parasitism. Predator include lady beetle larvae and asparagus beetle eggs are parasitized by tiny, metallic green wasp *Tetrastichus asparagi*.

Harvest: Once asparagus plants are strong enough to be harvest cut all new shoots in spring when they are about 8 inches tall. Snaping them of the soil line many seasoned gardeners use knife cut below the soil line.

Post-harvest handling: Asparagus gives off heat, loses moisture and can be lost if not handled properly after harvest loss quality begins at harvest and exposure to high temperature from 90 f to 100f for even a few hours will results in tremendous quality of losses.

Once packed asparagus should be rapidly cooled to 40 F by hydro cooling and maintained at a temperature good hydro cooling required adequate heat. Best quality asparagus to be held less than 10 days should be kept at 32 F to 34 F. RH should be 90 to 95% displaying asparagus with cut ends standing in trays of ice water help maintain quality.

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Applications of ICT Tools for Plant Disease Diagnosis, Monitoring and Forecasting

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The population of India goes to 1.32 billion, accounts 17 % of the world population and with the shrinking land resources, it is a great challenge for agricultural developing agencies and agriculture scientist to providing both food and nutritional security to the population. Crop productivity is mainly affected by pest and diseases as 40 % losses caused by weed, pest and disease.

Even though there are many effective and improved technologies are available there but somehow farmers face major constraints in terms of pest and disease management, which ultimately affect crop production and build a huge gap between demand and supply.

The several issues faced by farmers are:
1. Lack of field disease diagnostics tools available at farmer's level
2. Lack of expertise to choose the right management practices
3. Lack of information on prediction systems etc.

Due to Lack of right and timely knowledge of pest and disease and their management, farmers use huge number of pesticides, chemicals etc. to control this which ultimately results as hazardous effect on both environment and mankind. Although Govt. agencies are providing proper diagnosis and timely forecasting but somehow there is a communication gap. With the advancement of smart phones and other communication devises, these issues can be easily addressed by using ICT.

Information and Communication Technologies (ICT) tools include, radio, television, smart phone, computers, satellite; internet including email, video conferencing and social networking, these all had made it possible for users across the world to communicate with each other without of having physical contact.

Disease Forecasting

Plant performs all its physiological activity which terms as healthy plant, if plant disturbed by any pathogen, insect-pest, plant physiological activity will also alter. With the advancements of technology, disease forecasting can be easily done even without coming in direct contact and this can be only possible by using remote sensing. RS reflect EMR which is invisible to human eyes but important for vegetation. Spectrometer field in remote sensing usually detection of plant pest disease, nutritional status, weed control, water etc. Spectral property of different vegetation interoperates information about vegetable, plant health, crop, forest etc.

The information obtained during remote sensing is carried through electromagnetic radiation in the different forms of waves. Passive remote sensing sensors record incident radiation reflected or emitted from the objects while active sensors emit their own radiation, which interacts with the target to be investigated and returns to the measuring instrument.

Reflection Pattern of Healthy Plant

VIS :0.4-0.7µm, maximum absorption in this region and low reflection chlorophyll a absorb maximum, mostly induce a peak at green domain whereas NIR near infra-red: 0.7-1.3µm absorb very low and reflect max due to internal scattering at the air –water cell in the leave.

Reflection pattern of sick or dead plant: Changes in reflections results due to modification in plant tissues, when plant goes under stress condition whether abiotic or biotic, chlorophyll production decrease, which results in low absorption in blue and red bands, so along with green, red and blue bands also reflect. Hence yellow or brown color is developed. During stressed or disease condition mesophyll cell starts absorbing so a result a dark patch found in the images.

A leaf under stress is totally different from normal leaf in many aspects such as size, shape, anatomy etc. A stressed plant may close its stomata which can easily detect by NDVI spectral profile, it can easily differentiate between healthy and diseased plant.

Geographic Information System (GIS), Geographic Positioning System (GPS)

GPS is important technology enable us to obtain data specific to exact location and such huge data can be stored, retrieved and analyzed through GIS. The use of geospatial enable energy to collect information from various sources and Internet of things (IoT) established a good communication with entire world through internet to use data. It helps in making and maintain the farmland resource efficient, land use pattern and land cover site specification agronomy measures. These two ICT tools combined with remote sensing make it an excellent technology for studying epidemiology of plant diseases and the same may effectively employed for plant disease diagnostics over large area and also accurate prediction. These technologies are now been effectively employed for precision agriculture and disease forecasting services. Warning of disease and pest, can predict the situation, occurrence condition, trends, help in making strategy to control disease.

WSN Monitoring of Weather and Crop Parameters for Possible Disease Risk of Downy Mildew of Grape

Grape vine downy mildew caused by *Plasmapora viticola* is an important disease cause a heavy loss in production every year. Serious infection can be seen in climate with high rainfall and high relative humidity. For effective controlling farmer use huge number of fungicides frequently. So considerable efforts required to predict Agro meteorological variables i.e., Air Temperature, Air Humidity (Ipsita Das et al., 2008). Forecasting of grapevine downy mildew using two different existing models i.e., Logistic and Beta model. Experiments were conducted both in a lab shed-net house at IIT-Bombay and vineyard (commercial grape farm), Nashik, Maharashtra, India.

The WSN system consist of sensors which continuously monitor air temperature, relative humidity, soil temperature and leaf wetness. Each node transmit/receive data to a base station node. The leaf wetness sensor detects the presence of leaf surface moisture and calculates the duration of wetness. When moisture is present the sensor detects a decrease in electrical resistance. The resistance is displayed as a value between 0 (dry) and 15 (wet). Data were further transferred from a base station to a server, via GPRS connection established at embedded gateway.

The smart phones by android, IOS applications, enabled with high resolution camera and GPS. Analyze data for pest perdition and disease forecasting purposes.

For example: mobile app ‘Plantix’ (ICRISAT, Hederbad); ‘Rice Doctor’ (IRRI, Philippines) ‘riceXpert’ (ICAR-NRRI, Cuttack), CCRI-CITRUS’ (ICAR-CCRI, Nagpur) etc. for the disease diagnostic purposes.

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Use of Social Media and Mobile Applications in Agricultural Extension

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Role of Social Media in Extension

Social Media in education refers to the area of computing which deals with social networks and the collective human interaction using computational systems for staying connected at all times. Learning is nothing but a social activity. Since times immemorial, a classroom or laboratory interaction has been the preferred mode of teaching and learning. In the recent years people have started understanding the constraints of this methodology, and have increasingly looked towards integrating computers for teaching/learning. In pandemic situation teachers switch to learning management tools (LMS), e-learning, online platform such as zoom or cisco webex etc. for enhance the learning experience. It allows and empowers the students to explore materials at their own pace, provide more interaction with faculty, and allow students to contribute to learning materials. Projects and research are an important part of academics which is no longer limited to one specific department, or campus, and are highly collaborative in nature. The internet has further enabled the researchers to break the geographical barriers and explore large projects spanning multiple universities across the world. Social computing tools like collaborative project management and documentation tools, web conferencing, etc. have enhanced the feasibility of such partnerships for effective exchange of information. Such tools can also enhance the learning experience of students by providing more support for projects, exploring peer learning and providing access to experts.

The Core Principles Underlying Social Media Use in Extension

The six core principles governing the value of social-media solutions, and, in combination, serve as the defining characteristics that set social media apart from other forms of communication and collaboration. The principles are participation, collective strength, transparency, independence, persistence and emergence. Successful social-media solutions tap the power of mass collaboration through user participation. The only way to achieve substantial benefits from social media is by mobilizing the community to contribute in an effective manner with creative contents. Collective is applicable to all social media where people collect around the content to contribute rather than individually creating the content for distribution. Social-media also provides transparency as the users get to see, use, reuse, augment, validate, critique and rate each other's contributions. With independence, we mean that any participant can contribute completely independent of any other participant. No specific coordination between collaborators is required at any stage. With social media, the fruits of participant contributions are captured in a persistent state for others to view, share and augment. The emergence principle concludes the benefit of social media in an environment for social structures to emerge.

Some of the Popular Social Networking Sites

www.twitter.com: Twitter enables text-based posts of up to 140 characters displayed on the user's profile page which are publicly visible by default. The tweets enable the followers to know about the topic instantly in few lines. If the follower is interested in the content, he may refer to the complete story available on the links or can just pass by. Some of the links useful to the users are @agrigoi @e_agriculture @faoknowledgewhich regularly updates the information in learning related to the context of agriculture.

www.facebook.com: Facebook is a great source to share information with the creation of pages or groups. The interested can join the commodity specific groups created by farmers or some institution for greater information and regular updates. Some of the groups like Turmeric farmers association of India; Innovative Farmers Association, Hosiarpur, New Era Foods are helping the information reach the interested.

www.blogspot.com/ www.wordpress.com: These are blog-publishing service that allows private or multi-user blogs with time-stamped entries for the ease of locating time specific information. The blog posts can be understood as the traditional diary of past times. The blogs of e-agriculture for latest information on agriculture from around the globe is quite popular among the scientists. Also, the blog by Mr. M.J Prabhu regarding success stories of farmers have gained immense popularity among the practitioners.

www.linkedIn.com: LinkedIn is a business oriented social networking site which helps people grow educational communities for professional enrichment. People can find people working in their domain and can link with them for better collaboration and exchange of information.

www.youtube.com: YouTube is a video-sharing website on which users can upload, share, and view videos. YouTube have emerged as a major medium for improved learning experiences. A similar site called Teachertube.com enables leaning from quality institutes to the distant learners. YouTube channels like Unacademy, Byju's, NPTEL are making immense contribution in learning for both faculty members and the student community.

Online Platform: agMOOCs is an online platform designed to help students, professionals, and organizations to acquire and enhance knowledge and skills in the agriculture domain. The platform provides free access to numerous high-quality courses online offered by renowned faculty from the premier institutes of the country. The intent is to reach out to thousands of learners through these MOOCs thus enabling them to access higher agricultural education.

www.slideshare.com/ www.authorstream.com: SlideShare is an online slide hosting service which is host tomany slides on various domains of learning and entertainment. The slides help the learners to know the topic from multidimensional approach leading to improvement in the overall scenario.

Mobile Applications

Mobile applications for agricultural development provide an extension reach beyond voice and text communications in an economic and profitable way. Some of the popular mobile applications in the ICAR system is discussed below.

RiceXpert Mobile Application

The National Rice Research Institute (NRRI) under the ICAR has developed an android based mobile application for the rice farmers in the year 2016.

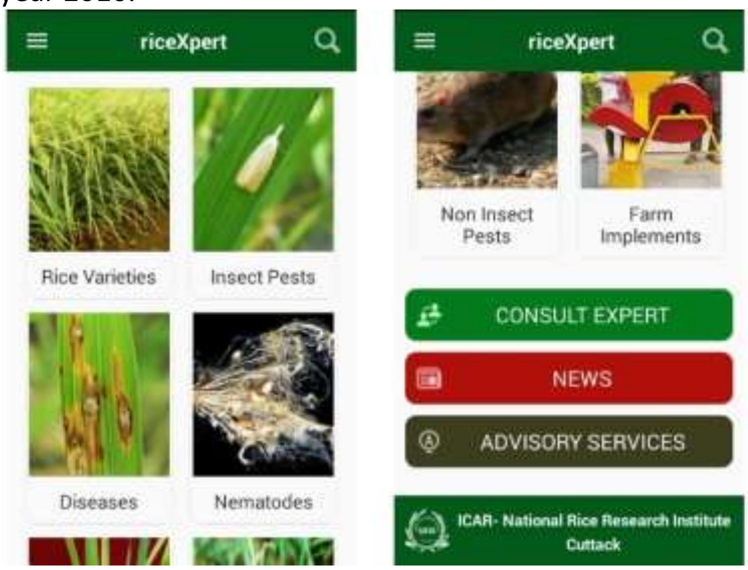

Fig. 6: Mobile application interface of RiceXpert

The application "riceXpert" provides information to farmers in real-time on insect pests, nutrients, weeds, nematodes and disease-related problems, rice varieties for different ecologies, farm implements for different field and post-harvest operations. The app has Web-based application systems which facilitates flow of information from the farmer to the farm scientist and get offer quick solutions. The farmers can send the photo and voice through this mobile app for solving their queries on rice related farming systems.

PusaKrishi Mobile Application

PusaKrishi app was launched by the ZTM&BPD Unit of ICAR-IARI, New Delhi in March, 2016. The app provides information related to new varieties of crops developed by Indian Council of Agriculture Research (ICAR), resource conserving cultivation practices as well as farm machinery and its implementation for the farming community. It gives information about the varieties of products available to farmers, technology that can be used to yield better crops, information about produces and the region it is best suited for, information about animal feed and bio-fertilizers, among others. The specialty of the app is that it gets updated regularly and showcases any new developments in the product or technology segment. A feedback section is also present to have a real time conversation with the stakeholders.

Fig. 7: Mobile application interface of PusaKrishi app

mKRISHI Fisheries Advisory Services

mKRISHI@Fisheries were launched in July, 2015 to provide mobile advisory services to the fishermen making fishing activities less expensive and environment friendly. It is available for the farmers of the state Maharashtra, Odisha, Andhra Pradesh, Gujarat and Karnataka. It has been developed by the Central Marine Fisheries Research Institute (CMFRI) to aid fishermen to increase their catch and reduce the cost of operations. It provides information on Potential Fishing Zone (PFZ), sea surface temperature, weather and the presence of phytoplankton which form the food of several fish species. It consolidates this information and presents advisories in local languages, with easy-to-use icons on Java and Android mobile phones. The app has been developed by the Mumbai Research Centre of the CMFRI, Indian National Centre for Ocean Information Services (INCOIS) and the Tata Consultancy Service (TCS) under the National Agriculture Innovation Project (NAIP). A study conducted by the CMFRI in 13 fishermen societies in Maharashtra found that the fishermen could save up to 30 per cent of fuel consumption. The reduction of the fuel consumption has benefits in terms of environmental impact where an estimated 1.2 per cent of global oil production is consumed in fisheries6.This app also helps the fishermen to get to know the wind speed and direction, wave heights in a color coded band helping them identify the unsafe regions in sea. Fishermen are advised to go only when the information map on the app is blue in colored it predicts five days upfront forecast which will help even trawlers who go for multi-day fishing trips. It disseminates the information on potential fishery zones and wind advisories to fisherman in Marathi and English languages.

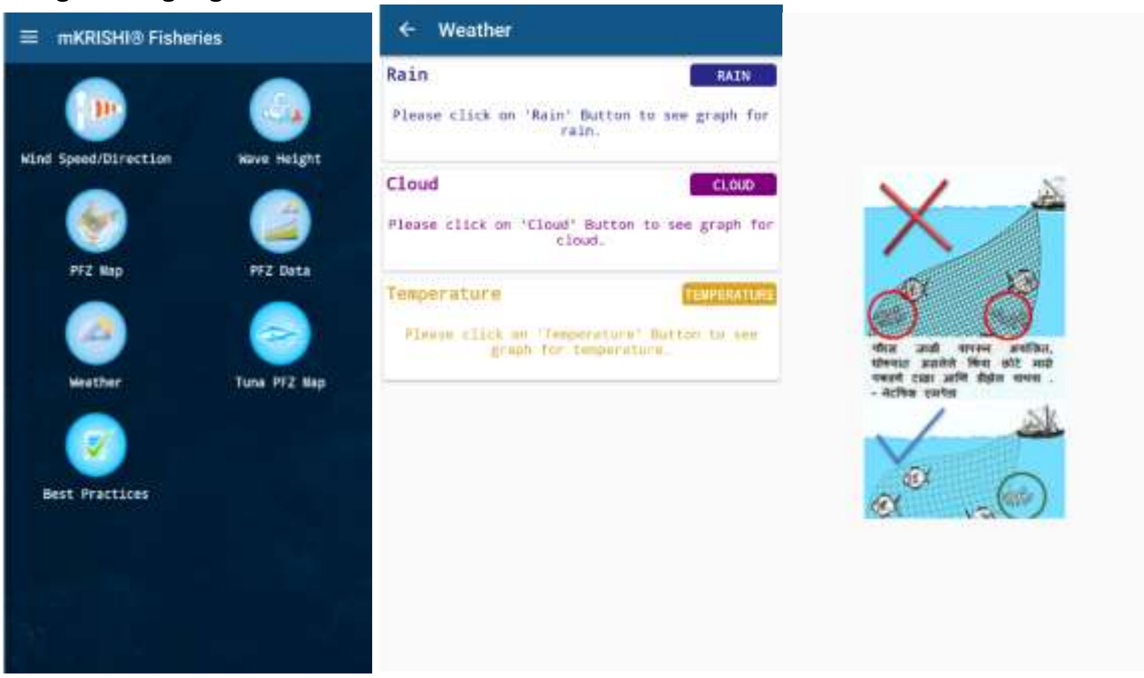

Fig. 8: Snapshot on mobile interface

Chanamitra Mobile App

The Chanamitra mobile application was launched in December, 2016 by the ICAR-Indian Institute of Pulses Research, Kanpur to reach the farming community with technical knowhow and do how related to pulse production technologies. The app provides information related to area specific improved chickpea varieties, crop production technologies, crop protection technologies for management of insect pest and diseases, post-harvest technologies as well as information related to market price and weather, which can be easily accessed for farmers and other stakeholders for making informed decisions.

Fig. 9: Mobile interface of Chanamitra app

The farmers and pulse researchers can also use the app for receiving solutions to the specific problems faced by them, right from the fields. The queries can be made in video, voice or text format. The unique feature of the app is that it is backed by a strong team of chickpea researchers working across the country for providing solutions to the queries made and related up dates.

Conclusion

Social media offers an exciting new direction in education for both learners and the educators. The past decades have seen a transformation from email to the blog which has at large changed our ways of living, working, and interacting with others. It doesn't have to stop with teens and teachers; increasingly, administrators are finding new, creative ways to integrate social media into their schools and colleges. The ubiquitous nature of networked computers connected through the Internet from homes and schools creates an exciting opportunity for students around the world to explore the subject together. With all right things in place, there is also a need for proper facilitation and development of high-level thinking skills so that the learners are accustomed to using internet in the better direction.

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Organic Matter Serves Important Role in Soil Health

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Introduction

A fertile and healthy soil is the basis for healthy plants, animals, and humans. And soil organic matter is the very foundation for healthy and productive soils. Understanding the role of organic matter in maintaining a healthy soil is essential for developing ecologically sound agricultural practices. The reason is that organic matter positively influences, or modifies the effect of, essentially all soil properties. Organic matter is essentially the heart of the story, but certainly not the only part. In addition to functioning in a large number of key roles that promote soil processes and crop growth, soil organic matter is a critical part of a number of global and regional cycles. All the components of soil, organic matter is probably the most important and most misunderstood. Organic matter serves as a reservoir of nutrients and water in the soil, aids in reducing compaction and surface crusting, and increases water infiltration into the soil. The difference between organic material and organic matter. Organic material is anything that was alive and is now in or on the soil. For it to become organic matter, it must be decomposed into humus. Humus is organic material that has been converted by microorganisms to a resistant state of decomposition. Organic material is unstable in the soil, changing form and mass readily as it decomposes. As much as 90 percent disappears quickly because of decomposition. Organic matter forms a very small but an important portion and it is obtained from dead plant roots, crop residues, various organic manures like farmyard manure, compost and green manure, fungi, bacteria, worms and insects.

Benefits of Organic Matter

1. Nutrient supply: Organic matter is a reservoir of nutrients released to the soil. Each 1 percent of soil organic matter releases 20 to 30 pounds of nitrogen, 4.5 to 6.6 pounds of P2O5, and 2 to 3 pounds of Sulphur per year. The nutrient release occurs predominantly in the spring and summer, so summer crops benefit more from organic matter mineralization than winter crops.

2. Water-holding capacity: Organic matter behaves somewhat like a sponge, with the ability to absorb and hold up to 90 percent of its weight in water. A great advantage of the water-holding capacity of organic matter is that the matter will release most of the water it absorbs to plants. In contrast, clay holds great quantities of water but much of it is unavailable to plants. An increase of 1 percent soil organic matter can result in an increase of 16,500 gallons of plant-available water per acre.

3. Soil structure aggregation: Organic matter causes soil to clump and form soil aggregates, which improves soil structure. With better soil structure, permeability (infiltration of water through the soil) improves, in turn improving the soil's ability to take up and hold water.

4. Erosion prevention: This property of organic matter is not widely known. Data used in the universal soil loss equation indicate that increasing soil organic matter from 1 to 3 percent can reduce erosion 20 to 33 percent because of increased water infiltration and stable soil aggregate formation caused by organic matter.

Improve Soil Organic Matter Levels

Building soil organic matter is a long-term process but can be beneficial. Here are a few ways to do it:
1. Reduce or eliminate tillage: Tillage increases the aeration of the soil and causes a flush of microbial action that speeds up the decomposition of organic matter. Tillage also often increases erosion. No-till practices help build organic matter.

2. Reduce erosion: Most soil organic matter is in the topsoil. When soil erodes, organic matter goes with it. Saving soil and soil organic matter go hand-in-hand.

3. Soil test and fertilize properly: Proper fertilization encourages growth of plants, which increases root growth.

4. Increased root growth can help build or maintain soil organic matter, even if you are removing much of the top growth.

5. Grow cover crops: Growing cover crops can help build or maintain soil organic matter. However, best results are achieved when cover crops are combined with tillage reduction and erosion control measures.

Conclusion

A good supply of soil organic matter is beneficial in crop production. Consider the benefits of this valuable resource and how you can manage your operation to build or at least maintain the organic matter in your soil.

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Indigenous Technical Knowledge System in Organic Farming

Article ID: 10567

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Introduction

Traditional knowledge encompasses belief systems that play a fundamental role in people. This traditional knowledge includes mental inventories of local biological resources, animal breeds, local plant and tree species.

Traditional knowledge mainly includes information about trees and plant that grow being together, about indicator plants that show the soil salinity, or known to flower at the beginning of the rains. It includes practices and technologies, such as seed treatment and storage methods, and tools used for planting and harvesting.

Indigenous Technical Knowledge Uses

Crop Production, Crop Protection, Crop Storage and Seed Storage.

ITK's in Organic Crop Production

1. Use of mixture of ash and manure: In hill areas, wood obtained from forest has been major fuel. Ash dust is a product obtained after the burning of fuel wood. The kitchen ash, thus obtained has been mixed with the FYM and applied into the field. This ash dust improves the soil structure and water holding capacity in addition to supply of nutrients. It contains phosphorus, which may be helpful in supplying phosphorus to the crop.

2. Burning the residue of crops: The residues left over in the field after the harvesting has been burnt. The ash obtained room burning has been mixed in the soil by ploughing. The dry organic matter of the harvested crop takes long time in its degradation that is why farmers prefer to burn it.

3. Sewage and Sludge: In the modern system of sanitation adopted in cities and town, human excreta if flushed out with water which is called sewage. The solid portion in the sewage is called sludge and liquid portion is sewage water. Both the components of sewage are separated and are given a preliminary fermentation and oxidation treatments to reduce bacterial contamination and offensive smell.

ITK's in Crop Protection

1. Neem and ash: Before transplanting seedlings are kept in small plots of pounded water mixed with ash and pulverized neem seeds were best free of pest and diseases.

2. Spray of tender coconut and buttermilk extract: To maintain uniform flowering, one spray of 10% buttermilk extract or 3% tender coconut should be given during the bootling stage. It may control few Pest and Diseases i.e., stem borer, brown plant hoppe diseases such as blast, brown plant hopper and tungro virus.

3. Keeping Neem cake bags in irrigation canals: The gunny bags should be filled with neem cake and placed along the water canals. Neem cake gets dissolved in the water flowing along the canals and irrigates the field. This practice prevents attack of pests and diseases affecting the roots and tillers of the crop.

4. Use of plants with pest repellent properties: The concentration of the leaf's extraction can be increased or decreased depending on the intensity of the pest attack. It controls sap feeders and all kinds of larvae. Eg. Neem cake/Neem leaves, Moringa leaves

5. Burning of cow-dung cakes: The burning of cow dung cakes, pine leaves and leaves of other plants ash has been provides nutrients to seedling. It was reported the attack of white grubs on chilli plant is not observed.

ITK's in Seed Storage

1. Use of dried leaves for storage of food grains: Foods grains have been dried properly for storage while storing the food grain leaves of Akharot, Bithon or Tun have been used. The leaves of these plants have been taken and kept under the sun for one day. Then the dried leaves have been crushed and mixed in the food grains. The food grain shave been kept in storage structures.

2. Use of mustard oil for storage of pulses: In pulses storage problem has been very serious. For storage of the pulses, leaves of the plants mentioned above had been used. In addition to it, the farmers know the practice of applying mustard oil on the pulses. Farmers reported that 10-20 ml of mustard oil is sufficient to be applied on one Nali of the pulse.

3. Use of ash for storage: Ash obtained from burning of fuel wood has been mixed with the food grains. The probable reason for its use may be its ability to absorb moisture, which otherwise will be absorbed by the grains and make them prone to pest attack.

4. Use of Table salt: To store rice grains Table salt had been mixed with these grains. About 50 gm of the salt had been mixed with one kilogram of the grains. This practice has been reported to be helpful in storage by the farmers.

5. Storage of vegetable seeds with cow dung: Farmers believed that cow dung has pesticidal property, which would keep the seeds away from storage pests. Also believed that cow dung's immune stimulant properties increased the germination (90%) and viability of the seeds considerably. Eg. Vegetable seeds etc.

6. Storage of tamarind with salt: Farmers stored tamarind by mixing salt with it. After harvest, tamarind was removed from its pods and then stored in earthen pots in layers. Farm women indigenously practiced spreading of salt in between the tamarind layers. By this way of storage, storage pests like beetles and Indian meal moth were prevented.

Conclusion

This traditional method of food preservation and storage are much favored by the people and they use it to save food for future use. These practices or indigenous technical knowledge can form a basis for sustainable agriculture after further standardization and validation (R.K Dhaliwal and Gurdeep Singh 2010). However, their techniques are poorly conceived and require improvement to reduce the food losses which make the traditional methods lose their importance of keeping food safe and for a long period of time.

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Small Scale Aqua Business in India For Women Empowerment- Ornamental Fish Farming

Article ID: 10568

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Abstract

Aquarium fish keeping is one of the most popular hobbies in the world. The growing demand of aquarium fish has evolved into an 8 billion industry globally. It has the potential to become an important source of employment and income, especially for empowering women financially, as it can be taken as a leisure time activity and allows balance between productive and reproductive roles.

Small-Scale Farmers

The distribution of the population, size of the family, education and job status of 110 families of Howrah. Most of these families run small home units to earn additional monthly income of Rs. 2500- 5000. Generally, the men have other professions and they only look after the seed collection and marketing. The women and children do the everyday care like water exchange, feeding.

Fish Species

Two categories of ornamental fish are being marketed - exotic ornamental fish and native fish of India, which have ornamental value for coloration or behavior. Exotic fish dominate the domestic market. Already 288 exotic varieties have been recorded in Indian market. More than 200 species of these freshwater fish are bred in different parts of India and others still have to be imported as fry

1. According to availability, demand, and climatic conditions the ornamental fish farmers are mainly engaged in breeding and rearing of common exotic live bearers and egg layers

2. The egg layers lay sticky or non-sticky eggs on the glass wall or aquarium plants. Some parents show parental care and some destroy their eggs so different breeding setups are needed. Live bearers release young in batches and are easy to breed. Among the preferred fish, there are common exotic live bearers like guppy, *Poecilia reticulata*; molly, *Poecilia latipinna*; swordtail, Xiphophorus helleri; platy, Xiphophorus maculatus and egg layers like gold fish, *Carrassius auratus*; koi, *Cyprinus carpio*; tiger barb, *Puntius tetrazona*, Siamese fighter, Betta splendens; *serpae tetra, Hyphessobrycon serpae* and on-growing of some imported fish like silver shark, *Balatocheilus melanopterus*; angel etc.

Major Breeding Centres in India

There 212 MPEDA authorized breeding centres in India. Kerala 126 nos, Tamil Nadu 44 nos, Mathya Pradesh 11 nos, Himachel Pradesh 10 nos, West Bengal 8 nos, Maharastra 7 nos, Rajasthan 4 nos, Karnataka 2 nos.

Culture Tank

Cement cisterns, all glass aquaria, earthen ponds, even earthen pots are being used as culture tanks. The urban and suburban landless farmers generally use cement cistern in the backyard or on the roof. Two or three cement cisterns are sufficient for a small rearing unit (around 3m x 2m x 1m). The cisterns are built above ground level for easy drainage. Indoors, all-glass aquaria are preferred for breeding purposes as heaters and aerators can be used. Farmers with small earthen tanks can use them for rearing juveniles with the food fish. Marginal farmers even use large earthen pots of 1.5m diameter for rearing the larvae and juveniles.

Generally, the area of the tank depends on the type and size of the candidate species. In the case of fresh water tropical species, generally the farmers consider that for each 1cm of fish length, 20cm2 of surface area is sufficient.

Culture Water

In the municipal areas the farmers use normal tap for farming. Before use it is aerated for few days for dichlorination. Tube well water is also used directly in the rural areas. The average temperature of the rearing water in the area is 15- 28C and the pH is slightly alkaline. Other parameters are not so crucial. Most of the species cultured prefer soft to medium hard water.

Food and feeding Food, especially the first food of larvae is vital for achieving good survival rates. The small-scale farmers cannot afford different readymade pellet feed or brine shrimp larvae. However, they have successfully substituted low-cost alternative live feeds. Green water, water fleas, Tubifex or sludge worm, mosquito larvae and chopped earthworm are used.

Different homemade feed like whole-wheat bread, vegetable peelings and rice are also fed. However, most farms depend on Daphnia, tubificid worms and mosquito larvae. The farmers collect Daphnia from the nearby ponds by sieving through fine mesh in the early morning. Tubicid warms and mosquito larvae are generally collected from the sewage water channels.

In fact, there are quite a few people whose profession is to collect these live foods and sell them to the farmers. Generally, the farmers dispense the feed once daily, preferably in morning. The rate of feeding depends on species, size and season. Overfeeding is more harmful than under feeding as the excess feed destroy the water quality.

Health Management

In ornamental fish farming, proper water quality maintenance is the primary preventive measures as they are very sensitive to temperature and pH. The common health hazards of the ornamental fish are white spot, mouth fungus, tail and fin rot. The farmers use some easily available and economic chemicals and medicines as preventive measures.

Marketing

The fish are set to different states of India by air or road. A fair amount is also exported. Two parallel marketing procedures exist for exotic and native fish. In the case of exotic species, more than 99% is consumed by the domestic market and a few species like gold fish and angelfish are exported. On the other hand, 90% native ornamental species are collected and reared to meet export demand. The amount of marine ornamental fish trade is negligible in this area. The marketing process is generally being done through the following channels: Firstly, the producers directly sell the ornamental fish directly to the wholesalers, but the amount is very negligible Secondly, there are some big middle tired men who buy large volumes of fish at very low prices from the producers, rearing the fish for 2-3 months before selling at the wholesale markets again for increased profit. Lastly from the wholesale markets, retailers and others purchase the ornamental fish. For export, the Marine Products Export Development Authority has 20 registered exporters. They either have their own farm or collect the fish from different areas for export. The USA, Japan and Singapore are the main markets.

Outlook

Ornamental fish farming can be a promising alternative for many people. It requires little space and less initial investment than most other forms of aquaculture. At the first stage of starting of an ornamental fish farm, very sophisticated or complicated equipment is not necessary.

As less manpower is needed, the women or the elders can run small home units. With slightly more sophisticated equipment such as heaters, aerators and power filters, and practices such as selective breeding, stock manipulation and proper feeding, large units can be maintained in urban areas also.

Indian Future Prospects

India's share to global ornamental fish trade is less than 1% but still India is projected as a "sleeping giant" because of yet untapped potential resources. Popularization of planted tanks will open new avenues for increasing the existing market. Popularization of marine aquarium with synthetic salts is showing increasing trends it needs to be tapped. Development of packing techniques will help our farmers to compete with regional players this would definitely uplift the existing market level. Indian domestic trade in this area is growing @ 20% annually and demand at domestic level is higher than supply. Selective breeding of fish and developing new stain of ornamental fish is a common practice but in India this technology not yet popularized and hence the indigenous ornamental fish are not accepted in large scale due to their less attractiveness.

Conclusion

Even though there is good demand for Indian indigenous ornamental fish in the international markets, limited numbers are exported due to many reasons. The most important of these is the sustainability factor; secondly, there is not much interest in breeding indigenous fishes which are not popular in the domestic market. Although breeding techniques for selected indigenous ornamental fishes have been scientifically perfected in the country, their large-scale production is yet to begin. If government institutions could set up large scale facilities and provide specialised training and assistance to breeders, more indigenous ornamental fish can be produced for enhancing export from the country.

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Seed Production Technology of Amaranthus (Chaulai)

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Amaranthus belongs to the genus Amaranthus and the family Amaranthaceae. Chromosome No = 30, 32, 34. Origin The leafy amaranthus is native of India, the genus Amaranthus includes 50 to 60 species, the leaves and stems of which are edible. These are most important leafy vegetables of the tropical countries in South Aisa, South-East Asia, East Africa, Central Africa, West Africa, Ethiopia, the Pacific and Far East. Amaranthus is an annual herb, erect or trailing, scarce to profuse branched, shallow to deep tap-rooted, stem green to purple, leaf simple, alternate or opposite, color green to purple. Inflorescence terminal and axillary, branched spikes, flower small, regular, mostly unisexual, monoecious. In general, the cultivated species are monoecious.

Soil and Climate

The crop can be grown in almost all types of soil. However, loam and sandy loam soils with good drainage facility is best suited. Vegetative growth of stem amaranth is favored in the hot humid climates of summer in plains and flowering is generally encouraged when summer temperature starts falling. Pusa kiran best for summer and CO3 is best grown in winter or spring season in India both for vegetable and seed purpose.

Land Preparation, Manure and Fertilizer

Land should be well prepared by several ploughing and harrowing. Sufficient compost, urea 80 kg, Tri Super Phosphate 100 kg and Murate of Potash 80 kg per hectare is needed. Entire quantity of compost, TSP and half of MP should be applied at the time of land preparation before sowing. Urea and the remaining MP should be applied in two splits at 20 and 15 days after sowing.

Sowing and After Care

Sowing is done in lines on raised beds of 120 cm width. Three lines are sown on one bed at a distance of 45 cm keeping 15 cm away from the edge of the beds. A 45 cm wide drain is kept in between two beds. Seeds are mixed with ash or fine soil before sowing and sown by hand along the lines at one cm depth. Sowing is done in July-August for stem amaranth and October-November for Lalsak (leafy amaranth). As seedlings start growing, thinning is to be done. Final spacing of 30 cm between plants is to be established after 2-3 thinnings of weak and off type plants. The field should be kept clean and free from all weeds including "Katanate" *(Amaranthus spinosus)*. About 3-5 kg seed will be needed for one hectare of land.

Irrigation

Irrigate before and after sowing and at weekly intervals after germination.

Improved Varieties

A.tricolor –Pusa Kiran, Pusa Kirti, CO-2, CO-3, CO-4 Arka Sugna, Arka Arunima, Pusa Choti Choulai, Pusa Lal Choulai, Lal sag, Pusa Badi Choulai .

A. dubius- CO-1

A. tritis- CO-2

Floral Biology

Inflorescence is terminal and axillary, branched spike different colored from green to deep purple and orange and with shades. Flower are small regular and mostly unisexual, monocious, pentamarous, branched, and bracteolate which are scaly perianth parts 4-5 imbracte, membraneous, often persistent, stemens 2-5, placed opposite to parienth part. The percentage of staminate flower per glomerule is 0.5-1 in grain type and 1-2 in leafy type. Ovary superior. fruit is botanically utricle, indehiscent, color is black, brown or white.

Breeding Behaviour

Monoecious crop and generally both self and cross pollination by wind (anemophilous). Abundant pollen production led to self-pollination. From the breeding point of view, the small closely grouped flowers in glomerulus make emasculation extremely difficult. The most satisfactory method of as soon as the stigma is receptive and remove the staminate flower by hand. The stigma of the pistillate flowers become receptive several days prior to the opening of the staminate flower.

Outlook

Ornamental fish farming can be a promising alternative for many people. It requires little space and less initial investment than most other forms of aquaculture. At the first stage of starting of an ornamental fish farm, very sophisticated or complicated equipment is not necessary.

As less manpower is needed, the women or the elders can run small home units. With slightly more sophisticated equipment such as heaters, aerators and power filters, and practices such as selective breeding, stock manipulation and proper feeding, large units can be maintained in urban areas also.

Isolation

Since it is a wind cross-pollinated crop, an isolation distance of about 400 m has been recommended (Agrawal, 1980). 80 Seed Harvesting, Threshing and Cleaning Seeds are ready for harvest when they are fully matured and come out when rubbed by hand and the plants start dying.

Plants are cut (either whole plant or the seed-bearing branches) and dried on canvas or concrete floor. Seeds are extracted by beating with stick when plants dry up. Cleaning is done manually by winnowing and dried in the sun.

Plant Protection

Pest: Leaf eating caterpillar *(Hymenia recurvalis):* it is a Destructive pest. Widely distributed in tropical and subtropical regions including Africa, Asia and Australia. In the Indian sub-continent, it is found all the year round, but is more active during warmer, rainy and early winter months. Larvae scrape the epidermal and palisade tissues of leaves web the leaves with silken threads resulting in drying of webbed leaves.

Control: It can be controlled by spraying Carbaryl 50 WP @ 2 g/lit.

Diseases

Leaf spot (*Cercospora* sp.): leaf spot diseases which affect the amaranth plants to a great extent in case of leaf spot, is the causal organism affecting this crop. This disease is characterized by the presence of numerous small brown circular spots on the leaves.

White rust (*Cercospora* sp.): It is characterized by white, blister like circular or irregular pustules on the lower surface of the leaf and opposite each pustule on the upper surface a yellow patch develops. Severe infection causes leaves to die and turn brown, giving the field a blighted look. or any other copper fungicide.

Control

Spraying Dithane M-45 & Carbendazim @ 1 g/l of water. Spraying Sulphur compounds should be avoided.

Harvesting and Seed Yield

Pods are harvested when they have turned brownish in colour but have been completely dry and seed in the pod are firm and well developed. Maturity of seed takes about 140-150 days. Three or four harvesting are generally sufficient. drying seed to a moisture level of 10 % for long storage and 12% for short storage is done.

The seed yield is about 800-1000 kg/ha.

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Physiochemical Behaviour and Modification of Sex Expression in Cucurbits

Article ID: 10570

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Abstract
A wide range of variation in sex forms owed to evolve from primitive sex form i.e., hermaphrodite could lead to evolution of predominant sex form i.e., monoecious and advanced sex form i.e., gynoecious (Robinson and Walters, 1999). Sex modification is attributed to alter the ratio of male to female flowers within the individuals. Sex expression in cucurbitaceae family is regulated by environmental, genetic and hormonal factors. In general, female sex expression is promoted by low temperature and short photoperiod, which may influence the level of endogenous hormones (ethylene, auxin and gibberllins) which in turn influence the sex expression. Sex inheritance plays an important role in breeding programme. Gynoecious lines acts as a male sterile line in cucurbitaceous vegetables. Growth regulators have tremendous effects on sex expression and flowering in various cucurbits lead to suppression of male flowers or an increased number of female flowers (Al-Masoum and Al-Masri, 1999).

Introduction
The cucurbit vegetables are the largest and diverse group comprised of 900 species classified under 130 genera (Jeffrey, 1964) belongs to the family cucurbitaceae. A wide range of variation in sex forms ranging from primitive hermaphrodite to gynoecious advanced sex form is observed in cucurbitaceous vegetable crops. The original and primitive sex form of cucurbits are assumed to be hermaphrodite nature, and evolutionary changes had been occurred in later generations might be due to the environmental, genetic and hormonal factors factors, the dominant mutation effect may lead to the modification of sex from hermaphrodite to the intermediate sex forms like monoecious, gynoecious, andromonoecious, gynomonoecious, androecious, trimonoecious, gynodioceous and dioecious. Sex manipulation is attributed to alter the ratio of male to female flowers within the individuals. The sex modification leads to alteration in the sequence of flowering phenology by modifying beneficial sex ratio in order to enhance the economic yield.

Different Sex Forms in Cucurbits

Sex Forms	Cucurbits
Monoecious	Cucumber, Musk melon, Pumpkin, Summer squash, Winter squash, water melon, Sponge gourd, Round melon, Bottle gourd, Bitter gourd
Gynoecious	Cucumber, Bitter gourd, Musk melon, Watermelon, Ridge gourd
Androecious	Cucumber, Musk melon
Dioecious	Pointed gourd, Ivy gourd, Spine gourd, Sweet gourd and Teasle gourd
Andromonoecious	Water melon, Musk melon
Gynomonoecious	Cucumber, Musk melon, Ridge gourd
Trimonoecious	Cucumber

Control of Sex in Cucurbits

1. Non-genetic factors:

a. Influence of environmental effect on sex expression: Sex expression mainly influenced by environmental factors, attributing female sex expression is promoted by low temperature, short photoperiod and high moisture availability, (Atsmon amd Galun, 1968). Cantliffe (1981) reported that high temperature and long photoperiod results in male flower production.

b. Influence of cultural practice on sex expression: Application of potassium fertilizers in potassium deficit soils increased the female flowers and subsequently enhanced fruit yield in squash (Abduljabbar and Ghurbat, 2010) and application of bio-fertilizers significantly enhanced the induction of female flowers and reduced male flowers in squash plant (Abd El-Fattah and Sorial, 2000). The application of 100 kg/ha of NPK 15:15:15 induced the increased male to female flowers in pumpkin (Agbaje et al., 2012).

c. Phyto-hormone and chemicals role in sex expression: Growth regulators have tremendous effects on sex expression and flowering in various cucurbits lead to suppression of male flowers or an increased number of female flowers (Al-Masoum and Al-Masri, 1999), without imposing any deleterious effect on environment and human health. Indigenous hormonal level decides the sex expression even exogenous application at the two- or four-leaf stage, which is the critical stage at which the suppression or promotion of either sex is possible. GA_3 acts as an ethylene biosynthesis blocker which blocks the ethylene precursor due to which the ethylene production is hindered. Similarly, $AgNO_3$ acts as an ethylene action blocker avoids the ethylene action and increases male flower production.

Table 1 Effect of growth regulators on different crops:

Crop	Growth regulator	Dosage	Effect
Muskmelon	GA3	10 mg/l	Increased fruit yield per hectare
Cucumber	Silver nitrate	400 ppm	Increased total number of staminate flowers/plant, early days to flowering in main axis, early node of first male flowering in main axis
	Ethephon	100 and 200 mg/l	Increased yield
	Ethrel	500 ppm	Increased female flowers and reduced male flowers
	Ethephon (ethrel)	400 ppm	Maximal suppression of staminate flowers
Watermelon	GA3	10 ppm	Produced a greater number of female flowers
	TIBA	50-200 ppm	Producing a favourable female to male ratio and increased number of fruits.
Bitter gourd	Ethrel	200 to 600 ppm	Stunting growth and significant reduced production of male flowers
	GA3	10 ppm	Effective in improving the yield components
Pumpkin	Ethephon	300 mg/l	Increased number of female flowers
Pointed gourd	Ethrel	150 ppm	Pistillate flowers, fruit numbers/plants, fruit size and fruit weight were increase

2. Genetic factors:

Breeding for sex manipulation traits: A wide range of variation in sex forms ranging from hermaphrodite to monoecious forms is observed in cucurbitaceous vegetable crops (Robinson and Walters, 1999). Development of hybrids in any crop is expensive (Behera, 2004). However, the utilisation of gynoecy is economical and easier for exploiting hybrid vigour in many cucurbitaceous crops.

Conclusion

The reduction in sex ratio, stabilizing the gynoecious character and development of stable gynoecious inbred parents is the main objective of cucurbit breeding programs. A unique opportunity for the study of the physiological genetics of sex expression exists with the development of isogenic lines differing only in the genes or alleles that control sex expression. Inspire new applications and research into mechanisms underlying the development, function, and evolution of cucumber sex determination and floral morphogenesis.

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E-Nose and its Applications: Classification of the Food Quality

Article ID: 10571

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Introduction

A meal is an important part in the daily routine of each and every human and live animal. All living organisms are able to do any work because the energy which is produced by the consumed food only is utilized for the purpose. Whatever we consume through breakfast, lunch or dinner, it supplies nutritional support to our body. In our daily foodstuff a large variety of food are available e.g., drinks- milk, water, juice, some soft drinks or cold drinks and solid food- vegetables, fruits, meat, seafood, chicken, eggs, nuts, cheese, grains and beans and so many which provide us the vitamins, nutrients, proteins, fats or carbohydrates to simulate the growth of our body and its maintenance. Because the food is our life and is necessary to maintain the life, the poisonous or spoiled or expired food is harmful or dangerous to our health. Many health hazards (such as weakness, diarrhea, abdominal cramps, mild fever, vomiting, nausea, loss of appetite or headaches etc.) are created by the food poisoning or by consuming toxic or spoiled food. Sometimes the food poisoning can be a very serious issue indicating: difficulty in seeing or speaking, fever higher than 101.5°F, symptoms of severe dehydration (like dry mouth or passing little to no urine or difficulty keeping fluids down, etc.) and diarrhea persisting for more than 3-4 days, etc. Hence healthy food is necessary to our body growth and maintenance.

Review of E-Nose

In the past decade, a lot of techniques are used for the determination of the quality and freshness of food like electronic nose, electronic tongue and image processing, etc. In this field, E-nose and wireless e-nose are the interesting and new techniques introduced for the detection of healthy fruits and vegetables. Electronic nose with wireless data transmission has tremendous advantages over wired electronic nose.

Electronic nose is an instrument consisting of a gas sensor array with fractional specificity and an appropriate pattern recognition arrangement that is able to aware of the single and or multifaceted odors. In environmental systems, an electronic nose uses an array of sensors with partial overlapping sensitivities to classify and recognize the odors. In general, it is composed of a variety of coordinating devices such as gas sensors array, data acquisition system and a pattern recognition algorithm with appropriate arrangements with respect to the application in hand and its implementation. The role of the sampling system is to collect and convey the volatile signal from the sample to the sensors and then to restore previous conditions by means of a cleaning procedure. The interaction between the sensors and odors is the first fundamental step of the data acquisition process, since its execution influences all the successive steps.

Design and Development of E-Nose

E-Nose with wired system is applicable where the monitoring section and fruit/vegetable (samples chamber) section are at the same place, whereas the wireless electronic nose (WEN) is the development for those users which are not at the monitoring section i.e., the user interfacing segment and the fruit section are at different places. The hardware of wired electronic nose and WEN system are divided in to two sections; one is a sensor array with fruits/vegetables chamber (sensor node) and another one is user interfacing section (or coordinator node). Sensor node is the actual section of the sample monitoring (or fruits and vegetable section) and while coordinator node is the observer section where the sensors data have been represented. An electronic nose using wired connections is shown in figure 1.

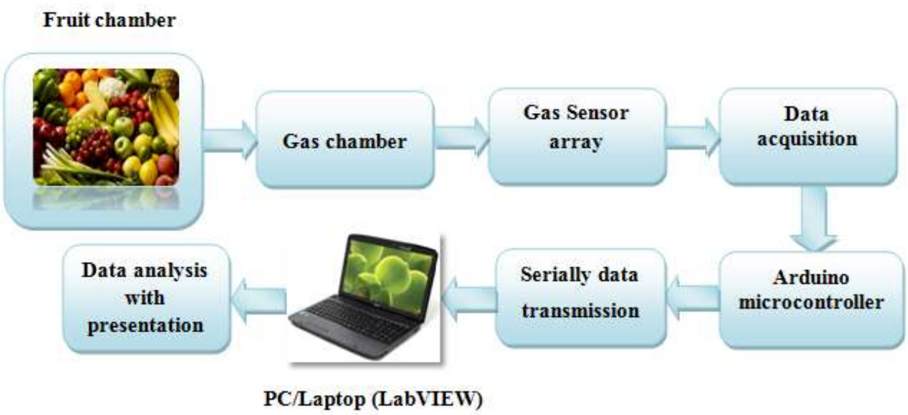

Fig. 1. Development of an electronic nose with wired connection

The wired electronic nose is divided into two parts; Part 1 and Part 2. Part 1 is hardware part includes two chambers (i.e., fruit/gas chamber and sensor array chamber), gas sensor array and measurement circuit design and PCB design, whereas part 2 includes data acquisition and data transmission (Data analysis (PC/Laptop) using software.

Fig. 2. Data Collection and Training for Papaya using E-Nose

We have selected three different papayas: unriped, riped and over riped (spoiled) for the testing of developed e-nose. Papaya is a climacteric fruit. botanically it is classified in to berry in fleshy category. Rate of ripening process of papaya is faster than the banana. When it is wrapped up (or covered) by a paper, the rate of ripening process increases. It emits ethylene gas and VOC during ripening process continuously after harvesting. All the steps under testing and measurements were repeated for these three papayas. Gathered data were sorted out for the analysis and displayed using appropriate methods.

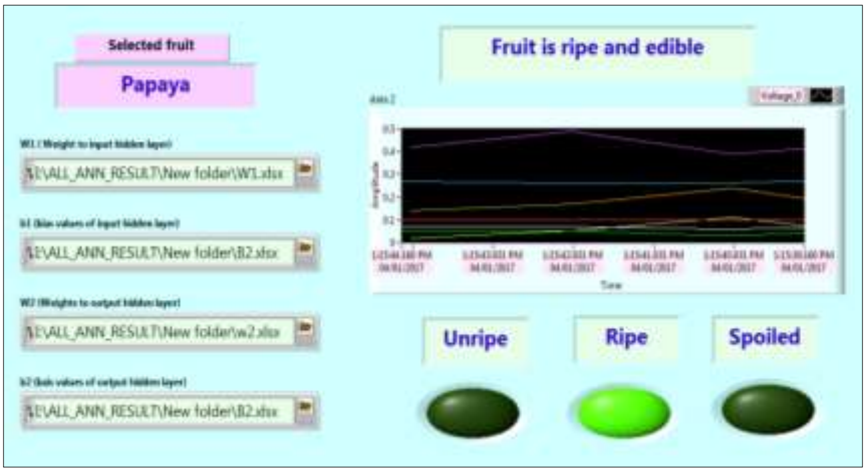

Fig. 3. Interfacing window of LabVIEW software

Graphical representation of the present system and the interfacing window of the e-nose development is shown in the figure 3. Figure shows status of the given sample (i.e., Ripe and fresh Papaya) on the indicator form and graphical form. Also, the text of the state is displayed on the front panel (i.e., output of the system).

Conclusion

The developed system has successfully demonstrated all the tasks which are expected and are predicted. Hence the system is capable of classifying and identifying the given samples. The system can be implemented for all the types of samples (fruits and vegetables) with a little change and training. The classifications of the fruits and vegetables, quality and freshness of the vegetables, ripening stages of the fruits are successfully studied and demonstrated using an electronic nose.

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Utility of Heckman's Selection Model in Farmers' Decision Making

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Summary

Heckman's sample selection model is considered as one of the most significant econometric models designed for eliminating the self-selection bias arises due to non-random variables in the sample. He emphasized the modeling of the dummy endogenous variables as well as developing two-stage procedure by using the least square regression method. This article focuses on the utility of Heckman's two-stage multinomial probit model to the farming community. Two-stage probit model enables the optimum decision making of the farmers to enhance their net income levels and ultimately imparts socio-economic development to the farming community as a whole.

Introduction

Farmers in all the sectors very often face the dilemma mostly in the decision-making process i.e., whether to follow a practice or not; if follows, what may be the consequences? One of the most important decision-making stage faced by the farmers is related to the choice of most profitable marketing channel among the available alternatives. The basic problem underlying sample selection process is when it makes the sample unrepresentative of the true population which generates biased estimates against the standard Ordinary Least Square (OLS) regression. To overcome this problem of self-selection bias, Heckman has proposed a two-step Limited Information Maximum Likelihood (LIML) method (Heckman, 1979). Multinomial probit method is most commonly followed for this estimation, where predicted probabilities for choosing modern marketing channels is used for calculating a correction term, which is known as Inverse Mills Ratio (IMR).

Heckman's Two-Stage Probit Model

Two equations are involved in two stage probit model: 1) the selection equation (where outcome is observed in a portion of the sample) and 2) the regression equation (to determine the outcome variable) (Ketema et al., 2016). To put this model in context, we can put forward one example of decision making by the dairy farmers for selecting the best marketing channel. In first stage, the factors influencing the choice of milk marketing channel by the dairy farmers are determined and in second stage, the impact of milk channelization through modern marketing chains on the net income level of farmers can be analyzed (Kumar et al., 2011).

a. Factors influencing the choice of modern marketing channel: The choice of dairy farmer to sell milk through modern marketing chain can be modeled as:

$\alpha ij = \beta jXij + \varepsilon ij,\ \varepsilon ij\sim\ (0,1)$

where,

αij is the latent variable i.e. choice of farmer for milk marketing channel (j = 1 for modern marketing channel) of the i^th farmer

$\alpha = 1$, if $\alpha ij > 0$ i.e. farmers are selecting modern marketing channels

$\alpha = 0$, if $\alpha ij \leq 0$ i.e. farmers are selecting traditional marketing channels

βj is the vector of parameters to be estimated

εij is the random error

Xij is the independent variables affecting the decision

Some of the factors like age, education and experience of the farmer, number of animals holding of the farmer, price of milk and distance travelled by the farmer for disposal of milk can be responsible for affecting the selection of modern milk marketing channels. The marginal effects obtained during this stage can be interpreted as the probability of their effects on the farmer's decision to select modern marketing sector for his/her milk disposal (Kumar and Staal, 2010).

b. Impact of milk disposal through modern sector on net income level: In this stage, impacts of milk marketing through modern channels i.e., αij on the net income level of farmers can be studied. The IMR obtained from the first stage enters as a regressor in the second stage for controlling sample selection bias. The coefficients of the variables impacting the net income level can be estimated by Ordinary Least Square (OLS) method (Kuma et al., 2014).

The impact equation can be modeled as:

$Yi = \beta iXi + ui \sim (0,\delta 2)$

where,

Yi is the observed dependent variable i.e. the net income level of farmers preferring modern marketing channel

Xi is the explanatory variable hypothesized to affect net income level of farmers

βi is the coefficients of explanatory variables

ui is the random errors with zero mean and constant variance

Conclusion

Heckman's selection model is considered as a potentially useful tool to test and correct the self-selection bias created by non-random samples in the outcome variable. This model can be used to overcome the biasness from the samples as well as to recommend the correct decision to the farmers. Farmers must be encouraged to take correct decisions as per the recommendations from this Heckman's tool which will ultimately help to increase the remuneration and standard of living of the farm families.

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Impact of Moisture and Storage on Seed Quality Enhancement with Special Reference to Rapeseed Mustard

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Introduction

The word "rape" comes from the latin word "rapum", means 'turnip'. On the other hand, the word 'mustard' is derived from latin word "mustum" or "must", which denotes 'expressed juice of grapes and "ardens" means "hot and burning". From the biological point of view, rapeseed and mustard belongs to the family cruciferae which comes under the genus Brassica with large number of species and subspecies cultivated in India. Rapeseed mustard has been considered as the most essential oilseed crops followed by groundnut contributing around 25% of the total oilseeds production. Cultivation of Indian mustard which is commonly known as Rai has occupied around 85-90% of the total area cultivation of rapeseed mustard. In terms of ensuring better germination with better yield, enhancement of quality seeds is essential.

Although seed quality is governed by genetic make-up, but deterioration of quality seeds occurs during storage period. According to the reports of Kurdikeri et al (1994), quality of seeds remains superior at the time of physiological maturity which gradually deteriorates with the course of time. In the year 1983, Narian and Khosla concluded that deterioration in quality of the oilseed crops that occurs during storage is mainly due to the use of traditional storage containers, which lacked moisture proof and had no potential to protect the stored grains from insect attacks. Deterioration in seed quality is due to the poor storage conditions which ultimately results in the loss of viability. Due to the increase in storage temperature and moisture content, longevity of seed decreases. Some of the major factors which encourages rate of deterioration in seed quality mainly includes temperature, relative humidity, seed moisture content and storage container (Usberti et al 1998). Apart from it, there are some types of containers which regulate temperature, relative humidity and seed moisture contents. Rate of germination capacity is the key constraint of seed deterioration.

Effect of Moisture Content During Seed Storage

From the seed technological point of view, seeds are considered as highly hygroscopic living materials due to its potential of absorbing moisture from air if it is stored in an environment where relative humidity is higher than seed moisture content. Gorechi (1982) stated that loss of viability and vigour was more in seeds in which it was stored in a condition of high relative humidity as compared to that stored in dry air. Reduction in planting value of seeds as well as an enhancement in seed deterioration is due to the presence of higher moisture content in seeds. Paricha and his co-workers in the year 1977 concluded that viability of seed decreased with increasing relative humidity and storage time.

An example of types of containers affecting its moisture absorbance and seed quality during storage of seeds has been clearly mentioned. When seeds are stored in gunny bags, rate of moisture absorbance is higher since the gunny bag is not an air tight container and due to this reason, deterioration in quality of seeds is higher in gunny bags. Such results are in agreement with the reports of Copeland (1976) who reported that storing of seeds in gunny bags and other local storage environment may influence to increase moisture and deteriorate seed quality. On the other hand, tin and polythene bags are moisture proof materials. Hence rate of moisture absorbance is lower in air tight polythene bags.

Storage

Before storage of rapeseed mustard seeds, it is essential to clean it properly and remove plant foliage and stems which helps in heating and development of carbon dioxide thereby leading to deterioration of quality in seed mass. Hence, the mustard-rapeseed should be stored under low moisture content of around 8 per cent and temperature at 25-degree Celsius. Here in figure 1 (a) and (b) shows the harvesting and sun drying of mustard seeds. Seed ageing during storage is an inevitable phenomenon, but the degree and speed of decline in seed quality depends strongly, beside storage conditions, on plant species stored and initial seed quality (Balesevic et al 2005). Tien and his coworkers in the year 2008 reported that exposure of seed lots at higher temperature and higher relative humidity which is commonly known as accelerated ageing of seeds results in loss of vigor and viability which is considered to be an appropriate method for determination of changes in vigor during storage.

Fig.1 Crops harvested after attaining a maturity stage of 120 days and left in the field for 3-4 days for sun drying

Requirements for Safe Seed Storage

While storing of oilseed crop such as rapeseed mustard, following requirements are essential.

Godown Selection

The bags of mustard seeds should be stored in a well-protected area which is free from moisture, excessive heat, insects and rodents. Go-down should be constructed on a well-built platform of a height of 1 ft. from ground level to prevent soil moisture and dampness. Sufficient height should be provided for the roof of the go-down in order to maintain a space between the mustard seed stacks and the roofs for keeping minimum possible temperature. There should be sufficient space provided in between the stacks for proper air circulation in storage.

Cleaning and Sanitation of Godown

For safe storage, grains of previous years or the left-over grains should be thoroughly cleaned in order to avoid infestation and contamination of the new stock. Walls of go-down should be painted with coal tar or whitewashing can also be done up-to a height of 1 ½ meter. For sanitation, go-down should be sprayed with Malathion or DDVP. Apart from it, in order to fill up some cracks and crevices of go-downs, proper care has to be taken timely in order to act as a barrier to avoid crawling infestation.

Separation on Storage of Old and New Stacks

For preventing the occurrence of crawling infestation as well as for further maintaining hygienic conditions of go-down, stacks of oilseeds specifically rapeseed mustard has to be kept and stored separately.

Sanitization and Cleaning of Bags

Before storage of oilseeds, fumigation of old and new bags should be done with the help of Aluminum Phosphide. Storage of seeds should be practiced in new gunny bags which are free of moisture and dirt, while on the other hand, if storing of seeds is done in old gunny bags, it has to be properly cleaned and dried in sun before storage.

Drying and Cleaning of Seeds

For enhancing the quality of seeds as well as for safer storage, seeds of rapeseed mustard should be properly cleaned and dried to further prevent from dust, dirt particles and moisture content.

Use of Dunnage

Since the floor of the go-downs have the capacity of absorbing moisture, bags of oilseeds should not be stored directly on the floor of the go-down as there is a provision of arrangements of wooden crates or bamboo mats along with a cover of polythene sheets. Otherwise, the bottom layer of oilseed bags of the stack may be damaged by absorbing moistures from the floor.

Aeration of Godowns

The stacks of the godown have to be aerated regularly in order to maintain the quality of stocks. Therefore, it is advised to provide proper aeration during sunny days but care has to be taken to avoid aeration during rainy days.

Regular Inspection of Stocks

In order to maintain health and hygiene of the stocks, regular inspections at an interval of 15 days is essential.

Earthen Pots

Earthen pots are generally used by the farmers at rural areas made up of un-burnt clay mixture with straw or cowdung mixture, mud and bricks and are cylindrical in shape.

Bamboo Baskets

Rapeseed mustard producers in villages prepare baskets from bamboo in smaller quantity for safe seed storage.

Gunny Bags

In India, producers, traders, processors, packers etc use bags made up of jute which are being widely used for storing seeds in larger quantities.

Circular Steel Bins

Commonly known as Anaj Kothi is built up by compiling 4-6 pieces of corrugated or plain metal sheets which can be conveniently used for storing smaller quantities of rapeseed mustard up to 3 tonnes as well as for preserving mustard seeds at domestic level.

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