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Soilless Farming

Article ID: 11300

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Introduction

Researchers discovered in the 19th century that plants absorb essential mineral nutrients as inorganic ions in water. In natural conditions, soil acts as a mineral nutrient reservoir but the soil itself is not essential to plant growth. When the mineral nutrients in the soil dissolve in water, plant roots are able to absorb them. When the required mineral nutrients are introduced into a plant's water supply artificially, soil is no longer required for the plant to thrive. Almost any terrestrial plant will grow with hydroponics. Hydroponics is also a standard technique in biology research and teaching.

Advantages

Some of the reasons why hydroponics is being adapted around the world for food production are the following:

1. No soil is needed.
2. The water stays in the system and can be reused - thus, lower water costs.
3. It is possible to control the nutrition levels in their entirety - thus, lower nutrition costs.
4. No nutrition pollution is released into the environment because of the controlled system.
5. Stable and high yields.
6. Pests and diseases are easier to get rid of than in soil because of the container's mobility.

Today, hydroponics is an established branch of agronomy. Progress has been rapid, and results obtained in various countries have proved it to be thoroughly practical and to have very definite advantages over conventional methods of horticulture. The two chief merits of the soil-less cultivation of plants are, first, hydroponics produces much higher crop yields, and, second, hydroponics can be used in places where in-ground agriculture or gardening is not possible.

Disadvantages

The hydroponic conditions (presence of fertilizer and high humidity) create an environment that stimulates salmonella growth. Other disadvantages include pathogen attacks such as damp-off due to Verticillium wilt caused by the high moisture levels associated with hydroponics and overwatering of soil-based plants. Also, many hydroponic plants require different fertilizers and containment systems.

Different Types of Techniques

Static solution culture: In static solution culture, plants are grown in containers of nutrient solution, such as glass Mason jars (typically, in-home applications), plastic buckets, tubs, or tanks.

Figure 1. Hydroponics

The solution is usually gently aerated but may be unaerated. A homemade system can be constructed from plastic food containers or glass canning jars with aeration provided by an aquarium pump, aquarium airline tubing and aquarium valves. The nutrient solution is changed either on a schedule, such as once per week, or when the concentration drops below a certain level as determined with an electrical conductivity meter. Whenever the solution is depleted below a certain level, either water or fresh nutrient solution is added (Figure 1).

Continuous-flow solution culture: In continuous-flow solution culture, the nutrient solution constantly flows past the roots. It is much easier to automate than the static solution culture because sampling and adjustments to the temperature and nutrient concentrations can be made in a large storage tank that has potential to serve thousands of plants. As a general guide, flow rates for each gully should be 1 liter per minute. At planting, rates may be half this and the upper limit of
2 L/min appears about the maximum.

Aeroponics: Aeroponics is a system wherein roots are continuously or discontinuously kept in an environment saturated with fine drops (a mist or aerosol) of nutrient solution. The method requires no substrate and entails growing plants with their roots suspended in a deep air or growth chamber with the roots periodically wetted with a fine mist of atomized nutrients. Excellent aeration is the main advantage of aeroponics.

Medium: One of the most obvious decisions hydroponic farmers have to make is which medium they should use. Different media are appropriate for different growing techniques (Figure 2). The most popularly used medium are peat, calcined clay, rock wool, coconut fiber (coir dust), pine bark, perlite, pumice, saw dust, vermiculite, rice hulls, sand, gravel and wood shaving.

Figure 2. Soilless agriculture (Courtesy: Image via Garden Design Plus)

Conclusion

Soilless culture system is one of the most common method of production technique. It will result in higher yields, even when the conditions are not conducive for production. Many organic and inorganic soilless media was used to improve growth and yield. The selection soilless culture system is based on crop productivity, usage life and cost economics.

Pathogen Population Genetics and Breeding for Disease Resistance in Plants

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What is the Population Genetics?

The objective of the population genetics describes the genetic variation of the population, quantify and use this variation to infer the evolutionary process that affects the population (Hartl and Clark, 1997, Hedrick, 1985). The evolutionary forces such as mutations, migration, genetic drift, selection and recombination change gene frequencies in populations and shape their genetic structure. Population geneticists focus on genetic variations and evolutionary processes below the species level (microevolution), but the distinction between population genetics and systematics (macroevolution) is not always clear. The genetics of the population applied to the plant pathogens has a considerable promise to understand the evolutionary force to control pathogens, and this knowledge can be used to improve disease management (Burdon, 1993).

Virulence Variation in Pathogen Populations

Plant pathologists and plant breeders have long understood the importance of pathogen variation to the effectiveness and durability of host resistance. The type of pathogen can interact with a specific host genotype leading to a "break down" resistance in a very short period (Brown, 1995). Detection of pathogen variation has traditionally relied upon the identification of virulence variation (races) in the pathogen population by inoculating a sample of pathogen isolates on a series of hosts with defined resistance genes (differentials) and observing the resulting compatible or incompatible disease phenotype. This approach to monitoring pathogen populations has been tremendously valuable in the development and deployment of host resistance (Andrivon and De Vallavieille-Pope, 1993, Roelfs, 1985, Wolfe and Limpert, 1987), and has provided important insights into the evolution of pathogen populations in response to selection by host resistance genes (Andrivon and De Vallavieille-Pope, 1993, Kolmer, 1989, Wolfe and McDermott, 1994). Pathotype monitoring is still used extensively in many pathosystems today and continues to provide timely information about the structure of pathogen populations that is relevant to breeding programs and resistance deployment.

Pathogen Population Genetics and Resistance Breeding

This opinion hopes to identify various key areas of genetic studies of the pathogenic population that may have an immediate impact on the resistance breeding. It is necessary to focus on the population of pathogens in order to obtain a better understanding of pathogenic variation related to close collaboration between plant breeding and plant pathology. The author's research experience is limited to pathogenic fungi. This review will therefore be focused on fungal pathogens. However, the concepts described here are also applicable to pathogenic bacteria, nematodes and viruses, and we plan to increase the interest in genetic studies of the population on these pathogens. Below we have confirmed some major issues on the pathogen to solve successful resistance breeding programs. We try to enlighten some of these quetions with in-depth explorations of two pathosystems where pathogen population genetics is already making an impact on resistance breeding. A similar approach will be pursued with other pathosystems, and a stricter integration of pathology and breeding will result in more efficient and durable disease control in the future.

How about the Genetic Variability of the Pathogenic Population Distributed in Space?

The pathogenic geographical distribution of the genotype is an important consideration for screening for the resistance of the breeding program. Pathogenopathy is often geographically under structured, which can only be found by in-depth sampling and the application of appropriate genetic markers. The effects and durability of the resistance of the host can be predicted with a thorough knowledge of pathogen population structure.

Are Early-Generation Resistant Plants Exposed to All Potential Variation in the Pathogen?

Screening of resistant germplasm often occurs in only one location (i.e., a screening nursery) and/or plants are often inoculated with only a limited number of pathogen genotypes. It is essential to know if the pathogen population at the screening site is representative of variation in the pathogen population once the resistant plants are deployed. For controlled inoculation studies, it is important to expose resistant plants to all potential variation in the pathogen population. This may involve inoculating a much larger number of pathogen genotypes than is currently used in many breeding programs.

How is Genetic Variation in Pathogen Populations Distributed in Time?

The composition of pathogen populations can change through time and this can also be an important consideration for breeding programs. The complete replacement of one dominant genotype by another has occurred recently with late blight (*Phytophthora infestans* on potato and tomato) and these sorts of changes must be taken into consideration in designing resistance screening programs. Pathogen populations should be monitored on a regular basis to determine if new genotypes have been introduced into a region and whether frequencies of certain pathogen genotypes change over time.

Is there Evidence for Pathogen Genotype by Host Genotype Interactions?

The existence of pathogen genotype by host genotype interactions can have a profound impact on the rate at which pathogens evolve increased virulence on host plants and the durability of resistance. Resistance that is specific for particular pathogen genotypes (races) is termed race-specific resistance. Resistance which is effective against a large number of pathogen genotypes (i.e., lack of interactions) is known as non-race specific resistance or partial resistance. It is thought that partial resistance may be more durable than race-specific resistance because pathogens are less likely to evolve the ability to overcome partial resistance.

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By-Product Utilization - A Boon in Fish Post-Harvest Technology

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Introduction

Micronutrients are abundant in fish. Despite the high quantities of nutrients, notably micronutrients, found in the head and bones of large fish, they are eliminated during fish processing. Malnutrition is reduced by using fish by-products to make a low-cost, high-quality meal. Instead of abandoning nutrient-dense fish by-products, they are processed for human use. They're high in vitamins A, D, and B12 and minerals like calcium, phosphorus, iron, zinc, selenium, and iodine. They're also high in high-quality proteins and lipids, including long-chain omega-3 fatty acids.

Fish Liver Oil

Fish liver oil is important by-product produced from fish. During the cleaning and dressing of fish, the liver is the part of offal discard, and it is the rich source of glycogen, fat and vitamin A and vitamin D. The ability of certain fish livers like Cod, Shark, Ray, Halibut, and Tuna to provide highly therapeutic liver oil has made them extremely valuable commercially. The composition of fish liver oil is 20% to 36% of water content, 5% to 10% of protein and 55% to 75% of fat mostly unsaturated fatty acids than saturated which carries a high concentration of Vitamins A and D.

This fish liver oil mainly used for burning purposes or making lights in curing yards by fishers, cure or prevent the occurrence of disease caused by vitamins A and D deficiency such as rickets, xeropthalmia, impaired vision and eye defects, abnormalities of skin, mucous membranes and vertebrae, improve the growth of bones and teeth, Good quality soaps production, leather curing, preparation of animal and poultry feeds, mordant in the dyeing of synthetic fibres and wetting and an anti-bloom agent in the chocolate industry.

Fish Body Oil

Fish body oil is obtained from the entire body of fishes like Herring, Sardine, Salmon, Mackerel, Anchovy, etc., and offal and other waste discards. A high amount of body oil derived from fatty fishes like sardine than non-fatty fishes. Generally, to produce 0.5 kg of fish body oil, it required 5 kg of fish. Fish body oil varies with species, sex, size and maturity and location of catch. Fish body oil is lacking in vitamins A and D and considerably differs from fish liver oil.

The fish body oil mainly used for edible purposes, manufacturing paints, varnishes, laundry soap, cheaper grade toilet soaps, insecticidal soap, cosmetics, lubricants, candles, cutting oils printing inks, water-proofer preparations, plastics, dressing of leather and tanning of the skin, medicinal purposes, preparation of animal and poultry feed, and also used for coating the surface of boats for longer preservation.

Fish Meal

Fish meal is the most important by-product prepared after the extraction of liver and body oil. It has a high nutritive value and an excellent supplement material for poultry and animal feed production. The nutritional value depends on the raw material, landing season and preparation procedure. It has 6-12% of moisture content, 55-70% of protein, 2-15% of fat, 10-20% of minerals and rich in vitamins such as A, B, B_{12}, D, K and E. Fish meal is used for the preparation of excellent poultry and animal feed. Rich source of calcium, phosphorus, iodine and vitamins, it promotes building of tissue and bone.

Fish Manure and Guano

Fish manure and guano are of a lower grade of fish meal. It is unfit for ingestion by animals. Fish manure is a waste product of curing yards, fish glue factories, and oil extraction companies that use rubbish or damaged fish. Fish manure is made from spoiled and unfit for consumption fish such as mackerel, horse mackerel, sardine, etc. The highest content of nitrogen (5-7%), phosphates (4-6%) and lime (1-5%) in fish manure used for the culture of crops such as coffee, tea and tobacco. Fish guano is a by-product of body oil extraction containing a high level of nitrogen (8-10%) and phosphoric acid.

Fish Flour

Fish flour is a high-quality fish meal made under tight supervision and care and an excellent protein supplement for people of all ages, even infants as young as three months old. Fish flour is treated with petroleum for the removal of fat and increasing quality.

It is an essential protein source in supplement diet for both adults and infants, enriching bakery products (bread, biscuits, cakes, soup), suitable for convalescing patients struck with malnutrition, anaemia, etc.

Fish Silage

Fish silage is a liquid/semi-solid fish meal with a high nutritive value used for animal feed directly also used as an ingredient. It is obtained by adding an acid (3-4%), generally formic acid, sulphuric, and propionic acid, to a minced meat and fermentation (lactic acid bacteria in molasses).

The benefit of fish silage over a fish meal is that the vitamins are essentially unaltered, and the product has no fishy odour. It is favoured in temperate regions (Norway, Denmark, etc.) over tropical countries for cultivation.

Fish Soluble

Fish soluble is the residual part of the liquid from fish oil extraction. They are generally used as additives in animal feed preparation because of their high protein and vitamin B-complex source with 50% water content, 33.9% of protein, 2.6% fat, and 9.4% of Ash.

Fish Sausage and Ham

Fish sausage is made by stuffing minced fish meat inside a prepared intestine or other casing. On the other hand, Fish ham combines pasted fish meat with tiny bits of solid fish meat (one square cm). Spices and additives are used to prepare and store to improve the taste, flavour, and shelf life. Salt, sugar, chillies, onion, coriander, glutamate, egg white, hydrogenated vegetable oil, and other spices are used. Antiseptics and antioxidants are used as additives to prevent rancidity. It is also possible to use colouring agents. These goods are manufactured commercially in Japan, Russia, and the United States and are made from less valuable waste fish.

Fish Macaroni

Macaroni is a type of dried, hollow tube pasta made from wheat flour. *Puntius carnaticus* fish macaroni is a product made from the fish *Puntius carnaticus*. The fish is diced first, then combined in equal portions with tapioca or sorghum flour. After that, it is seasoned with salt, chillies, and tamarind. Extrusion and drying of the finished product (paste).

Fish Biscuits

Fish biscuits are manufactured by adding minced fish meat added in biscuit mixture before baking, mainly in Chile and Morocco.

Fish Glue

Fish glue is a good adhesive made by trimming the bones and skin of fishes such as cod, pollack, and hake. Streaking the backs of glued stamps and labels, photo-engraving, ann adhesive for paper boxes and shoes are common uses.

Isinglass

Isinglass is obtained from the air-bladder or swim bladder of fishes like sturgeons, carps and catfishes. It is a gelatin-like material. The isinglass is used to clarify wine, beer and vinegar, preparing special grade cement and plaster.

Fish Skin

The dried and spiny fish skin used for making war helmets. For the production of lanterns, the dried fish skins used in Japan. Then the larger fish skins like cod, halibut, shark, and rays are tanned and marketed as ornamental leather and can be dyed in different colours and also, shark fish leather is used for making shoes, wallets, bags and tobacco pouches. Shagreen is a product prepared from dried fish skin used for making purse and jewel box.

Artificial Pearls

Artificial pearls have been created using the silvery scales of European cyprinids. A glossy pigment is obtained by scraping the scales. After that, it is coated inside and shaped into hollow glass beads. After that, the beads are filled with wax.

Fish Fins

Except for the shark's caudal fin, the fins are cut, washed, mixed with wood ashes, lime and dried under sunshade or smoked. In China and the Philippines, the cured product is crisp and brittle and used in soups.

Fish Roe and Fish Caviar

Roe is a mass of eggs or spawns from a variety of fishes that is eaten. The protein in roe is tasteless, with a digestibility coefficient of 81 percent and a biological value of 88 percent, respectively. Roe fat is distinguished by high levels of lecithin (59%) and cholesterol (14 percent). Vitamin B is abundant in roe. Vitamins C, E, and D are also present. Caviar is the roe of any large fish that has been prepared and salted. Sturgeon caviar is highly regarded as a delectable delicacy that may be served as an appetizer.

Medicinal Products

Insulin is abundant in the pancreas of sharks and whales that catties as a source of raw material for insulin. Sciaenids' huge otoliths are taken from the head and rubbed and mixed with water before being administered to convalescent youngsters with rickets. *Amphipnous cuchia* mucus is used as a highly therapeutic for persons who have impotence. The species such as *Clarias batrachus, Heteropneustes fossilis,* and Channa sp. are live fish valued for their strong nutritional and therapeutic characteristics. *Sillago sihama* is thought to be nutritious and beneficial for nursing moms.

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Vegetable Seed Production for Small Scale Farmers

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Introduction

Quality seed is a key component for successful vegetable production. A good seed ensures better germination that results in a good crop stand with increased yield and purity. Since age long, there has been a common tradition of saving a portion of the produce as seed for the next cropping season in Indian farming. As the population of India is increasing at an alarming rate, it is an utmost need to increase the production and productivity per unit area. This can be achieved through quality seed availability at reasonable rate, especially of the hybrids.

Principles of Vegetable Seed Production

1. Isolation distance: To produce genetically pure seeds, the field should be separated from other varieties of the same crop, same family, cultivated species and wild species. The isolation distance can be achieved by following ways:

> **a. Time isolation:** It is applicable where land is a constraint. It allows seed production of different varieties of the same crop in the same field in a year. For example, seed production of early, mid and late maturing cauliflower varieties can be isolated by time.
>
> **b. Distance isolation:** The isolation distance of self-pollinated varieties is lesser than the cross-pollinated crops. In cross pollinated crops, it depends on direction of wind and insect flight.

2. Selection of season and site: For successful seed production, the crop should be grown such that dry season prevails at the maturity time. The locations are also important for quality seed production as different crops perform well under different climatic conditions. For example, Nandyal valley of Andhra Pradesh is suitable for cucumber seed production and Kufri hill of Shimla is the main area of potato seed production.

3. Roguing: Generally, self-pollinated vegetable crops exhibit more uniform and stable growth than the cross-pollinated vegetable crops. The off-types are to be removed to maintain genetic purity of the crops. The different stages of rouging are as follows-

> **a. Before flowering:** Plants having different morphological characters like plant height, foliage morphology, colour etc. should be removed from seed production fields.
>
> **b. At flowering:** To prevent mixing of varieties of the same crop, rouging is done on the basis of curd maturity in cauliflower, sex expression in cucurbits and flower initiation time in Solanaceous crops.
>
> **c. At fruit development:** On the basis of true to type characteristics of developing fruits like fruit shape, ripening colour, size etc., the off-types should be removed.
>
> **d. At maturity:** Late maturing plants in case of early maturing varieties and vice versa should be rouged off immediately.

4. Threshing and Seed extraction: Threshing can be done manually or by machines. Proper cleaning should be done to avoid admixtures. Seeds can be extracted from dry fruits or from fruits when the seeds are wet.

5. Purity testing and certification: The genetic purity of the hybrids can be tested through Grow Out Trails (GOTs) and biochemical markers. In GOT, morphological traits of the plants grown from test sample are compared with the pants grown from genuine sample. Commercially, the SSR (Simple Sequence Repeat) markers are generally used for purity testing in vegetables like cauliflower (Zhao et al., 2011), capsicum (Mongkolporn et al., 2004), tomato (Liu et al., 2007) and artichoke (Bianco et al., 2011).

A seed certification agency inspects the field and seed standards like isolation distance, disease and insect incidence percentage, purity percentage, germination percentage etc. for successful accomplishment of the certification.

Method of Hybrid Seed Production in Vegetable Crops

Sl. No.	Method	Crops
1	Hand emasculation + hand pollination	Tomato, Okra, Chilli, Brinjal
2	Pinching of staminate flowers + hand pollination	Pumpkin, Bottle gourd, Bitter gourd
3	Removal of staminate flowers + emasculation + hand pollination	Watermelon, Musk melon
4	Functional male sterility + hand pollination	Tomato, Brinjal
5	Genetic male sterility + bee pollination	Chilli
6	Cytoplasmic male sterility + natural pollination	Capsicum, Carrot, Radish, Cabbage, Onion
7	Self-incompatibility + natural pollination	Broccoli, Cauliflower
8	Gynoecium + natural pollination	Cucumber, Bitter gourd
9	Plant Growth regulator + natural pollination	Squash
10	Detasseling + hand pollination	Sweet corn, Baby corn

Source: Singh and Tomar, 2015

Conclusion

The major reasons for lower vegetable productivity in our country are due to limited availability of quality seed and high price of the hybrid seeds. Currently, the private seed companies are growing fast thereby creating a 60:40 ratio between the private and public sector seed industry. Therefore, it is the utmost need of the hour that farmers should produce their own seed to combat the high cost of seeds and also to emerge as seed entrepreneurs.

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Semi Intensive Backyard Poultry Farming: Powerful Tool for Alleviation of Rural Poverty

Article ID: 11304

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Backyard poultry farming is mostly popular in rural and resource-poor areas of India and provides rural families with income, nutritionally rich food sources (meat and eggs), boosts up women and unemployed youth, and reduces the gap between demand and supply of poultry eggs and meat. There is hardly any requirement of infrastructure setup for backyard poultry farming and it can be easily handled by women, aged family members and children. Poultry eggs and meat are the best and cheapest sources of protein, which are easily available to meet the requirement of protein for rural Indian people. Major constraints of backyard poultry farming in India are high mortality rate in young chicks due to a combination of diseases, lack of infrastructure, and low production performance of desi birds, lack of scientific knowledge, predation, malnutrition, climatic exposure and feed price fluctuations throughout year. In order to overcome these constraints, there is a need of introducing improved varieties of poultry suitable for backyard farming, scientific skill development of farmers on feeding, housing and disease prevention as well as management.

What Sets Indigenous Birds Apart?

1. Superior adaptability to their habitat and ability to survive can reproduce with low nutrition under sub-optimal management.
2. Require fewer inputs as they scavenge and are raised with little veterinary care.
3. Exhibit broodiness and hatch their own eggs.
4. Their eggs and meat are preferred and fetch a premium price compared to commercial farm-bred chickens.
5. Can protect themselves from predators.
6. A reservoir of superior genes.
7. Act as insurance for the poor during difficult times.

Improved Backyard Poultry

Given some of the limitations of indigenous backyard poultry breeds, research organizations and private institutions have developed improved varieties of birds for meat, eggs or dual purpose. Improved varieties lay more eggs, gain greater body weight, have attractive plumage, involve low input costs, have high disease resistance, a better survival rate and lay large brown eggs resembling desi eggs. However, desi hens can be used for brooding eggs of improved bird varieties. The improved layer varieties have the potential to produce 140-170 eggs in a laying year under free range conditions and 160-200 eggs under organized farm conditions. The birds weigh on average 2.5-3.5 kg in males and 1.5-2.0 kg in females. A few improved egg purpose varieties developed in India are discussed.

Improved Dual-Purpose Varieties for Backyard Poultry Production

Varieties developed for meat have the potential to gain 1.4-1.6 kg weight in eight weeks under semi-intensive conditions while dual-purpose varieties may gain only 1.2-1.4 kg during the same period. The body weight of these varieties depends on the quality and quantity of feed and management practices followed. Recently, broiler breed Raja II was developed under AICRP at Veterinary College, Bengaluru, (KVAFSU) with ICAR support. It has plumage similar to backyard rural varieties and gains a weight of 1.6-1.8 kg with feed efficiency of 1.6 in six weeks. However, improved varieties developed for meat and dual purposes cannot fly owing to their weight and are susceptible to predators. They also require more feed supplement to meet their nutritional requirements.

Management of Improved Varieties of Backyard Poultry

Backyard poultry can be reared for egg production in small numbers (10-20) under free range conditions if optimum natural feed resources are available. However, if the local demand is for meat, birds can be reared in larger numbers under intensive/semi-intensive conditions by providing inputs similar to those given to commercial broilers. Consequently, they need to be reared under proper brooding/nursery management up to six weeks, after which they may be released under a free range or scavenging system.

Brooding / Nursery Management (Up to Six Weeks)

1. Brooding care of chicks ensures constant body temperature and protection from predators.
2. The brooder house floor must have a uniform 1-2 inch spread of clean litter like sawdust, paddy husk, rice husk, coconut husk, etc.
3. Litter absorbs moisture from poultry droppings and provides warmth in winter and coolness in summer.
4. Rake the litter frequently and treat it with slaked lime to avoid caking. Remove moist litter and replace it with fresh litter.
5. Spread newspapers on the litter to prevent chicks from feeding on it till they are accustomed to differentiate litter from feed.
6. Rear the chicks on standard chick starter ration.
7. Brooding can be natural or artificial; the former involves a broody hen and the latter may involve heat sources, reflectors, electric bulbs, etc.
8. Secure the brooding area with a brooder guard/ chick guard made of cardboard sheet, GI sheet, wire mesh, mats, etc to restrict bird movement close to the heat source.

Managing Adult Birds After Six Weeks

1. Let the birds free to forage/scavenge during the day; provide them shelter during night.
2. Provide clean drinking water before letting them out.
3. The preferred flock size is 12-15 birds per household depending on the area and natural food available.
4. Extra roosters can be reared separately and marketed for meat.
5. Night shelters should be well ventilated, have adequate light and protection from predators.

Constructing a Night Shelter

1. Use low cost and locally available materials like bamboo, wooden planks, polythene sheets, etc.
2. Build the shelter in a well-drained area a few inches above the ground to avoid dampness.
3. Provide adequate space per bird and avoid overcrowding.
4. For laying hens, dark, raised secure nests with clean nesting material should be available. Nests can be in the fenced area or in the shelter itself.
5. Dimensions for a 10-bird night shelter: 4 ft long x 3 ft wide x 3.5 ft high and 1.5-2 ft above the ground, with a slope 3.5 ft to 2.5 ft.
6. Drinker (waterer) and feeder must be in the front with nests or baskets at a back corner of the shelter.

Space Requirements for Chickens

Age (weeks)	Floor space (sq. ft)	Feeding space (cm)	Watering space (cm)
0-4	0.5	2.5	1.5
4-8	1.0	5.0	2.0
8-12	2.0	6.5	2.5

Feed Management

1. Should be reared on standard chick starter ration during the initial six weeks under nursery rearing or brooding.
2. In the second growing stage, besides the feed material available in free range, provide natural food or greens like waste grains, germinated seeds, mulberry leaves, azolla, drumstick leaves and subabul leaves (high protein sources).

3. Extra feed will depend on the free range available, intensity of vegetation, availability of waste grains, insects, etc.
4. A handful of grains or kitchen waste in the morning and evening can be given to supplement scavenging.
5. The scavenging feed base is very important for propagation of backyard birds. Soil type and cropping systems dominated by wheat, maize, rice, sugarcane and finger millet make up supplementary feed base.
6. Supplemental calcium sources like limestone powder, stone grit and shell grit at 4-5 gms per bird daily, especially during the laying phase, leads to a high rate of survival and good egg production.
7. Any feed of grain or household scrap should be given inside the shelter. When regularly provided in the evening, it will help train the birds to willingly enter the enclosure before nightfall.
8. A locally available feed formulation includes:
    a. 50% cereals (maize, sorghum, pearl millet, finger millet, broken rice).
    b. 28% bran (rice bran, wheat bran, deoiled rice bran).
    c. 20% meal/oil cakes (soybean meal, groundnut meal, sunflower meal, linseed cake, etc.).
    d. 2% additives (vitamin and mineral mixture).

Importance of Fresh Drinking Water

1. Access to fresh, clean and cool water at all times of the day is a must.
2. If birds are not provided water for two days, they will cease producing eggs and the birds will start moulting, during which the reproductive physiology of the bird is allowed a complete rest from laying. The bird builds up its body reserves of nutrients and requires at least 10-15 days to restart egg laying.
3. A bird can drink twice as much water as its weight as it eats feed. A simple trough, floor-based waterers or hanging waterers can be used.

Breeding Management

1. A rooster can service six to eight hens to obtain fertile eggs.
2. Collect fertile eggs from the nest regularly and store them in a cool and well-ventilated place.
3. Place 10-12 eggs under a brooding hen within two weeks of egg collection for higher hatchability.
4. Rural hatcheries can be set up using a community-based approach for improved hatchability under field conditions.

Health Care

1. Vaccinate birds against Marek's disease, Newcastle disease (Ranikhet disease), fowl pox, etc. for greater immunity.
2. Deworm birds regularly to protect from internal parasites due to their scavenging nature.
3. While debeaking is discouraged in rural poultry given that the birds need to forage and scavenge, it is recommended if the farmer is rearing about 80- 100 or more birds to avoid cannibalism, egg biting, feather pecking, etc.
4. After the first deworming, repeat at three-week intervals for a total of four deworming sessions.
5. While medicating via drinking water, follow the veterinarian's advice on the amount of medicine to be mixed in the water that chicks normally consume in four hours (approximately 6 litres for 100 birds per day, at six weeks).
6. Provide extra water only when all the medicated water is consumed.
7. Dust and dip the birds or fumigate the house at the slightest indication of external/ecto-parasites. • Take care not to dip the head and avoid dipping on rainy days.
8. Strictly follow the instructions of veterinarians and manufacturers to avoid health hazards. Avoid rearing different species of poultry together (chicken with ducks, turkeys etc.). Separate young and adult stock.
9. Maintain hygiene in poultry houses and keep equipment clean. Ensure proper disposal of dead birds. Prevent entry of rodents. Though biosecurity is cost intensive, it pays in the long run-in terms of fewer losses from infection and good quality production. Periodical culling is advised to control the spread of diseases.

Record Keeping

How do you monitor the performance of individual birds? Some basic record keeping is essential.

1. This is easy to follow as each hen lays eggs in separate nests and the number of birds reared in backyards is generally small.
2. Tracking each hen's egg laying capacity and hatching performance helps in choosing hens to produce the next generation.
3. Recording expenses, production and sales provides insights into the economics of backyard poultry farming.
4. Record keeping of egg production also helps farmers identify underperforming/best performing birds to either cull/breed them to enhance production.
5. Information on vaccination and deworming may also be recorded.

Marketing of Backyard Poultry

While products of backyard poultry are in great demand in India, they require the right market. Community-based approaches like Self Help Groups (SHG), Farmer Producer Organizations and poultry cooperatives can provide the right platform to market the birds without the involvement of middlemen. Encourage marketing on the basis of net weight instead of flock selling.

Information Sources for Scientific Backyard Poultry

Several research institutions under the Indian Council of Agricultural Research (ICAR),State Agricultural and Veterinary Universities (https://www.icar.org.in/) and associated Krishi Vigyan Kendras (KVKs) (https://icar. org.in/content/krishi-vigyan-kendra) are involved in developing and promoting indigenous and improved poultry breeds suitable for backyard rearing apart from delivering scientific information on poultry farming. The Department of Animal Husbandry and Veterinary Services of state governments are also involved in such activities. Private industries, Farmer Producer Organizations, Non-Government Organizations, Self Help Groups and Farmers' Associations to promote backyard poultry. Farmers can readily procure pullets from these organizations or procure fertile eggs of native breeds to hatch to make their own stock.

Conclusion

India has nearly 70% of its population living in rural areas. However, in the present scenario most of the commercial poultry production is concentrated in urban and peri – urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition. Free range and small scale semi commercial back-yard poultry production can be advantageously promoted in rural areas, as the large commercial poultry production continues to be concentrated in urban and peri – urban locations. It can be used as a powerful tool for alleviation of rural poverty, eradication of malnutrition and creation of gainful employment in vast rural areas.

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Hydroponics: An Advanced Technique for Vegetable Production

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Summary of Article

Vegetable growers are using indiscriminate use of chemicals and pesticides for management of the insects, pests during the vegetable production. Harvest the vegetables without gap of spraying of the pesticides. So that the big part of insecticides leads to different types of diseases like dermatology and cancer through residue of pesticides.

So, in present scenario, availability of quality vegetables is the major issue, besides this use of indiscriminate uses of chemicals and pesticides, the production cost of vegetable is also increasing resulting in decrease in net return. To get rid of this issue, there are many techniques adapted by farmers for improved quality of vegetable production. Hydroponics is one of those useful techniques, in this, several benefits are, less time for growing crops than conventional growing, minimum disease and pest incidents, weeding, spraying and watering, etc. can be eliminated.

Under hydroponics, by nutrient film techniques (NFT), production of leafy as well as other vegetables, 70%-90% water is saved. Some leading countries like Israel, France, Canada and Netherlands have adopted this technique at commercial level. On the basis of above performance, it is revealed that hydroponics can play a significant role in quality vegetable production.

Introduction

Hydroponics is the science of growing plants without soil. Learn how just about any plant, especially vegetable, can be grown using this method. The term Hydroponics was derived from the Greek words meaning “hydro” (water) and “pono” (labor) the first modern use of hydroponics was by W.F. Gericke from the University of California during the 1930’s.

Gericke used hydroponics to grow tomatoes, beets, carrots, potatoes, fruits, flowers and more plant are grown in rows or on trellises, just like in a traditional garden, but they have their roots in water rather than in dirt.

Hydroponic crop production has significantly increased in recent years worldwide, as it allows a more efficient use of water and fertilizers, as well as a better control of climate and pest factors. Furthermore, hydroponic production increases crop quality and productivity, which results in higher competitiveness and economic incomes.

In fact, soil provides structure, not the actual food itself, for plant roots. The food comes from other materials mixed in the soil, such as compost, broken down plant waste or fertilizers. Plant grown hydroponically can actually grow faster and healthier than plants in soil because they do not have to fight soil borne diseases in addition, all the food and water they need are given directly to their roots around the clock.

Actually, Europe is considered the biggest market for hydroponics in which France, the Netherlands, and Spain are the three top producers, followed by the United States of America and Asia- Pacific region.

Types of Hydroponic Techniques

There are many different hydroponic techniques used throughout the world. Four of the main types:

1. Nutrient film technique.
2. Dynamic root floating technique.
3. Water culture technique.

4. Ebb and flow method.

Nutrient Film Technique (NFT)

It is one of the most popular systems. Channels are built out of plastic or wood and are lined with polyethylene plastic. A pump is used to circulate water throughout the channel. Plants are suspended above solution with the roots dangling down into the solution. The channels are slightly sloped and the water is collected and reused by pumping it back to the holding tank. Plants with large root systems that can effectively reach down into the water can be grown using this technique (Turner, 2008). Occasionally, overgrown roots can block the channel and water must be filtered for debris before returning to the holding tank (Lenzi et al., 2011).

Dynamic Root Floating Technique (DRFT)

It is a hybrid of several hydroponic systems. In Taiwan, The Taichung District Agricultural Improvement Station developed the DRFT in 1986. Nutrient solution is pumped through one end and allowed to circulate through all the channels before being collected back into the tank reservoir. Instead of a continuously circulating nutrient solution system like in the NFT, the water pump is constantly turned on and off to alter the depth of the water.

Alternatively, the pump can remain on at all times and a drainage system can be installed to vary the depth. One feature of the DRFT is the concave panels underneath the floating boards. This extra space allows roots called aeroroots to grow above the nutrient solution and therefore receive more oxygen. Also, various techniques are used to control the temperature of the nutrient solution. When temperatures reach above 300C, semitransparent polyethylene sheets are hung over the roof to block out some sunlight.

Additionally, the DRFT channels are lined with insulating material to impede heat transfer from the immediate surroundings. The main advantage of the DRFT is that it can maintain the temperature of the nutrient solution. Since oxygen is less soluble in warm water, the DRFT is well-suited for hydroponic farming in tropical and subtropical climates such as those found in Thailand (Kao, 1991).

Water Culture Technique

In the technique, plants are supported on top of the nutrient solution as this differs from the NFT and the DRFT systems because the roots hang freely into the nutrient solution. Root aeration can be a major problem when water is left to stand, so an air bubbler can be used to oxygenate the water. Alternately, pumps can be used to circulate the water and baffles located at the end of each bed will oxygenate the water as it returns to the reservoir. Roots should remain in complete darkness to ward off the growth of nutrient consuming algae. The plant stems are supported on trays that float on top of the solution (Resh, 1997). This method is effective for plants such as lettuce, but not for larger plants or those that take a long time to grow such as tomatoes or cucumbers (Choi et al., 2012).

EBB and Flow Method

In this method water is pumped into the tank and then allowed to gradually drain. This differs from the water culture method because as the water drains, the roots are exposed and receive more oxygen. Also, cycling the water ensures that the water is less stagnate and will contain more oxygen. Careful attention must be given to the pumps because if the pumps fail, the plant roots can dry out quickly, especially in hot climates (Singh and Singh, 2012). Ebb and flow systems work best with small plants such as basil or parsley (Turner, 2008).

Table-1. Various crops grown under soil less hydroponic system:

Sl. No.	Type of crops	Name of the crops
	Cereals	Rice, Maize
	Fruits	Strawberry
	Vegetables	Tomato, Chilli, Brinjal, Green bean, Beet, Winged bean, Bell pepper, Cucumbers, Melons, green Onion
	Leafy vegetables	Lettuce, Spinach, Celery, Swiss chard, Atriplex
	Condiments	Coriander leaves, Methi, Parsley, Mint, Sweet basil, Oregano

	Flower / Ornamental crops	Marigold, Roses, Carnations, Chrysanthemum
	Medicinal crops	Indian Aloe, Coleus
	Fodder crops	Sorghum, Alfa alfa, Bermuda grass, Carpet grass

Table-2. Comparative results between hydroponics and conventional soil-based production:

Crop	Results
Basil	The hydroponic cultivation improved the contents of vitamin C, vitamin E, lipoic acid, total phenols, and rosmarinic acid, as well as their antioxidant activities.
Lettuce	Hydroponics offered 11 ± 1.7 times higher yields compared to conventionally produced, but also required 82 ± 11 times more energy.
Lettuce	Levels of alpha-tocopherol here were higher in hydroponics compared to conventional soil-based production.
Lettuce	The content of lutein, beta-carotene, violaxanthin, and neoxanthin were lower in hydroponics compared to the soil-based production, due to less exposure of hydroponics to sunlight and temperatures, which had significant impact on carotenogenesis decreasing their levels.
Lettuce	Hydroponics-grown lettuce had significantly lower concentration of microorganisms compared to other in-soil-grown lettuce.
Onion	Total flavonoids were similar between hydroponics and soil-based cultivation.
Red paprika	The content of carotenoids capsorubin and capsanthin was higher in hydroponics (4.50 and 46.74 mg/100 g dry weight, respectively) compared to convention soil culture (2.81 and 29.57 mg/100 g dry weight, respectively).
Strawberry	Fruit yield per plant was 10% higher in hydroponic raspberries compared to soil-grown raspberries.
Sweet potato	Carotenes, ascorbic acid, thiamin, oxalic and tannic acids, and chymotrypsin and trypsin inhibitors were higher under hydroponics.
Tomato	No significant differences between hydroponic and nonhydroponic tomatoes in the levels of lycopene content (averaging 36.15 and 36.25 µg/g, respectively).
Tomato	Highly controlled conditions of electrical conductivity (EC) and salinity of water, pH, and nutrients provide optimum condition for enhancing the levels of sugars, Brix, pH, and organic acids, which are quality criteria of consumer acceptance toward tomato.

Advantages of Hydroponic Vegetable Production

1. Hydroponically produced vegetables can be of high quality and need little washing.
2. Soil preparation and weeding is reduced or eliminated.
3. It is possible to produce very high yields of vegetables on a small area because an environment optimal for plant growth is created. All the nutrients and water that the plants need is available at all times.
4. One does not need good soil to grow vegetables.
5. Water is used efficiently.
6. Pollution of soil with unused nutrients is greatly reduced.

Disadvantages of Hydroponics

1. Hydroponic production is management, capital and labour intensive.
2. A high level of expertise is required.
3. Daily attention is necessary.
4. Specially formulated, soluble nutrients must always be used.
5. Pests and diseases remain a big risk.
6. Finding a market can be a problem.

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Raising A Healthy Dairy Calf

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Introduction

The calf is functionally a monogastric animal. At birth all four compartments of ruminant stomach except abomasum are non-functional, undeveloped, small in size and disproportionate to the adult digestive system (Sato T et al., 2010). Rapid rumen development in calves brings about important changes in metabolites that may have synergistic effects on growth. Development of the rumen is an important physiological challenge for young ruminants (Jiao et. al., 2015). Inoculation and establishment of the rumen microflora, intake of solid feed, its fermentation processes and absorption mechanisms are all needed to trigger the development of the rumen. The upkeep and proper management of young calves are a pre-requisite to the success of any dairy development programme. An optimum level of nutrition in early life favours faster growth and earlier onset of puberty. Calves should be reared carefully to obtain optimum gain in bodyweight, so that they attain about 70-75 per cent of mature body weight at puberty. Poor feeding of young calves leads to higher age at first calving and overall loss of productivity in the lifespan. Therefore, milk producers need to recognise the implications of poor feeding of young calves.

Colostrum Feeding to Newly Born Calves

Colostrum is the first secretion produced by the mammary gland of cows/buffaloes after calving, and is a rich source of protein, fat, minerals and antibodies. The calf should receive colostrum within 1-2 hours of birth. The ability of the calf to absorb maternally-derived immunoglobulins (antibodies) contained in colostrum is maximum within the first hour following birth and remains fairly good for upto six hours. After this, there is a progressive loss in the calf's ability to absorb colostral antibodies. Colostrum is an invaluable gift of nature to newly born calves. Compared to whole milk it contains 4-5 times protein, 10 times vitamin A and plenty of minerals.(composition in table 1.)

Colostrum acts as a mild laxative as it helps in removing digestive residue, muconium from the intestines of newly born calves. In case of non-availability of colostrums due to accidental death of mother or agalactia, colostrums substitute can be used. It can be prepared by mixing 2 whole eggs in one litre of milk and 30 ml of castor oil. It should be fed three times in a day.

Table 1:

Constituents	Colostrum	Milk
Total solids	28.30	12.86
Total Protein	21.32	3.34
Albumin	1.5	0.54
Globulin	15.06	-
Casein	4.76	2.8
Lactose	2.5	4.8

Milk/ Milk Replacer

Milk or milk replacer is the main diet of newborn calves. Young calves need to be fed two litres of milk daily, at least for a period of two months, which should slowly be replaced with a good quality calf starter. Milk producers prefer to sell this milk to meet their day-to-day needs, rather than feeding it to the calf. Consequently, calves are starved of milk, which severely affects their growth and age at maturity. This reduces productive life of dairy animals. Milk replacer could be an economical alternative to milk for feeding young calves, comprising skim milk powder, soybean meal, groundnut meal, edible oils, grains, vitamins, mineral mixture, preservatives etc. On feeding milk replacer, followed by feeding calf starter, age at maturity could be reduced by up to 12 months. However, the chemical composition of liquid feed (milk) and its shunting effect on the esophageal groove limits its ability to stimulate rumen development.

When the neonatal calves are fed exclusively on milk/milk replacer, there is a limited metabolic activity in their rumen epithelium which hampers their proper development and hence minimal absorption of volatile fatty acids. Even the rumen size may increase with age but the rumen function remains underdeveloped in calves fed only milk or milk replacer. Therefore, although milk-based diet promotes rapid and efficient growth of the young animal however, it does not contribute to prepare the pre-ruminant to utilize solid diets (Govil et. al., 2017). The type of Liquid feed and its composition may also influence plasma IGF1 concentration, insulin and other growth factors, which in turn play an important role in stimulation of rumen epithelial cell proliferation.

Calf Starter and Rumen Development

Calf starter is a balanced concentrate mixture, comprising ground cereal grains, protein supplements, minerals and vitamins. Calf starter plays an important role in proper ruminal development. Feeding this starter early is critical as it has been shown that a four-week-old calf fed starter has a more developed rumen than a twelve-week-old calf that did not receive starter. Reticulo-rumen is non-functional in calves and hence feeding of calves should be treated as non-ruminant as they cannot utilize roughages containing higher amount of cellulose. Feeding calf starter and good quality leguminous hay from early life, stimulates early development of rumen papillae (rumen wall), essential for rumen functions, which favours digestion of larger proportion of fodder at an early age. After about six months, calf starter should be replaced with calf growth meal, which is more economical for growing calves. Composition of calf starter meal and calf growth meal on Dry Matter (DM) basis, are given below (Table 2).

Table 2:

Characteristics	Calf starter meal	Calf growth meal
Crude protein (per cent), min.	23.0	22.0
Crude fat (per cent), min.	4.0	3.0
Crude fibre (per cent), max.	7.0	10.0
Acid insoluble ash (per cent) max.	2.5	3.5
Iodised common salt (per cent), max.	1.0	1.0
Calcium (per cent), min.	0.5	0.5
Available phosphorus (per cent), min.	0.2	0.2
Urea (per cent), max.	NIL	NIL

Rumen development is stimulated by volatile fatty acids primarily butyrate and propionate produced by micro biota of the rumen. The rumen epithelial development is largely influenced by the chemical composition of feed and the fermentation end products. Butyric acid provides energy for rumen development through thickening of the rumen wall, formation of papillae, and increasing capillary development (Suarez et. al., 2007). Corn is most commonly used grain in calf starters because it promotes VFA production and a subsequent reduction in the rumen pH, which is responsible for the growth of papillae in the rumen. A smooth transition from liquid feed (milk or milk replacer) to solid feed (grains or forage) is a key factor in minimizing mortality and morbidity losses with diseases and increasing daily weight gains (Khan et. al., 2008), as well as in minimizing weight loss and distress at weaning.

Calf starter should not contain any non-protein nitrogen source. It should contain only traditional and highly palatable ingredients such as soybean meal, decorticated cotton seed meal, wheat bran, rice polish, crushed maize etc.

Roughage is responsible for promoting the growth of the muscular layer of the rumen and to maintain the health of the epithelium. Fibrous feeds stimulate saliva production by chewing and rumination. The saliva provides urea and minerals, such as sodium bicarbonate that aids in maintaining normal rumen microbial growth and development. However, these feeds do not provide sufficient amounts of the volatile fatty acids (VFA) needed for development of the rumen mucosa. Although forage intake contributes less to rumen papillae development, but its intake promotes rumination and maintains the integrity and health of the rumen wall.

Water is very important for rumen bacteria to survive and aid in its development. Water in the rumen liquor comes mostly from free water intake. From three days of age, fresh, clean, free-choice water should be made available to the calf.

Summary

Proper feeding and care of young calves is the first step in raising healthy, productive replacement animals to enter your milking herd. Feed four quarts of high-quality colostrum within the first eight hours to provide calves with essential nutrients and antibodies. Offer a palatable calf starter by three days of age to stimulate rumen development and allow weaning by four to six weeks of age. Finally, remember that nutrition is not the only factor affecting calf health and growth. Provide calves with clean, dry, draft-free housing that protects them from harsh sun in the summer and cold winds in the winter. Work with your veterinarian to ensure that calves receive adequate vaccination and to develop treatment protocols for sick calves.

Bottom line: Good dairy herds are raised, not bought.

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Covid Times: Prolonged Dependency on Digital Screen May Lead to Serious Health Concerns Among Children

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Summary

Due to lockdown everyone is confined to home and knowingly or unknowingly they used to spend quite handsome amount of their time in staring at their digital gadgets. Apart from other negative impacts of pandemic upon the mental health, there are multiple serious concerns regarding physical and emotional health. The stress and uncertainty surrounding the coronavirus pandemic presents daily challenges to the well- being of families and children. It is very important to develop a daily schedule which covers all aspects of a healthy living such as diet, physical exercise, sleep patterns and of course to some extent there have to be social interaction using digital gadgets. The healthy schedule will assist us to maintain healthy lifestyle in such a terrifying time of pandemic.

Introduction

Across the globe, due to the spread of coronavirus disease (COVID-19), the entire populations are affected by physical distancing, quarantines and isolation. From young children to older adults everyone is facing challenges as per their age group. Spending a lot of time indoors is kind of setback for a societal creature like human. In the past, a lot of parents were used to thinking of screens as somewhat unhealthy. Given a choice between, say, having our kids play team sports or having them sit at home scrolling, the healthier option was obvious. But with the continuing pandemic, the unfortunate reality is that staying home is generally the safer choice.

Children of 4-16 years age range have to spend their majority of time on digitalized screen. Although schools are closed, but the online school is running and children do attend classes, exams and other activities there is only one way to study, interact and contact with school system is through digital devices. School closure during the first stage of the pandemic brought the widespread adoption of online learning, a sudden change for which no one was prepared.

UNICEF's recent 2019 report on Growing up in a connected world states that while a small group of children will inevitably encounter adverse experiences when they use digital technology, this is not directly related to the time they spend online. Rather, when considering such experiences, more attention should be paid to what children do online, the content they encounter, and their life environment and support networks in general. Not too much, not too little, but just the right amount of screen time seems to be optimal for children.

According to a survey conducted by OLX India, children in the age group of 5 to 15 years spends a majority of their time on digital screen and this percent has been shot up by 100% since the first lockdown. 84% of parents are worried about the increase in screen time for children due to the pandemic and social distancing norms. Screen-time has also been blamed for physical inactivity as a leading risk factor for global mortality which also contributes to childhood obesity.

A recent study published in JAMA Ophthalmology of over 120,000 children in China found that the prevalence of myopia increased up to three times in children aged 6 to 8 in 2020 compared to the previous five years. Rates of myopia, already the most common eye condition worldwide, have been increasing steadily for several decades.

Even under these extreme circumstances, it's still important to be aware of the role that screen time plays in your child's life. But because limiting screen time is so hard right now, try thinking in terms of your child's overall health and how they spend their time in general, rather than counting hours of TV and other platforms.

Without a lot of other options, we might not be able to cut down on your child's screen time overall, but we can help them make the most of the time they do spend with their devices. Quality matters just as much as quantity, and there are lots of ways that screen time can enrich kids' lives during this tough time.

During this time, family may be a source of connection and it may also provide a way of maintaining relationships, especially for young kids. Setting your children up to chat with relatives can also give you a chance to relax or get other things done, which can benefit the whole family.

Connecting with friends virtually isn't a perfect substitute for the real thing, but it's still valuable. If they're not already doing it, nudge your kids toward interactions that go beyond social media. Playing games online, watching a movie while texting with a group, or even just having lunch with classmates over Zoom are all ways that kids can feel less isolated and more connected to their peers. If you're concerned about whether a game your child wants to play is appropriate, try playing it with them or having them walk you through it to get a better sense of what they'd be experiencing.

Nowadays, there are multiple kid-friendly activities which are available online that can keep them active offline. This can be a good time for kids to dig deeper into their interests and build self-esteem, without the pressure of having to achieve anything in particular.

Conclusion

The coronavirus disease 2019 (COVID-19) pandemic has critically impacted physical and mental health globally. People staying at home or closed places spend higher hours watching television or using digital media for entertainment purposes. The use of digital screens, including television, computers, mobile phones and smart devices, can be associated with a wide range of health outcomes. As several empirical studies have reported a rising trend of screen time during this pandemic, it is critical to assess the adverse health outcomes that may appear as its long-term consequences globally.

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Artificial Intelligence (AI): Advance Technology for Precision Agriculture

Article ID: 11308

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Advance technologies in artificial intelligence by the means of machine vision, geographic information system, global positioning systems, actuators, and mechatronics have furthered the implementation and development of robotic systems and intelligent technologies which are used for precision agriculture. Herein, we are going to give a brief but comprehensive review of Artificial Intelligence (AI) on farm management and other technologies employing the use of senses.

Greenhouse advanced management technologies and systems have been greatly developed in the past recent years, integrating both the internet of things and wireless sensor network. Machine learning and Artificial Intelligence (AI) have been greatly utilized and applied in farming for automated and agriculture through robot.

Using machine vision and learning as Intelligence technologies, developed for many reasons such as planting, irrigation, harvesting, weeding, pruning, and mainly plant disease identification or detection. Machine learning methods such as deep and transfer learning, usually present promising results for clarity in image processing and plant symptom identification. Moreover, diagnostic specificity may be a challenge for some microorganism control. Thus, the development of robotics and mechatronics solutions for disease management should follow with since questions related to pathogen diagnosis should always be considered along with some common robot-related issues.

Recently, the research in most of the automatic recognition of pests and diseases have been growing rapidly, with sensors applied on robots to recognize every single plant, in different location and identify presence of diseases, and conduct a routine for disease management.

AI in Robotic Management of Plants

Technological advances in Unmanned Aerial Vehicle (UAVs), global positioning systems, geographical information system, mechatronics, have enabled the development of precision agriculture. With machine vision technology, identification and locating of individual plants with prospective use in automated context has been made easy. For many years, object recognition has always been considered as one of the hard tasks in robotic. However, with developments of better sensing tools, machine vision navigation tools have been able to guide autonomous tractors well in agriculture fields.

	
Drone	**Sensor Satellite**

AI in Robotic Precision Plant Protection

Precision plant protection is considered as a critical part of precision agriculture, where a site-specific application of insecticide or pesticides plays a key role in agriculture sustainability. In this area, control and monitoring of environmental parameters is an essential feature for automating machinery and robots. Further, precision agriculture is representing a cyclic system where steps are divided into data collection and localization, management decisions on applications, data analysis, and evaluation for further action and management decisions. The data that are stored in a database can then be used as historical data for future decision-making. This is a very useful feature for plant protection purposes. Even if further investigation may be required, many parameters can be monitored and controlled in a well-defined space.

Plant Disease Detection Robot

AI in Abiotic Stress

Among many of the abiotic stresses, water management represents the main topic in robotic management. This is because of how important water is in the eco-system. Automated and smart irrigation systems are key variables in farming. This is because growth performance and water management are intertwined. Pathogen development relies on water disposal as well, while water surplus can lead to increased costs, the sensors deployed on robots utilizes the amounts of water use and minimises wastage. This is known as soil moisture sensor that can easily control water pump for target-based irrigation and precision.

Smart Irrigation Water Pump

AI in Weed Control

Besides the invention of robots that are used for auto-navigation purposes, the weed control represents the main area of research, this is because:

1. Of the economic relevance of this topic.
2. The feasibility in distinguishing target which are the weeds from non-target which are the cultivated plants items by machine vision technology.

Distinguishing between the above two factors represent the first step in achieving effective weed control. The use of sensors to regulate the application of agrochemicals such as herbicide for weeding offers an efficient solution to growers, while keeping in mind the environmental impact.

Smart Weed Killing Robot

AI and Data

Advanced analytics in agricultural industry is also informing how growers should manage pests in their farms. Data analysis and digital tools in this industry are being deployed to deal with pests in a more precise and scientific deal with these harmful organisms. Generally, it is with the help of very many types of sensors that have made data collection possible. Data is information, and information is power.

AI and Temperatures of Plants

Thermographic imaging has been made possible by the help of sensors which detect moisture and humidity. This is similar to the technology that is used in night vision sniper goggles that can monitor surface temperature of different crops. When the leaves show some certain threshold, the farmer can safely assume that the plant is in a state of stress and needs attention.

Thermographic Imaging

Conclusion

By using highly sensitive sensors remotely, images and data set of different aspects and health of the plats can be collected. The images taken by drones or satellites, are critical digital tools that can be used to spot trouble well before the normal traditional signs of disease wilting, browning, or discoloration.

The Importance of Opinion Leaders in Agricultural Extension

Article ID: 11309

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Abstract

We can observe that opinion leaders tend to have access to mass media information and external contacts that provide them new ideas from outside. Additionally, the opinion leaders have greater contact with change agents, social participation, higher social status, and more innovativeness. Opinion leaders are used as role models in the adoption of innovations. This can be effective at the social and economic levels of the diffusion process. From the economic perspective of projects' implementation when diffusing an innovation, opinion leaders multiply the efforts of the change agent, by carrying the message to more possible adopters. This translates into effectiveness by achieving more diffusion in less time. At the social level, once opinion leaders have adopted an innovation, that innovation acquires local sponsorship and credibility. Where, Opinion leaders are heterophilous individuals who observe and evaluate innovations proven by innovators. They are considered early adopters of culturally acceptable innovations and generally are opponents of culturally unacceptable ones. Once opinion leaders approve and adopt and innovation, it influences others in the group who also adopt the innovation to maintain a social and economic status among the social system. Leaders are important determinants of rapid and sustained change, as diffusion happens faster when it is initiated by them. They are considered the bridge between farmers and sources of innovations.

Keywords: Local Leaders, Leadership, and change agent.

Introduction

Transferring the relevant technologies is the main job of extension personnel. But also, opinion leaders have to play a vital role in dissemination of agricultural information among their followers and other farmers and in a way, are responsible for bringing desirable changes in the community for its overall development. Leadership in rural areas functions amidst of small groups. The human relations approach is also important, as most of the villagers are ignorant, innocent, needy and sensitive. Various writers have tried to define the term 'leadership'.

However, still a comprehensive definition for the term does not exist. According to Linderman, 'a leader is an individual whose relations, judgments and feelings are accepted (responded to) by the group, as the bases of belief and action.' In the view of Allport, 'leadership according to our present usage means the direct, face-to-face contact between leader and followers; it is personal social control. The importance of opinion leaders in the diffusion and adoption of improved agricultural practices is described and discussed. Opinion leaders are those individuals who have a greater-than-average share of influence within their community because they modify the opinions of others in an informal manner.

Opinion leaders usually conform closely to the norms of their social system. They make use of unbiased and technically accurate sources of information, and they are better equipped than their followers, in terms of knowledge, insight and judgment, to put innovations to practical use. Opinion leaders are usually cosmopolitan in their attitudes. They mix well with other people, are of relatively high social status and tend to be more innovative than their followers.

The personal influence of opinion leaders is very important in the persuasion stage of the innovation-decision process. Opinion leaders are perceived as expert and trustworthy precisely because of their relative objectivity regarding innovations. Indeed, most of their judgments about innovations are negative. One implication of this tendency is that innovations perceived as radical are especially likely to be rejected by opinion leaders and, thus, are better targeted first to innovators who are sources of information for the opinion leaders in question.

The Role of Opinion Leaders in Diffusion of Knowledge

Knowledge management systems are effective when the innovations are pioneered by organizations. Apart from the innovations themselves, they have to be diffused throughout the organization to benefit the employees. the key question here is that when there are thousands of artifacts and documents as part of the knowledge base of an organization, how do rank and file employees sift through them and find out what is relevant and applicable to them as well as what is accurate and a rich source of information. In other words, employees must not waste their time looking for the best possible sources of information and artifacts in the knowledge management system and instead, must have a tool or a ranking system where they can find the most relevant and pertinent articles easily and without great difficulty. This is where the roles of the opinion leaders and the change agents are important as their certification and ranking of the articles would lend credibility and importance to the artifacts. Each organization has certain employees who are known throughout the organization as opinion leaders and change agents and hence, their recommendations carry weight and lend the much-needed respectability to knowledge.

Importance the Working Change Agent with Opinion Leaders

The extension agent should take great care to develop the qualities mentioned above. His own relationship with local leaders will also be important and he should always try to be available to support and encourage their work. There are four main aspects of working with local leaders which the agent should keep in mind.

1. Inform opinion leaders of extension activities and proposals for new programmes, and keep them supplied with extension literature.

2. Visit them as often as is necessary - enough to ensure that they are not isolated or left on their own. Try to make the visits regular so that the leader can build them into his own work routine.

3. Train the opinion leaders in the aspects of extension activities with which they may be unfamiliar; formal training sessions can be set up at which the leaders will learn about a new practice, how to run a demonstration or how to hold a farmers' meeting.

4. Encourage the opinion leaders to take the initiative and to begin to act with some independence. The more they can become recognized and effective, the better chance the extension agent will have of making an impact in the area. An extension agent who has the use of the services of a group of good, efficient opinion leaders has a tremendous additional resource at his disposal and will be in a far better position to get extension work going in that area than if he had to work alone and unsupported.

Importance of Rural Leadership

The utilization of rural leaders is essential because of the following reasons: Extension has a long tradition of using leader in extension work. Extension worker as an outsider may not have complete knowledge about different aspects of village community nor they are supposed to have similar perceptions and feelings about village problems as local people may have. Thus, there are good reasons to use such people who belong to the community. Leaders by virtue of their influences can convey messages of development more convincingly in the people's language. They can use arguments and styles of presentation most appropriate for the target population. They can also help to get social sanction for development. Besides, they can also serve as mouthpiece of people before extension workers, they can explain elaborately the needs and aspirations of people. Number of extension workers is proportionately far less than required. Thus, use of leader can help to multiply effects of extension work conveniently and convincingly. Leaders can help in enlisting participation of people in programmes of their own development. It is possible to organize people around concrete problems. Leaders can use their influence and skills to bring people together and empower them to take action for their development. Villages in India are still haunted by deep rooted beliefs, customs, superstitions and ignorance which influence development negatively. It calls for different types of efforts 3 to overcome social barriers. Leaders, if positively inclined, can play prominent roles in master minding development in right earnest.

Characteristics of Opinion Leaders

Numerous studies have been conducted attempting to identify opinion leader characteristics. The research is not conclusive, but we have some understanding of the opinion leader's profile. First, opinion leaders have approximately the same social-class position as non-leaders, although they may have higher social status within the class, Opinion leaders have approximately the same social-class position as non-leaders, although they may have higher social status within the class. This does not mean that personal influence does not flow across different class lines, but is likely to be infrequent and of a visual nature rather than verbal. Opinion leaders have greater exposure to mass media that are relevant to their area of interest. For example, opinion leaders for women's fashions could be expected to have higher exposure to such magazines as Vogue and Glamour. Similarly, automobile opinion leaders might be expected to read Motor Trend or Hot Rod. Exposure to relevant mass media provides them with information useful in enhancing their leadership potential. Opinion leaders have greater interest and knowledge of the area of influence than do nonleaders. This finding is closely related to their greater media exposure. Of course, knowledge is not a prerequisite for opinion leader influence. Undoubtedly, much influence takes place by those who are ignorant of the topic of conversation. Opinion leaders are more gregarious than nonleaders are. This finding is logical, given that they must interact with those whom they influence. Thus, opinion leaders are generally more sociable or companionable. Opinion leaders have more innovativeness than do nonleaders. This does not mean, however, that they are innovators (the first people to purchase a new item). In fact, innovators and opinion leaders have been found in several studies to have differing characteristics and lifestyles. In the fashion market, for instance, the innovator is seen as an adventurer who is the earliest visual communicator of the newest styles aimed at the mass of fashion consumers." The opinion leader, however, may be characterized more as an "editor" of fashions, who defines and endorses appropriate standards. Opinion leaders are also more familiar with and loyal to group standards and values than are nonleaders. This refers to the fact that opinion leaders are vested with leadership authority by group members, and in order to maintain this position, the individual has to reflect underlying norms and values for that area of consumption leadership. The clothing influential, for instance, cannot be too far ahead of or behind fashion, but must reflect the current norms in clothing

Conclusion

Opinion leaders play a very important role in the agricultural extension where, Opinion leaders, who are also local farmers, are sufficiently heterophilous to be good sources of new information and advice. They usually enjoy considerable influence on the way other locals think and behave. Opinion leadership is not a characteristic applicable under all conditions of rural innovation. Some farmers might be opinion leaders in a wider context, and others might have leadership roles restricted to specific issues. Opinion leaders for midsize farms under certain conditions can be useless for smaller operations or under other conditions, and social interaction among those groups can be limited. Separate communication networks might. The importance of opinion leaders does not mean that extension activities should be concentrated exclusively on these people, while forgetting about the remaining farmers. There will always be a section of the farming community who will be antagonistic towards extension officers and research workers. These farmers seldom make use of publications and relatively few of them will attend meetings and symposia. They will instead turn to other farmers for advice, discarding the extension officer as a man "with no practical experience", whose knowledge is obtained exclusively from books. To help these farmers improve their standards of productivity, the only avenue available is through their opinion leaders.

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Crop Diversification – Strategies & Constraints

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Introduction

Crop diversification refers to the addition of new crops or cropping systems to agricultural production on a particular farm taking into account the different returns from value added crops with complementary marketing opportunities. In simple terms, it is shift from one crop to another crop. In real sense, diversification in agriculture brings desirable change in the existing cropping pattern towards more balanced cropping system to meet ever increasing demand for cereals, pulses, oilseeds, fibres, horticultural crops, fodder, grasses and fuel etc. It aims to improve soil health and agro ecosystem with socioeconomic improvement of the people. It takes into account the economic return from different crops and other allied farming for the development of the nation by ensuring better farm income. Soil health will be taken into account while selecting the crops for crop diversification. Cropping pattern would change from less remunerative crops to more remunerative as well as sustainable crops.

There is a need to grow livestock, fishery and forestry products along with field crops which makes agriculture diversification possible. It improves the income of farmers as well as maintains the sustainability. New and improved varieties should be incorporated in the cropping pattern which enhances the plant productivity and maintains the soil sustainability. It reduces the risk of total crop failure and also provides alternative means of generating income, as different crops will respond to climate scenarios in different ways.

Crop Diversification as a Strategy for Food and Nutritional Security and Poverty Alleviation

Crop diversification can be used as a strategy for addressing food and nutritional security. The diversification of horticultural crops especially fruits and vegetables have been very important in ensuring nutrition security. This also has played a pivotal role in poverty reduction. It is not only in the increase of food grain production but also the production of commercial crops like cotton, oilseeds, sugar cane, fruits and vegetables as well as livestock production including fisheries have contributed significantly to poverty reduction. Crop diversification can help the farmers in addressing the important determinants of poverty such as:

1. Lack of income and purchasing power.
2. Lack of productive employment.
3. The continuous increase in price of food.
4. Inadequacy of social infrastructure, affecting the quality of life of the people and their employability.

Strategies for Crop Diversification

1. Replacement of low yielding value crops with high yielding & high yielding value crops with longer shelf life.
2. Intercropping in rainfed areas.
3. Diversion of high-water requiring crops with less water requiring crops.
4. Legume's intervention.
5. Inclusion of crops having both domestic and international demands.
6. Inclusion of energy efficient crops.
7. Systems with higher productivity, profitability and sustainability.
8. Shift high risk crops with short duration pulses and drought resistant oilseed crops.

The combination of various crops in agro-ecosystems in smallholder farming not only permits more efficient utilization of agro ecological processes, but also provides diversity of human diet and/or improves household income, nutrition, and security. Improving income further improves the purchasing power of the household thereby allowing purchase of other food products. Thus, crop production diversification and consumption habits should include a broader range of crop plant species, in particular those identified currently as underutilized and/or scarce in household food diets ceteris paribus. Crop diversification can as a result contribute significantly to livelihoods, improved health and nutrition, household food security, climate resilience, and ecological sustainability.

Major advantages of crop diversification are:

a. Increase in the income of small farm holdings
b. Less risk for price fluctuation, climatic variability etc
c. Balances the food demand
d. Increase in the production of quality fodder for livestock animals
f. Conservation of natural resources
g. Minimizes the environmental pollution
h. Reduces the dependence upon off farm inputs; and community food security can be increased.

Constraints in Crop Diversification

1. More than 60% of the cropped area in the country is rain fed and is dependent on rainfall
2. Sub-optimal and over-use of resources like land and water resources, causing a negative impact on the environment and sustainability of agriculture
3. Inadequate supply of improved and quality seeds and planting material of improved cultivars
4. Fragmentation of land holdings and lack of mechanization of agriculture due investment constraints and land holding sizes
5. Poor basic infrastructure like rural roads, power, transport, communications etc
6. Inadequate post-harvest technologies and inadequate infrastructure for post-harvest handling of perishable horticultural produce.
7. Very weak agro-based industry.
8. Inadequate research - extension - farmer linkages.
9. Inadequately trained human resources and large-scale illiteracy amongst farmers.
10. Emerging species of diseases and pests affecting most crop plants.
11. Poor database for horticultural crops and insufficient investments in the agricultural sector.

Summary

Persistent low level of farmers' income can cause serious adverse effect on the future of agriculture in the country. To secure future of agriculture and to improve livelihood of half of India's population, adequate attention needs to be given to improve the welfare of farmers and raise agricultural income. Introduction, adaption and acceptance of new varieties as well as new and upcoming production technologies can potentially strengthen farmers' cropping systems by increasing yields, improving drought resilience, boosting resistance to pests and diseases and also by capturing new market opportunities. There is a need to identify crops and varieties that may suit to a range of environments and farmers' preferences. Crop diversification provides better conditions for food security and enables farmers to grow surplus products for sale at market and thus help to obtain increased income to meet other needs related to household well-being. Crop diversification can enable farmers to gain access to national and international markets with new products, food and medicinal plants. Diversifying from the monoculture of traditional staples can have important nutritional benefits for farmers in developing countries and can support a country for becoming more self-reliant in terms of food production. Diversification can also manage price risk, on the assumption that not all products will suffer low market prices at the same time and increase the profitability of the farming community.

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Significance of Vitamin and Mineral Biofortification in Genetically Modified Crops

Article ID: 11311

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Introduction

Biofortification refers to the indirect addition of essential nutrients or other substances to foods for the purpose of nutritional or health enhancement. “Biologic fortification” or “biofortification” when referring to agriculture, indicates crops that have been nutritionally enhanced using agronomic practices, conventional plant breeding practices, or modern biotechnology. As with industrial food fortification, the basis for biofortification as a strategy to improve nutrient intake is based on the regular daily consumption by all family members of a consistent and large amount of food staples which predominate in the diets of the poor, thus implicitly targeting low-income households. The intention is to provide nutrients that are essential for health and development, but for metabolic, physiological or economic reasons are not available to all population groups at all times.

There are three, non-mutually exclusive methods which are used to develop biofortified crops: application of fertilizer (agronomic biofortification), conventional plant breeding, and bioengineering or genetic modification (including trans-genetic manipulation). Since biofortified crops are usually more nutrient-dense than non-biofortified varieties and assuming similar nutrient bioavailability and nutrients retention after cooking or processing, persons will consume and absorb more of such nutrients from biofortified crops than from non-biofortified crops

Biofortified crops offer the possibility of rural-based interventions that could reach remote populations, where micronutrient deficiencies are more prevalent, and also could potentially penetrate to urban populations as production surpluses are marketed. From an economic point of view, once the biofortified crops are developed, there are no costs of buying the fortificants and adding them to the food supply during processing, as is the case for industrial fortification of staple foods.

Enhancing Nutrition in Agricultural Crops

Golden Rice: Mammals make vitamin A from β-carotene, a common carotenoid pigment normally found in plant photosynthetic membranes. Here, the idea was to engineer the β-carotene pathway into rice. Professor Ingo Potrykus and Peter Beyer discovered that geranyl geranyldiphosphate (GGPP), a precursor of carotenoids, was present in rice seeds.

Subsequently, genes (two Daffodil genes and single bacterial gene) that code for enzymes that were necessary to create carotene from GGPP were introduced into the rice genome (Beyer et al., 2002). It appeared that the daffodil psy gene needed to be replaced with a better functioning or more active version in order to increase the production of carotenoid. The rice endosperm with the maize psy gene exhibited an increase in carotenoid production of about 12-fold to those with the daffodil psy.

Vitamin E- Maize: Barley HGGT gene was found to be over-expressed in maize seeds, leading to a 20-fold increase in tocotrienol level, which translated to an eight-fold increase in total tocols (tocopherols and tocotrienols). HGGT (Homogentisic acid Geranylgeranyl transferase) catalyzes an analogous reaction to HPT, only it is highly specific for GGDP whereas HPT uses PDP as its prenyl substitute.

Results from the expression of barley HGGT in transgenic plants suggest that this enzyme has strong substrate specificity for geranylgeranyl diphosphate, rather than phytyl diphosphate. Expression of HGGT enzyme in tobacco calli and Arabidopsis leaves resulted in accumulation of Vitamin E antioxidants in the form of tocotrienols, principally as γTocotrienols, and generated little or no change in the content of Tocopherols (Cahoon et al., 2003).

Golden mustard: Golden mustard also may yield provitamin A which would enrich cooking oil. New varieties of corn, sorghum and wheat are being developed to provide more lysine, an important dietary protein.

Tomatoes with increased anthocyanins: Anthocyanins are present in many foods and have been shown to reduce the risk of several diseases. As very few peoples consume the recommended portions of vegetables and fruits daily, improving the nutritional value of those that are most frequently consumed has the potential to improve human health.

Tomatoes are an important crop worldwide; however, their levels of flavonals (which includes anthocyanins) are considered sub-optimal. By increasing the health-promoting compounds in tomatoes, consumers will receive increased nutritional components, which is particularly important when the daily recommended values are not being met. Cathie Martin and colleagues expressed two transcription factors from snapdragon (Del and Ros1 under control of the E8 promoter) which dramatically increased the level of anthocyanins and produced purple-coloured tomatoes.

Initial feeding studies in mice found that these high-anthocyanin tomatoes significantly increased the average lifespan compared to animals fed normal tomatoes. Further studies are needed to determine the potential beneficial role of these purple tomatoes in human health.

Iron fortification of rice seed: The ferritin gene has been isolated and sequenced in plants, including soybean, French bean, pea, and maize. Ferritin is thought to play two main roles in living cells; one is to provide iron for the synthesis of iron proteins such as ferredoxin and cytochromes.

The other is to prevent damage from free radicals produced by iron/dioxygen interactions. The entire coding sequence of the soybean ferritin gene was transferred into Oryza sativa (L. cv. Kita-ake) and obtained a three-fold increase in iron concentration from 8.6-14.3 ppm to 13.3-38.1 ppm (Lucca et al., 2001).

AmA 1 Potato: Potato is the most important non cereal food crop that lacks the essential amino acids lysine, tyrosine, and the sulphur containing amino acids methionine and cysteine. Seed albumin gene AmA1 from Amaranthus hypochondriacus was cloned and introduced into potato (Chakraborty et al., 2010). The AmA1 protein is non allergenic in nature and is rich in all essential amino acids. AmA1 gene improves the nutritive value of potato.

High-iron bio-fortified pearl millet: ICRISAT's high-Iron pearl millet variety ICTP-8203Fe was released as Dhanshakti in Maharashtra state of India early this year. The history of this variety goes back to 1988, when ICTP 8203, an open-pollinated variety of pearl millet developed at ICRISAT in 1982 from selection within an iniadi landrace from northern Togo, was released for cultivation in peninsular India in 1988.

It was rapidly adopted by farmers, occupying about 800,000 ha at the peak of its adoption in 1995. This variety was found to have the highest level of iron density among a diverse range of populations, open-pollinated varieties and hybrids in several trials conducted during 2004-2008.

By exploiting intrapopulation variability for iron density within it, one of its improved versions, ICTP 8203 Fe-10-2 (ICTP 8203 Fe for short), was developed.

Conclusion

Role of biofortified crops in improving micronutrient status as constituent of regular diets and patterns of production and consumption worldwide, and it helps to overcome the malnutrition in humanbeigns. To increment of plant or crop quality & increment of variety in germplasm.

Easy distribution when released too needy. Fortification doesn't require changes in existing food patterns nor individual complience – which are very difficult to achieve.

Biofortified staple foods cannot deliver as high a level of minerals and vitamins per day as supplements or industrially fortified foods, but they can help to bring millions over the threshold from malnourishment to micronutrient sufficiency.

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Role of Tissue Culture for Production of Disease-Free Planting Material

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Introduction

Plant tissue culture is a technique of growing plant cells, tissues, organs, seeds or other plant parts in a sterile environment on a nutrient medium. Used to eliminate virus from infected germplasm as rapidly growing meristem of plants are usually free of viruses, or have much lower concentration. Commonly used in cassava, potato, sweet potato and ornamental plants.

Tissue culture had its origins at the beginning of the 20th century with the work of Gottleib Haberlandt (plants) and Alexis Carrel (animals). In 1952, Morel and Martin applied tissue culture techniques for elimination of viral infection in Dahlia. In 1962, Baker and Phillips, successfully eliminated the fungus *Fusarium roseum* f.sp. *Ceraialis* from carnation plants using meristem cultures. In 1965, Tramier obtained gladioli plants from meristem-tip cultures which were free from *Fusarium oxysporium* f.sp. *gladioli*.

Production of Virus Free Planting Materials

Meristem tip culture is generally employed in case where the aim is to produce disease-free plant,size of the explant is critical for virus elimination and various reasons attributed to the escape of the meristem by virus infection.

1. Viruses move readily in the plant body through the vascular system, which is absent in meristem.
2. A high metabolic activity in the actively dividing meristem cells does not allow virus replication.
3. A high endogenous auxin level in shoot apices may inhibit virus multiplication.
4. The virus inactivating system in the plant body, has higher activity in the meristem than in any other region (Hollings, 1965).

Steps Involved in Tissue Culture Techniques

1. Selection of plant.
2. Isolation of explant.
3. Sterilization of explant.
4. Inoculation of explant.
5. Incubation.
6. Initiation of callus.
7. Sub-culturing.
8. Regeneration.
9. Hardening.

Culture Indexing

1. Remove top cuttings (5-8 cm long) from the mother plant and number them. Excise the bottom 2 cm portion of each cutting with sterile knife in the laminar airflow blood. Surface sterilize for 10 min in a commercial bleach solution.

2. Wash the disinfected-cutting portions with sterile distilled water three times, slice each cutting portion aseptically into thin (2mm) sections.

3. Transfer sections onto a test tube containing sterile nutrient broth and incubated at 23°-25°C (ambient temperature) for 10-14 days; presence of bacterial or fungal pathogen is confirmed in case the nutrient broth turns cloudy.

4. Discard original numbered cuttings as well as the mother plant from which sections retest the tested pathogen-positive; retain only those cuttings (with mother plants), sections of which yielded no micro-organisms in the nutrient broth.

5. Grow all cuttings that tested pathogen (bacteria or fungi) free in the incubation greenhouse and after 3-4 months retest the plants obtained for detection of pathogens, following step 1-5, to ensure negative pathogenicity.

6. At least 3-4 culture indexing should be done in a year to confirm that plants are pathogen-free.

Production and Productivity of Tissue Culture Disease Free Planting Material in Different Crops

Sweet Potato:

a. Fuglie et al, concluded that the rapid diffusion of virus free sweet potato planting material in Shandong province of china, reaching 80% of the province`s small growers within the only four years, can be explained by several factors.

b. Most importantly, users of the new roots showed yield increment by 10 t/ha, or 30%. Further the technical package was simple and required only one small change in the farmers' production system.

Potato:

a. The production of potato seed under conventional system has not been effective in avoiding or reducing the buildup of pathogens and has consequently led to reduced quality potato seed and low crop yields.

b. Plants once cleaned through meristem culture and induction of tuberization under aeroponics system, produce high quality potato seed tubers rapidly that are free from contamination of pathogens.

c. Further multiplication of potato seed tubers under aeroponics also compliments tissue culture (micro propagation), as it clones mini tubers in a short time and reduces numerous labor steps associated with direct use of plantlets from tissue culture into the field in the post flask stage.

Musa Species:

a. To date, five viruses infecting Musa spp. have been reported ABMV, BBMV, BBTV, CMV and BSV. These viruses can be transmitted in vegetative planting material.

b. Successful control of virus diseases should begin with virus free planting materials. The solution is to develop cheap, efficient production of "clean" planting material through tissue culture.

c. Since the tissue culture program began in 1983, a total of 26 million banana plantlets have been produced for commercial planting in Taiwan.

d. This way, the farmers can now be able to replace their degraded orchards with superior material which is early maturing 12-16 months compared to the conventional banana of 2-3 years, bigger bunch weights of more than 30 kg and a higher annual yield per same unit of land, 40-60 t/ha have been observed.

Citrus:

a. Most of the citrus growing regions are experiencing decline in the population due to different reasons. This is mainly attributed to the different viruses which are spreading through planting of infected planting material.

b. Viruses like Tristeza, Posorosis and Xyloporosis, and Greening bacterium are causing decline in citrus and the need is felt to revive citrus plantations on sound footing with appropriate biotechnological interventions.

c. Meristem culture and shoot tip grafting have been trend in different citrus varieties and have become an important regulation in different citrus growing countries.

d. It is suggested that the desired scion varieties may be first made virus free using meristem culture, tested for virus detection using different serological techniques followed by shoot tip grafting (STG) to raise healthy specific-virus-tested (SVT) clones.

e. The mother plants regenerated so be then maintained in net-house containment and then multiplied on the desired rootstocks using micro-budding method.

Conclusion

The plant tissue culture technology has been greatly contributed to producing disease free planting materials of vegetative propagated crops in horticulture industry of many countries. Usage of tissue culture generated plants has increased productivity per unit area, particularly in horticultural crops but capacity is insufficient to fulfill the high demand for the plantlets. The technology has created several employment opportunities and opened up many entrepreneurial fields. Tissue culture has been one of the main technological tools and reasons that have contributed a lot to feed 7 billion people in the globe.

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Food Processing Techniques for Pesticide Reduction in Food Products

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Introduction

Food is more basic need of man than shelter and clothing. fruit and vegetable provide rich nutrients for healthy body's growth, maintenance and also useful for reproduction. After Chine, India is second most populous country in world and nearly 64% of population depend on the agriculture In India the diverse agro climate condition and its different approaches for cultivation and crop protection due to increased productivity through major input fertilizer and pesticides. India stands at 7th position in use of pesticides on crops. Every pesticide used on crops needs some waiting period before harvesting that differs from pesticide to pesticide and also from one crop to another. Food products become safe for consumption only after waiting period has lapsed. If fruits and vegetables are harvested before completion of the waiting period, they are likely to have higher level of residues, which are hazardous to health. The long-term effects could result in reduction of live sperm and fertility, increase in cholesterol levels, high infant mortality rates and several metabolic and genetic disorders. Food processing at domestic and industrial level would offer a suitable means to tackle the current scenario of unsafe food.

Food Processing

The processing of food commodities generally implies the transformation of the perishable raw commodity to value added product that has greater shelf life and is closer to being table ready Unit operations normally employed in processing food crops reduce or remove residues of insecticides and other pesticides that are present in them.

Food Processing Techniques

Food processing techniques implies the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans or animals either in the home or by the food processing industry. This section reviews the most common food processing techniques that would aid in pesticide dissipation. These operations such as washing, peeling, blanching and cooking play a role in the reduction of residues.

Different Methods of Food Processing Techniques

1. Milling.
2. Malting and brewing.
3. Drying and dehydration.
4. Blanching, steaming, boiling, cooking, frying, baking and roasting.
5. Peeling.

Milling

Majority of pesticides used for stored grain protection are contact pesticides, and the residues remaining mostly on the grain surface, milling substantially removes their residues. Thus, wheat grain scouring removed 17-28% more pirimiphos-methyl than conventional cleaning (Brown et al., 1991), and similar results were observed by Sgarbiero et al. (2002) as, compared to whole grain, bran had approximately 2.5 times more pirimiphosmethyl residues, and whole flour had about the same, while white flour had 60% of the residues. Uygun et al. (2005) reported a reduction in malathion residues of approximately 95% in wheat after flour milling.

Malting and Brewing

During the process of malting and brewing, fermentation is the main production stage but only one that is responsible for the overall pesticide reduction in final products. Pesticide residues present in grain and hops dissipate throughout the beer production process (Farris et al.,1992). During malting, it was revealed that fenithrothion, phenthoate and triflumizole were considerably reduced through steeping and kilning (Miyake et al., 2002). According to Navarro et al. (2007) the amounts of myclobutanil, propiconazole and nuarimol remaining in maturated and filtered beer did not exceed 3.5%, whereby the majority of pesticides were eliminated during the first, mashing phase, and fermentation highly reduced propiconazole and nuarimol (47 and 39%, respectively), and myclobutanil (8%) somewhat less. Fenitrothion and nuarimol concentrations also declined throughout the beer production process in different proportions, whereby steeping was found to be the most important stage in pesticide removal (52%), followed by germination (25%) and kilning (23%) (Navarro et al., 2007). Chlorphenapyr, quinoxyfen, tebuconazole, fenamirol and pyridaben found on hops were shown not to carry over into the final beer product, while dimethomorph carried over in milling, boiling and cooling steps during the brewing process did not affect triadimefon residues significantly but fermentation highly promoted its degradation (Konget al., 2016).

Drying and Dehydration

Drying is a simple traditional method of food preservation. Whether commodities are dried in the sun, oven or a food dryer, the procedure has been found to reduce pesticide residues considerably. Thus, Lee (2001) reported that sun or hot air drying eliminated 20-30% of chlorpyrifos and fenitrothion residues from red pepper, while Mergnat et al. (1995) found that industrial dehydration reduced phosalone levels in apples by over 80%. According to Cabras et al. (1998, 1998a, 1998b), sun drying caused greater reductions in pesticide residues than the oven process. Thus, bitertanol decreased by 50% in apricots, dimethoate residues 81% in raisins and iprodion 50% in prunes during sun drying, while oven drying led to 72% dimethoate decline in raisins and even increased bitertanol amount in apricots and phosalone in prunes. Athanasopoulos et al. (2005) also reported 64.2-71.9% loss of methamidophos in grapes dried in the sun, and Shabeer et al. (2015, 2015a) confirmed similar effects for dimetomorph, famoxadone, cymoxanile, pyraclostrobin and metiram residues. The recorded decreases in pesticides were attributed to evaporation of their residues during drying, while the increase in residue levels were most likely due to weight changes during the process.

Blanching, Steaming, Boiling, Cooking, Frying, Baking and Roasting

Literature contains reports showing that blanching, steaming, boiling, cooking, frying, baking or roasting have roles in pesticide residues reduction. Cabbage boiling for 30 minutes reduced 80-90% of diazinon and dichlorvos (Kang & Lee, 2005). Potatoes blanching removed 28.3, 22.9, 26.0, 47.3, 46.3 and 45.9% residues of HCB, lindane, p,p-DDT, dimethoate, pirimiphosmethyl and malathion (Soliman, 2001), while dichlorvos residue concentration in spinach decreased by 72% during blanching for 2 min and 81% during cooking for 20 min (Kang & Lee, 2005). Randhawa et al. (2007) found that the effect of cooking on chlorpyrifos residue reduction was highest on potato, followed by spinach, eggplant and cauliflower (59.6, 48.1%, 28 and 12%, respectively). Cooking of eggplant in boiling water reduced cypermethrin by 41% (Walia et al., 2010), while in cauliflower, cooking reduced the level of quinalphos up to 60% (Lalitha et al., 1998). During boiling for 5 minutes, reductions of α-cypermethrin, azoxystrobin, boscalid, chlorpyrifos, iprodione, λ-cyhalothrin and pyraclostrobin in broccoli were 34, 81, 69,43, 87, 34 and 52%, respectively, while the same procedure on tomato reduced azoxystrobin, boscalid, cyprodinil, fludioxonil and pyraclostrobin by 82, 97, 86, 69, and 75% (Łozowicka & Jankowska, 2016). Cypermetrin residues decreased by 15-33% in cooked and 6-26% in blanched tomato (Kadian et al., 2001), maneb decreased by 74% in tomato cooked for 15 min (Kontou et al.,2004).

Peeling

Peeling is an important step in the processing of most fruits and vegetables. Whether it is chemical, mechanical, steam or freeze peeling, this method can achieve significant or virtually total removal of pesticide residues from many commodities, depending on their constitution, the chemical nature of the pesticides, and environmental conditions. Peeling has been identified as the most effective procedure for reducing the residues of chlorpyrifos-methyl and fenitrothion in peaches intended for baby food (Balinova et al.,2006).

Conclusion

The levels of pesticide residues that remain in food commodities as a result of pre- and postharvest treatments could be effectively decreased by various food preparation steps and processing into different products. Thus, common, simple and cost-effective processing techniques may lead to remarkable reductions in the content of harmful pesticides in final food products. Application of pesticides in increasing the Agri-cultural productivity must be weighed against the possible health hazard arising from the toxic pesticide residues in food. Further the current shift in world opinion from ‘chemical farming’ towards ‘organic farming’ is a sustainable approach to minimize the damage posed by widespread contamination of environment by pesticides. However, the challenge lies in achieving food safety in developing countries where the indiscriminate application of pesticides results in the presence of residues in food commodities. food safety through suitable processing techniques and appropriate storage period that enhance food safety even in developing countries especially for the poor populace which cannot afford the expensive organic food. In this background common and simple processing techniques acquire significance for reducing the harmful pesticide residues in food product.

Edible Mushrooms and their Nutritional Facts

Article ID: 11314
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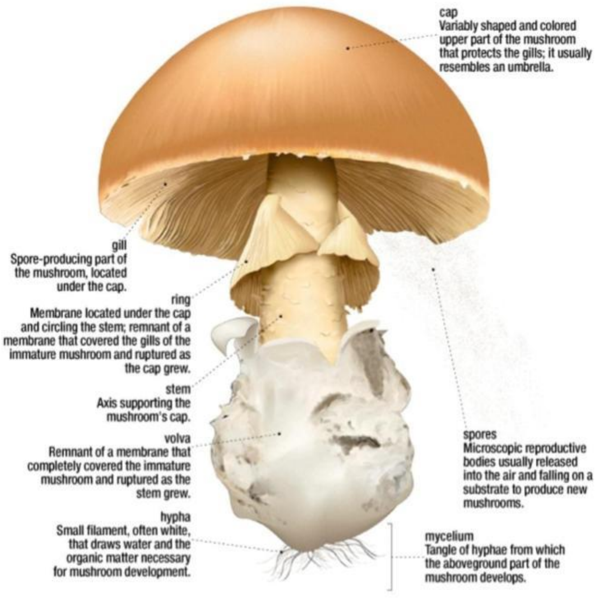
Introduction

As we all know mushrooms are consumed as a part of diet. Mushrooms are usually cooked like vegetables. They are often used as a vegetarian meat substitute as they are suitable for it. They are low in calories, carbohydrates, fats, cholesterol-free, sodium and has some more nutrients in them. They also act as antibacterial agents, help in improving immune system. Additionally, they are important sources of bioactive compounds.

Edible Mushrooms

1. Edible mushrooms have the fleshy and edible fruit bodies. They can appear either below ground or above ground
2. Below ground mushrooms are called hypogeous mushrooms and above ground mushrooms are called epigeous mushrooms
3. Edibility is defined by points like absence of poisonous effects on humans and desirable taste and aroma
4. Edible mushrooms are consumed as they have nutritional and culinary value present in them
5. Edible mushrooms include many fungal species that are either harvested wild or cultivated
6. Some of the edible mushrooms are oyster mushroom , white button mushrooms etc.

Morphology: Generally, a mushroom has a root cap, roots, stem, semi opened umbrella shaped top.



Structure of a mushroom

Nutritional Facts

Every 100g of edible white mushroom has:

1. Energy: 93kj (22kcal).
2. Fat: 0.3g.
3. Carbohydrates: 3.3g.
4. Protein: 3.1g.
5. Water quantity: 92g.
6. They also include many types of vitamins and minerals.

Health Benefits

1. Mushrooms are rich in fiber, protein and antioxidants, also low-calorie substitutes.
2. They may also help in lowering the risk of health conditions like cancer, diabetes, alzheimers, heart disease, hypertension etc.
3. They are also great sources of selenium.

Conclusion

Knowing that mushrooms are rich and has health benefits people get excited and can consume it as a part of diet. But taking too much of mushrooms can cause some physical uneasiness. In some cases, anxiety and panic attacks like vomiting and Diarrhea can occur. Therefore, selecting good mushrooms and consuming them according to need for diet maybe helpful.

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Trichoderma viridae: A Biological Agent for Plant Protection

Article ID: 11315

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Introduction

Biological control of soil borne plant pathogens by species of Trichoderma is a vital area of plant pathological research all over the world in these days (Mukhopadhyay, 1987). *Trichoderma* is a genus of fungi in the family Hypocreaceae, that is present naturally in all soils, where they are the most prevalent culturable fungi and highly effective for the control of seed and soil borne diseases of majority of economically important crops including plantation crops. Many species in this genus can be characterized as opportunistic avirulent plant symbionts. This refers to the ability of several Trichoderma species to form mutualistic endophytic relationships with several plant species. The genus was described by Christiaan *Hendrik Persoon* in 1794 and it is named as for producing green mold.

Trichoderma species are known to utilize a wide variety of carbon and nitrogen sources for their growth and activity in soil. In the present-day agriculture, the usage of pesticides has become an indispensable component. Application of pesticides generally disturbs and alters the biological equilibrium in soil. *Trichoderma* sp. is highly interactive in root, soil and foliar environments. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion (Mannina and Segrc, 1997).

Classification

Kingdom: Fungi
Division: Ascomycota
Class: Sordariomycetes
Order: Hypocreales
Family: Hypocreaceae
Genus: *Trichoderma*
Species: *viridae*

Characteristics

The following are some of the other characteristics of Trichoderma sp.:

1. Colonies, at first transparent on media such as cornmeal dextrose agar (CMD) or white on richer media such as potato dextrose agar (PDA). Mycelium typically not obvious on CMD, conidia typically forming within one week in compact or loose tufts in shades of green or yellow or less frequently white (fig.1). Yellow pigment may be secreted into the agar, especially on PDA.

2. Conidiophores are highly branched and thus difficult to define or measure, loosely or compactly tufted, often formed in distinct concentric rings or borne along the scant aerial hyphae (fig.2). Main branches of the conidiophores produce lateral side branches that may be paired or not.

3. The longest branches distant from the tip and often phialides arising directly from the main axis near the tip. The branches may rebranch, with the secondary branches often paired and longest secondary branches being closest to the main axis. All primary and secondary branches arise at or near 90° with respect to the main axis. The typical *Trichoderma* sp. Conidiophores with paired branches assumes a pyramidal aspect.

4. Phialides are typically enlarged in the middle but may be cylindrical or nearly subglobose. Phialides may be held in whorls, at an angle of 90° with respect to other members of the whorl, or they may be variously penicillate (gliocladium-like).

5. Conidia appear like they may be held in drops of clear green or yellow liquid and smooth.

6. Synanamorphs are formed by some species that also have typical Trichoderma pustules. Synanamorphs are recognized by their solitary conidiophores that are verticillately branched and that bear conidia in a drop of clear green liquid at the tip of each phialide.

7. Chlamydospores may be produced by all species, but not all species produce chlamydospores on CMD at 20° C within 10 days. Chlamydospores are typically unicellular subglobose and terminate short hyphae; they may also be formed within hyphal cells. Chlamydospores of some species are multicellular (e.g. *T. stromaticum).*

8. Teleomorphs of *Trichoderma* sp. are species of the ascomycete genus Hypocrea. These are characterized by the formation of fleshy, stromata in shades of light or dark brown, yellow or orange. Typically, the stroma is discoidal to pulvinate and limited in extent but stromata of some species are effused, sometimes covering extensive areas. Perithecia are completely immersed. Ascospores are bicellular but disarticulate at the septum early in development into 16 part-ascospores so that the ascus appears to contain 16 ascospores. Ascospores are hyaline or green and typically spinulose.

Fig.1: Colonies of *Trichoderma* sp. in PDA

Fig.2: Microscopic Image of hyphae of *Trichoderma* sp.

Biocontrol Agent

Several strains of *Trichoderma* have been developed as biocontrol agents against fungal diseases of plants. The various mechanisms include antibiosis, parasitism, inducing host-plant resistance, and competition. Most biocontrol agents are from the species *T. asperellum*, *T. harzianum*, *T. viride* and *T. hamatum*. The biocontrol agent generally grows in itsnatural habitat on the root surface, and so affects root disease in particular, but can also be effective against foliar diseases.

This biocontrol agent i.e *Trichoderma viridae* when applied colonizes the seed or rhizoshere soil area of the crop and multiplies on the surface of the seed but also gives protection against soil borne pathogens until life time of crop by actions of mycoparasitism and antibiosis. The effective control of soil borne diseases like *Rhizoctonia solani, Macrophomina Phaseolina* and *Fusarium* spp. Makes it a very important weapon against diseases such as root rot,seedling diseases, charcoal rot, wilt, damping off, collar rot etc. In addition, *Trichoderma viridae* Enhances yield along with quality of produce. Boost germination rate. Increase in shoot & Root length Solubilizing various insoluble forms of Phosphates augment Nitrogen fixing. Promote healthy growth in early stages of crop. Increase Dry matter production substantially. Provide natural long-term immunity to crops and soil.

Recommended Crops

Trichoderma sp. is used for protecting crops such as Cauliflower, cotton, tobacco, soybean, sugarcane, sugarbeet, eggplant, red gram, banana, coconut, tomato, chillies, potato, citrus, onion, groundnut, peas, sunflower, brinjal, ginger, turmeric, pepper, betel vine, cardamom etc. against soil borne diseases.

Methods of Application

1. Seed treatment: Mix 6 - 10 g of *Trichoderma* powder per Kg of seed before sowing.
2. Nursery treatment: Apply 10 - 25 g of *Trichoderma* powder per 100 m2 of nursery bed. Application of neem cake and FYM before treatment increases the efficacy.

3. Cutting and seedling root dip: Mix 10g of *Trichoderma* powder along with 100g of well rotten FYM per liter of water and dip the cuttings and seedlings for 10 minutes before planting.
4. Soil treatment: Apply 5 Kg of *Trichoderma* powder per hectare after turning of sun hemp or dhainch into the soil for green manuring. Or Mix 1kg of *Trichoderma* formulation in 100 kg of farmyard manure and cover it for 7 days with polythene. Sprinkle the heap with water intermittently. Turn the mixture in every 3-4 days interval and then broadcast in the field.
5. Plant Treatment: Drench the soil near stem region with 10g *Trichoderma* powder mixed in a liter of water.

Trichoderma Formulations

Important commercial formulations are available in the name of Sanjibani, Guard, Niprot and Bioderma. These formulations contain 3x106 cfu per 1 g of carrier material. Talc is used as carrier for making powder formulation.

Advantages

There are some advantages of *Trichoderma viridae*:
1. Effective against seed borne diseases by eliminating the seed borne pathogen on the seed surface.
2. It gives protection to the seeds and plants through elimination of pathogens in rhizosphere region.
3. Application of *Trichoderma* formulation is safer to the environment thus promotes organic agriculture.
4. Easy to apply and safer to human and other beneficial organisms.
5. It can be combined with usage of other biofertilizer or biopesticides.
6. *Trichoderma viridae* will multiply very fast in soil and over comes residual problems also.
7. It gives protection against diseases throughout the crop period.
8. Less costly compared to chemical-based plant diseases management.
9. It also promotes the plant growth by various mechanisms.
10. Due to their capacity to attack and destroy other types of fungi as well as various other organisms such as bacteria, *Trichoderma* sp. are also used for the production of pesticides and other biological agents used to control the spread of other fungi and pathogenic organisms in agriculture.
11. As decomposers, the *Trichoderma* fungi not only make nutrients readily available for plants (biomass) but also play an important role in nitrogen and carbon cycle (important for plant development).

Precautions

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

Compatibility

1. *Trichoderma* is compatible with Organic manure *Trichoderma* is compatible with biofertilizers like *Rhizobium, Azospirillum, Bacillus subtilis* and *Phosphobacteria*.
2. *Trichoderma* can be applied to seeds treated with metalaxyl or thiram but not mercurials. It can be mixed with chemical fungicides as tank mix.
3. *Trichoderma viridae* shows compatibility with some insecticide (Mancozeb, Imidacloprid).
Anitha *et al.* (2001) screened carboxin and metalaxyl against fungal and bacterial antagonists in the laboratory and found that carboxin and metalaxyl did not inhibit the growth of *Trichoderma viridae*.

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Gerbera Cultivation Inside Poly House Under North Bihar Agro-Climatic Condition

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Introduction

Flowers are heart, soul and ornamentation of nature; it is really hard to explain the beauty and essence of flower, which is adored by everyone, even the God himself. Flowers convey us the feeling of truthfulness simplicity, purity and piousness, flowers seem to be intended for the solace of ordinary humanity and mankind. One of such flowers, out valuing all utilities of the world through its magnificent beauty, varying hues and colours is pride of nature- '*Gerbera'*. Gerbera belongs to family Asteraceae.

This group at present comprises 45 species, native to tropical Asia and Africa. About seven species were recorded in India distributed in temperate Himalayas from Kashmir to Nepal. Gerbera species of Indian origin are *Gerbera andria, G. kunzeana.* Gerbera produces attractive flowers known as 'head' or 'capitulum'. The plant is dwarf herbaceous perennial and grows in clump with solitary flower heads on a long slender stalk, which grows well above the foliage.

The leaves are petioled, entire or pinnatilo bed, coarse or sometimes tubular and two lipped. Achenes are beaked; pappus or rough bristles in two or more rows. The daisy like flowers is available in wide range of colours including yellow, red, orange, cream, white, pink, brick red, scarlet, salmon peach, maroon and various other intermediate shades.

Climatic Parameters

The ideal temperature for Gerbera flower initiation is 23°C and for leaf unfolding is 25-27ºC. The flowering of Gerbera is harmed below 12ºC and above 35ºC. The optimum humidity inside the greenhouse should be 70-75%, which will maintain the health of the plants.

Air Temperature

The temperature directly affects the crop growth due to variation in photosynthesis, respiration, absorption of water and nutrient etc. Biological reaction of most of the plants takes place between 0°C to 50°C. The plants can't sustain below 0°C due to freezing of water and above 50°C due to denaturation of proteins. The temp required for gerbera under polyhouse during day hour is 20-24°C and in night hour is 18-21°C.

Bed Preparation

The dimensions of the bed were, Bed height: 45 cm, Width of bed: 80 cm and Pathways between beds was 30 cm. Regarding nutrient application 4 Kg FYM (Farm Yard Manure), 0.5 kg castor cake and 10 gm Thimate per sqm was applied before bed preparation and 10 kg vermi compost per sqm was applied during bed preparation.

Two rows were planted on one bed at 37.5 cm distance between the rows and 27 cm distance between the plants in one row.

Fertigation Scheduled

N: P: K was applied on raised bed of soluble fertilizer @ 20:10:24 gm/sqm during vegetative growth and @ 10:12:25 gm/sqm/month during flowering period. Fertigation was done at weekly interval. Besides, micronutrient like Zn, Fe &Ca etc. was applied at fornighty interval on the basis of soil analysis. The soil is deficient in Fe and Zn.

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Planting

Six varieties of tissue cultured plant of Gerbera namely Palm beach, Debora, Orosis, Avemaria, Esmaria, and Vivian were planted in polyhouse, on Dated 16 December maintaining a plant density of 10 plant per sqm. It was planted on raised bed of size (18m×0.8m×0.45m).

		
Palm beach	**Debora**	**Avemaria**
		
Esmaria	**Orosis**	**Vivian**

Fig: Flowers of different variety of gerbera

Cost Economics

The economics of gerbera cultivation in polyhouse worked out with the help of cultivation cost and present market price of flowers. Cost of cultivation include cost of FYM, cost of castor cake, cost of planting material, cost of bed preparation and plantation, cost of fertilizers, pesticides and irrigation and cost of labour charge. While total income was calculated on the basis of total production of flowers and average market rate per flower.

Cost of cultivation = Cost of FYM, Castor cake and Thiamate + Cost of planting material + Cost of bed preparation and plantation + Cost of fertilizers, pesticides and irrigation + Cost of labour charge.

Total number of flowers = Total number of flowers per plant × Number of plants.

Gross income = Total number of flowers × Average market rate per flower.

Net benefit = Gross income – Cost of cultivation

$$\text{Benefit-Cost Ratio} = \frac{\text{Net Benefit}}{\text{Total Cost}}$$

Conclusions

Studies on the varietal evaluation of gerbera (viz., Palm beach, Debora, Orosis, Esmaria, Vivian and Avemaria) cultivation under polyhouse conditions was carried out the salient findings of the investigations are summarized hereunder.

1. The highest number of flowers per plant was produced by Palm beach (31.36) followed by Vivian (25.34), Avemaria (23.88), Orosis (23.42) and Debora (20.18). While Esmaria registered least (19.00) number of flowers per plant in 6-month-old crop.

2. Among the different genotypes studied, Avemaria (56.80) was produced largest amount of leaf per plants compared to another genotype Vivian (54.75), Orosis (46.10), Debora (43.08), Esmaria (39.20) and Palm beach (37.15).

3. Flower diameter was larger in Palm beach (12.85 cm) followed by Avemaria (12.15 cm), Debora (11.90 cm),Orosis (11.24 cm),Vivian (11.05 cm) and Esmaria (10.95 cm).

4. Esmaria (12-13 days) recorded maximum vase life compared to other cultivar studied viz. Palm beach (11-12 days), Debora (11-12 days), Vivian (11-12 days), Orosis (10-11 days) and Avemaria (9-10 days) in tap water.

5. The maximum net return was given by Palm beach (3.01) followed by Vivian (2.80), Avemaria (2.53) Orosis Debora(2.42) and Esmaria(2.30).

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Current Situation of Sugarcane Diseases in Bihar

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Abstract

On the basis of survey carried out under different sugar factories of Bihar during last three planting seasons, it is observed that due to increasing trends of so many diseases in different cane growing areas of Bihar affecting several commercial varieties, which leads to heavy losses in qualitative as well as quantitative cane parameters. Red rot, smut and wilt are the major diseases of sugarcane in Bihar. However, red rot disease of sugarcane is the most serious disease among all the diseases known to occur in Bihar. The red rot incidence ranged between 2-30%, smut incidence varied from trace to 15%, whereas, wilt incidence ranged between 2 to 80%, pokkah boeng incidence was recorded up to 10 percent in different sugar mills areas of Bihar. Incidence of bacterial diseases noticed more in ratoon crop and ranged from trace to 2 per cent while, viral and phytoplasmal diseases has been also noticed with no serious problem and its occurrence varied from traces to 5 per cent in some pockets of cane growing areas of Bihar.

Introduction

Sugarcane is an important crop in the tropic and sub-tropics, the major source of sugar, alcohol with global importance as a high valued multipurpose agro-industrial cash crop and will remain one of the major contributors to Indian economy and employment generation for rural youth. In India, it is cultivated in an area of 5.20 million ha. of land with production of 400.37 million tonnes and the average cane productivity of 76.99 tonnes per ha. In Bihar state, it is cultivated in an area of 3.04 lakh ha of land with a production of 182.85 lakh tonnes and its average cane productivity of 60.15 tonnes/ha (GOB, 2019).

The disease severely differs under different agroclimatic condition and the varieties grown in the regions. Sugarcane is vegetatively propagated crop which helps in buildup of inoculum in planting materials that favours in the development of the various diseases in the field. Besides, this long duration crop, high sugar accumulation, practice of monoculture in larger areas, heavy rainfall and humidity leads to the large number of pathogens.

In spite of several efforts were made to develop or evolve disease free varieties, the crop is suffering more from so many different diseases. Due to increasing trends of various diseases in sugarcane growing areas of Bihar many commercial varieties viz. CoSe 95422, CoSe 92423, CoS 8436, Co 0238, CoH 160, CoH 167, Co 0233, CoSe 93232, CoLK 8102, BO 145 and BO 138 were noticed affected with red rot and other diseases resulting in heavy losses to different cane parameters. Wherever, the plants are raised exhaustively, highly contagious forms of pathogens become more active which force to substitute with acceptable and resistant varieties.

More than 60 diseases in sugarcane were reported from different cane growing states of India, due to which 10-15% sugar is lost (Viswanathan and Rao, 2011) but in Bihar situation, about 15-20 diseases were observed during recent few years, out of which a few diseases viz. red rot, wilt, smut, sett rot, pokkah boeng, ratoon stunting, mosaic, grassy shoot and in some pockets of cane growing areas yellow leaf disease threatened sugarcane cultivation. Some of these diseases are of major concern because they are affecting nationwide and scattered all around which leads not only major dent in yield but also provoking serious worry because of their impacts on cane quality.

Cultivation of disease-free planting material is vital step in management of sugarcane diseases and thus we are able to manage red rot, smut and wilt diseases. However, we will not be able to overcome on all the diseases through host resistance and ultimately, we need to adopt novel strategies to manage the diseases through integrated approach. Before managing the disease first, we should have the knowledge of major sugarcane diseases in Bihar.

Sugarcane Disease Situation in Bihar

Sugarcane red rot, smut and wilt are the major diseases of Bihar. However, red rot disease is the most serious among all the diseases known to occur in Bihar which is aptly called as "Cancer" of sugarcane (Sharma and Tamta, 2015), causing considerable losses both in yield as well as juice quality. The planting of sugarcane setts having different types of infection caused drastic reduction in the sett germinability in response to especially red rot disease and the extent of reduction varied according to the types of the disease infection.

The reduction in cane weight, juice content and recovery of jaggery varied according to the levels of disease infection. With an increase in the levels of disease infection, the extent of losses in yield attributes and juice quality was also increased. This disease is responsible for the rejection of several elite clones from the cultivation (Viswanathan, 2010). Due to red rot disease considerable reduction in yield (30-100%) and in sucrose recovery (25-75%) were observed by Tiwari et al. 2010. Losses due to this disease was also observed by Minnatullah and Kamat, 2018 and they observed that reduction in Brix 16.60% to 20.80%, sucrose 31.60 to 38.26% and in juice purity 18.00 to 22.10%. Red rot disease was observed in varieties Co 0238, COH 167, Co0233, Co0235, BO 145, CoSe 95422, CoSe 92423, CoSe 8436, CoLK 8102, CoSe 93232, etc. and its incidence ranged between 5-30% during recent years in Manjhaulia, Sugauli, Riga and Gopalganj sugar factories reserved areas.

Wilt and smut diseases are another two major sugarcane diseases in the state which affect various cane parameters. Other diseases are of minor concern which appear occasionally and trigger insignificant loss. Recently, increasing trends were observed in wilt disease of sugarcane in most of the varieties grown in Bihar condition and the varieties affected with wilt are Co 0238, Co 0118, Co 0233, COH 167, BO 141, CoPant 97222, Co 92006, CoV 92102, CoH 160, etc. which ranged from 2 to 80 per cent. The disease incidence was noticed more under waterlogged areas. However, smut incidence increased upto 15 per cent in variety Co 0238. It was observed that ratoon crop was more vulnerable in comparison to plant crop. The varieties affected with smut diseases are BO 141, BO 147, BO 154, CoSe 98231, CoH 167, CoP 2061, Co 0238, Co 0118, Co 0233, CoSe 03234 and it varied from 5- 15 per cent. Pokkah boeng incidence is also increasing at an alarming pace and affecting almost all the popular commercial sugarcane varieties like Co 0238, BO 141, Co 0118, BO 154, CoP 2061, CoV 92102, CoP 9301, Co 0233, CoSe 03234, BO 153, CoSe 95422, CoS 8436, CoLk 94184 and disease incidence in these varieties were recorded upto 15 per cent.

In bacterial diseases viz. red stripe, leaf scald and ratoon stunting disease appeared. The incidence in exceptionally in traces upto 2 per cent. Ratoon stunting disease has been noticed more in ratoon crops and its incidence is one of the factors in reducing the yield. Grassy shoot disease a phytoplasmal disease has been also noticed with no serious problem so far in varieties grown in Bihar. Its occurrence upto 3 per cent in certain areas of Sidhawalia, Riga, Pusa, Hasanpur sugar factories in varieties CoJ 64, BO 147, BO 141, CoH 167, Co 0233, Co 0235 was observed under ratoon crop with overall traces in different mill areas. Yellow leaf disease incidence increased in different states of the country and the disease became a serious threat to sugarcane cultivation (Viswanathan and Rao, 2011). The data revealed that associated virus infection reduced plant growth and juice by 39 to 43 per cent and 30-34 % respectively in susceptible varieties due to impact of varietal degeneration (Viswanathan et al. 2014). In Bihar situation yellow leaf disease was noticed on varieties Co 0238, Co 0233, CoPant 97222, CoV 92102 in few clumps.

To know the disease situation and varietal susceptibilities, an extensive survey under various sugar factories of Bihar were carried out during 2018-19, 2019-20 and 2020-21 planting seasons. The following (Table 1-3) showed the different commercial varieties were affected with different diseases at different locations during the mentioned period.

Table 1: Naturally occurring diseases on sugarcane varieties during 2018-19:

Sl. No.	Varieties	Diseases	Locations/ areas
1.	CoV 92102, Co0238, Co 0233	Yellow Leaf disease (T), Smut (T) and Pokkah boeng disease (2%)	Pusa, Sidhwalia, Majhaulia, Narkatiyaganj
2.	Co 03234	Smut (2%), Wilt (5%) and Pokkah boeng disease (2%)	Majhaulia

3.	CoP 2061	Smut (T)	Kalyanpur,Pusa, Majhaulia
4.	CoLK 94184	Ratoon stunting disease (T)	Sidhwalia
5.	Co 0118	Wilt (10%) and Pokkah boeng disease (5%)	Gopalganj
6.	CoPant 97222	Wilt (20%) and Yellow leaf disease (2%)	Gopalganj, Hasanpur
7.	Co 0235	Red rot (2%) and Wilt (10%),	Majhaulia
8.	BO 141, Co 0233	Wilt (15%) and Pokkah boeng disease (2%)	Riga
9.	BO 153, BO 154	Pokkah boeng disease (2%)	Kalyanpur,Pusa
10.	Co 0238	Wilt(10%), Pokkah boeng disease (5%) and Yellow leaf disease (T)	Hasanpur

Table 2: Naturally occurring diseases on sugarcane varieties during 2019-20:

Varieties	Diseases	Locations
BO 141	Pokkah boeng (2%), Smut (2-10%) and Wilt (5%)	Riga
Co 0233	Mosaic (T), Yellow leaf disease (2%), Red rot (5%) and Wilt (10-25%),	Bankata (Gopalganj), Riga
Co pant 97222	Yellow leaf disease (T), leaf spot (2%) and Wilt (10%)	Riga, Gopalganj, Hasanpur, Pusa
Co 0238	PBD (10%) and Smut (5%)	Riga
Co 0238	PBD ((5%) and Smut (15%)	Manjhaulia
Co 0238	Wilt (20%) and Red rot (5-10%)	Sidhwalia
Co 92006	Wilt (5%) and Mosaic (5%)	Bhagwanpur (Gopalganj)
Co 0118	Mosaic (2-5%), leaf spot (25%), Wilt (10%), Yellow leaf disease (T) and Pokkah Beong Disease (5%)	Gopalganj
CoH 167	Smut (2%), Wilt (15%) and Red rot (5-10%)	Gopalpur Farm (Riga)
Co 0118	Yellow leaf disease (T), Wilt (20%) and Red rot (10%)	Belahiya , Kutirpur, MahwaBhusa, (Narkatiaganj)
CoP 9301	Wilt (2-5%)	Narkatiaganj
Co 0238	Wilt (5-15%), Yellow leaf disease (T) and Red rot (2-5%)	Raibari Mahuwa, Bariyawa (Harinagar)
Co 0238	Wilt (5-10%), Pokkah boeng disease (10%) and Yellow leaf disease (T)	Hsasanpur
BO 154	Pokkah boeng disease (5%)	Kalyanpur Farm, Pusa
CoP 2061	Pokkah boeng disease (5%) and Smut (T)	Manjhaulia
CoV 92102	Yellow leaf disease (5%), Wilt (10%), Pokkah boeng (T) and Mosaic (2%)	Pusa

Table 3: Naturally occurring diseases on sugarcane varieties during 2020-21:

Varieties	Diseases	Locations
Co 0238	Red rot (5%) and Wilt (20%)	Lauria
Co 0118	Wilt (5-10%), Pokkah boeng Disease (5%) and Red rot (5%)	Gopalganj
Co 0118	Wilt (10%) and Pokkah boeng Disease (5-10%)	Sugauli
Co 0118	Wilt (10%) and Red rot (2-5%)	Sidhwalia
Co 0238	Red rot (20%) and Wilt (40%)	Riga
CoH 167	Red rot (30%) and Wilt (50%)	Riga
CoP 2061	Pokkah boeng Disease (5%)	Pusa
Co 0238	Smut (5%) and Pokkah boeng Disease (10%)	Hasanpur
Co 0238	Red rot (30%) and Wilt (50%)	Manjhaulia

Co 0238, Co 0118 CoP 2061	Red rot (30%) and Wilt (50%) Red rot (5%) and Wilt (20%) Wilt (5%)	Madhopur (Sidhwalia)
CoH 160	Red rot (30%), wilt (80%)	Gopalpur (Riga)
BO 154 Co 0233	Smut (5%) and Pokkah boeng (5-10%) Wilt (25%), Red rot (5-10%) and Pokkah boeng (5-10%)	Riga

Conclusion

Though, diseases are affecting the qualitative as well as quantitative cane parameters and eliminating many popular sugarcane varieties from cultivation. Considering the seriousness of the diseases and recurring losses caused by the diseases there is a need to identify the various sugarcane diseases and formulate their management practices timely, which is beneficial and pre-requisite for evolving varieties resistant to sugarcane diseases.

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The Battle During Plant-Pathogenic Oomycete Infection

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Introduction

Oomycetes encompass numerous destructive pathogens in genera such as *Phytophthora*, *Pythium*, *Albugo*, *Saprolegnia*, and *Aphanomyces*, plus numerous genera of downy mildew pathogens. Oomycetes include pathogens of different lifestyles, such as biotrophs, hemibiotrophs, and necrotrophs, that have evolved distinct strategies to infect hosts. Control of oomycetes is highly challenging, as these pathogens are highly adaptable, rapidly overcoming host resistance and chemical controls and jumping to new hosts.

Plants and pathogens are engaged in a dynamic co-evolutionary struggle for survival. Over time, plants have evolved a complex and versatile immune system to ward off potential pathogens and manage potentially beneficial microbes. Therefore, in order to successfully infect plants, plant-pathogenic oomycetes have evolved large arsenals of secreted proteins termed effectors that act as weapons to promote the success of the pathogen. According to their predominant sites of action, effectors may be classified as apoplastic effectors or intracellular effectors. Apoplastic effectors of oomycetes include toxin proteins, glycosyl hydrolases, pectate lyases, proteases, protease inhibitors, lipases, and lipid-binding proteins. At least two major classes of intracellular effectors have been identified: *RXLR* effectors and *Crinkler* (CRN) effectors. *Phytophthora* and downy mildew genomes encode hundreds of RXLR effectors, but these are not present in the genomes of other oomycetes. In contrast, CRN effectors are more widely distributed in the oomycetes, being found in the Pythiaceae and in *Albugo* species (Fig. 1).

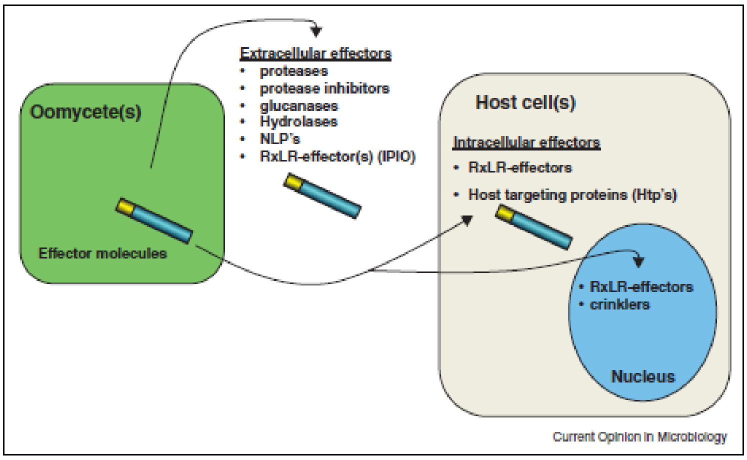

Fig.1. Location of oomycete effectors during an infection

The plant immune system consists of three layers, a recognition layer, a signal-integration layer, and a defense action layer (Fig.2). The recognition layer includes cell surface pattern recognition receptors (PRRs) that can recognize apoplastic effectors, microbe-associated molecular patterns (MAMPs; e.g., flagellin or pathogen cell wall fragments), or damage-associated molecular patterns (DAMPs; e.g., plant cell wall fragments or ATP). The recognition layer also includes intracellular receptors that can recognize intracellular effectors by direct binding, recognize complexes of host proteins with effectors, or recognize host proteins that have been modified by effectors. The signal-integration layer accepts signals from the recognition layer, as well as incoming signals from neighboring cells and distant tissues, and outputs a tuned set of signals to the defense reaction layer. The complex nature of the signal-integration layer renders it resilient to interference by pathogen effectors. The defense-action layer consists of diverse actions that can be tuned to provide protection against one or more specific pathogens, as well as modulate interactions with the ambient microbiome.

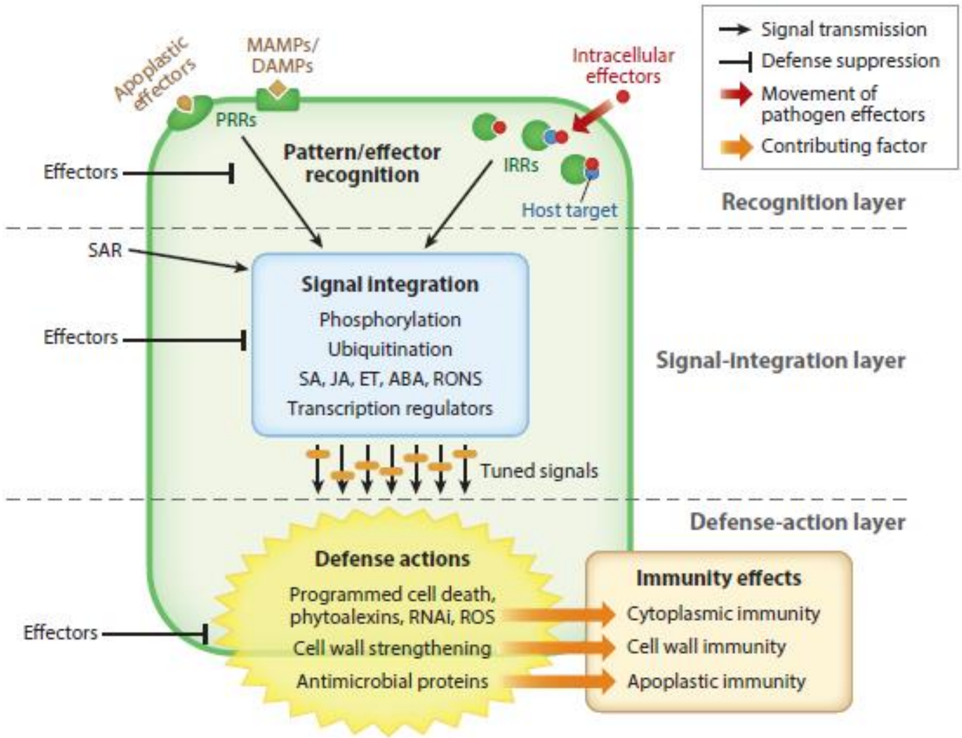

Fig. 2. Three Layered immunity: a new paradigm for understanding plant defense and pathogen counter-defense

Defense in the Extracellular Arena

The initial interaction between plants and cellular pathogens takes place in the extracellular arena, including the plant surfaces and the apoplast. Constitutive and induced physical and chemical defenses in the apoplast constitute the first line of defense against cellular pathogens. In addition, plant cells employ PRRs on their plasma membrane to directly detect molecules released by pathogens, triggering immune responses.

1. Cell Wall–Mediated Defenses: Plant cell walls are composed of complex carbohydrates including cellulose (and other β glucans), hemicellulose (xylans and xyloglucans), and pectins (including polygalacturonates), plus proteins and in some cases, lignin, cutin, or suberin. Cell walls provide a physical defense against pathogens, and they may be strengthened by deposition of lignin, suberin or callose for added defense.

2. Recognition of Oomycetes in the Apoplast via Pattern-Recognition Receptors: Plant PRRs include membrane-localized receptor-like proteins (RLPs) or receptor-like kinases (RLKs), both of which form dramatically expanded families in plants. RLKs contain an extracellular ligand-binding domain, a single-pass transmembrane domain, and a cytosolic kinase domain that transduces signals through phosphorylation of downstream signaling components. In contrast, RLPs lack the cytosolic kinase domain and often associate with RLKs to transduce defense signals. During infection, oomycetes release MAMPs and apoplastic effectors that can be recognized via PRRs.

3. Plant Apoplastic Antimicrobial Proteins That Mediate Oomycete Resistance: During infection, plants release many proteins into the apoplast that can function as antimicrobial agents. Several such proteins play important roles in defense against oomycetes.

4. Secondary Metabolites That Attack Microbes Directly: Plants produce a wide array of antimicrobial chemicals called phytoalexins (induced by infection) and phytoanticipins (constitutively produced). These may act in the apoplast, in the cytoplasm, or within regions of tissue killed by necrotrophs. Many are effective against oomycetes.

5. Antimicrobial Small RNAs: Small RNAs have emerged as a novel player in plant defense against oomycete infection. Host induced gene silencing in microbial pathogens is a small RNA–based process that can confer effective plant resistance.

Counter Defense in the Extracellular Arena

In order to counter the extracellular defenses of their hosts, pathogens produce proteins that directly interfere with host extracellular defense proteins or attack the host cell wall. In addition, they secrete intracellular effectors that can enter plant cells to interfere with defense signaling or interfere with secretion of host defense proteins. In this section, we discuss oomycete mechanisms for directly countering host extracellular defenses.

1. Inhibition of Host Glucanases: The soybean β-1, 3-glucanase A (EGaseA) attacks the *Phytophthora sojae* cell wall and releases β-1, 3-glucans that act as MAMPs, triggering immunity. As a counter, *P. sojae* produces the glucanase inhibitor protein PsGIP1, which binds to and inhibits EGaseA.

2. Inhibition of Host Serine Proteases: The apoplastic subtilisin-like serine proteases are widely distributed in plants and accumulate as a response against various microbes. In *P. infestans*, two distinct Kazal-like extracellular protease inhibitors, EPI1 and EPI10, bind to P69B and could completely inhibit its protease activity.

3. Inhibition of Host Cysteine Proteases: Papain-like cysteine proteases (PLCPs) are also central targets of oomycete extracellular inhibitors. During infection, *P. infestans* secretes several inhibitors that block the activity of PLCPs. *PiEPIC1* and *PiEPIC2B* are two cystatin-like protease inhibitor genes of *P. infestans* that are upregulated during infection of tomato. Both inhibitors physically interact with the tomato PLCPs RCR3 and C14 and inhibit their enzyme activity. PiEPIC2B also binds and inhibits *Phytophthora*-inhibited protease 1 (PIP1), another PLCP that is closely related to RCR3.

Defense in the Intracellular Arena

While the hyphae of oomycete pathogens typically proliferate in the apoplast, biotrophic and hemibiotrophic species also establish specialized hyphal intrusions into host cells, called haustoria. In addition to being major sites of nutrient acquisition, and probably because of that, haustoria appear to be a major site of effector secretion, especially for effectors targeted to the host cell cytoplasm. The cytoplasm-targeted effectors remodel cell structures and metabolism and suppress plant defense responses. To defend against these effectors, plants have evolved intracellular receptors that can sense these effectors and their disturbance of cell physiology. Effector recognition triggers a set of plant defense actions that can occur both inside and outside plant cells.

1. Intracellular Recognition of Oomycete Effectors: The recognition of specific effectors *via* specific plant receptors constitutes the molecular basis of gene-for-gene resistance. So far, the known intracellular immune receptors against oomycetes are nucleotide-binding domain leucine-rich repeat (NLR) proteins with predicted N-terminal coiled coiled (CC) or Toll/interleukin (TIR) domains, central nucleotide–binding (NB) domains, and C-terminal LRR domains.

2. Integration of Signals from Pattern and Effector Recognition: In the wild, plants interaction with a vast array of microbes and microbe-derived molecules at anyone time, including multiple pests and pathogens. Thus, plants must integrate numerous signals produced by recognition of a vast diversity of patterns and effectors. Some integration occurs at the level of common signal transduction proteins that interact with pattern and effector receptors.

3. Integration of signals from pattern recognition: For oomycete MAMPs, all of the PRRs identified so far, including ELR, RLP23, and RXEG1, are RLPs that lack a cytoplasmic signaling domain. These PRRs associate with two membrane-localized RLKs, namely BAK1 and SOBIR1, to transduce defense signaling.

4. Integration of signals from effector recognition: For several resistance proteins, effector-triggered signaling also requires helper NLR proteins that belong to the NRC (NB-LRR protein required for hypersensitive response–associated cell death) family.

5. Signal transduction cascades: Plant mitogen-activated protein kinase (MAPK) cascades regulate plant immunity by transducing signals from immune receptors to downstream components for defense activation.

6. Regulation of defense responses by plant hormones and reactive oxygen species: The hormones SA, jasmonic acid (JA), and ET are elevated upon recognition of apoplastic or cytoplasmic effectors, or of MAMPs, and play central signaling roles in regulating and integrating plant defense signals.

7. Intracellular Defenses: Programmed Cell Death: PCD is an extremely effective defense against obligately biotrophic pathogens such as downy mildews and white rusts. PCD is also highly effective in destroying haustorial cells formed by hemibiotrophs such as *Phytophthora.* PCD is a key component of the hypersensitive response, a very vigorous set of defense responses commonly resulting from intracellular effector (*i.e*., gene for- gene) recognition.

Counter Defense in the Intracellular Arena

Adapted oomycete pathogens employ diverse strategies to counter host immunity through use of their effector arsenals. The intracellular effectors constitute a very important component of these arsenals that counter components of plant immunity.

1. Countering Plant Defense by Suppression of Pattern-Triggered Signaling: During infection, oomycete pathogens secrete a substantial number of intracellular effectors that interfere with pattern-triggered signaling.

2. Countering Plant Defense via Evasion of Effector Recognition: Genetic mechanisms that allow oomycetes to evade effector recognition include complete deletion of the effector gene, silencing of the effector gene, and mutations in effectors that eliminate or diminish recognition by R proteins (usually NLRs). Some mutations in effector genes cause major changes to the proteins, such as frameshift mutations that produce truncated proteins. In other cases, where the effector protein is important to infection, minor changes to the amino acid sequence may preserve the virulence function of the effector but prevent the effector from binding to the R protein and/or the host target protein that is being guarded by an R protein.

3. Countering Plant Defense via Effector Decoys: To counter recognition, oomycete pathogens may also secrete decoy effectors that directly interfere with effector binding by NLRs.

4. Countering Plant Defense by Manipulating MAPK Signaling: As noted above, MAPK cascades are important for defense signaling. In P. infestans, the RXLR effector Pi17316 associates with a potato Raf-like MAP3K, termed StVIK, is essential for the effector to attenuate plant immunity.

5. Countering Plant Defense by Manipulating Phytohormone-Mediated Signaling: The hormones SA, jasmonic acid (JA), and ET are elevated upon recognition of apoplastic or cytoplasmic effectors, or of MAMPs, and play central signaling roles in regulating and integrating plant defense signals.

6. Countering Plant Defense via Suppression of Programmed Cell Death: PCD is a highly effective defense against biotrophic and hemibiotrophic oomycetes, especially those that form haustoria.

Circumventing Pathogen Counter Defense for Crop Disease Resistance

1. Boosting Extracellular Immunity: Extracellular immunity acts at the front line of plant-pathogen interactions. Therefore, elevating the effectiveness of extracellular immunity may lead to broad-spectrum disease resistance in the field. This could include

a. **Stacking immune sensors to broaden the recognition of oomycete pathogen:** So far, three PRRs, *ELR, RLP23*, and *RXEG1,* have been identified that recognize oomycete MAMPs. Overexpression of each confers enhanced resistance to *Phytophthora* pathogens, despite the presence of multiple antagonistic *Phytophthora* effectors that suppress downstream signaling. For example, overexpression of *Arabidopsis* RLP23 conferred enhanced resistance to *P. infestans* in potato. These observations suggest opportunities to incorporate multiple distinct PRRs as sensors of microbial infection, to broaden the recognition of pathogens by crops and increase basal resistance.

b. **Modulating signal-transduction pathways to boost defense responses:** PRRs do not work alone but integrate with other partners such as BAK1 to fine-tune defense signal transduction through the signal-integration layer. Several plant RLKs, such as BIR2 and BIR3, were found that associate with BAK1 and negatively regulate defense signaling There are also positive regulators of pattern-triggered defense, such as FER, FIR, or ISO1, that promote BAK1 interaction with PRRs. Therefore, manipulation of regulators such as BIR2, BIR3, FER, FIR, and ISO1 may further strengthen pattern-triggered defenses against a broad spectrum of microbial pathogens.

c. Increasing the activity of apoplastic antimicrobial proteins: Modifying apoplastic antimicrobial proteins might contribute to coping with pathogens and their virulence factors. For example, tomato cysteine protease RCR3 evades inhibition by *PmEPIC1* from *P. mirabilis*, the sister species of *P. infestans*. This observation suggests the possibility to edit the sequences of RCR3 that are essential for *PiEPIC1* binding while not affecting antimicrobial activity.

2. Increasing the Sustainability/Durability of Intracellular Resistance: Effector-triggered resistance is often cultivar specific since the corresponding effectors are race or isolate specific. Therefore, expanding the recognition spectrum of the resistance gene products may lead to improved plant intracellular resistance. One strategy may be to identify and combine new resistance genes that target essential, well-conserved effectors. Targeting virulence-essential effectors might slow the appearance of isolates able to avoid those resistance genes. Another potential, but unproven, strategy would be to expand the recognition spectrum of resistance gene products by genome editing. To defend against effectors that target host susceptibility proteins, host target modification may be a promising strategy.

3. Challenges: Although genetic editing techniques offer powerful new tools, deployment of resistance genes to engineer durable disease resistance still faces many challenges. The increasing introgression of new host resistance genes into crops places strong selective pressures on oomycete pathogens, which may result in rapid evolution of virulence. In addition, extensive activation of plant defense may create a fitness penalty on crop yield. Moreover, development of plant resistance should also consider the surrounding biological community, namely the microbiota. For example, it was observed that infection of *Arabidopsis* by *H. arabidopsidis* promotes the accumulation of beneficial microbes in the rhizosphere that function synergistically in activating plant systemic disease resistance. Furthermore, since many MAMPs, such as nlp20 and XEG1, are conserved across different microbial taxa, expanded expression of PRRs to increase plant resistance may disrupt interactions between the microbiota and plants.

Conclusions and Future Directions

Plant-pathogen interaction studies, including those with oomycetes, are oriented to answer two basic questions, namely, how does plant immunity protect plants from infection, and how do pathogens overcome plant immunity. Oomycete diseases have tremendous impacts on global agriculture. Given the increased understanding of molecular plant-oomycete interactions, it is reasonable to consider how to exploit these mechanisms in plant breeding for sustainable control of oomycete diseases. Especially, the development of genetic editing technologies, such as CRISPR/Cas, allows targeted modifications of the plant immune system. To further strengthen our knowledge of oomycete-plant interactions, future studies should focus on (a) the physiological effects of plants' defense actions on oomycete pathogens, especially on the deployment of their apoplastic and intracellular effector repertoires; (b) the global set of interactions among oomycetes, plants, other biotic players, and the physical environment that occur in natural settings; and (c) the evolutionary potential of oomycete pathogens to evolve new counterdefense strategies, for example, through epigenetic plasticity.

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Overview of Rice Gall Midge: *Orseolia oryzae*

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Identification of Pest

1. Eggs: Female fly lays elongate, cylindrical, white or reddish pink eggs singly or in clusters at the base of the leaves.
2. Maggot: These are 1 mm long, creamish after hatching with pointed anterior end. It pupates in silver shoots.
3. Pupa: At the time of emergence, it wriggles to the tip of the onion shoot with its antennal horn.
4. Adult: Fly is yellowish brown, mosquito like where males are ash grey in colour.

Nature of Damage

Rice gall midge, *Orseola oryzae* Wood-mason (Cecidomyiidae; Diptera) is a major pest of paddy crop in Southern and Southeast Asia because of its ability to grow on the weeds and destructiveness at critical stages of crop growth viz., tillering, booting stages with sometimes infestation is being noticed from nursery. The gall midge remains inactive as a pre-pupa in wild rice or weeds during the dry season. At the onset the monsoons, it becomes active and completes one or two generation in grasses before it moves to the rice crop.

1. Maggot irritates the tissues of leaf sheath
2. Produces cecidogen
3. Leaf sheath walls grows together to form a gall (silver shoot or onion shoot)
4. Culm stops developing therefore gets stunted and the so developed tillers will not give panicle.
5. Produces more tillers under certain conditions.

	
Maggot	**Pupa**
	
Adult midge	**Silver shoots**

Factors for Flaring Up

1. May/June rainfall triggers emergence of adults.
2. Expanded transplanting window.
3. Continuous rainfall and cloudy conditions.

4. Growing susceptible varieties.
5. Availability of Weed hosts in off-season and lack of natural enemies.

Management

1. As it is a major pest of kharif paddy, early transplantation has to be followed.
2. Based on the biotype existence over that particular area, suitable resistant varieties of paddy need to be selected.
3. ETL: 10% Silver shoots.

Botanical Control

Two sprays of Neem Baan (1.0% EC) at 20 days of interval gave good control of silver shoot over untreated plots (Kumari and Prasad, 2020) while soap nut extract + neem oil @ 2.5+2.5% (17.0% silver shoots) was found superior followed by *Randia spinosa* @ 5%, *Gnidia glauca* leaf extract @ 5% and nimbecidine @ 3 ml/l which recorded a mean of 23.1%, 23.2% and 24.9% silver shoot, respectively (Archana et al., 2018).

Biological Control

Within the consecutive planting areas, infestation by the rice gall fly is extremely low, thanks to high activities of parasites and predators which are *Platygaster oryzae*, egg-larval parasite, *Neanastathus oryzae*, larval parasite, and *Amblyseius imbricatus*, egg predator.

Insecticidal Control

1. Organophosphates: Application of phorate 10G @ 1.00 kg a.i. ha-1 gave good control of silver shoots (Rani and Venkatesh, 2018).
2. Seedling root dip with chlorpyriphos @ 200 ml/ 200 liters of water gives good management in early stages of crop growth.
3. Carbamates: Application of carbofuran 3G @ 1.0 kg a.i. ha-1 at 10 DAS and 10 DAT has exhibited highest per cent reduction of silver shoots over control with 64.74, 68.0 and 60.19 per cent at 30, 40 and 50 DAT during Kharif and with 65.63, 72.93 and 77.55 per cent at 30, 45 and 50 DAT during Rabi, (Rani and Padmalatha, 2019).
4. Phenyl pyrazoles: Archana et al., (2012) reported fipronil 5 SC @ 75g a.i/ha treated plot had shown lower number of silver shoots (2.6% incidence).
5. Diamides: ready mix combination product of flubendamide 240 SC + thiacloprid 240 SC (i.e. 480 SC) applied as foliar spray @ 250 ml/ha helps in reducing the incidence of silver shoot upto 3.09% (Kumari et al., 2018).

Conclusions

Based on pest severity or ETL (Economic Threshold Level), plant protection measures have to be followed. Application of insecticides at indiscriminate levels leads to development of resistant strains (biotypes in this case) and residues over the food grains. So ETL based studies are important for effective control of insect pests. Gall midge can be controlled efficiently by integrating both chemical and genetic resistance in endemic areas.

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Ideas for Drought-Tolerant Landscape in Dry Land

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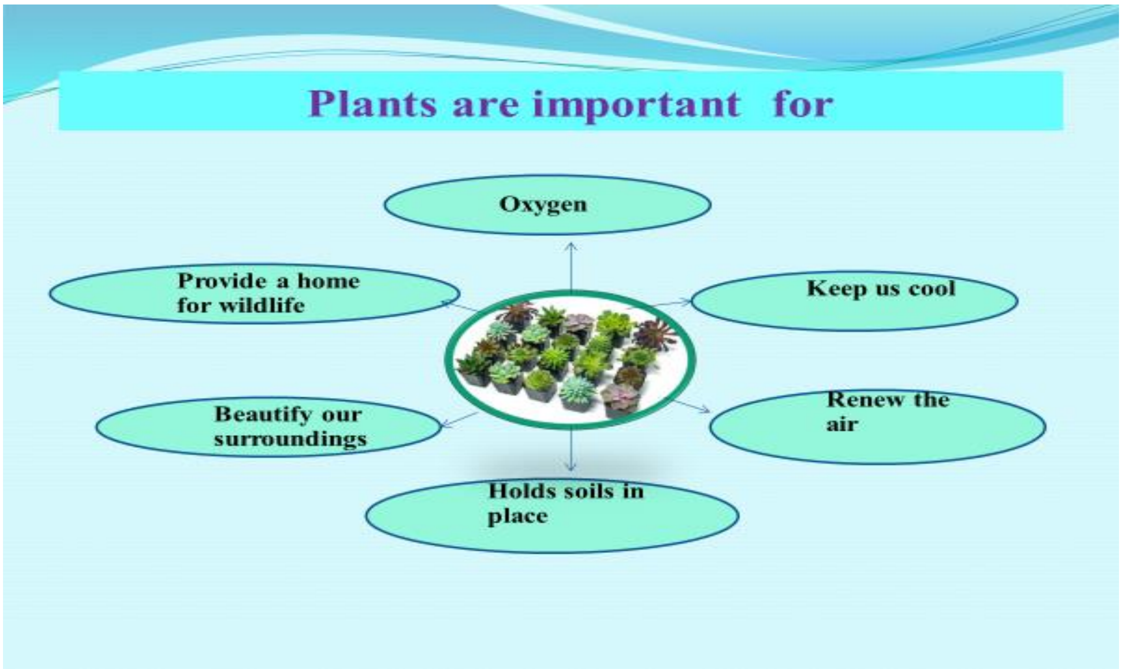
Landscape

Landscaping is an art of beautifying a piece of land or a landscape with planting material, non-living material in order to create a picturesque effect or to imitate nature. Landscaping makes a place more peaceful, beautiful, appealing or pleasing, where people can rest and enjoy with their family and friends.

Ideas for Drought-Tolerant Landscape

1. Replace your grass with artificial grass: Grass is the largest water waster in the yard and it's the high maintenance item. On top of the watering there's the mowing, mulching, aerating, fertilizing and re-seeding or re-sodding. There are a lot of realistic artificial grass options with varying amounts of multi-colored hatch.



2. Replace your grass with gravel and stone: Artificial grass looks more like the real deal than ever before, but a gravel, stone and paver garden give the garden a contemporary, minimalist look. It's still low maintenance (and requires zero water) and is a great counterpoint to succulents and a fire pit.

Fig. 1. grass with gravel and stone

3. Use succulents in garden design: Plants that have some parts that are more than normally thickened and fleshy, usually to retain water in arid climates or soil conditions. The way combining many different types of succulents in the same garden adds amazing texture and colour. We are particularly obsessed with aloe vera, burro's tails, hens and chicks.

4. Grow plant ornamental grasses: Many types of grasses that aren't average green blanket lawn grasses but are drought-tolerant and perfect for a low-water garden. Some of the most beautiful and low water ornamental grasses worth adding are:

a. Little Bluestem (grey-green blades that go to shades of purples and red).
b. Fountain Grass.
c. Blue Oat grass.
d. Purple Fountain grass.
e. Blue Fescue.
f. Pampas Grass.

When planting grasses, mix it up: Use both tall and short grasses along with a few of the more colorful grasses thrown in for pop.

5. Grow perennial flowers: It's possible to create a colorful drought-tolerant landscape simply by selecting the right assortment of succulents and colorful grasses. But if you love seeing flowers in your landscape, go for perennials that are sturdier and require less water:

a. Blanket flower (red, yellow and orange daisy-like flowers)
b. Russian Sage (fragrant, delicate silver leaves with fine lavender-color flowers)
c. Yarrow (normally yellow flowers, but there are other color varieties available)
d. Salvia (bold crimson-red blooms)
e. Lavender (fragrant and colorful) and
f. Kangaroo Paw (exotic plant with beautiful, bright red, orange or yellow velvety flowers).

Importance of Landscape in Dry Area

1. Reduces soil erosion.
2. Increase tourism places.
3. Increase aesthetic enjoyment.
4. Increase beautification.

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Mitigation Options for Methane Emission in Agriculture

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Landscape

Methane is about 25-times more effective than CO_2 as a heat-trapping gas. Main sources of methane are: wetlands, organic decay, termites, natural gas and oil extraction, biomass burning, rice cultivation, cattle and refuse landfills. The primary sources of methane from agriculture include animal digestive processes, rice cultivation and manure storage and handling. The main sinks of methane are soil and removal in the stratosphere. Methane is produced as a by-product of the digestion of feed in the rumen under anaerobic condition in ruminant animals.

Methane is also formed in soil through the metabolic activities of a small but highly specific bacterial group called methanogens. Their activity increases in the submerged, anaerobic conditions developed in the wetland rice fields, which limit the transport of oxygen into the soil and microbial activities render the water-saturated soil practically devoid of oxygen.

Drivers of Emission

1. Increased livestock numbers linked to increased demand for animal products.
2. Area under agriculture.
3. Deforestation.
4. Use of fertilizer.
5. Area under irrigation.
6. Per capita food availability.
7. Consumption of animal products.
8. Increased human and animal populations.

Table 1: Greenhouse gas emission from Indian agriculture (Pathak et. al., 2010):

Source	CH_4	N_2O m t	CO_2 eq.
Enteric fermentation	10.10	-	212.09
Manure management	0.12	-	2.44
Rice cultivation	3.37	-	84.4
Agricultural soil	-	0.22	64.7
Crop residue burning	0.25	0.01	8.21
Total	13.84	0.23	371.68

Mechanisms for the Transfer of CH_4 from Paddy Soil to the Atmosphere

1. Ebullition (in bubbles from paddy soils).
2. Diffusion (across the water surface).
3. Rice plant aerenchyma (Release to the atmosphere through the shoot nodes: most important emission mechanism accounting for more than 90% of the total CH_4 emission from rice fields.

Mitigation Options in Agriculture

1. Selection of varieties: There are large differences in methane transport capacity (MTC) of rice plants during different growth stages and among cultivars. Root and aboveground biomass determine MTC during initial vegetative growth in all cultivars, except in hybrids where it is directly related to growth during the entire plant development. Tiller number is a major controlling factor of plant-mediated CH_4 transport rates in widely different cultivars. Therefore, plants with less biomass and fewer tillers could minimize CH_4 emission. Cultivation of new plant type cultivars that have the minimum tiller number, higher proportion of productive tillers and larger panicles (more grains) on each tiller and that can transport less amounts of

CH_4 seems to be an economically feasible, environmentally sound and promising approach to mitigate CH_4 emissions from rice fields (Aulakh *et. al.*, 2000).

Use of high-yielding cultivars with low photosynthate carbon translocation towards root would result in lower CH_4 emission. Rice cultivars having higher photosynthate carbon allocation capacity to rice grain and lower translocation of carbon to root for methanogenes might help to reduce methane emission from paddy fields without compromising the grain yield. Development of new plant type of rice with balance source and sink capacity may be important in mitigating methane emission from paddy field (Kaushik and Baruah, 2008).

Exudate quality and quantity influence the rate of methane generation, as the root exudate contributes the substrate for methane formation in rice fields. So, there will be variable number of exudates utilized in methane formation in the rhizosphere of different cultivars. In general, increase in emission of methane recorded along with the increase in plant biomass (Nirmali *et. al.*, 2008).

2. Tillage: Reduction in tillage (minimum tillage or no tillage) protects organic matter from microbial attack in soil aggregates which could reduce the productions of CH_4 and N_2O. Also, gas diffusivity depends inversely on bulk density. Therefore, gases which are generated at greater soil depths take more time to travel towards the atmosphere. This provides more time to consumers to act on the gaseous molecules thereby improving efficiency of consumption (Divya *et. al.*, 2012).

Dipak Kumar *et. al.*, (2016) reported that adoption of zero tilled wheat followed by direct seeded rice could significantly reduce global warming potential per unit of crop yield. Grain yield under zero tilled wheat treatments was higher as compared to conventional tilled wheat. On an average, about 5 per cent higher yield was obtained under zero tilled wheat treatment.

3. Methods of establishment: The activity of CH_4 producing bacteria was less and thus CH_4 production was much lower under system of rice intensification (SRI) due to maintenance of aerobic conditions and as a result of alternate wetting and drying in SRI, there is saving of 6 and 4 irrigations over conventional and double transplanted rice respectively (Priyanka *et. al.*, 2013).

Dileep Kumar (2017) found that aerobic rice with drip fertigation recorded significantly lower methane emission (19.13 kg ha^{-1}) than conventional method (95.19 kg ha^{-1}). The reduction in methane emission under aerobic method may be attributed to an increase in soil redox potential (Eh) and proper aeration of soil and more activity of beneficial microbial activity and lack of anaerobic condition which makes inactivity of methanogenic bacteria leading to mitigate methane emission.

4. Nutrient management: Sulphate containing fertilizers are known to decrease CH_4 emission because of the competition between the sulphate reducing bacteria and methanogens for the substrates, hydrogen and acetate. Increase in the application of rate of ammonium sulphate from 45 to 135 kg ha^{-1} (compared to conventional rate of 90 kg ha^{-1}) decreased CH_4 emission and increased rice yield under field conditions (Kazunori *et. al.*, 2006). Bharati *et. al.*, (2000) found that lowest efflux of methane in rice (20.62 kg CH_4 t^{-1} grain yield) was recorded in the plots where *Azolla* was grown as dual crop. This could be related to the release of oxygen in the standing water by the growing *Azolla* leading to less reduced conditions in the soil.

Integrated application of chemical nitrogen with cyanobacterial mixture, *Azolla microphylla* or cyanobacterial mixture plus *A. microphylla* to rice fields led to increase methane oxidation by soil cores over that with chemical nitrogen alone, irrespective of the level of chemical nitrogen applied. Oxygen, released during photosynthesis by cyanobacteria into the standing water, can diffuse into the soil and provide aerobic conditions, not congenial for methanogenesis (Radha *et. al.*, 2002). Fresh biochar application (2.8 t ha^{-1} annually) significantly increased methanotrophs abundance. It exerted great influence on the microbial community within the microzone, which was due to the liming effect and enriched nutrients introduced by biochar, which provides better habitat for microorganisms (Qiong *et. al.*, 2020).

5. Irrigation: Intermittent wetting and drying resulted in a sharper decline in the emission of CH_4 , due to drying of soil which made the soil aerobic and inhibit CH_4 emission in rice-wheat cropping system in Indo-Gangetic plain (Pathak *et. al.*, 2003). Maninder *et. al.* (2011) reported that the methane flux was reduced to half (1.02 and 0.47 mg m^{-2} hr^{-1}, respectively in 2005 and 2006) when rice fields were irrigated 2-3 days after infiltration of flood water into the soil. Irrigating the field at 0.15 bar matric potential reduced seasonal methane flux by 60% (0.99 and 0.41 mg m^{-2} hr^{-1}, respectively in 2005 and 2006) as compared to completely flooded conditions, without any decline in grain yield (60 q ha^{-1}).

Prolonged mid-season drainage proved effective in reducing CH_4 emissions at sites where organic matter such as crop residue was added to the soil. It was also effective in reducing the net global warming potential as compared to conventionally adopted mid-season drainage (Masayuki *et. al*., 2011).

Mitigation Options in Livestock

1. Improved feeding practices e.g; feeding more concentrates, replacing forages.
2. Specific agents and dietary additives e.g; Ionophore antibiotics, halogenated compounds, probiotics, vaccines against methanogenic bacteria etc.
3. Longer term management changes and animal breeding.

Biomethanation of Agricultural Residues

Biomethanation or anaerobic digestion is a biological approach whereby anaerobic microorganisms decompose biodegradable substrate into biogas, nutrients and additional cell matter. Biomethanation of agricultural residues can be regarded as one of the most propitious energy bearers for future as it can manage the huge agricultural waste generated, abate the GHG emissions, improve the soil fertility (by using the biodigestate as fertilizer) and above all to meet the soaring energy demand.

Table 2: Energy potential and greenhouse gas emissions reduction potential of various substrates (Dar et. al., 2021):

Feedstock	Energy (biomethane) generation		Greenhouse gas emissions reduction	
	Current (bcm)	Potential (bcm)	Current (Mt CO_2 eq. $year^{-1}$)	Potential (Mt CO_2 eq. $year^{-1}$)
Crop residues	22.31[a]	357.85[b]	89	979
Food waste	2.87[e]	98.98[d]	16	535
Energy crops	30.4[e]	425.51[f]	81	1129
Livestock manure	14.02[g]	326.73[h]	47	1096

bcm: billion cubic metres.
Mt CO_2 eq.: Metric tonne CO_2 equivalent.
a, b- 5 and 80 % sustainable recovery rates of crop residues (rice, maize, wheat, barley, oats, rapeseed, sugarcane, sorghum and sugar beets), respectively.
c, d - 2 and 68.5 % food waste capture rates, respectively.
e, f - 0.5 and 7 % of agricultural land under energy crops production, respectively.
g, h- 3 and 70 % manure capture rates, respectively.

Conclusion

1. Cultivation of new plant types cultivars that have minimum number & higher proportion of productive tillers and transport less amounts of CH_4 are promising approach to mitigate CH_4 emissions from rice fields
2. Dual cropping of Azolla in conjunction with urea can be used as a practical mitigation option for minimizing CH_4 flux from flooded paddy
3. Biochar application can be promising and sustainable for achieving long term mitigation of CH_4 emission in paddy fields.
4. The seasonal CH_4 emissions and GWPs can be suppressed by employing alternative water-management strategies
5. Genetic selection of animals, vaccination, probiotics, prebiotics and plant improvement are promising for methane emissions mitigation.

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Feeding Management in Poultry

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Introduction

Poultry farming is the form of animal husbandry which raises domesticated birds such as chickens, ducks, turkeys and geese to produce meat or eggs for food. It has originated from the agricultural era. In Poultry, mostly chickens are farmed in great numbers. More than 60 billion chickens are killed for consumption annually (Global Animal Slaughter Statistics and Charts, 2018). Chickens raised for eggs are known as layers, while chickens raised for meat are called broilers. India ranks 3rd in egg production and ranks 5th in chicken meat production.

The 70% of total cost of production includes feed cost. So, to have a best profit from poultry farming without harming nutritional quality of feed, better feed management is needed. The quantity of feed, and the nutritional requirements of the feed, depends on the weight and age of the poultry, their rate of growth, their rate of egg production, the weather, and the amount of nutrition the poultry obtain from foraging. There are many specifications are formulated for poultry feeding which Mainly include NRC (National Research Council) BIS (Bureau of Indian Standards 2007). In this article feeding specifications of poultry and various strategic in feeding management for sustainable poultry production are concentrated in order to improve the performance of birds.

General Principles of Feeding in Poultry

1. Poultry feed should contain all essential nutrients like protein, fat, carbohydrates, energy, fibre, minerals, vitamins & moisture in proper proportion depending on type, category of bird & season.
2. The feed should be free from all pathogenic organisms like salmonella, E coli, etc & also devoid of toxins like gossypol, aflatoxin, etc.
3. The finished feed should not be stocked for more than 1 to 1.5 months to avoid loss of nutrient & to prevent development of rancidity, fungal growth, moulds & also spoilage by rodents.
4. Formation of cakes in feeders should be avoided to stop the growth of fungus & moulds in feeders.
5. Feeders should not be filled more than 1/3rd to ½ level to control wastage.
6. The nutrient level should be changed as per need of season.
7. Minimum two feedings in the form of all mash or pellets are good for optimum consumption & to ensure correct intake of micronutrients.
8. Poultry birds at any stage should not be under or over fed.

Methods of Feeding

1. Whole grain feeding method: This is the traditional practice of feeding in the backyard poultry in villages. The birds are allowed free roaming and grains are fed at home. As poultry are reared at present on commercial lines, this system has no relevance. However, with the craze for organic 'natural' eggs now, this system of feeding is coming back.

2. Grain & mash feeding method: Mash means a mixture of grounded feedstuffs. Whole grain feeding is supplemented with high protein mash mixture to provide additional feeding. Mash also helps to provide vitamins and minerals that may be deficient in the all grain feeding system. This is not a common practice, but can be used for improving feeding levels of backyard poultry.

3. All mash feeding method: This is the most common system practiced at present. This comprises of a mixture of ground grains, millet feeds, and protein and mineral/vitamin supplements combined in calculated proportions to meet the nutrient requirements of the birds. It is an all-in- one type of complete

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feed. Different mashes with different protein and energy levels are prepared for very young chicks – starter mash, for growing birds – grower mash, for layers – layer mash and for layers and broiler mash for broiler birds are prepared. Mash is the common method of feeding large-scale commercial poultry complexes. If stored for long period occurrence of mycotoxicosis is the main disadvantage in this type of feed.

4. Pellet feeding method: Pellets are made from mash, which is then heated and compressed into a hard compact pellet. Chicken feed pellets are designed to be a complete feed, with the right levels of proteins, vitamins and minerals. Because pellets are larger and more difficult to digest, they are generally used for adult hens and not for young chicks or pellets. As the feed is heat treated occurrence of mycotoxicosis can be avoided.

5. Crumble form of feeding method: Crumbles are made from whole pellets, which are cracked or rolled into a smaller size. Chicken Crumble is designed to be a complete feed, with the right levels of proteins, vitamins and minerals. Crumble is a popular choice for pullets (teenage chickens) as a transition from mash to pellets. However, crumble is also used as feed for chicks and laying hens.

	
Fig1: Mash Feed	**Fig2: crumbles Feed**
	
Fig3: Whole grains Feed	**Fig4: pellets Feed**

Feeding Systems in Poultry

1. Ad-libitum feeding.
2. Controlled feeding/ Restricted feeding.
3. Supplementary feeding.
4. Forced feeding.

Methods of Ration Restriction

1. Skip-a-day method: not fed for one day in a week.
2. Feeding limited quantity every day: measured feed is given once a day usually in afternoon. This is the best method of ration restriction.
3. Reducing feeding time: by increasing dark hours or taking off feed.
4. Limiting nutrient intake: protein & energy intake is limited by diluting the feed with more fibre content.

Advantages of Restricted Feedings

1. Delays sexual maturity & onset of egg production by few days to 3 or 4 weeks depending on level of restriction.
2. Reduces body weight of bird at sexual maturity usually by reducing the amount of fat deposition.
3. Reduces cost of growing pullet & results in better liveability during egg production.
4. Increases the size of initial eggs laid as age is an important factor to regulate the size of eggs.

5. Careful feed restrictions result into overall better economy with birds fed ad libitum.

Ad-Libitum Feeding

In this system feed is always available and the bird can eat at will. Ad-libitum feeding is practiced in broiler chicken where maximum body weight is the ultimate goal for rearing the birds. Ad-libitum feeding is easy to manage. Feed can be supplied for several days at a time and needs no monitoring or supervision of the bird's daily intake. In this system a bird regulates its total intake themselves. Due to the higher cost of feed ad-libitum feeding system is not of very great interest.

Forced Feeding

Applied in poultry if feed and water are denied for more than 36 hours to prevent dehydration and save life. Mash water mixture, skim milk, hydrolysable protein, medicine etc. can be used. Rubber catheter or smooth tube may be applied to force the slurry down the gullet below the wind pipe entrance. Commonly practiced in turkey.

Supplementary Feeding

Improving the nutritional quality of poultry feed by supplementing minerals, vitamins, and amino acids are essential to maintaining a healthy, valuable flock. There are three main groups of nutritional supplements that can be added to poultry feed: proteins and amino acids, vitamins, and minerals. These groups can be broken down further to come up with the five most common types of poultry feed supplements: Electrolytes, Amino acids, Vitamins, Minerals, Probiotics and fermentation products. Using a healthy balance of poultry feed additives and supplements will ensure your flock can thrive and bring production levels back to optimal levels.

Feeding of Layers (As per BIS 2007)

1. Chick feed for layer (CFL): A ration to be fed to chicks. intended for egg production, from 0 to 8 weeks.

2. Grower feed for layer (GFL): A ration to be fed to growing chickens, intended for egg production, from 9 to 20 weeks or until laying commences.

3. Layer feed for phase–I (LFP-I): A ration to be fed to laying birds from 21 weeks to 45 weeks.

4. Layer feed for phase –II (LFP-II): A ration to be fed to laying birds from 46 weeks to 72 weeks.

Note: Phase II and I feed in Layer cycle is necessary because there are changes in production, egg size, requirement of calcium, efficiency of digestion, age. etc.

Table 1: Layer feed specification:

Sl. No.	Characteristics	Layer feed			
		CFL	GFL	LFP-I	LFP-II
1.	Moisture (% by mass) max.	11	11	11	11
2.	Ether extract (% by mass) min.	2	2	2	2
3.	CP (% by mass) min.	20	16	18	16
4.	CF (% by mass) max.	7	9	9	10
5.	Acid insoluble ash (% by mass) max.	4	4	4	4.5
6.	Salt (% by mass) max.	0.5	0.5	0.5	0.5
7.	Metabolizable energy (kcal/kg) min.	2800	2500	2600	2400
8.	Calcium (% by mass) min.	1	1	3	3.5
9.	Phosphorous (% by mass) min.	0.7	0.65	0.65	0.65
10.	Methionine (% by mass) min.	0.4	0.35	0.35	0.3
11.	Lysine (% by mass) min.	1	0.7	0.7	0.65
12.	Aflatoxin B1 (ppb) max.	20	20	20	20
13.	Methionine + cystine (% by mass) min.	0.7	0.6	0.6	0.55

Feeding of Broilers (As per BIS 2007)

1. Broiler Pre-starter Feed (BPSF): A ration to be fed to chicks, intended for meat production and to be used from 1st to 7 days.

2. Broiler Starter Feed (BSF): A ration to be fed to growing chickens, intended for meat production, from 8 to 21 days.

3. Broiler Finisher Feed (BFF): A ration to be fed to growing chickens, intended for meat production, from 22 days to finish.

Table 3: Broiler feed specification:

Sl. No.	Characteristics	Broiler feed		
		BPSF	BSF	BFF
1	Moisture(% by mass) max.	11	11	11
2	Ether extract (% by mass) min.	3	3.5	4
3	CP (% by mass) min.	23	22	20
4	CF (% by mass) max.	5	5	5
5	Acid insoluble ash (% by mass) max.	2.5	2.5	2.5
6	salt (% by mass) max.	0.5	0.5	0.5
7	Metabolizable energy (kcal/kg)min.	3000	3100	3200
8	Calcium (% by mass) min.	1	1	1
9	Phosphorous (% by mass) min.	0.7	0.7	0.7
10	Methionine (% by mass) min.	0.5	0.5	0.45
11	Lysine (% by mass) min.	1.3	1.2	1.0
12	Aflatoxin B1 (ppb) max.	20	20	20
13	Methionine + cystine (% by mass) min.	0.9	0.9	0.85

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Tips for Successful Cultivation of Kharif Fodder Crops in Punjab

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Livestock rearing plays a significant role in the economy of India. However, supply and production of quality animal products is a challenge faced by farmers and entrepreneurs due to poor availability of quality fodder. To bridge the gap between fodder demand and supply, intensive production system with improved inputs is desirable. The human population is growing rapidly which increases pressure on livestock to meet the animal products (milk, meat, wool etc.) demand. For higher productivity of livestock, it is essential to provide green fodder to the livestock. The poor quality of green forage not only reduces milk quality but also affects the animal health. Forage quality mainly depends on its genetic trait; however, it can be improved by implying improved agronomic practices viz., timely/adequate tillage operations, optimum nutrient management, sowing at right time with adequate seed rate, intercropping system, timely water management, weed management and harvesting at right stage.

Table1: Crop Varieties, seed rate, time of sowing, green fodder yield and characteristics.

Crop	Seed Rate (kg/acre)	Time of sowing	Green Fodder (GFY) Yield (q/ac)	Remarks /Characteristics
Sorghum				
SL 44 (Single-cut)	20-25	March to July	240 q(GF)	Sweet, juicy and thin-stemmed and suitable for cultivation in irrigated areas. Fodder is green and sweet. Has a high content of digestible dry matter?
Punjab Sudax Chari 4 (Multicut variety)	15	April to May	445 q(GF)	Plants are tall with broad leaves and ready for first cut after 60 DAS. Gives three good cuttings. Moderately resistant to leaf spots and shoot fly.
Punjab Sudax Chari 1 (Multicut variety)	15	do	480 q (GF)	Stems are tall, has long broad leaves, juicy and sweet. It is tolerant to red-leaf spot disease and gives 3 cuttings
Bajra				
PCB 165	6-8	March to August	234 q (GF) and 86q of Stover	Quick growing dual purpose with a greater number of tillers. Plant tall with average height and late maturing.

				Good fodder quality possessed more crude protein. Tolerant to all major diseases.
PHBF 1	do	March to August	256 q (GF)	Plants attain a height of 198 cm with succulent stem, multicut nature, better in tillering and has long and broad leaves. Tolerant to major diseases and pests. Better fodder quality than FBC-16 in terms of dry matter intake, digestible crude protein and total digestible nutrients.
PCB 164	do	March to August	210 q(GF) and 59 q dry fodder	Quick growing having medium stalks and flexible stem with average plant height of 207 cm. Plants remain green till maturity with good nutritional quality Tolerant to downy mildew.
FBC 16	do	March to August	230 q (GF)	Provides green fodder for a longer period. Have a average height with long and broad leaves which remain green at maturity and tolerant to major diseases. Higher voluntary dry matter intake and contains low number of oxalates.
Maize				
J 1007	30	March to September	168 q(GF)	Plants are tall with broad leaves and possess better fodder nutritional characters, ears long, thick and cylindrical, grains are white, bold and semi flint to semi dent. Moderately resistant to maydis leaf blight and charcoal rot.

J 1006.	do	do	165q	Plants are tall, vigorous and broad leaved. Moderately resistant to maydis leaf blight and brown stripe downy mildew diseases. Ears are long, thick and cylindrical. The grains are white, bold and semi-flint to semi-dent.
Napier bajra				
PBN 342	11000slips of stem and root	April late sown in May roots die	877q	Leafy hybrid with long, smooth, non-hairy and broad leaves. Sprouts earlier in spring and remains in vegetative growth till the onset of winter.
PBN 346	do		715q	Leafy hybrid with long, smooth, non-hairy and broad leaves. It sprouts earlier in spring and remains in vegetative growth till the onset of winter. The silage quality of this hybrid is better than PBN 233.
PBN 233	do		1100q	Non-hairy with smooth long and broad leaves. It maintains its active vegetative growth for longer duration than PBN 83 because it sprouts earlier in spring and remains in vegetative growth up to onset of winter. Its' winter dormancy period is about 15 days less than PBN 83.
PBN 83	do		960q	Non-hairy, smooth-leaved fast growing and late-flowering hybrid. It maintains its active growth longer in winter and sprouts earlier in spring.
Guinea grass				
PGG 518:	6-8	June to July	750 q	Plants are erect with profuse tillering and leafy growth, leaves are longer and broader, flowering takes place 5-

				7 days later than PGG 101 and thus maintains its forage quality for a longer period. Crop is harvested with maximum nutrients is cut for the fodder at boot stage provides 5-6 cuttings from May to November. It has low degree of seed shattering. Panicles are initially white in colour which change to light-yellow on maturity
PGG 101	6-8		675 q	Plants have profuse tillering and leafy growth. It has bold seeds which help in better germination and produces in 5-6 cuttings from May to November. Harvesting should be done before flowering to get nutritious fodder.

***Green fodder (GF)**

Most of fodders like (Maize, Sorghum, Bajra, Guinea grass and Napier bajra belongs to Gramineae family their varieties are discussed in Table 1 and require hot moist to hot dry climate conditions to grow (Table1).

Preparatory tillage: Field should be properly levelled and free from weeds. A seed bed is prepared by 2-3 ploughings followed by planking is best for growing fodder.

Fertilizer Application: Fertilizer should be applied according to soil type and its requirement. Different types of fodder crops require varying degree of nitrogen, and potash fertilizer as in Table 2.
Irrigation: For all crops 4-7 irrigation are required at different intervals according to seasonal requirement.

Weed Control: In maize weeds are controlled by 500-800gm per acre of Atrataf in 200 litres of water is sprayed within 10 days of sowing. Two hoeing at 21 and 42 days of planting is recommended in Napier Bajra. In bajra, sorghum, and guinea grass one to two hoeing are sufficient.

Harvesting: The sorghum crop is harvested from boot to milk stage (65-80 days) and multicut at 55-65 days, after sowing between 55 -85 days, bajra crop at ear initiation or flag leaf emergence(45-5 days) and in maize between milk ripe stage and dough stage of grain development (50-60 days after sowing), in Napier Bajra first cutting in about 50 days after planting and guinea grass 55 days after sowing and subsequent cutting after 25-30 days in Table 2.

Table2: Crop, farm yard manure, Urea, Single Super phosphate and harvesting:

Crop	FYM (tones/acre)	Urea (kg/acre)	Single Super Phosphate (kg/acre)	Harvesting
Sorghum (Single Cut)	-	20kg N(44kg urea) at the time of sowing and another same amount after a month	8kg P2O5 (50kg SSP) at time of sowing	Pre boot –milk stage (65-80 DAS)

Sorghum (Multicut)	-	20kg N(44kg urea) at the time of sowing and another same amount after a month, after subsequent cuttings apply 40 kg N(88kg Urea)	8kg P2O5 (50kg SSP) at time of sowing	1st cut- 55-65 days after sowing subsequent cut 35-45 days interval
Bajra	10	20kgN (44kg Urea) in doses first half at basal dose and second half 3 weeks after sowing	-	Flag leaf to ear initiation stage (45-55 DAS)
Maize	10	35 kg N (75 kg Urea) one third at time of sowing, one third at knee high stage and one-third at pre-tassel ing	12kgP2O5 (75kg SSP) one third at time of sowing	Milk to dough stage (50-60 DAS)
Guinea grass	20	20 kg N (44kg Urea) 20 days after sowing and second dose of 10kg N (22kg N) after 35 days after sowing. After each cutting apply 30 kg N(66kg Urea) with first irrigation	-	1st cut-55 days after sowing subsequent cut-25-30 days interval
Napier Bajra hybrid	20	30 kg N(66kg of Urea) per acre 15 days after planting and repeat same after each cutting	Apply 38 kg P2O5 (248kg of SSP) is used for ratooning	1st cut-50 days after sowing subsequent cut- 1m height of plants

Plant Protection

1. Sorghum Insect-Pests

Shoot fly: Shoot fly remains active throughout the year but has two peak periods of infestation, viz March-April and August-September. The early sown crop from (April-May) multicut sorghum hybrids are severely attacked by shoot fly and produces dead heart symptoms in young plants. For control of this insect pest, treat the seed with 10 ml Slayer 30 FS (thiamethoxam) per kg seed.

Mite: Mite causes the reddening of leaves. Other pests like grasshoppers, grey-weevils, leaf-hoppers and pyrilla also attack Sorghum crop.

2. Bajra Insect Pests:

Root bug: This insect causes damage to the bajra crop in south-western districts along with grasshopper, grey weevil and also attack this crop.

Maize borer attacks the crop from March to October. For effective control, the attacked plants should be uprooted and destroyed after 2-3 weeks of sowing. It can also be controlled with spray of 40 ml Coragen 18.5 SC (chlorantraniliprole*) in 60-80 litres of water per acre. Do not feed the fodder for atleast 21 days after the spray of Coragen. Alternatively use tricho-cards twice having 50,000 eggs of *Corcyra cephalonica* per acre parasitized by *Trichogramma chilonis*; first release on 10 days old crop and second one week after first release. Cut tricho-cards into 50 strips, each having approximately 1000 parasitized eggs. Place these strips in the central whorl uniformly at 50 spots per acre during evening hours. These tricho-cards are available at the Biocontrol Labs, Department of Entomology, PAU Ludhiana and Regional Stations, Abohar, Gurdaspur and Bathinda.

3. Maize Fall armyworm: The young larvae feed by scrapping the leaf surface making papery windows. The bigger larvae feed voraciously on the central whorl leaves causing round to oblong holes and produce a large amount of faecal matter. The following control measures adopted by avoiding staggered sowing in adjacent fields and prefer mixed cropping of fodder maize with cowpea/ bajra/ sorghum by using recommended seed rate (30 kg per acre) and follow line sowing method rather than broadcasting. Monitoring the field to collect and destroy egg masses of fall armyworm from leaves regularly. Egg masses are covered with hairs and are easily visible. Spray the crop with Coragen 18.5 SC (chlorantraniliprole*) @ 0.4 ml per litre using 120 litres of water per acre, for crop up to 20 days old. On older crop (up to 40 days old crop only), the amount of water used per acre needs to be increased up to 200 litres with corresponding increase in dose of insecticide. For effective control, direct the nozzle towards the whorl. Do not harvest fodder for 21 days after insecticide application to ensure safety to farm animals.

Diseases

Bajra Ergot: The disease is caused by the fungus Claviceps fusiformis at blossoming, a pinkish or light-coloured fluid (honey dew) exudes from the spikelets in different parts of the ear. Later dark sticky patches appear on the ear and small dark-brown sclerotia appear in place of grains between the glumes. The seed set is poor or completely inhibited. The ovary is replaced by a fungal mass with many folds on its surface. The fungus perpetuates through the seed-borne and soil-borne sclerotia. The contaminated grains, if fed to cattle or used by human beings can cause poisoning. Therefore, take the following precautions: Once the disease appears, it is difficult to eliminate. So, following precautions is taken to prevent its spread by immersing seed in 10 per cent salt solution and remove the sclerotia and smut-balls by skimming. Then wash the seed in ordinary water and dry it thoroughly. Burning infested ears with honey-dew, as soon as they are observed in the field. After harvesting the crop, the debris should be buried with a furrow turning plough so that the ergot sclerotia rot in the soil. After threshing the ergot affected crop, the left-over-ear-heads of bajra in the threshing floor should also be burnt. Sowing bajra in same field next year should be avoided

Sorghum Grain Smut: Seed should be treated before with sulphur dust @ 4 g/kg seed before sowing control grain smut *(Sphacelotheca sorghi).*

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Soil Degradation and Resilience of Soils

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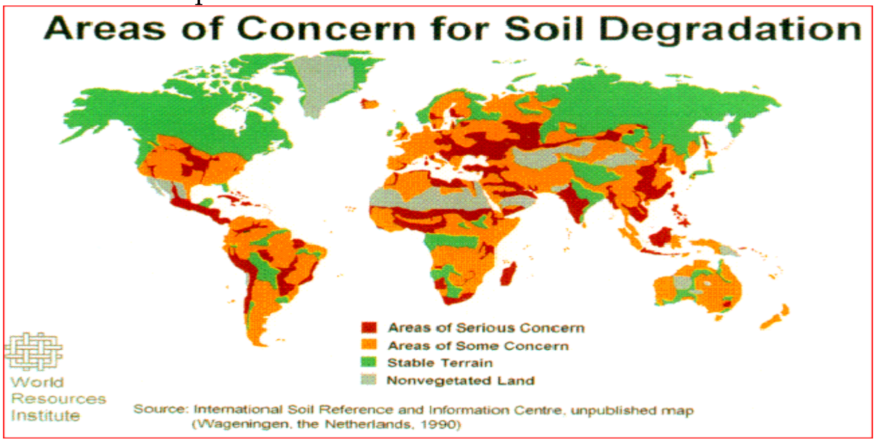
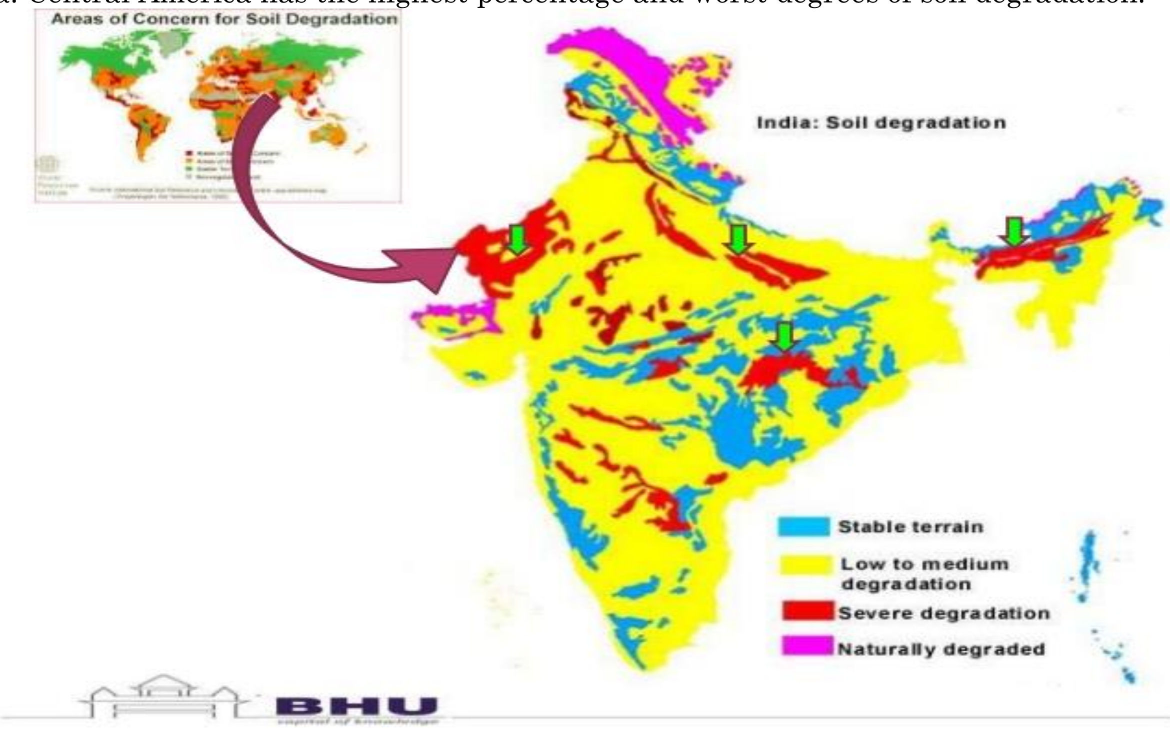
Soil is a dynamic and living entity used to produce goods and services of value to humans but not necessarily with perpetual ability to withstand the degradative processes (e.g., soil erosion, nutrient depletion, compaction, pollution and salinization) unless appropriately managed. As soon as land is newly put into production, the soil degradative processes are set in motion triggering deterioration of soil structure and disruption of cycles of carbon, depletion of soil nutrient reserves, and weakening of nutrient recycling mechanisms.

Land degradation is a process in which the value of the biophysical environment is affected by combination of human-induced processes acting upon the land. Soil degradation is the loss of actual or potential productivity or utility as a result of natural or anthropogenic factors. Essentially, it is the decline in soil quality or reduction in its productivity and environmental regulatory capacity. It is a severe problem, especially in the tropics and subtropics.



Of the world's 1.2 billion hectares with moderate to severe soil degradation, the largest areas are in Asia and Africa. Central America has the highest percentage and worst degrees of soil degradation.



1. Naturally degraded: These are the arid mountains of Ladakh, the snow caps of the north east and the salt flats of the Rann of Kutch.

2. Stable terrain: In some of these areas the forest-cover is dense and in others the land is has not lost its nutrients and is fertile and therefore stable

3. Low to medium degradation: The land here has been degraded to some extent due to water erosion, as for example in Assam, or there is depletion of nutrients from the soil.

4. Severe degradation: Areas in the Thar desert have been severely degraded due to the effects of wind erosion. The riverbanks such as those of the Ganga and the Brahmaputra are degraded due to water logging.

Land Degradation Status in India

Degradation type	Area (M ha)	Percentage of total area
Soil erosion by runoff	**148.9**	**45.3**
Loss of top soil	132.5	
Terrain deformation	16.4	
Wind erosion	**13.5**	**4.1**
Loss of top soil	6.2	
Terrain deformation	4.6	
Over blowing	2.7	
Chemical deterioration	**13.8**	**4.2**
Loss of nutrients	3.7	
Salinization	10.1	
Physical deterioration	**11.6**	**3.5**
Water logging	11.6	
Total	**187.8**	**57.1**

Effects of Soil Degradation on Productivity

Information on the economic impact of soil degradation by different processes on a global scale is not available.

Soil compaction: Soil compaction is a worldwide problem, especially so with the adoption of mechanized agriculture. Severe compaction has caused yield reductions of 25±50% in some regions.

Accelerated soil erosion: Accelerated soil erosion is another principal cause of soil. As with compaction, few attempts have been made to assess the global economic impact of erosion. On plot and yield scales, erosion can cause yield reductions of 30±90% in some root-restrictive shallow soils. Yield reductions of 20±40% have been measured.

Nutrient depletion: Nutrient depletion is another principal process of soil degradation, with severe economic impact at a global scale. Annual soil fertility depletion rates were estimated at 22 kg of N, 3 kg of P and 15 kg of K ha^{-1}.

Salt-affected soils: Salt-affected soils occupy an estimated 950 million ha of land in arid and semi-arid regions, nearly 33%of the potentially arable land area of the world. Productivity of irrigated lands is severely threatened by build-up of salt in the root zone. The potential and actual economic impacts on global scale are not known. Soil acidity, and the resultant toxicity caused by high concentrations of aluminium and manganese in the root zone, are serious problems in sub-humid and humid regions.

Soil Resilience

Soil resilience is important to food production and to other issues of global importance with regard to:
1. Sources and sinks for C.
2. Environmental regulatory functions.
3. Sustainable development.
4. Soil restoration.

Some soils can restore themselves, if the disturbance/stress is alleviated. Although specific techniques depend on soil and site characteristics, ease of restoration depends on the resilience of the soil. Highly resilient soils are easily restored by appropriate management. Soil conditions may be improved in resilient soils by appropriate land use and judicious soil management. Agronomic productivity of non-resilient soils may fall quickly below the economic level, even with improved systems of soil and crop management.

Resilience of Soil

Soil resilience has been defined as the capacity of a soil to recover its functional and structural integrity after a disturbance. (Herrick and Wander 1998).

Resilience is an ecological concept that involves several attributes that govern responses to disturbance or stress.

Soil resilience refers to the ability of soil to resist or recover from an anthropogenic or natural perturbation. Soil is resilient if the new state can perform its functions efficiently and profitably.

Factors Affecting Soil Resilience and Resistance

1. Soil type (soil biota) and vegetation.
2. Climate.
3. Land use.
4. Disturbance regime.
5. Temporal as well as spatial scales.

Soil resilience and resistance depend on soil type (including soil biota) and vegetation, climate, land use, disturbance regime, and temporal as well as spatial scales (Lal 1994). The concept that numerous factors can affect soil resistance was demonstrated by Willen (1964), who found the potential erodibility of three soils was related to the parent material, vegetative cover type, aspect, slope, and elevation.

Soils can be grouped into different classes according to their degree of soil resilience. Highly resilient soils have high buffering capacities, high rates of recovery, and large amplitudes. Fragile soils are unstable, cannot recover to the initial state, and may have lost some or all of their specific functions in the new state. Soil functions are an important aspect of soil resilience. Soil is resilient if the new state can perform its functions efficiently and profitably. Non-resilient soils become dysfunctional following a perturbation.

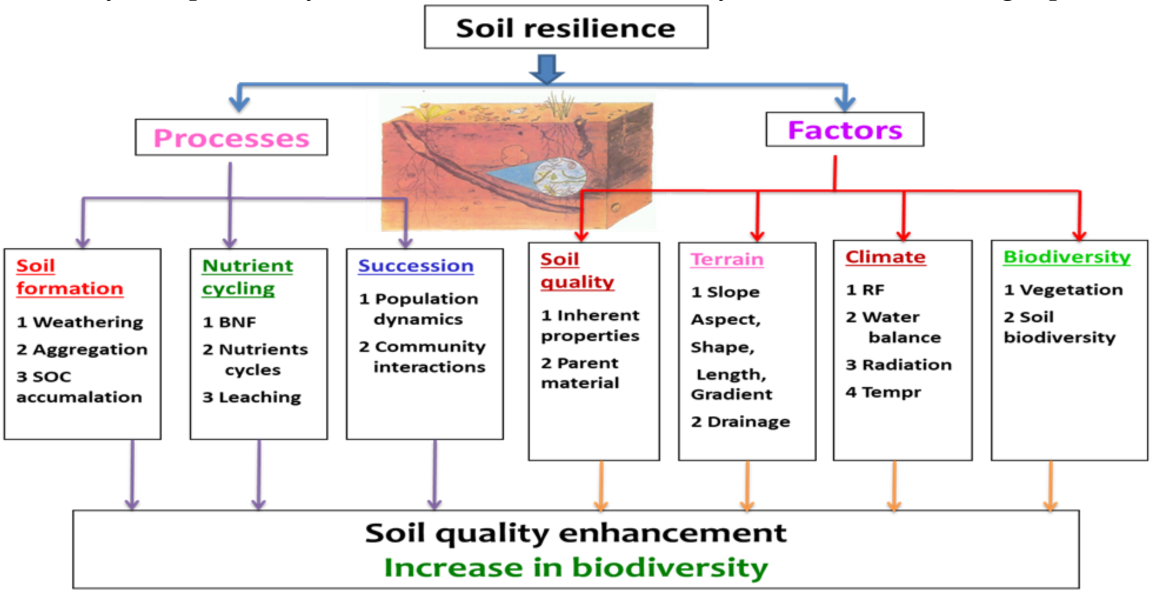


Figure 1. Processes and factors of soil resilience

Table 1. Soil résilient classes:

Class	Resilience	Description
0	Highly resilient	Rapid recovery, high buffering
1	Resilient	Recovery with improved management
2	Moderately resilient	Slow recovery with high input

3	Slightly resilient	Slow recovery even with change in land use
4	Non-resilient	No recovery even with change in land use

Soil Resilience and Land Use and Management

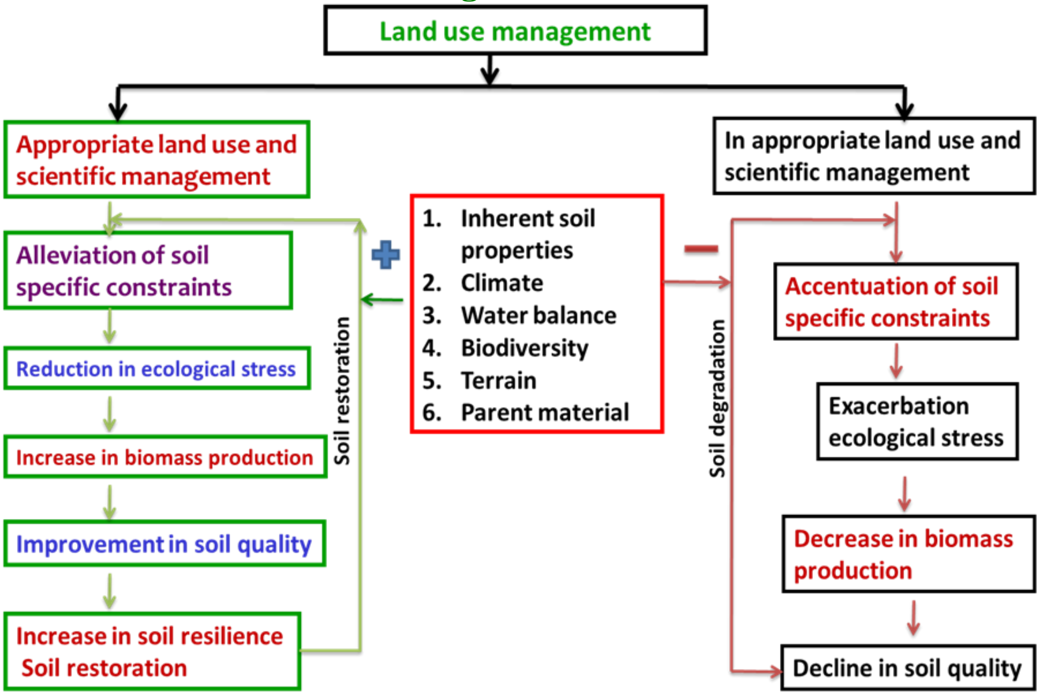


Fig. 4: Land use management effects on soil resilience and degradation

Exogenous factors of land use and management have a drastic effect on soil resilience. Appropriate land use and judicious management, based on intensity of technological input, set in motion soil restorative processes that enhance soil resilience. With scientific input, there is a synergistic and positive effect on inherent soil properties, terrain and landscape and climatic factors. Inappropriate land use and exploitative methods stimulate soil degradative processes that accentuate soil degradation and decrease soil resilience. Inappropriate land use exacerbates the adverse effects of poor parent material, different terrain, and harsh climate.

Assessment of Soil Resilience

To be functional and operational, it is important to develop methods of quantification of soil resilience. There are various approaches to quantifying soil resilience.

1. Assessment of the rate of soil degradative Process: The rate of soil degradation under a specific ecological stress can be used to evaluate relative soil resilience. These stresses include the rate of soil erosion, SOC decline, changes in soil chemical and nutritional properties, clay and colloid content, and change in porosity.

$Sr = -dS_q/dt$

S_q is soil quality and *t is time.*

2. Assessment of the rate of soil restoration: In contrast to degradation, the rate of soil restoration can be used to assess soil resilience. Because of the strong hysteresis, there may be differences in degradative and restorative pathways. The rate of soil restoration can also be related to changes in soil quality.

$Sr = dS_q/dt$

S_q is soil quality and *t is time.*

3. Modelling: Temporal changes in soil quality and soil resilience can be modelled.

a. Soil renewal rate.
b. Physical analogue.
c. Capacity to withstand stress.
d. Characteristic return time.

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Cannibalism in Poultry

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Cannibalism is a prevalent vice in chicken which may begin with feather pecking and directed towards body, toes, tail ad vet area. It may range from simple feather pecking of other birds to serious skin, tissue organ injuries or even death sometimes to its fellow mates. So, this progression from simple feather pecking to severe cannibalism can lead to great stress and losses due to tissue injuries and mortality. Cannibalism can occur in all types of housing including free range and different types of poultry birds and even in best managed flocks. It is a learned behaviour ad once established can spread throughout the flock. Although mechanism underlying it is poorly understood, but both genetic and environmental factors have been related to cannibalism.

Causes of Cannibalism

There are a number of factors which can trigger cannibalism and some important one are briefly discussed here.

1. Large crowded flocks: Overcrowding leads to competition among the birds for feed and water and as a result dominant birds chase away weaker by resorting to cannibalism behaviour, which not only deprives them of feed but also suffer from beak inflicted injuries by dominant birds.

2. Excessive Heat: High temperatures make the birds uncomfortable and such birds resort to cannibalism. Entire brooding spaces should not be heated alike and some room should be left to birds to move away from heat.

3. Excessive light: Longer duration and higher intensity of light arouses cannibalistic behaviour in birds and makes them hostile towards each other. Constant light stresses birds by depriving them of rest period which makes them irritable. The presence of bright lights enhances the chance of feather pecking as it assists for the exposure of everted cloacae after the egg is laid.

4. Unbalanced Nutrition: Providing well balanced diet depending upon age and body weight is essential as deficiencies of various nutrients like sodium, phosphorus and protein especially methionine leads to feather pecking and cannibalism. Birds deficient in salts will preen themselves by using oil from preen gland near tail as it has salty taste. Likewise excessive high energy and low fibre diets makes birds active and aggressive.

5. Mixing of birds: Mixing of different types, ages and colours of birds disturbs social order in flocks and increases the chances of cannibalism.

6. Abrupt Changes: Abrupt changes in feeding, water and environment leads stress and cannibalism. Changes should be allowed to be introduced slowly so that birds get adapted to changes.

7. Introducing new birds: New birds introduced into the flock are more prone to cannibalism as it disrupts the pecking order.

8. Allowing dead or injured birds to remain in the flock: Injured and dead birds should be immediately removed from the flock as their presence intensifies cannibalistic behaviour due to social order and curiosity.

9. Inadequate nest boxes: Facilitating proper laying conditions and appropriate number of nest boxes to prevent cannibalism.

Prevention and Control

It is always better to prevent cannibalism than to treat it. A number of strategies could be adopted to minimize the incidence of cannibalism.

1. Overcrowding in the flocks should be avoided and flock size should be reduced.

2. Intensity and duration of light should be kept optimal. Light duration of more than 16 hours is stressful to birds and optimum intensity is 0.5-2-foot candles is optimum for broilers. Also, excessive heat should be avoided.

3. Injured birds should be isolated and treated for wounds and dead birds should be immediately removed from the flock. Small, sick and weak birds should also be separated from the main flock.

4. Birds showing cannibalistic behaviour should be separated from the flock.

5. A well-balanced diet should be provided to bird and adequate amount of safe drinking water should be made available. Quantity of vitamins, minerals and salt should be added marginally in the diet and methionine amount should be increased in the layers diet.

6. Fresh greens like clovers should be made available to the birds to address fibre deficiency.

7. Additional laying nests and perches should be added to the housing environment.

8. Sudden changes in housing and management should be avoided and mixing of birds of different colours, ages and types should be avoided.

9. Stocks that are genetically less prone to cannibalism should be selected.

10. Environmental richness should be provided to the stock by putting certain objects in the shed to meet behavioural tendencies of birds and provide flock the opportunity to free range in an environment that mimics as closely as possible their natural foraging behaviour.

11. Debeaking is the last resort to control cannibalism. In young chicks, the beak is so soft that touching the beak to a hot metal blade usually removes enough beak to prevent cannibalism. Mature birds may need to have their beaks trimmed periodically to prevent cannibalism in older flocks. Beak should be trimmed by removing about 1/3 of the tip of the beak providing a square tip. Being associated with pain, debeaking should never be done indiscriminately.

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Future Prospects and Constraints of Medicinal Plants Cultivation

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A comparative analysis of the prospects and constraints of the medicinal plant-based drug industry in our country reveals the following.

Prospects

The World Health Organization (WHO) has emphasized the need for better utilization of the indigenous system of medicine, based on the locally available medicinal plants in the developing countries. In the USA and UK, plant-based drugs are being used in recent years on a considerable scale. The former USSR countries, East European countries and China have adopted an integrated system of allopathic, traditional and folk systems of medicine.

During the last two decades, there has been a tremendous transformation of medical systems in the world. Owing to the realization of the toxicity associated with the use of antibiotics and synthetic drugs, Western countries are increasingly aware of the fact that drugs from natural sources are far safer. Therefore, there is an upsurge in the use of plant derived products.

Medicinal plants and their derivatives will continue to play a major role in medical therapy in spite of advances in chemical technology and the appearance of cheap, synthesized, complex molecules from simple ones through highly specific reaction mechanisms. The reaction involved is either difficult or expensive to duplicate by classical chemical method.

For example, in Vitamin A, disogenin and solasodine of plants, where stearic forms are possible, chemical synthesis yields a mixture of the isomers which may be difficult to separate. The product obtained by synthesis may therefore be toxic or have a different therapeutic effect than what is obtained in nature.

Drug development out of medicinal plants is less costly than synthetic drug development. Reserpine is a good example of this. The synthesis of reserpine costs approximately Rs.1.25/g, whereas, commercial extraction from the plant costs only Rs.0.75 /g.

The vast range of agro climatic conditions in India, varying from alpine/mild temperate to tropical regions with abundant rains and sunshine make it an ideal place for the luxuriant growth of flora. India is endowed with incredible natural plant resources of pharmaceutical value. Despite comprising only 2% of the land mass, India is blessed with 25% of the biodiversity of the world.

Over 7000 species of plants found in different ecosystems are said to be used for medicine in our country. The Indian pharmacopoeia records about 100 medicinal plants available in India and their preparations. Out of these, quite a few are also recorded in the pharmacopoeias of other countries of the world and there is a growing demand for them in the international market.

There has been a tremendous upsurge in the demand for phytopharmaceutical raw medicinal herbs and vegetable drugs of Indian origin from the Western nations. There is also an increase in domestic demand for raw material used for perfumeries, pharmacies and biopesticidal units.

The demand for traditional herbal drugs is also increasing rapidly mainly because of the harmful effects of synthetic chemical drugs and also because of an expansion of pharmacies manufacturing natural drug formulations.

Our country is the proud possessor of an impressive medical heritage which encompasses various systems of medicine, viz., Ayurveda, Siddha, Unani, folklore and grandma medicine. India has an invaluable treasure trove of various scriptures on diverse medical systems.

India is the source of cheap labor and skilled manpower which readily absorbs technological change and also adopts the same.

Being strategically located in the world map, India could become a potential supplier of phytopharmaceuticals, alkaloids and raw medicinal herbs for the emerging world market. At present, India is not self-sufficient in pharmaceutical products, and drugs worth millions of rupees have to be imported every year by the pharmaceutical industries in order to meet the national demand for drugs. Hence it is necessary to bestow utmost attention to check the import by producing the raw material and fine chemicals within the country.

In addition, these crops have many virtues like drought hardiness, capability to grow on marginal lands. They are relatively free from cattle damage and hence, can be profitably grown in areas where stray cattle or wild animals or pilferage is a major problem. As it is, medicinal plants are better earners than many of the field crops. Since they are new crops, there is an immense scope for further improvement in their productivity and adaptability, in order to obtain further increase in returns. They are suitable for incorporating into various systems of culture like intercropping, mixed cropping and multi-tier cropping.

Constraints

Although India is a leading exporter of medicinal plants in the world, the rate of growth of these crops in relation to their economic prospects is not at all satisfactory. The reasons for this apparent backwardness are many and varied. So far, there has been no organized research set-up to continually recharge scientific inputs in order to make their cultivation not only economically viable but also more profitable, so that they can claim their due share in the cropping systems of the country.

In spite of the thrust given by the government of India through the institutions like the Centre for Medicinal and Aromatic Plants (CIMAP): the Regional Research Laboratories (RRL), at Jammu, Bhubaneshwar and Jorhat; Directorate of Medicinal & Aromatic Plants (DMAPR), National Botanical Gardens, Forest Research Institutes, state Cinchona Directorates in Tamil Nadu and West Bengal, the replenishment of renewable inputs like quality planting material of improved varieties, developing extension literature, organizing training and quality testing, are very limited because of the number of medicinal plants as well as their divergent uses.

The other major constraint is marketing of the cultivated raw material because of the quality considerations. Lack of testing facilities at the procurement and trading centres together with unscrupulous market handling, results in wide fluctuations in prices, often going down to uneconomic and unrealistic levels. Thus, speculative trade has been one of the most serious deterrents to the development of this enterprise.

The systematic cultivation of a few medicinal plants has been found to be a discouraging enterprise, mainly because of the uneconomical price they command. For example, the sale price of Phyllanthus amarus is as low as Rs.10/kg, making it a commercially unviable proposal. There is a need for the user industry to come forward and ensure that the cultivated product is going to be homogeneous, in comparison to those collected from natural sources, where there is possibility for wide variation.

Although most of them are industry-oriented crops, the pattern of land-holdings does not lend itself for commercial cultivation on an extensive scale. In case of a few plants, viz., aonla, asoka, arjun, bael, nutmeg, neem, the cultivation involves a long gestation period due to which many farmers are reluctant to grow them.

Unstable market conditions have also kept farmers away from taking up cultivation of these crops. In the phytopharmaceutical industry, presently, no quality standards have been fixed, either for the raw material or the final product and, as such, one finds wide variation in the quality specifications.

Difficulty in proper identification of medicinal plants has led to the use of adulterants or mimics. Physical verification is also a difficult proposition, mainly because the plant part used in many cases like the barks, roots, etc, show close resemblance. The only way to check adulterants would be by chemical examination.

The package of practices for number of medicinal plants has not been standardized to suit different agro ecological conditions. The supply of raw material for the phytopharmaceutical industry is virtually monopolized. It is found that supply and price patterns are often determined by the minor forest produce contractors/gatherers. In a number of cases the produce has to be used fresh for which instant transportation is a must, and in many cases, it cannot be stored for long periods as this would entail fumigation which at times, results in chemical contamination of the raw material and eventually the final product, because of its residual effect. Generally, the maximum period for which plant material should be stored is around 5-6 months and no more.

To overcome these constraints, it is necessary to organize the cultivation of medicinal crops on specific regional basis and organize their marketing on similar lines as that of other cash crops like coffee, tea cardamom, to maximise their production and returns. In fact, in some states like Tamil Nadu, there are some organized production systems like contractual farming, group farming which are exclusively engaged in the production, procurement and marketing of these crops.

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Care and Management of Heifers

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Introduction

Young female cattle usually from 12 months of age to first calving is called heifer. Heifers are the future cows of dairy farm. During heifer stage, the animal is still growing. The proper growth and body condition of the heifer is associated with early sexual maturity and age at first breeding as well as for their productivity performance in later life.

The usual practice is replacement of 20% of cows in a dairy herd by fresh cows every year. Dairy farmer must provide optimum feed, environment and care for proper growth and development of heifers to mature and breed them early, as replacement to older and culled cows in the herd (Table 1).

Table 1. Normal body weight of heifers at the different age (kg):

Age of heifer	Zebu cattle	Jersey	Buffalo	Holstein
At Birth	20-15	25	25-30	43
6 Months	82-102	113	100-126	170
12 Months	150-185	216	180-236	307
18 Months	200-236	282	250-300	398
24 Months	250-271	252	350-372	500

Age of Separation

Calves irrespective of sex can be raised together up to 6 months age and then separated sex-wise for their proper growth and development.

Method of Raising Heifers

1. Outdoor system / grazing method: Heifers under outdoor system are reared chiefly on grazing. Care be taken not to over stock on limited grazing land and shift daily from one to another field which means grass plots be grazed rotationally. Provide legume pasturage for them. Arrangement of shade and drinking water on pasture be made for heifers and concentrates with minerals be fed from centrally located troughs in field, and protected from rain water.

2. Indoor system: This is the conventional system of heifer management in covered area. Feed and water should be provided as per the requirement. Heifers under indoor system are managed in yards with enough shade. Legume hay rich in protein, minerals and vitamins may be fed free of choice.

Amount of hay or green forage will depend upon forage quality, succulency, palatability, age and size of heifer etc. Grain mixture of 18% DCP and 65-70% TDN should be given @ 0.5, 1.5 and 2 kg to young, breeding and pregnant heifers respectively.

Steaming Up

Feeding grains to pregnant heifers prior to calving (called steaming up) @ 1.5 kg/day helps in their growth, bear the stress of unborn viable calf, producing more milk after calving and increase lactation length.

Age of Breeding and Calving

It depends upon level of nutrition, system of feeding, individuality and breed but under good management conditions breeding generally at the age of 24 months in case of non-descript/indigenous cattle and buffalo, and 18-20 months in case of crossbred and exotic dairy heifer. Accordingly, first calving age is 3 to 3.5 year for zebu or indigenous, 2.5 year for crossbred and 2 years for exotic.

Feeding of Heifers

The growth is continued in heifer stage. So, sufficient feed should be given to heifers to maintain normal growth. In general straw, greens and concentrates mixture are fed to heifers in the required quantity. Most heifers grow well if good quality hay is given *ad libitum*. In the absence of good quality hay or greens, concentrate mixture should be a part of heifer diet.

Effect of Breeding and Lactation on Growth

Lactation imposes a greater strain on heifer and it is more pronounced when heifer is in lactation and bred early. In such case there is an adverse effect on growth and average daily milk yield.

Training the Heifers

Heifers in early age should be lead with halter to make them docile cows. Pregnant heifers, a month before calving be housed along with milking cows and udder be washed with warm water and mopped with duster to accustom her to feel the hands in this place. Just few days before calving pulling test slightly may be practiced so that after calving, she would not get excited and become a docile animal.

Exercise

Heifers managed under outdoors system need no extra exercise but those kept indoors need little open area in front of pen to give freedom of movement for exercise as it keeps them thrifty growing and maintains normal appetite.

Health Control Measures of Heifers

Cleaning and sanitation of the farm and its premises, deworming, spraying with proper insecticides and vaccination against dreadful diseases should be done as per schedule. Since worms affects the growth, reduces vitality and lowers resistance, heifers be dewormed at 4 to 6 months interval. Regular grooming and periodical rubbing malathion dust into the hair will help in prevention of ectoparasites.

Vaccination

At 6 months of age heifers should be vaccinated for Foot and Mouth diseases, T.B., Rinderpest diseases.

Routine Farm Management Practices for Heifers

These are as follows:

1. Grooming: It is to be practised regularly. It has many advantages, including removal of ectoparasites and making the animal docile.

2. Regular exercise: It is essentially needed for heifers. It helps in maintaining their health and preventing obesity. Obesity in heifer may hamper normal reproductive functions, including fertilization and conception. Rearing of heifers in outdoor system or under loose housing system needs no extra exercise. However, in case of indoor system of rearing, an open space should be there for the purpose of freedom of movement and exercise.

3. Culling: Culling of heifers should be done periodically. It is generally done on the basis of growth and physical performance. Heifers with genetic defects, anatomical and functional defects, including ill developed sex organs, and abnormally heavy musculing indicating lack of feminity, are generally culled from the herd. Obese heifers are also culled. Heifers which are poor in growth and late maturing are usually culled.

4. Identification: Heifers should be identified by branding at the age of 12 months. Before that, the animal may be identified by tagging or tattooning.

5. Record keeping: It is essential to keep records of body weight and growth, age at first breeding, expected date of calving, pregnancy diagnosis, occurrence of any disease, vaccination and other medication, etc.

6. Breaking-in of heifers: Heifer may develop nervousness after first calving, may kick the milkman while milking, and become a problem cow. So, before calving, heifer should be accustomed to handling and to the milking procedures. For this, pregnant heifer should be housed in a shed along with milking cows about a month prior to calving. Washing of udder with lukewarm water and moping of udder is to be done to accustom her to feel the hands in this region. Just few days prior to calving, pulling teats slightly may be practised so that heifer would not be excited. It is called breaking-in of heifers.

Conclusion

It is concluded that the time of heifer from birth to young to be taken very carefully. The care and management of heifer should be properly managed. The dairy sector improves the growth through heifer. So just after birth of young one, proper care and managemental practices are major things for developing a new environment for that heifer.

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Golden Rice: A Genetically Modified (GM) Food

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Introduction

Ingo Potrykus and Peter Beyer in the 1990s were engineered normal rice to produced Golden Rice for human health improvement. Golden Rice has an engineered multi-gene biochemical pathway in its genome. This pathway produces beta-carotene, a molecule that becomes vitamin A, when metabolized by humans. Ingo Potrykus worked at the Swiss Federal Institute of Technology in Zurich, Switzerland, and Peter Beyer worked at University of Freiburg, in Freiburg, Germany. The US Rockefeller Foundation supported their collaboration. The scientists and their collaborators first succeeded in expressing beta-carotene in rice in 1999, and they published the results in 2000. Since then, scientists have improved Golden Rice through laboratory and field trials.

The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin A deficiency (VAD). In 2005, 190 million children and 19 million pregnant women, in 122 countries, were estimated to be affected by VAD (vitamin A deficiency). VAD is responsible for 1–2 million deaths; 5, 00,000 cases of irreversible blindness and millions of cases of xerophthalmia annually. Children and pregnant women are at highest risk. Vitamin A is supplemented orally and by injection in areas where the diet is deficient in vitamin A. As of 1999, 43 countries had vitamin A supplementation programs for children under 5; in 10 of these countries, two high dose supplements are available per year, which, according to UNICEF, could effectively eliminate VAD. However, UNICEF and a number of NGOs involved in supplementation note more frequently, low-dose supplementation is preferable. Because many children in VAD affected countries rely on rice as a staple food and for genetic modification of rice to produce the vitamin A precursor, beta-carotene was seen as a simple less expensive alternative for supplementation. Golden Rice is named for its golden colour, which is caused by beta-carotene. Normal rice, *Oryza sativa*, does not express beta-carotene in its endosperm. Beta-carotene is part of a class of molecules called carotenoids, one of hundreds that plants naturally produce, and it has a yellow-orange colour. Carotenoids are essential nutrients for humans, because they are precursors to molecules needed in metabolism. The human body transforms beta-carotene, also known as pro-vitamin A, into vitamin A, which is necessary to produce retinal and retinoic acid. When people lack access to foods containing beta-carotene, because they eat mostly cereal crops such as rice, wheat, or sorghum, they are at risk of blindness and disease.

Vitamin A Deficiency

The intake of vitamin A provides humans with an important nutrient for vision, growth, reproduction, cellular differentiation and integrity of the immune system. Vitamin A deficiency can result in visual or ocular malfunctions such as night blindness and xerophthalmia and can reduce immune responsiveness, which can result in an increased incidence or severity of respiratory infections, gastrointestinal infections, and measles. Vitamin A can be obtained from food, either as preformed vitamin A in animal products (eg, eggs and dairy products) or as provitamin A carotenoids, mainly beta-carotene in plant products (eg, dark-green leafy vegetables and fruits). Rice, a food staple produces geranyl geranyl diphosphate (GGPP), an early precursor of beta-carotene. The whole beta-carotene biosynthesis pathway (2 daffodil genes and 1 bacterium gene) was engineered with into rice endosperm to convert the GGPP to beta-carotene.

Efficacy of Carotenoids

Clinical and subclinical vitamin A deficiency is still a problem, affecting 250 million school children worldwide. To prevent clinical vitamin A deficiency in developing countries, chemically synthesized vitamin A supplements have been distributed periodically to deficient populations. This has been shown to be an efficient and generally safe strategy. However, supplementation programs with a periodic mass distribution have been difficult to sustain because of high distribution costs. Recently, food-based interventions to increase the availability of provitamin A–rich foods and their consumption have been suggested as a realistic and sustainable alternative to overcome vitamin A deficiency globally. However, the efficacy of carotenoid-rich foods in the prevention of vitamin A deficiency has been questioned in several recent studies, which reported little or no nutritional benefit of vitamin A from the increased consumption of dark-green or yellow vegetables. Recently, studies have shown that the equivalency of vegetable provitamin A carotenoids to vitamin A is in the range of 10–27 µg all-trans β-carotene to 1 µg retinol activity. These studies showed that food matrices greatly affect the bioavailability of vitamin A and carotenoids. The textbook example of bio fortification is Golden Rice, genetically engineered to contain high levels of the vitamin A precursor beta-carotene.

In recent years, scientists have introduced the biosynthetic pathway for provitamin A carotenoids into staple foods, including genetically engineered Golden Rice, which contains 1.6–35 µg β-carotene per gram of dry rice. Golden Rice-1, which was transformed with a construct containing a phytoene synthase gene from daffodil, contains 1.6 µg carotenoids (0.8 µg β-carotene) per gram of dry rice. Golden Rice-2 was transformed with a construct containing a phytoene synthase gene from maize and contains up to 35 µg β-carotene per gram of dry rice. Because the vitamin A equivalency of various foods and supplements varies from 2 µg β-carotene to 1 µg retinol (when provided as a β-carotene supplement in oil) to 27 µg β-carotene to 1 µg retinol (when provided as vegetable β-carotene), and this equivalency is matrix dependent, it is important to determine the vitamin A equivalency of β-carotene from Golden Rice. This information is critical for the purpose of designing informed, food-based nutritional strategies for rice-eating regions throughout the world where vitamin A deficiency is common. Because vitamin A is homeostatically regulated in the circulation of healthy subjects and it is impossible to distinguish the newly formed vitamin A from endogenous vitamin A, we chose intrinsic labelling of the provitamin A carotene as the optimal approach to determine its vitamin A equivalence. We produced intrinsically labelled Golden Rice, fed the rice to healthy volunteers, and used an isotope reference method to determine the conversion factor of Golden Rice ß-carotene to vitamin A.

Advantages

1. Combat malnutrition.
2. Reduce preventable blindness.
3. Improve our economy.
4. No apparent substantial environmental risk.

Disadvantages

1. Used as means for corruption.
2. Counter-productive commercialization.
3. No substantial health benefits.

In addition to providing energy in the form of calories, our food also supplies us with essential vitamins and other nutrients to keep us healthy. Vitamin, or "micronutrient", malnutrition is a substantial contributor to disease. To increase micronutrient consumption, many countries fortify their food with these vitamins. Another strategy to improve vitamin intake and prevent disease, especially in developing Nations, is the development of genetically modified organisms (GMOs). How do traditional fortification and GMOs compare, and are they equally effective and safe? Golden Rice, engineered to contain high levels of the vitamin A precursor beta-carotene, is a good case study to discuss these points and examine the science behind efforts to improve nutrition through genetic modification.

Conclusion

Initially, the justification for promoting adoption of Golden Rice as an additional intervention for vitamin A deficiency will be based on studies which have clearly demonstrated that a universal source of vitamin A can prevent 23–34% of global under five years' child mortality, and up to 50% mortality prevention in the case of measles. It has also been known for a long time that vitamin A deficiency is the most important cause of irreversible childhood blindness. Sophisticated science has already confirmed that the beta-carotene in Golden Rice is very efficiently converted to circulating vitamin A in both adults and children: "Golden Rice may be as useful as a source of vitamin A as preformed vitamin A from vitamin A capsules, or eggs and milk". Green vegetables are an important source of beta-carotene. But the conversion of beta-carotene in green leaves to vitamin A is very inefficient. So, vitamin A deficiency is common even in populations where green vegetables are easily available and consumed. Additionally, lack of dietary variety, especially the lack of sufficient animal products in the diets of many who depend on rice, is responsible for vitamin A deficiency. Over to you, dear reader, to turn Golden Rice's potential into reality.

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Inheritance of Seed Dormancy and its Safe Removal

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The seed, containing the embryo as the new plant in miniature, is structurally and physiologically equipped to sustain the growing seedling until it establishes as a new plant. Some trait is acquired during evolution for capacity to survive under unfavourable condition. One such trait is DORMANCY, an intrinsic block to germination, exists. It's a genetically inherited trait whose intensity is modified by environment during seed development. Seed dormancy most commonly exhibited in wild species.

In general seeds are resistant to environmental extremes because they are metabolically inactive: they are either quiescent (in seeds that are too dry to germinate) or dormant (in seeds wet enough to germinate, that don't).

What is Dormancy?

"Seed dormancy is a block to the completion of germination of an intact viable seed under favourable conditions"

Biology of Process

Seed formation passes through several overlapping but rather independent stages. Before the beginning of flowering, embryonic structures are formed out of apical meristem. The switch from the vegetative stage of development to the reproductive one is regulated by different mechanisms. Among these mechanisms are inner biological clock, hormonal background, and environmental conditions such as a day length, temperature fluctuations, humidity etc.

At the first stage, a pollination followed by fertilization will occur.

The second stage is characterized by establishment of a general composition of the future plant. Embryonic tissues (protoderm, procambium, ground meristem) are being differentiated. The axis of development of an embryo is being formed, with apical meristem of a root from one side and apical meristem of a stem – from the other.

At the following stage, storage substances are being intensively worked out, these substances will be necessary at subsequent stages, during seed germination. Seed development is finished by preparation of a seed to the dormancy stage and final maturation at the dormancy stage.

Eenink (1981) inheritance of dormancy and the results of selection of non-dormant genotypes in segregating populations of lettuce were investigated. They noticed that genetical variation for seed dormancy was only governed by chromosomal genes. Selection for dormant and non-dormant seed in Sinpis arvensis was carried to the seventh and fourteenth generations, respectively. Crosses between the dormant and non-dormant lines clearly showed both a material and embryonic component of seed dormancy (Garbutt et al., 1986).

Types of Seed Dormancy

1. Primary dormancy - Exogenous Dormancy:

a. Physical: Seed coats are impermeable to water. Embryo is generally quiescent. The cause of physical dormancy is the structure of the outer cell layer which becomes impermeable to water. Macrosclereid cells, a mucilaginous outer cell layer or a hardened endocarp are three reasons that seed coats become impermeable to water. Such seed coats develop during the last stages of seed development. Eg. Legumes.

b. Mechanical dormancy: Seed coats are too hard to allow the embryo to expand during germination. Causes include: Structure of seed coats. In nature - coats are softened by environmental agents such as acid in guts, microorganisms in warm, moist, environment, forest fires etc. To overcome - Scarify with sandpaper, hot water, acid, and fire (melts resins in cones). Eg. Olive.

c. Chemical dormancy: Presence of chemical inhibitors in the outer coverings of many fruits and seeds. This occurs in fleshy fruits, hulls, and capsules of many dry fruits. Very often this kind of dormancy disappears with dry storage. O2 may be restricted by mucilaginous layers. Occurs in spinach, some of the Asteraceae Eg. Apples, citrus, grapes, desert plants. To overcome - Leach with running water; change water daily for several days; chilling for a few days; excising the embryo (= removing seed coat); use of hormones, especially GA_3.

2. Endogenous dormancy - Morphological dormancy: Embryo is not fully developed at time of ripening. Need additional embryo growth after the seed is separated from the plant. Eg. Ranunculus, poppy; woody species such as holly; tropical plants such as date palms. Often combined with other kinds of dormancy such as hard seed coats. Rudimentary embryo – occurs at pro embryo stage due to presence of inhibitors. Ex: Ranunculaceae, Papaveraceae, Araliaceae. Linear embryo – occurs at torpedo stage, may be due to inhibitors. Ex: Umbelliferaea, Ericaceae, Primulaceae. Undifferentiated embryo – Ex: orchids
To overcome – expose to alternate warm and cool temperatures; treat with hormones such as GA3, exposure to cool temperatures. Some tropical species require extended period at high temperatures for full development of embryo.

3. Physiological:

a. Non-deep: Often short-termed and disappears with storage. Usually lasts from 1 month to 6 months, dormancy disappears as the seed is stored. The major problem is in seed testing labs. Photodormancy - Controls are thought to be in inner membranes of freshly harvested seed. May be due to inhibitors, control of gas exchange (oxygen). Eg. Lettuce seed requires light to germinate when the seed is fresh. But this light requirement can be substituted by cool temperatures i.e., by growing the seeds in the dark below 730 F. To overcome - Dry storage, pre-chilling for several days, light, alternating temperatures, treating seeds with KNO3 and hormones such as GA3.

b. Intermediate internal: Controls thought to be in seed coats and in tissues surrounding embryo as well as in the embryo itself. The embryo itself is quiescent, non-dormant and will germinate if excised. The exact mechanism is not known. To overcome - stratification for 1 to several months and treating with GA_3.

c. Deep physiological dormancy: Controls are within the embryo itself. It is the characteristic of many temperate trees. To overcome – Stratification and moist chilling.

4. Combinational dormancy:

a. Epicotyl dormancy: Seeds initially germinate during warm period, produce root and hypocotyls growth. Require 1-3 months chilling to release epicotyl from dormancy. Eg. Lilium and peony.

b. Epicotyl and radicle (double dormancy): Require chilling period for embryo, followed by a warm period for root, then a second cold period for shoot growth. Eg. Trillium and other native perennials.

5. Secondary dormancy: Imposition of a new dormancy mechanism during unfavourable conditions. The critical point is that this dormancy occurs after the seed has been separated from the plant. It prevents germination during unfavorable conditions in seed that have overcome primary dormancy. Ex. Maple seeds. To overcome this dormancy, need chilling or light and sometimes GA_3.

Conclusion

In general seed dormancy is controlled by gene and the inheritance of dormancy is varies with the crops. In some crop, it is governed by 'nuclear gene' and in some cases governed by cytoplasmic genes. Further it is governed by either single gene or two genes. Limited and contradictory information is available on the inheritance of seed dormancy of seed dormancy and hence nature of inheritance is cop specific.

Seed dormancy is should be removed to get good germination and plant stand in crop plants. Although several methods are available to remove the dormancy, there is need to work on inheritance of seed dormancy to bred non-dormant variety where dormancy is a problem. Chief and eco-friendly techniques have to be developed for some crops to break the dormancy.

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Bio Wall: A Unique Way to Grow Vegetables in Urban Pictures

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Preface

With the beginning of modernization and urbanization, people are shifting from rural to urban areas, thereby, urban population is increasing day by day resulting in jammed cities and towns. All around the world, a vast number of constructions are being constructed adding many more in future. Throughout the years, replacement of vegetated surfaces with paved and impervious surfaces in the urban areas have increased the temperature as compared to rural areas, because the paved surfaces absorb, retain and reradiate more solar energy than vegetation. The ambient temperature in urban area can be as much as 6^0C higher than the air in rural areas.

Carrying land to life and life to land is the need of the era and the conversion from grey to green walls is only possible by landscaping. Since, there is no scope of horizontal expansion and only vertical space is available which can be converted to vertical gardens. It will increase carbon capture and better environment change adaptation. Vertical gardens are also referred as green wall, Bio wall or Bio walls. A green wall is a wall, either free-standing or part of a building that is partially or completely covered with flora. Vertical gardening is an ideal option for those staying in city areas, where agricultural land is limited. It is said that a vertical Gardening system is able to double crop yields up to 3-4 folds when compared with conventional systems, i.e., directly planted in the ground. Vegetables are rich source of vitamins, fibres, minerals, antioxidant so vertical gardening of vegetable will not only serve greenery but also Nutritional and food security. Vertical gardening developed in Switzerland and French Botanist Patrick Blanc gave the concept of Vertical gardening.

Past of Green Walls

The concept of the green wall dates back to 600 BC with the Hanging Gardens of Babylon, one of the seven wonders of the ancient world King Nebuchadnezzar II built the Hanging Gardens of Babylon and ancestor of the modern green wall (Ashmawy 2006, Hamilton 2009, Green roofs for healthy cities, 2008). Romans used to train grapevines, on garden trellises and on villa walls, climbing roses were the symbols of secret gardens. In 1920's British and Americans stimulated the integration of garden features and plant usage, for example, using pergolas, trellis structures and self-climbing plants. In 1988, there was the introduction of the stainless-steel cable for green facades. In 1990s, cable and wire rope net systems and modular trellis panel systems were introduced. In the year 1993, the first major application of the new trellis panel system was featured at the Universal City Walk in California. In 1994, In Canada, Life Building in Toronto (an indoor bio wall) was created with bio-filtration system. Perhaps the world's most famous vertical garden designer is Paris-based botanist Patrick Blanc who named it "vegetal walls". His creations can be seen in cities as diverse as São Paulo and Singapore. In the year 2005, around thirty different modular systems for vertical gardens were available.

Classification of Green Wall

According to growing method, vertical garden can be classified as green façades and bio wall system (Dunnett and Kingsbury 2004; Köhler 2008).

1. Green Walls: Green Wall with alternative name Vertical Garden is the term of used to denote to all form of vegetated wall surfaces. Green walls are not only enormously beautiful, but also helpful in enlivening the ambiance. Green walls can absorb heated gas in the air, lesser both indoor and outdoor temperature, providing a healthier indoor air quality as well as a more stunning space.

2. Green facades: Green facades are a type of green wall system in which climbing plants or cascading flora. Green facades can be anchored to existing walls or built as unconnected structures, such as fences or columns. Three green facade systems that are regularly used are Modular Trellis Panel, Grid System and Wire – Rope Net System. Due to lower diversity and density of plants, green facades normally need less intensive care and protection than bio walls.

a. Modular trellis panel system: The building block of this modular system is a stiff, light weight, three-dimensional panel made from a powder coated galvanized and welded steel wire that supports plants with both a face grid and a panel depth. This system is planned to hold a green facade off the wall surface so that plant materials do not attach to the building, provides a "captive" growing environment for the plant with multiple supports for the tendrils, and helps to maintain the integrity of a building membrane. Panels can be stacked and joined to cover large areas, or formed to create shapes and curves, are made from recycled content steel and are recyclable. Because the panels are rigid, they can span between structures and can also be used for freestanding green walls. Example: In tomato.

b. Grid and wire-rope net systems: Preparation the Grid and wire-rope net systems used cables and wires. Grids are working on green facades that are designed to support quicker growing climbing plants with denser foliage. Wire-nets are often used to support leisurelier growing plants that need the added support these systems provide at closer gaps. Both systems use high stretchy steel cables, anchors and supplementary equipment. Various sizes and patterns can be accommodated as flexible vertical and horizontal wire- ropes are connected through cross clamps. Example: Cucumber, tomato, beans etc.

c. Bio walls: Bio walls, also called bio walls or vertical gardens. Bio wall systems are composed of pre- vegetated panels, vertical modules or planted blankets These panels can be made of plastic, expanded polystyrene, synthetic fabric, clay, metal, and concrete, and support a great diversity and density of plant species. Bio walls need more protection than green facades because of its diversity and density of vegetation. Bio Walls are made with three parts: a metal frame, a PVC layer and an air layer (do not need soil). This system supports a variety of plant species, such as a mixture of vegetation). It performs well in various climate environments. However, the selection of better species may adapt to the prevailing climatic condition, so that the maintenance of the system be made easy. Generally, is used self-automated watering and nutrition system, to make maintenance of the bio walls easy.

Modular bio wall: A modular bio wall system emerged in part from the use of modules for green roof applications, with a number of technological innovations. Modular systems consist of square or rectangular panels that hold growing media to support plant material. Example: lettuce and leafy vegetable.

Vegetable Suitable for Vertical Gardening

Vertical garden type	Plants	Growing media
Wall climbing	Pole bean Peas Water melon Cucumber	Soil in ground or in plantex box
Hanging down	Sweet potato Tomato	Plants are planted in basket with long hanging down stem
Modular	Kale Shallot Leek Lettuce Spinach Swiss chard Red amaranthus	Light weight panel having artificial media

Steps Involved in the Preparation of Vertical Garden

1. The Vertical Garden is composed of three parts: a metal frame, a PVC layer and a layer of felt. The metal frame is hung on a wall or can be self-standing.
2. PVC sheet of 1.00 cm thickness is riveted to the metal frame. This layer brings rigidity to the whole structure and makes it waterproof.

3. A felt layer, made of polyamide, is stapled on the PVC. This felt is rot proof and its high capillarity allow homogeneous water distribution and the plant roots grow well on felt.
4. Slits are cut in the outer felt layer to create pockets into which the plants are placed.
5. Plants are installed on this felt layer as seeds, cuttings or already grown plants. The density is about thirty plants per square meter.
6. The watering is provided from the top supplemented with nutrients. Watering and fertilization are automated.
7. A pump and drip irrigation system supply nutrient-laden water, which slowly cascades down the wall through the felt material layers until reaching the bottom where a collector recovers the excess for reuse.
8. The whole weight of the vertical garden including plants and metal frame is lower than 25 kg per square meter. Thus, the vertical garden can be implemented on any wall, without any size or height.

How Bio Wall Works?

1. Two layer of synthetic fiber sandwich root mass.
2. Water rich in nutrient recirculated from a manifold.
3. The plant absorbs carbon monoxide and produces cool fresh air.
4. Fan pulls environmental air through the system and distribute it throughout the space.

Maintenance

As the supply of the basic needs of plants (light, water and nutrients) are automated, plants remain healthy, reduces maintenance demand and makes the vertical garden possible to use on high buildings or other places where accessibility is limited.
1. Small scale domestic green walls require very little in the way of maintenance.
2. The plants have to be replaced as and when required. Climbing plants entering guttering or tendrils twining around window fixtures may need occasional sorting.
3. It is important to make sure that extensive areas of foliage are not allowed to become too tangled as this could compromise the support system and also the health of the plants. Where, there is the possibility of shoots penetrating between materials in the building, for example under tiles, cladding or roofs, this growth will need to be cut back to ensure that the facade does not interfere with the fabric of the building.
4. These maintenance measures will ensure a long-term lavish and attractive garden. Extending the plants or greenery on to the building façade has shown potential in improving air quality and reducing surface temperature in the built environment. Plants certainly help to promote thermal comfort as they cool down the building façade and the surrounding by transpiration. The breathing wall with vegetated façade tends to focus to develop the building as an ecologically complex and stable plant, microbial and human community that helps to improve the air quality in an interface between natural processes and the built structure environmental system.
5. The whole system works for the social, ecological and environmental benefits.

Benefits of Bio Wall

1. Aesthetic benefits: Green wall is often used to improve the aesthetic value of the urban area. Vegetation can provide visual contrast and relief from the highly built-up city environment. Plants also give the city dwellers a sense of closeness to the Mother Nature in the hard-concrete jungle in the city. Apart from that, natural landscape provides elements of natural scale and visual beauty as well as seasonal indicator to buildings and streets. In addition, softness of the greenery compared to the hard surface of the concrete can also provide visual relief to plain walls. Unattractive building walls can be veiled by the green walls and vegetation.

2. Improved thermal efficiency of the building: Plants can offer cooling benefits in the city through two mechanisms, direct shading and evaporative transpiration. The plants used in green walls provide shade to the building and shading extent depends on the density of the plants in the green walls. Shading of building leads to temperature reduction in and around building. Green walls provide minimum diurnal fluctuation through providing insulation to the building. It has been reported that Green walls can reduce the surface temperature of buildings by as much as 15.2oC

3. Indoor air quality improvement: Plants have been widely believed to be effective scavengers of both gaseous and particulate pollutants from the atmosphere in the urban environment. They can improve the air quality by filtering out airborne particles in their leaves and branches as well as by absorbing gaseous pollutants through photosynthesis. They filter airborne particles in their leaves and branches as well as absorb gaseous pollutants. Through bio filtration, Volatile Organic Compounds commonly known as VOCs are absorbed through both plants and planting medium.

4. Economic benefits: Plants introduced around buildings can improve construction integrity by reducing the weather effect. The uses of green walls reduce the climatic stress on building façades and prolong the service and practical life of buildings. It also helps in the reduction of building deterioration by UV (ultra violet) rays. Reduced cost on the painting materials is one of the economic benefits of the green walls. It has been reported that in warmer climates, energy used for cooling in a building can be reduced by 28%.

Improvement of Health and Wellness

It has been proved that visual and physical contacts with plants can result in direct health benefits. Green wall can generate restorative effects leading to decreased stress; improve patient recovery rate and higher resistance to illness. The vertical gardens help in absorbing the obnoxious gases and volatile compounds produced due to the use of all modern amenities, thus reducing the risk of cancer, stroke, depression, heart and respiratory ailments.

Reduction of Urban Heat Island Effect (UHI)

There are following causes of urban heat island effect.
1. Canyon geometry Urban canyons, especially the deep ones, work as traps which decrease the loss of both short-wave and long wave radiation emitted from streets and building will eventually find their way into indoor space or re-emit back to the surroundings after sunset.
2. Building materials During the day time, more sensible heat can be stored in building materials, such as concrete, brick and asphalt, due to their big heat capacity. The stored heat will then be released back to the environment at night.
3. Greenhouse effect Long-wave radiation can easily be trapped inside the polluted urban atmosphere due to the greenhouse effect.
4. Anthropogenic heat source Anthropogenic heat generated from industrial combustion, traffic, air-conditioners and so on can aggravate the UHI effect.
5. Evaporative cooling source The UHI effect can be mitigated by evaporative cooling means, such as vegetation, water body and so on, since more incident energy can be transformed into latent heat rather than sensible heat. Unfortunately, the lack of such evaporative cooling methods in cities, especially the loss of greenery, causes severe UHI effect.

Other Benefits of Bio Wall Includes

1. Reducing internal room temperature by 5 to 10 degrees in summer by installing them from outside.
2. Plants are away from soil- borne diseases.
3. More plants with in limited space.
4. Helps in saving water.
5. Helps in hiding less attractive portions of landscape.
6. Provides excellent air circulation for the plants.
7. Can provide privacy and a disguise from unattractive views.

Disadvantage

1. Less exploited for vegetable crops and other crops.
2. Cost of establishment is more in modular panel system.
3. Maintenance.
4. Humidity.
5. Less awareness.

Conclusion

The purpose of intensive vertical gardening is to harvest the most produce possible from a given space. An intensive garden minimizes wasted space. The practice of intensive gardening is not just for those with limited garden space; rather, an intensive garden concentrates effort to create an ideal plant environment, giving better yields. A vertical vegetable garden is easy to plan and build. Vertical gardening for vegetables provides many benefits including: save space, easy to harvest, better air circulation, keeps vegetables off the ground and better yields.

Future Thrust

The study in Vertical Garden is a new field to investigate, regarding the insulation properties, durability aspects, maintenance, choice of plants suitable to the existing climatic conditions, materials involved, etc. Effect of the factors such as the physical structure, materials and dimensions of the panels, substrate type, composition, depth on the performance of vertical greenery systems need to be studied. The study of Green walls of vegetable crop with respect to Indian conditions must be done. Developing green wall requiring minimum cost and maintenance is one of the challenges which must be fulfilled.

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Communication Network Analysis of Farm Women using UCINET: A Case Study

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Summary
Women in hill regions bear greater roles and responsibilities as compared to their male counterparts. Due to adverse living conditions, they show more dependency on interpersonal channels of communication rather than on mass media or cosmopolite channels of communication. This dependent relationship leads to establishment of a patterned flow of communication, often termed as communication network. The present article provides a case from two Himalayan villages explaining the network properties of the communication network of farm women using social network analysis (SNA) software, UCINET.

Introduction
The communication network of farm women portrayed the social relations, revealing patterns that exist within the villages. It illustrates the whom-to whom communication pattern of the farm women pertaining to agricultural information. The communication network was delineated separately for the two sampled villages namely Badiyakot in district Bageshwar and Sabli Talli in district Tehri Garhwal of hill state, Uttarakhand, India. A total of 298 farm women i.e., 177 from Badiyakot and 121 from Sabli Talli were surveyed through personal interview for sociometric responses. UCINET, SNA software (Borgatti et al., 2002) was used to analyse the network properties. The analysis exhibits that network were directional, non- symmetric and connected without any isolates, which means each farm women in the villages were connected to at least one person in the network.

Network Properties as Delineated from Communication Network of Farm Women
Network density (the observed number of ties divided by the total possible number of ties) illustrates the degree to which network members are tied to other members. Since, the density scores vary by network type; it cannot be interpreted as high and low in absolute terms. The network density scores for the two networks were found to be relatively equal i.e., 0.040 and 0.037 for Sabli Talli and Badiyakot. Though to a small extent, the actors in Sabli Talli networks were comparatively more connected than those in Badiyakot network. Despite, these connections between the farm women in the communication network of both the villages were rather diffused and sparse. The probable reason for scattered connections might be due to the fact that farm women in these areas were mostly separated by geo-topographical distances. As a consequence, they have less accessibility and proximity to others in the area. However, within the core-periphery networks, there were some who were densely connected internally, while all the others were sparsely connected among themselves. On the whole, the core individuals were found to be more prominent in the transmission of information to the larger proportion in the networks. High density of a social network is assumed to foster mutual confidence (Bodin et al., 2006). Actors in dense networks have easy access to information and are able to monitor the actions of others. At times, in dense network, the heterogeneity of actors involved can be decreased which is decisive for multifaceted knowledge base (Folke et al., 2005). However, diffuse networks may provide local diversity as actors have fewer overlapping connections and are more likely to receive new information (Folke et al., 2005). As stated by Grabher (1993) and Newman and Dale (2005), the extremely dense network can hinder innovation and development due to personal constraints of pushing through new strategies. Consequently, this was not the case in the present study.
Average degree represents the average number of ties of each actor. It indicates the extent to which farm women consulted others for agricultural information. The average degree for farm women in Sabli Talli was 4.826 which were lower than in Badiyakot i.e., 6.514. Average distance focuses on the average distance between two nodes, considering the length of the shortest path (Borgatti et al., 2002). At this, a path is a walk which can only be passed once by each actor and each relation (Hanneman and Riddle, 2005). Average

distance between the two farm women in the networks were found to be nearly same i.e., 3.132 and 3.392 in Badiyakot and Sabli Talli. With regards to distance-based cohesion and distance-weighted fragmentation, both networks showed relatively moderate cohesiveness. In Badiyakot, values for compactness and breadth were 0.356 and 0.664, while in Sabli Talli; it was 0.306 and 0.694.

Table 1: Network statistics of the communication network of farm women in sampled villages:

Sl. No.	Network Statistics	Badiyakot	Sabli Talli
1.	No. of Ties	1153	584
2.	Average degree	6.514	4.826
3.	Density	0.037	0.040
4.	Number of cliques (weak)	542	179
5.	Components	2	14
6.	Component proportions	0.994 and 0.006	0.893 and 0.008
7.	Component Ratio	0.0057	0.108
8.	Heterogeneity	0.0112	0.2024
9.	Connectedness	0.994	0.894
10.	Fragmentation	0.006	0.106
11.	Geodesic distance (Average distance among reachable pairs)	3.132	3.392
12.	Distance-based cohesion ("Compactness") (Range 0 to 1; larger values indicate greater cohesiveness)	0.356	0.306
13.	Distance-weighted fragmentation ("Breadth")	0.644	0.694
14.	Reciprocity Measures		
15.	Reciprocated Arcs	56	22
16.	Unreciprocated Arcs	1097	562
17.	All Arcs	1153	584
18.	Arc Reciprocity	0.049	0.038
19.	Symmetric Dyads	28	11
20.	Asymmetric Dyads	1097	562
21.	All Dyads	1125	573
22.	Dyad Reciprocity	0.025	0.019
23.	Number of Clusters	2	2
24.	Overall graph clustering coefficient	0.071	0.08

Reciprocity is the tendency for directed ties from actor i to actor j be reciprocated and sent back from actor j to actor i. In Sabli Talli, out of total 584 arcs (directed nodes), only twenty-two arcs were reciprocated with arc reciprocity score of 0.038. On the other hand, in Badiyakot, out of total 1153 arcs, 56 arcs were reciprocated with arc reciprocity 0.049. In terms of dyads, out of total 573 dyads only eleven were symmetric with dyad reciprocity of 0.019 in Sabli Talli while for Badiyakot, it was twenty eight out of 1125 with dyad reciprocity score of 0.025 respectively. On comparison, reciprocity values of farm women in Badiyakot were noted to be more than that of in Sabli Talli. This means more farm women in Badiyakot communicate each other as compared to that in Sabli Talli.

Components of a graph referred to sub-graphs that are connected within, but disconnected between sub-graphs. For directed graphs, one can define two different kinds of components. A weak component is a set of nodes that are connected, regardless of the direction of ties. A strong component requires that there be a directed path from A to B in order for the two to be in the same component. In a directed graph two vertices are in the same weak component, if there is a semi-path connecting them. Two vertices x and y are in the same strong component if there is a path connecting x to y and a path connecting y to x. In Sabli Talli, fourteen components were observed with one main component and thirteen minor components in proportion of 0.893 and 0.008. While in Badiyakot, only two components were identified in proportion of 0.994 and 0.006. The heterogeneity between components was comparatively more in Sabli Talli (0.2024) than in Badiyakot (0.0112).

Based on similarities, strength and cohesion, two clusters were identified in both networks. The degree of clustering determines the situation where dense regions of interconnected individuals appear in parts of the network. The overall clustering coefficients (i.e., mean of the clustering coefficient of all the actors) was found to be 0.08 and 0.071 for Sabli Talli and Badiyakot. With regards to clique, 542 and 179 weak cliques were identified in Badiyakot and Sabli Talli networks with none strong cliques. Clique refers a sub-set of a network in which the actors are more closely and intensely tied to one another than they are to other members of the network. With large networks, mostly cliques of three and four elements were identified. The absence of larger cliques might be the sign of atomized small groups, which could further, hamper the capacity of extensive collaboration through the network. Connectedness refers to the proportion of pairs of nodes that can reach each other by a path of any length. In other words, the proportion of pairs of nodes those are located in the same component. Fragmentation, on the other hand, is the number of pairs of nodes that cannot reach each other by any means. The components in the two networks were found to be relatively high in connectedness with value 0.994 for Badiyakot and 0.894 for Sabli Talli. As a consequence, the fragmentation score for the two networks were relatively low i.e., 0.006 and 0.106 for Badiyakot and Sabli Talli respectively.

Conclusion

Though there has been an explosion of application of social network theories and analysis in various disciplines, its expansion to social and agricultural sciences still requires more theoretical understanding. The present article provides a case of farm women in hilly regions interwoven in a compact and isolated network with its limitations. More investigative researches in similar lines need to be encouraged among the social and agricultural scientists.

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Crop Growth Response of Micro-Climatic Parameters Under Poly House

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Introduction

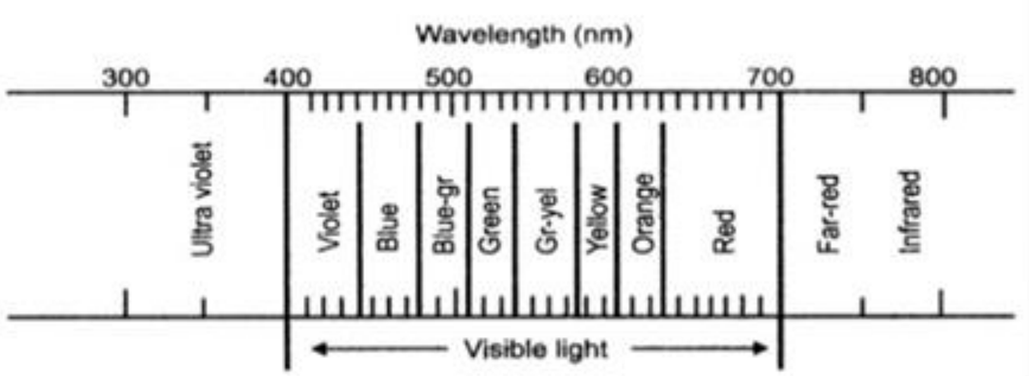
The productivity of a crop is influenced not only by its heredity but also by the microclimate around it. The components of crop microclimate are light, temperature, relative humidity, air compositions and the nature of the root medium. In open fields, only manipulation of nature of the root medium by tillage, irrigation and fertilizer application is possible. But in greenhouse permit control of any one or more of the components of the micro climate. The inside environment (microclimate) of a greenhouse is influenced by factors such as light, temperature, humidity and carbon dioxide concentration. The effects of greenhouse environment on growth, development and productivity of crops have been studied by many researchers. Crop yield mainly depends on the responses of plants to environmental influences (Ellis et al., 1990) for example, temperature has considerable influence on crop timing and yield (Pearson et al., 1995) and light is primary determinant of crop growth. Greenhouse air temperature, humidity and plant leaf temperature are in turn affected by the light transmission of the cover material.

Light

The visible light of the solar radiation is a source of energy for plants. Light energy, carbondioxide (CO_2) and water all enter in to the process of photosynthesis through which carbohydrates are formed. The production of carbohydrates from carbon dioxide and water in the presence of chlorophyll, using light energy is responsible for plant growth and reproduction. The rate of photosynthesis is governed by available fertilizer elements, water, carbon dioxide, light and temperature. The photosynthesis reaction can be represented as follows:

$$CO_2 + \text{water} + \text{light energy} \xrightarrow[\text{Plant nutrients}]{\text{Chlorophyll}} \text{carbohydrates} + \text{oxygen}$$

Considerable energy is required to reduce the carbon that is combined with oxygen in CO_2 gas to the state in which it exists in the carbohydrate. The light energy thus utilized is trapped in the carbohydrate. If the light intensity is diminished, photosynthesis slows down and hence the growth. If higher than optimal light intensities are provided, growth again slows down because of the injury to the chloroplasts. The light intensity is measured by the international unit known as Lux. It is direct illumination on the surrounding surface that is one meter from a uniform point source of 1 international candle. Green house crops are subjected to light intensities varying from 129.6 k lux on clear summer days to 32.2 K lux on cloudy winter days. Rose and carnation plants will grow well under summer light intensities. In general, for most other crops foliage is deeper green if the greenhouse is shaded to the extent of about 40% from mid-spring (May) to mid fall (August and September). Thus, it is apparent that light intensity requirements of photosynthesis are vary considerably from crop to crop. Light is classified according to its wave length in nanometers (nm). Not all light useful in photosynthesis process. UV light is available in the shorter wavelength range, i.e less than 400 nm. Large of quantities of it is harmful to the plants. Glass screens are opaque to the most UV light and light below the range of 325nm. Visible and white light has wavelength of 400 to 700nm.Far red light (700 to 750nm) affects plants, besides causing photosynthesis. Infrared rays of longer wavelengths are not involved in the plant process. It is primarily, the visible spectrum of light that is used in photosynthesis. In the blue and red bands, the photosynthesis activity is higher, when the blue light (shorter wavelength) alone is supplied to plants, the growth is retarded, and the plant becomes hard and dark in colour. When the plants are grown under red light (longer wavelength), growth is soft and internodes are long, resulting in tall plants. Visible light of all wavelengths is readily utilized in photosynthesis.



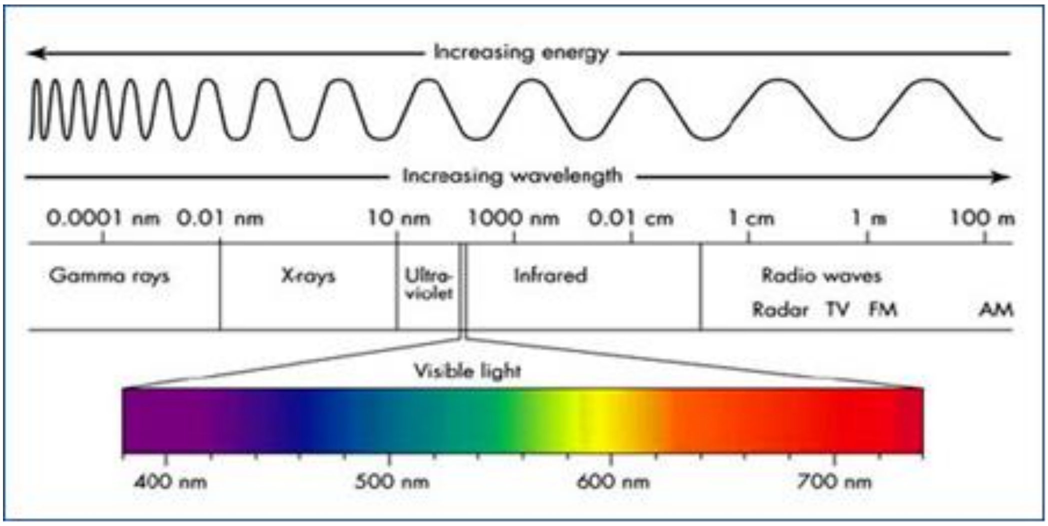


Fig. 1 Classification of light according to wave length

Temperature

Temperature is a measure of level of the heat present. All crops have temperature range in which they can grow well. Below this range, the plant life process stop due to ice formation within the tissue and cells are possibly punctured by ice crystals. At the upper extreme, enzymes become inactive, and again process essential for life cease. Enzymes are biological reaction catalyst and are heat sensitive. All biochemical reactions in the plant are controlled by the enzymes. The rate of reactions controlled by the enzyme often double or triple for each rise of temperature by 10^0C, until optimum temperature is reached. Further, increase in temperature begins to suppress the reaction and finally stop it. As a general rule, green house crops are grown at a day temperature, which are 3 to 6^0C higher than the night temperature on cloudy days and 80C higher on clear days. The night temperature of greenhouse crops is generally in the range of 7 to 21^0C. Carnation and cineraria at 10^0C, rose at 16^0C, chrysanthemum and poinsettia at 17 to 18^0C and African violet at 21 to 22^0C.

Relative Humidity

As the green house is a closed space, the relative humidity of the greenhouse air will be more when compared to the ambient air, due to the moisture added by the evapo-transpiration process. Some of this moisture is taken away by the air leaving from the greenhouse due to ventilation. Sensible heat inputs also lower the relative humidity of the air to some extent. In order to maintain the desirable relative humidity levels in the green houses, processes like humidification or dehumidification are carried out. For most crops, the acceptable range of relative humidity is between 50 to 80%. However, for plant propagation work, relative humidity up to 90% may be desirable. For this purpose, evaporative cooling pads and fogging system of humidification are employed. When the relative humidity is on the higher side, ventilators, chemical dehumidifiers and cooling coils are used for de- humidification.

Ventilation

There is a provision in green house for ventilation to either reducing the temperature inside greenhouse air or for replenishing carbon dioxide supply or for moderating the relative humidity of the air. Air temperatures above 35^0C are generally not suited for the crops in green house. It is quite possible to bring the greenhouse air temperature below this upper limit during spring and autumn seasons simply by providing adequate ventilation to the green house. The ventilation in a greenhouse can either be natural or forced. In case of small green houses (less than 6 m wide) natural ventilation can be quite effective during spring and autumn seasons. However, fan ventilation is essential to have precise control over the air temperature, humidity and carbon dioxide levels. Poor ventilation has a negative impact on indoor air composition, mainly by reducing the CO_2 concentration (Lorenzo et al., 1990). Inadequate ventilation generates overheating and excessive transpiration, leading to problems such as plant water stress and physiological disorders, including fruit cracking and abortion of flowers and fruits. On the other hand, natural ventilation helps to evacuate excess moisture and prevent its accumulation in the air layer near the leaves which can cause condensation, leading to the onset of diseases.

Carbon Dioxide

Carbon is an essential plant nutrient and is present in the plant in greater quantity than any other nutrient. About 40% of the dry matter of the plant is composed of carbon. Under normal conditions, carbon dioxide (CO_2) exits as a gas in the atmosphere slightly above 0.03% or 345ppm. During the day, when photosynthesis occurs under natural light, the plants in a greenhouse draw down the level of CO_2 to below 200ppm. Under these circumstances, infiltration or ventilation increases carbon dioxide levels**,** when the outside air is brought in, to maintain the ambient levels of CO_2. If the level of CO_2 is less than ambient levels, CO_2 may retard the plant growth. In cold climates, aintaining ambient levels of CO_2 by providing ventilation may be uneconomical, due to the necessity of heating the incoming air in order to maintain proper growing temperatures. In such regions, enrichment of the green house with CO_2 is followed. The exact CO_2 level needed for a given crop will vary, since it must be correlated with other variables in greenhouse production such as light, temperature, nutrient levels, cultivar and degree of maturity. Most crops will respond favorably to CO_2 at 1000 to 1200 ppm.

Summary

Microclimate of greenhouses is important for better plant growth and greater yield. The dynamic behaviour of the greenhouse microclimate is a combination of physical processes involving energy transfer and mass balance. The greenhouse microclimate can be manipulated by control actions, such as heating, ventilation, carbon dioxide enrichment to provide appropriate environmental conditions for crops. These modifications imply the additional use of energy in the production process. An optimal ambient control is needed to accomplish complicated processes involved in greenhouse energy balancing, including low emissions and reduced production costs. Greenhouse crops are grown at a day temperature, which are 3 to 6^0C higher than the night temperature on cloudy days and 8^0C higher on clear days. The night temperature of greenhouse crops is generally in the range of 7 to 21^0C. Inadequate ventilation generates overheating and excessive transpiration, leading to problems such as plant water stress and physiological disorders, including fruit cracking and abortion of flowers and fruits. Most crops will respond favourably to CO_2 at 1000 to 1200 ppm. Most crops, the acceptable range of relative humidity is between 50 to 80%. However, for plant propagation work, relative humidity up to 90% may be desirable.

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Distillation and Essential Oils Extraction Methods in Medicinal and Aromatic Crops

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Essential oils are natural plant products which accumulate in specialized structures such as oil cells, glandular trichomes, and oil or resin ducts. Chemically, the essential oils are primarily composed of mono and sesquiterpenes and aromatic polypropanoids synthesized via the mevalonic acid pathway for terpenes and the shikimic acid pathway for aromatic polypropanoids. And also, it is a kind of subtle, aromatic and volatile liquids extracted from the flowers, seeds, leaves, stems, bark and roots of herbs, bushes, shrubs and trees through distillation.

According to ancient Egyptian hieroglyphics and Chinese manuscripts, priests and physicians were using essential oils thousands of years ago to heal the sick. They are the oldest form of medicine and cosmetic known to man and were considered more valuable than gold. Science is only now beginning to investigate the incredible healing substances found in essential oils. The essential oils from aromatic plants are for the most part volatile and thus, lend themselves to several methods of extraction such as hydro distillation, water and steam distillation, direct steam distillation, and solvent extraction.

Essential oils can be divided into two broad categories:
1. Large volume oils which are usually distilled from leafy material, eg lemon grass, citronella and cinnamon leaves.
2. Small volume oils which are usually distilled from fruits, seed, buds and, to a lesser extent, flowers, e.g. cloves, nutmeg and coriander.

Distillation

The most important production method for Essential oils is distillation. The basic principle of distillation is the same but it is carried out in different ways depending on the botanical material and the condition of the material. Distillation is basically, producing steam. The steam is passed through the herbal material. The steam carries the essential oil from the plant in suspension which means the droplets of essential oils are not dissolved in the steam but remain separate as droplets of oil. When the steam is cooled it reverts to the liquid state which is water and in most cases the oil floats on the surface of the water. The oil is then separated from the water by dripping or pouring.

1. Water distillation: This is the simplest and usually cheapest distillation method. The plant material is immersed in water and boiled. The steam and oil vapour are condensed and the oil is separated from the water. Water distillation is used when the plant material has been dried and will not be damaged by boiling. It is also used for powdered materials such as powdered almond, and flowers, such as orange and rose, that need to float freely as they tend to lump together when just steam is passed through them. The material comes into direct contact with the boiling water and much care needs to be taken that the water does not boil away and cause the plant material to burn. The distillation temperature should be about 100°C. The distillation time depends on the plant material being processed, but is usually three hours. Prolonged distillation produces only a small amount of extra oil. Example of an oil prepared by this method is turpentine gum.

2. Water and steam distillation: The second method of distillation is water and steam. This is used for either fresh or dried plant material that would be damaged by boiling. The plant material is supported on a perforated grid. The water level is below the grid and low pressure, wet steam passes through the plant material. The most important aspect of this method is that the steam is never really hot and always at low pressure. The distillation temperature should be about 100°C and at atmospheric pressure Cinnamon and clove oils are prepared by this method.

3. **Steam distillation:** Direct steam distillation is similar to the second method but the steam is hotter and passed through the plant material at a higher pressure. This method is used for fresh plant material that has a high boiling point such as seeds, roots and wood. It is also used for fresh plant material such as peppermint and spearmint. The crop is cut and placed in a metal distilling tank on a truck. Steam is forced through the fresh herbs and the oil droplets are carried by the steam through a vapor pipe at the top of the tank onto a cool condensing chamber. In this method the temperature and pressure can be increased for certain oils. The rate of distillation and yield of oil are high and the quality of the oil is good.

a. Solvent Extraction: This is the most widely used modern method to prepare oils from flowers. The petals are mixed into a volatile solvent such as petroleum, ether or benzene, until the Essential oil is completely dissolved in the solvent. The solution is then filtered and the solvent is evaporated at reduced pressure. The result of solvent extraction is a concrete. The solvent is removed from the concrete by vacuum pressure without the use of heat to avoid any harmful effect to the oil. The concentrated essence that results is called an absolute. Absolutes are highly concentrated flower products without the natural waxes. The main advantage of extraction over distillation is that uniform temperatures are maintained throughout the process. High temperatures during the distillation process can produce altered chemical composition of the oil which alters the natural odor. However, this method is expensive compared to distillation, and chemicals or solvents used in the process may still be present after evaporation. There are three main ways that this can be performed.

b. Enfleurage: This is an old method which was used in the production of perfumes and pomade extracts for perfumery. Flower petals such as rose or jasmine are layered onto warm oils, cold fat or wax. This process is repeated each day until the base is saturated with the Essential oil. The resulting waxes or pastes contain up to 1 percent of Essential oil. The Essential oil is then extracted from the wax with a volatile liquid such as ethyl alcohol. In the final step the ethyl alcohol is evaporated at low temperatures and reduced pressure so that the pure Essential oil remains as a fairly thick liquid.

c. Maceration: This method involves putting the flowers in hot fat and the oils being extracted. This is very rare nowadays. Maceration lasts anywhere from hours to months. Fragrant compounds for woody and fibrous plant materials are often obtained in this matter. The technique can also be used to extract odorants that are too volatile for distillation or easily denatured by heat. Commonly used solvents for maceration include ethanol, hexane, and dimethyl ether.

d. Volatile solvent extraction: The flowers are put into the extractor and the solvent penetrates the flowers and dissolves the oils. This is pumped into an evaporator and concentrated at low temperatures. The solvent is driven off by a vacuum. This is expensive and dangerous due to the quantities of solvents used.

e. Cold Pressing or Expression: This method is mainly used to prepare citrus oils such as orange, lemon and tangerine. One method involves puncturing the oil glands by rolling the fruit over sharp projections that actually pierce the oil glands. The fruit is then pressed which removes the oil from the glands. It is then washed off with a fine spray of water. The juice is extracted by another tube. The oil is then separated from the water by rotating it at a very high speed. Another method involves separating the peel from the fruits and then cold pressing them. The Essential oil is collected along with small amounts of juice, which is separated.

Filtration

After the oil is collected, it should be filtered. This can be done through dry cotton wool. Water can be removed by saturating with sodium chloride and filtering.

Storage

The oils should be stored in darkened glass bottles, galvanized iron or stainless-steel containers. The head space in the containers should be minimal.

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Curry Leaf: Perennial Tree Vegetable Cum Spice Crop

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Common name: Karipatta, Meethi Neem.
Scientific name: *Murraya koenigii*
Family: Rutaceae.
Chromosome no: 2n = 18.
Origin: India.

1. *Murraya koenigii* (L.) Spreng. is an accepted name. This name is the accepted name of a species in the genus Murraya.
2. *M. koenigii* leaves and roots can be used to cure piles and allay heat of the body, thirst, inflammation and itching.
3. This plant is known to be the richest source of carbazole alkaloids. It displays various biological activities such as anti-tumor, anti-oxidative, anti-mutagenic and anti-inflammatory activities
4. Leaves rich in Vitamin A, Vitamin B, Vitamin B2, Vitamin C, calcium and iron help to purify blood, leaving your skin with a fresh glow.
5. The major constituent responsible for the aroma and flavor has been reported as pinene, sabinene, caryophyllene, cadinol and cadinene.

Curry leaf tree is a small strong smelling perennial shrub. It was originally cultivated in India for its aromatic leaves and for ornament is normally used for natural flavouring in curries and sauces. It is also used in many of the Indian ayurvedic and unani methods. It is now widely found in all parts of India and it adorns every house yard of southern India and also it is now cultivated and distributes throughout the world. Leaves are slightly pungent and retain their flavour even after drying. Ground curry leaf with mature coconut kernel and spices forms an excellent preserve. Recently it has gained importance as a commercial crop. Its volatile oil, curry leaf oil, produced from the plant has uses in the soap industry It is cultivated commercially in southern states like Tamil Nadu and Karnataka even also cultivated in West Bengal, Assam and Deccan Plateau.

Climate and Soil

It does not require a specific climate and can come up in dry climate too. It can grow up to 37°C. In places where temperature goes below 16°C, the growth of shoot will be slightly affected. Though it can be cultivated in most of the soil types, it comes up well in light textured red soils. But perform well at 5.5-6 pH soil.

Varieties

1. DWD 1: It is mainly cultivated in Karnatakan, 5.22% oil content. It is sensitive to winter season.

2. DWD 2 (Suwasini): It also cultivated in Karnataka 4.09% oil content. It is winter insensitive and gives higher yield than DWD 1.
3. Senkaampu It is a Coimbatore local type and the leaves have better aroma and flavour due to higher oil content.

Cultivation

Propagation:

a. Curry leaf is mainly propagated through seeds.
b. For raising seedlings, well-ripe fruits are collected from high-yielding plants.
c. The seeds are sown either in nursery or polybags filled with a mixture of 1:1:1 sand, soil and farmyard manure.
d. Seeds germinate in 3 weeks. One-year-old seedlings are planted in the main field.
e. It can also be propagated by root suckers.
f. There are a number of root suckers near its plants.
g. They are separated from the main plant during rainy season and planted immediately in the main field.

Planting:

a. Planting in the main field is done during the monsoon season.
b. The main field is ploughed thoroughly.
c. Pits of 30cm × 30cm size are dug at a spacing of 4m × 4m.

Manuring and fertilization: Generally, curry leaf plant is grown without inorganic fertilizers. However, for a better growth and yield, each plant may be fertilized with 15-20kg of Farmyard manure besides 150g nitrogen, 25g phosphorus, and 50g of potash per year. The fertilizers may be applied at the onset of the monsoon.

Aftercare: Regular irrigation is given to pit if there is no rain. The seedlings are irrigated once in five to seven days up to three years and once in 15 days afterwards. The field should be kept free of weeds. For development of better canopy, the plants should be trained and pruned a height of 1m. Their terminal buds are removed to encourage lateral branching. A minimum of 4–6 branches are kept per plant.

Harvesting and Postharvest Management

Leaves are ready to picked after 15 months after planting while Commercial harvest can be obtained from 3-year-old plants with good care and management, normal yield can be earned up to the age of 20–25 years. Harvesting of leaves is done at two-and-a-half to three months intervals .The average yield being 20–25 tonnes/ha.

1. Plant protection.
2. Pests.
3. Citrus butterfly:

a. Hand picking and destruction of the larvae
b. Spray entomogenous fungus, *Bacillus thuringiensis* 1 g /L
c. Spray carbaryl 50 WP 2.0 L in 1500-2000 L of water per ha during April and October.

4. Psyllid bug and scale: Psyllid bug and scales can be controlled by spraying Dimethoate @ 1 ml/lit. The traps also reduce the pests' reproductive capacity, helping to control populations (Yellow Sticky Traps).
5. Diseases: Leaf spot: Leaf spot disease can be controlled by spraying Carbendazim @ 1 g/lit of water. Spraying Sulphur compounds should be avoided.

Conclusion

Being a perennial and woody in nature as well as high value spice vegetable, this crop is known as Perennial tree vegetable cum spice crop. Curry leaf multi-utility crop with low investment cost and huge spice value. Despite multiple use and numerous benefits, the curry leaf is still an unexploited vegetable in terms of efforts towards its crop improvement and area under cultivation. It could be very good alternative crop to small and marginal farmers for climate resilient agriculture.

Advanced Package of Practices in *Aloe vera*

Article ID: 11335

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Aloe species, perennial succulent belonging to the family Liliaceae and has long been employed in medicinal preparation and for flavouring liquors and a source of the drug 'aloe'. Out of 275 species, three are commercially important species. They are: *A. barbadensis*, A. ferox and other species (*A. Africana* and *A. spicata*).Two of the major products derived from the leaves are the yellow bitter juice consisting of aloin and the gel consisting of polysaccharides. Apart from these products, several other products like dehydrated aloe powder, concentrates are also prepared. The Aloe contains cathartic anthrax-glycosides as its active principle ranging from 4.5 to 25 per cent of aloin. These are extensively used as active ingredients in laxative and anti-obesity preparation, as moisturizer, emollient or wound healer in various cosmetic and pharmaceutical formulations.

Origin and Distribution

Plants of the genus Aloe belong to the old world and are indigenous to Eastern and Southern Africa, the Canary Islands and Spain. The species spread to the Mediterranean basin and reached the West Indies, India, China and other countries in the 16th century and certain species are now cultivated for commercial purpose, especially in some of the West Indian Islands of the North Coast of South America. It is also cultivated in India.

Description of the Plant

Aloe is a coarse looking, perennial, shallow rooted plant with a short stem, 30-60 cm high. The plants have multiple tuberous roots and many supporting roots penetrating into the soil. Aloe does not have a true stem but produces bloom stalks. The plants generally grow slow close to the ground in a typical rosette shape. The fleshly leaves are densely crowded, strongly, cuticularized and have a spiny margin with thin-walled tubular cells. The flowers vary from yellow to rich orange in colour and are arranged in axillary spikes. The ovary is superior, triocular with axile placentation. The plant does not produce many viable seeds.

Species and Varieties

In India, 2 or 3 easily recognizable varieties are found, but their exact delimitations are not clear. In *A.vera* var.*chinensis* Baker, common all over the Deccan, the leaves have a distinct purple colour towards the base and the spies are not sharp. The leaves of *A.vera* var.*littoralis* Koenig ex Baker, found on the beach shingles in Madras right up to Rameswaram are smaller in size and have a dentate margin. Another variety which thrives on the Kathiawar coast, also called *A.abyssinica*, is the source of the Jaffarabad aloes. *A,variegata* called *A.varigata* Linn. A near kin of *A.vera* is found in parts of Maharashtra. It has large, fleshy, green leaves with sharp spines and white specks at the base of the leaves.

Soil

Because of its hardy nature, the plant can be grown on a variety of soils. It can be seen growing successfully from sandy coastal soils to loamy soils of plains with a pH of up to 8.5. However, water logged conditions and problematic soils do not suit its cultivation.

Climate

It has wide adaptability and can grow in various climatic conditions. It can be seen growing equally good in warm humid or dry climate with even 150-200 cm to about 35-40 cm of rainfall per annum. It is usually cultivated between March and June. However, in dry regions, the crop should be provided with protective irrigation.

Cultivation

Propagation: It is generally propagated by root suckers or rhizome cuttings, for this purpose, medium sized root suckers are chosen and carefully dug out without damaging the parent plant at the base and directly planted in the main field. It can also be propagated through rhizome cuttings. In this case, after the harvest of the crop, the underground rhizome is also dug out and made in to 5-6 cm length cuttings which should have minimum 2-3 nodes on them. It is rooted in specially prepared sand beds or containers and after it has started sprouting, it is ready for transplanting.

Planting: The field should be prepared well before the onset of monsoon and small furrows opened. About 15-18 cm long root suckers or rhizome cuttings are planted at a spacing of 60x45 cm in such a way that two third portion of the planting material should be under the ground.

Manuring: It is a newly domesticated crop and its full production technology including manurial requirement is yet to be worked out. Application of a mixture of 150kg/ha of nitrogen, potassium and phosphorus is recommended. The fertilizers are applied in the soil near the root system, after the plants are established.

Irrigation and weeding: Soon after planting, the land is irrigated. During the crop period, irrigation must be given according to the moisture status of the soil. Generally, 4 to 5 irrigations per year are sufficient. However, water should not be allowed to stagnate near plant. The land is kept weed free by weeding the plot as and when necessary.

Harvesting and yield: After about 8 months, the leaves are ready for harvest. While harvesting, the plants can be removed manually. The broken rhizome parts left in this soil throws new sprouts to raise the succeeding crop. Aloe plantation gives commercial yield from second year and up to 5 years. Thereafter, it needs replantation for economic yields. An average crop yield of about 10,000 to 12,000 kg on fresh weight basis may be obtained from on hectare.

Processing: The mucilaginous pulp from the leaf parenchyma, which is mainly carbohydrate in nature, is used in skin disorders. For the purpose of isolation of aloe gel, the portion of leaves remaining after the removal of their exudates is cut open and their mucilage is scraped out with a blunt edged knife. This mucilage is stirred vigorously in a blender to make it into a uniform solution and is strained through a muslin cloth and filtered. The gel is precipitated from the extract by slowly adding acetone. The gel is obtained by centrifuging and re-dissolved in slightly warm water. It is dried at high temperature and weighed.

Post COVID-19 Vaccine Diet to Maximise its Effects and Strengthens the Immunity System

Article ID: 11336

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Abstract

The country has been hit by the second wave of coronavirus. To improve the situation, the government has not just announced lockdown but has also started the third phase of vaccination. More and more people including those above 18 years are getting vaccinated each day. But as the vaccination, comes the fear of its side effects also arises. But these side effects are often easily managed if one eats right, rests properly and follows what is suggested by their healthcare provider. Eating the proper foods can help prevent any side effects on a large scale.

Introduction

The coronavirus pandemic has shown mankind vulnerable beyond measure people are now adviced to stay indoors and must avoid contact, even when they need assistance. Besides this, travelling, leisure activities, work and even the education system has taken a serious blow.COVID-19 vaccination was created to let people have a sigh of relief. The vaccination drive, which was rolled out in India in January 2021, is on a full swing and 143 million doses have been disseminated so far. The next phase, will target the 18 years and above population. Although only 1.7% of the Indian population is fully vaccinated at present, people have shared their opinion regarding the two shots and their after-effects. A vaccine is a weakened or a dead form of virus or its particle injected in a patient's body to strengthen the immune system against a virus. When the virus enters our bloodstream, the immune system gets activated, kills the virus, and becomes stronger for future contact. Therefore, when a vaccination shot is received, it is normal to experience a few disturbances because the immune system instructs your body to react in a certain way. Furthermore, blood flow increases throughout your body so that the immune cells can be put into action. As a result, when the immune system fights back the virus, it raises the body temperature for a certain period (Khanna et al., 2018).

After effects of the vaccination may include:
1. Fever.
2. Nausea.
3. Headache.
4. Chills.
5. Body ache.
6. Fatigue.
7. Muscle pain.

Foods Good for Reducing Fever

Foods like red meat, shellfish, unhealthy snacks, unpasteurized milk and similar products,coffee ,alcohol are hard to digest during a fever because your digestive system is not good. When you have a fever, you have to make sure that you should eat only stomach-friendly foods, as well as those that are rich in nutrients that your body greatly needs. So here are some of the foods that you should consume if you want to feel good during a fever and also bounce back from it so much faster:

Chicken Soup: There are several of reasons why a bowl of hot chicken soup is good for you when you are running a fever. First, it increases your overall fluid intake, helping to lower your body temperature as well as flush out toxins. Second, chicken soup supplies the body with protein which you need for accelerated healing.

Poultry and Fish: When you have a fever, your body needs all the protein it can get to recover from it at a much faster rate. Some of the best sources of protein are poultry and fish but make sure that they are thoroughly cooked for easy digestion. Fish, oily ones in particular, are rich in omega-3 fatty acids that helps to strengthen the immune system.

Vegetables: Nothing can provide your body with much-needed nutrients than vegetables. It's a good idea for you to have your veggies cooked thoroughly to make them easier to digest by your weakened stomach.

Fruits: It's also a wonderful idea for you to consume good amounts of fruits when you are having a bout of fever. Most fruits are packed with vitamin C, which is something you need for a strong immune system. If your appetite is not good, taking fresh fruit juices is highly recommended as they are so much easier to consume.

Greek Yogurt: Doctors recommend the consumption of Greek yogurt for anyone who has a fever because it provides the body with good bacteria that assists in fighting off invading microbes that cause infections. Greek yogurt is also an excellent source of protein that helps your body heal as quickly as possible.

You should also consume coconut water if you have a fever because it is a phenomenal hydrator of the body, it is very important for anyone who has a fever to remain hydrated. Especially if you are suffering from mild diarrhea, too, the intake of coconut water can help replace those vital fluids and electrolytes lost (Beckman et al., 2018).

Foods Good for Reducing Nausea

For milder symptoms, such as nausea due to morning sickness, eating low-fat foods that are easy on the stomach or drinking ginger ale may help to cold sweats, a sour stomach, and dizziness. Here are some foods that may help.

Apple: A little fibre goes a long way toward clearing nausea-inducing chemicals out of your system, but too much at one time can make you feel even worse. "Fibre slows down digestion, so it's possible that the slowing of the intestinal transit may help ease digestion and relieve nausea,".

Crackers: Foods high in starch — such as saltines, bread, and toast — help absorb gastric acid and settle a queasy stomach. "The bland nature of a cracker helps to satisfy hunger (excessive hunger can exasperate nausea) without the strong smells or tastes that may increase nausea,".

Ginger: Capsules of powdered ginger have been found to reduce nausea and vomiting. You could also try a cup of ginger tea, a glass of ginger ale a few gingersnap cookies, or a piece of ginger candy. "Ginger has been found to reduce symptoms of nausea, especially in pregnancy,".

Water: Small sips from a glass of plain water will help you stay hydrated and avoid the headaches that often accompany nausea. Start out by slowly drinking tiny amounts until you feel you can stomach a larger amount. "Drinking fluids prevents hydration, but drinking too much at one time can make nausea worse,".

Nuts: A lack of protein can make nausea feel even worse, so look to protein-packed foods, such as nuts even peanut butter, as long as you're not allergic that are easy to digest. They'll quickly replenish your depleted energy and help keep your nausea at bay. "Nausea from excessive hunger, low blood sugar, or pregnancy may respond well to the protein and fat in nuts,".

Chicken Broth: Chicken soup may make you feel better when you have a cold, but it's too heavy when you're nauseated. "Fats, which delay emptying of the stomach, should be avoided,". Instead, try soothing your symptoms with chicken broth — the lower in fat, the better. Broth made from bouillon cubes may be your best bet because it's easy to prepare and less likely to spoil.

Sports Drinks: Most sports drinks contain the electrolytes sodium and potassium, which help restore an athlete's depleted nutrients. "Small sips of electrolyte-rich beverages are appropriate to promote hydration and replenish electrolytes lost during vomiting,".

Banana: If your nausea is accompanied by dehydration, or if you have been vomiting, snack on a piece of this peel-and-eat fruit. Bananas can help restore potassium, which is often depleted as a result of diarrhea and vomiting. "Potassium is an electrolyte that's lost during vomiting or bouts of diarrhea," "Bananas are also starchy and binding, which may help to reduce diarrhea." Doctors also recommend starting on "bland" foods, like bananas, when you're ready to eat solids again.

Sprig of Mint: The refreshing aroma alone may be enough to make you feel better, but actually chewing on fresh mint or drinking a cup of mint tea is considered an effective remedy for nausea. "Deep breathing and other relaxation techniques may also be helpful," (Johnson et al., 2017).

Headache, Bodyache, Musclepain (Fibromyalgia)

An elimination diet involves eating very basic foods for several days, such as chicken, rice, and broccoli. After several days on a limited diet, you should slowly add other foods into your diet. This will allow you to see how each food affects your fibromyalgia symptoms. Eating guidelines for people with fibromyalgia are the same as those for people without the condition. This means eating a spread of fresh fruits and vegetables, and a sufficient amount of fat, carbohydrates, and protein every day.

Eat the Rainbow: Do your best to incorporate as many colourful fresh fruits and vegetables into your diet as possible. Different coloured foods have different vitamins and nutrients, which are all important to assist your body stay healthy and as pain-free as possible.

Stay Away from Refined or Processed Foods: You should focus on eating fruits, vegetables, and whole grains. Avoid eating processed and packaged snack foods, which contain food additives that are often not rigorously tested enough to determine safety of long-term consumption. Some food additives are classified as excitotoxins, which may trigger fibromyalgia symptoms. It's also a good idea to limit "white" carbohydrates such as white bread, pasta, and rice, as well as sugary foods, sweets, and sweetened beverages. These refined carbohydrates cause an increase in blood sugar with a resulting insulin spike that may also exacerbate symptoms. Focus on whole grains and complex carbohydrates that provide fiber, minerals, and vitamins (Starke et al. ,2013).

Conclusion

The bad news is that the second wave of Covid-19 is here to remain for some time, but the great news is that we have vaccines to fight it. However, a number of people have experienced some side-effects after taking the shot like headache, fever, body ache, fatigue, etc. But doctors say that with a healthy diet and routine, these can be minimised or avoided. In this paper there are some foods which strengthen immunity and maximise the effects of the vaccine. The after-effects of corona virus vaccination can be harsh on a few people who may experience discomfort in the arm where the dose was administered. Here are some ways to soothe the same. Both onion and garlic are good immunity-boosters and good for gut health. They must be made a part of the meal and cooked post the vaccination necessarily. Use Ice pack or cold compress on the vaccination spot, turmeric milk, avoid alcohol, drinking plenty of fluids, take an analgesic like paracetamol for mild symptoms. In case a patient experiences loss of taste and smell after the vaccination, it is advisable to reach out to a doctor for support.

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Formulas for Estimating Marketing Efficiency

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Introduction

Agricultural marketing is mainly the buying and selling of agricultural products. In earlier days when the village economy was more or less self-sufficient the marketing of agricultural products presented no difficulty as the farmer sold his produce to the consumer on a cash or barter basis.

Price Spread Analysis

Price spread in general is referred to as difference between the price paid by the ultimate consumer and that received by the growers per unit of the commodity. Price spread analysis would estimate the share of different market functionaries in the consumer's rupee and this would often facilitate the understanding of the relative efficiencies and otherwise of alternate marketing channels.

Farmer's Share in Consumer's Rupee

Farmer's share in consumer rupee was calculated with the help of the following formula.

$$Fs = (Fp/Cp) \times 100$$

Where,

Fs = Farmer's share in consumer rupee (percentage).
Fp = Farmer's net selling price.
Cp = consumer's price.

Same formula was used to know the share of different market intermediaries in the consumer rupee.

Estimation of Marketing Efficiency

Marketing efficiency is the degree of market performance. The movement of goods from the producers to the ultimate consumers at the lowest possible cost consistent with the provision of service desired by the consumers is termed as efficient marketing. The following formulae were used to estimate the marketing efficiency of different channels of marketing chilli.

a. Shepherd's Formula: Shepherd (1972) estimated marketing efficiency as the ratio of consumer's price to the total marketing costs and margins. Higher the ratio, higher would be the efficiency and vice versa. This can be expressed in the following form:

$$ME = \frac{CP}{MC + MM}$$

Where,

ME = Marketing efficiency.
CP = Consumers' purchase price.
MC = Marketing costs.
MM = Marketing margins.

b. Acharya's Approach: According to Acharya (2003), an ideal measure of marketing efficiency, particularly for comparing the efficiency of alternate market channels should take into account all of the following:

i. Total marketing costs (MC)
ii. Net marketing margins (MM)
iii. Price received by the farmer (FP)
iv. Price paid by the consumer (RP)

The following measure is suggested by Acharya,

$$\boxed{ME = FP \div (MC + MM)}$$

Agricultural Export Zones of Tamil Nadu

Article ID: 11338

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Introduction

The concept of Agri Export Zone (AEZ) was introduced in 2001, through EXIM Policy 1997-2001, to take a comprehensive look at a particular produce/product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing/packaging, leading to final exports.

Measures Envisaged Promoting Exports from Such Zone

Financial Assistance Both Central as well as State Government and their agencies are providing a variety of financial assistance to various agri export related activities. These extend from providing financial assistance for Training and Extension, R&D, Quality Upgradation, Infrastructure and Marketing etc. Thus, whereas Central government Agencies like APEDA, NHB, Deptt. of Food Processing Industries, Ministry of Agriculture provide assistance, a number of State Governments have also extended similar facilities. All these facilities would have to be dovetailed and extended to promote agri exports from the proposed Zones in a coordinated manner. Some additional features like providing grants from Market Access Initiative fund could also be considered.

Fiscal Incentives The benefits under Export Promotion Capital Goods Scheme, which were hitherto available only to direct exporters, have now been extended to service exporters in the Agri Export zones. Thus, even service provided to ultimate exporters will be eligible for import of capital goods at a concessional duty for setting up of common facilities. They shall fulfil their export obligation through receipt of foreign exchange from ultimate exporters who shall make the payments from their EEFC account. Exporters of value added agri products will be eligible for sourcing duty free fuel for generation of power, provided the cost component of power in the ultimate product is 10% or more and the input-output norms are fixed by the advance licencing committee of the DGFT. In view of the power intensive nature of most of the value addition, almost all the exporters of value-added agriculture produce will become eligible for such facility. Similarly, input-output norms can also be fixed for sourcing other inputs, like fertilizer, pesticides etc. duty free for cultivation purpose.

Benefits

1. Strengthening of backward linkages with a market-oriented approach.
2. Product acceptability and its competitiveness abroad as well as in the domestic market.
3. Value addition to basic agricultural produce.
4. Bring down cost of production through economy of scale.
5. Better price for agricultural produce.
6. Improvement in product quality and packaging.
7. Promote trade related research and development.
8. Increase employment opportunities.

Agri Export Zones in Tamil Nadu

To promote Agri Horticultural Produce Exports from Tamil Nadu, four Agri Export Zones for specific commodities have been established as detailed below.

1. Agri Export Zone for Cut Flowers at Hosur comprising of Dharmapuri and Krishnagiri Districts: In Tamil Nadu, Agri Export Zone for cut flowers has been approved and Memorandum of Understanding was signed with APEDA. In 198.73 acres of land, "TANFLORA", a joint venture company of TIDCO and private promoter established infrastructural facilities like Central Packing House comprising of sorting, grading, packaging, cold storage and marketing facilities at Hosur at a cost of Rs. 24.85 crores. During the year 2007-08, 120 lakhs of cut flowers worth Rs.12 Crores have been exported to Europe, Middle and Far East Asian countries, Australia and Japan.

2. Agri Export Zone for flowers in Nilgiris District: An Agri Export Zone for flowers at Ooty covering Nilgiris district is being established with the participation by private promoter at a project cost of Rs. 15.89 crores. Memorandum of Understanding has been signed with APEDA. Infrastructure facilitie s like auction centre, mother plant nursery, pre-cooling, cold storage, reefer vans, Hi-tech training centre, common marketing facility, etc., are to be provided in the zone. The department of Horticulture & Plantation Crops is conducting Hi-tech floriculture training and providing planting materials at 50% subsidized cost and subsidy for green houses, shade nets to flower growers. An information centre for providing technical consultancy and other horticultural information to the growers established at Ooty. On 6.2.2007, Electronic Flower Auction centre at a cost of Rs. 11 lakhs have been opened in Nilgiris and it is utilised by the farmers to sell their flowers.

3. Agri Export Zone for Mangoes in Theni District: An Agri Export Zone exclusively for mango has been established in Theni and five other districts namely Madurai, Virudhunagar, Tirunelveli, Dindigul and Kaniyakumari with private sector participation at a project cost of Rs.24.60 crores. Memorandum of Understanding has been signed with APEDA. The private promoter M/s. Maagrita Exports Limited has established infrastructure facilities like state-of-the-art Pack House, collection centre, processing units, grading halls, hot-water treatment plant, pulping centre, dehydration unit, canning unit, etc. in Nilakkottai Food Park.

4. Agri Export Zone for Cashew in Cuddalore District: Agri Export Zone for cashew at a project cost of Rs. 17 crores at Cuddalore district have been approved. Memorandum of Understanding has been singed with APEDA. M/s Sattva Agro Export Pvt. Ltd., has been selected as the anchor promoter for cashew Agri Export Zone through private promoter participation. The Detailed Project Report for the construction of common infrastructure facilities was prepared by M/S Sattva Exports and handed over to TIDCO. TIDCO has approved to release an amount of Rs. 47.25 lakhs as State equity to M/S Sattva Agro Export Pvt. Ltd. The Agri Export Zone work commenced in the year 2006-07 and the construction of infrastructure facilities and modernised nurseries is under progress. A survey has been conducted by the Firm for the procurement of cashew from 120 farmers through contract farming.

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Phyllanthus niruri – The Stone Breaker

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Introduction

A natural gift that God has bestowed upon us; the Indians for more than 5,000 years is nothing but ayurveda. It not only teaches us a healthy lifestyle but also emphasizes on the use of vast herbal remedies. Bhumi Amla is one of those immortal herbal remedies, even described in the slokas of ayurveda. So, what is it? What are its benefits? Let's analyze!

The botanical name of bhumi amla is *Phyllanthus niruri.* Being a relative of spurges, it belongs to genus *Phyllanthus* and family Euphorbiaceae. It is a tropical plant that grows 50-70cm in height. This herb is called Bhumi amla because it is a small plant present near the bhumi (land) usually found in rainy season. Basically, it is a field weed and its genus includes 600-700 species with minor distinguishing features among them. In his great book Charaka Samhita, *P. niruri* is described to be an effective treatment of asthma, stimulating liver, improving digestion, increase apetite and produce laxative effects. It has been categorized by Maharishi Charaka as Kasahara: alleviates cough, Swasahara: relieves asthma, mootrarogahara: cures urinary disorders, Kaphapittahara: relieves the kaphapitta dosha, Kaamalaahara: cures jaundice, and Bhava prakasa Nighantu: cures cough and blood disorders. It tastes bitter but is sweet in the post digestive effect (vipaka) and also used as astringent. The bark of the plant is light green in color and smooth. The fruits are tiny, smooth in capsules form containing seeds. The flowers are insignificantly pale green in color, often flushed with red color.

Bhumi amla is commonly known as chanca piedra, stone breaker, seed-under-leaf or gale of the wind. In India, it is called by different names in different areas such as:

1. Assamese: Holpholi; Poram-lokhi.
2. Bengali: Noar.
3. Hindi: Chalmeri, Harfarauri, Bhuiaonla.
4. Kannada: Kirunelli, Nela Nelli.
5. Konkani: Bhuin-avalae.
6. Telugu: Ratsavusirike, Nela Usiri.
7. Tamil: Arunelli, Keela Nelli.
8. Malayalam: Arinelli,Kizhanelli,Nellipuli
9. Marathi: Rayavali, Bhuiavli.
10. Odia: Narakoli, Badi aonla.
11. Sanskrit: Amala, Bhumyamlaki, Sukshmadala, Vitunika, Bhoodatri.

What is the Difference Between Aonla and Bhumi Amla?

This herb lies close to the ground and is so called as 'Bhumi Amla', which means Earth. It is similar to Amla in appearance but it grows to only about 50 cm above the ground. But, as both belong to same genus, nevertheless they share some similar properties such as both are rich in Vitamin C.

Bhumi Amla – The Stone Breaking Mechanism

Bhumi Amla is alkaline in nature and has diuretic properties. It reduces urinary oxalate and increases urinary excretion of magnesium and potassium in patients with hyperoxaluria. Regular consumption of Bhumi Amla also helps in reducing urinary calculi. It is also less expensive over the prescribed alternative, potassium citrate for the same. In 2010, some studies showed that Bhumi Amla was found to interfere the crucial stages of stone formation and worked by relaxing the ureters and thus by helping to expel the stones to pass by urine. It also helps the patients to urinate more. In one study, out of 56 people having kidney stones, who took 4.5gm of Bhumi Amla per day, the stone decreased in size and number in about 2/3rd of its participants. Bhumi Amla is rich in Vitamin C. Vitamin C has the characteristic property to convert the cholesterol into bile in the liver. Consuming proper dose of Bhumi Amla, reduces the blood cholesterol level as well as likelihood of any pesky gallstones. Yet, there is no scientific support to use Bhumi Amla for reducing gall stones.

Home Remedies and its Other Benefits

1. Its juice from all the body parts (panchang), on old chronic wounds, being mixed with rice-washed water is applied, thus healing the inflammation.
2. Its leaves are boiled well with water for some time and that water is applied on the wounds to give a relieving effect.
3. Its leaves can also be powdered raw and is applied on the wounds to heal it.
4. 10gm of its bark is powdered with 1 teaspoon of rock candy (misri) or honey to make a paste, either to drink or to apply near the nostrils to heal the breathing problems.
5. Its raw leaves are powdered with pinch of salt and the mixture is applied on itching parts of the body, even on thighs to heal them quickly.
6. Its fruits are rubbed inside a copper vessel with some rock salt (singha namak) and applied on the outside of eyes to heal eye problems.
7. 50gm of its raw leaves are boiled well with 200ml of water and is used for gurgling purpose to heal the mouth ulcers.
8. 50gm of its all-body parts (panchang) is boiled well with 1/2lt of water and when the mixture becomes one-fourth of its volume, the boiling process is stopped. One teaspoonful of this mixture is taken twice a day to heal cough problems.
9. 20gm of its raw leaves are boiled well with 200ml of water and the mixture is strained and is taken 2 teaspoonful amounts twice a day to relieve abdominal pains.
10. Its fruits are dried well in shade and kept. 10gm of these dried fruits are boiled well with 400ml of water till it reaches one-fourth of its volume and is strained. This mixture can be taken one hour before breakfast and dinner to heal intestinal ulcers.
11. 10ml of its fruit juice is mixed with pinch of cumin seeds and sugar and is taken to relieve from urinary inflammation and other urinary disorders.
12. 50gm of its all-body parts (panchang) is boiled with 400ml of water till it reaches one-fourth of its volume and 5gm of fenugreek powder is added to the mixture. The mixture is taken time and again to relieve from diarrhoea.
13. 15gm of its all-body parts (panchang) is mixed with 20 numbers of black pepper seeds and is powdered well. This powder is taken 5gm thrice a day to heal the diabetes problem.
14. A paste of its raw fruits is made and taken with some amount of butter milk to get relief from jaundice.

How to Grow Bhumi Amla?

For commercial purpose:

a. For Bhumi amalaki, land is prepared in the month of April – May. One deep cultivator and then tillering 2-3 times is done to bring soil to fine tilth. Beds of convenient length i.e., 30-40 cm, are prepared.

b. It is grown in wide variety of soil ranging from alkaline to neutral and acidic soil. It can also be grown on calcareous soil with well drained and light textured soils.
c. Sowing temperature: 30–33-degree celcius and harvesting temperature: 23-20-degree celcius and rainfall: 25-30cm.
d. For good yield, seed rate is 400g/acre.
e. At the time of land preparation, apply well decomposed organic manure i.e., FYM @5-10tonnes well mixed with soil. A proper fertilizer dose N, P and K is not required by the crop.
f. Spraying of Nuvacron @0.2% is done to keep plan pest free.
g. Application of Sulfex @0.25% is done to cure from disease.

For home garden:

a. Basically, bhumi amla is a weed. Its seed move in the wind and fall everywhere. So, it is called gale of the wind. So, if it has grown by chance in your garden, never to remove it, but grow it in a better place.
b. Or else, we can grow it by seeds or directly by transplanting, available easily in the market at affordable prices.
c. The crop will grow in 3-4 months well.
d. As all the parts of the weed is utilized in a very good way, everyone should grow this in their home garden.

Conclusion

Plant trees, save lives! It might be said like this now! Plant medicinal weeds, save lives! Isn't it? In this age of deadly pandemics, this bhumi amla plant can be regarded as golden gift of nature to us. Apart from this, we all are now living in an environment, exhausted with air and water pollution. There is literally, no fresh air to breathe in! So, in this present context, if this plant gives relief from so many diseases and minor bodily defects, then why not to grow it extensively? Now, it's high time to think that it is better to be cured naturally and get natural oxygen, than to be in oxygen ventilators!

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Reproductive Behaviour of Insects

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Introduction

Behavior can be defined as anything that an individual does during its life, involving action in response to a stimulus. Reproductive behavior in insects is the physiological urges and stimulation by insect of opposite sex.

Reproductive Behaviour Involves

1. Sexual selection.
2. Finding mates.
3. Choosing mates.
4. Nuptial gifts.
5. Mating systems and strategies.
6. Sperm competition.
7. Tandem positions.
8. Non – contact guarding phase.

Sexual Selection

The competition among males for mating with females is called intrasexual selection, in which females remain passive. The active choice of females by males is called as sexual selection. Males select high quality females based on size, color or vigor. It is also called as epigamic selection. Males find females and then compete with other males including enlarged antennae for detecting a female's pheromone or horns for fighting with other males.

Finding Mates

Bees, Wasps, Ants, Butterflies and Beetles – Males are known to search emergence sites when they can mate with emerging virgin females. Males go in search of females to their oviposition sites. Eg: Fruitfly. Males go to the extreme of detecting virgin females before they emerge as fully mature adults, which is called as forced copulation. Hill topping is a common mating strategy for males in which males fly to prominent topographical features and mate with virgin females.

Hercules beetle

Choosing Mates

Once a mate has been located there is no courtship behavior before copulation – Eg: Sawflies. Courtship may be extravagant. Courtship takes many forms. Acoustic signaling is an important method for attracting mates with stridulation. Eg : Crickets, Grasshoppers and Cicadas.

Grasshopper

Nuptial Gifts

Courtship also includes nuptial gifts of food from males to females in many species. The male can display his competence as a hunter or provider of food and the female can make a choice. Male gifts female by providing a significant meal which enhances her fecundity. It reduces her risks of hunting for food.

Mating Systems and Strategies

1. Monogamy – Termites – Each sex mates once. Each sex has a single mate for life.
2. Polygyny – Mosquitoes – Females mate once. Males mate several times.
3. Polygynandry – Wasps – Both sexes have variable mate numbers. Male mating success is more than female mating success.
4. Polygamy – Spiders – Both sexes have variable mate numbers. Male mating success is approximately equal to female mating success.
5. Polyandry – Widow spiders – Males mate once. Females mate several times.

Sperm Competition

Inseminated sperm is stored by the female in the spermatheca. Sperm remains viable for a long time. Once females have mated there is always the chance that a subsequent male will mate with her and displace the sperm in her spermatheca from a previous mating. This chance is maximized when females mate several times before eggs are fertilized. This is prevented by mating plugs. Mating plugs block the genital passages of females after copulation, preventing or reducing possibilities of subsequent copulations. Example: Diptera, Hymenoptera and Lepidoptera.

Red cotton bugs

Tandem Positions

Tandem positions or passive phases occur when males remain attached to a mated female but without genital contact. Males defend females against other males, often while the female oviposits. Eg: Locusts, Grasshoppers, Crickets, and in Dragonflies and Damselflies.

Damselflies

Non – Contact Guarding Phase

Non – contact guarding phases involve males which guard females they have copulated with, but the pair do not remain in contact. A female may remain in the territory of a male which defends against entry by other males.

Conclusion - Reproduction and Success of Insects

Reproductive success is one of the most significant measures of an organism's fitness. In insect population, females often produce large numbers of eggs (high fecundity), most of the eggs hatch (high fertility) and the life cycle is relatively short. The above-mentioned reproductive behaviour enables insects to produce remarkably large number of offspring. The queen of a termite colony may be the mother of more than ten million workers during her 20 to 25 years lifespan.

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Fermented Onion Products

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Introduction

Onion (*Allium cepa* L.) is an important vegetable crops used as a food ingredient. It is consumed raw, cooked or different onion processed products in the daily diet. Onion added into different food products makes rich in bioactive compounds with potential beneficial health effects. Onions are valued for their flavorful addition to our meals, and their value-added health components. As a vegetable crop, it is a low in fat and calories, although, it primarily consumed to enhance the flavor of the foods. It is a good source of vitamins, minerals, polyphenols and a number of phytonutrients. In addition to this, onion bulbs have a unique combination of three families of health benefit compounds i.e., fructans, flavonoids and organosulfur compounds. Onion bulbs are richest sources of dietary flavonoids and it has antioxidant properties. It is usually consumed as fresh, however since losses of fresh onion in storage have been reported to be about 20-30% (Chadha and Sidhus, 1990), processed products are the most practical solution.

Chemical Composition

Nutritional value of onions varies from variety to variety. Its major value is in its flavor and medium in calorific value. Nutritional value of onion is given in Table 1.

Table 1. Nutritional value of onion (100 g of fresh bulb):

Composition	Value
Moisture, (g)	82.77 ± 0.07
Total Carbohydrate, (g)	14.77 ± 0.04
Crude Protein, (g)	1.489 ± 0.4
Crude Fat, (g)	0.721 ± 0.05
Total Sugar, (g)	2.32 ± 0.2
Crude Fibre, (g)	1.659 ± 0.8
Ash content, (g)	0.248 ± 0.1
Ascorbic acid (mg)	5.7 ± 0.5

(Source: Bhattacharjee et al. 2013)

Types of Onions

Onions of all colors – yellow, red, and white and available round the year. Seasonal differences like flavor and texture are noticeable and highlighted as follows.

Yellow: It has papery skin of yellow-brown or pale golden colour. Yellow onions are all-purpose and can be used for any recipe. Sweet and mild types are best for raw, soaked or lightly cooked. Full-flavored types are ideal for grilling, roasting, and caramelizing. When caramelized, they turn a rich, dark brown give French onion soup for its famous color and flavor.

Red: Mild red onions are often consumed raw or pickled; they can be spicy, or pungent depending on the variety and growing season. Their color and texture gives well to grilling char-broiling, and roasting. Red onions are commonly used for salads and sandwiches.

White: White onions have a distinct onion flavor with little to no after-taste. When pan-fry (fry quickly in a little hot fat), they have a mellow flavor (pleasant, smooth, and rich) and turn a golden color.

Fermented Products

1. Pickle: Pickling of onion can be done in two ways. Vinegar based pickling and oil-based pickling with spices. Oil based pickle can be prepared as other pickles (mango, lemon etc) by adding different spices as per the desired taste. However, addition of pH regulators is important to keep the pH below 4, which is important to store for longer time without any microbial growth.

a. Brine pickle: Salt cured pieces are freshened and preserved in fresh brine and vinegar. For brine pickles minimum prescribed salt of 8 to 12% is permitted. Sometimes even 16% salt is also added. Additions of spices help to improve the flavour of brine pickles.

b. Vinegar pickle: The brine is drained from the salt cured product, excess salt is removed and the material is kept in plain vinegar with 2 to 3% salt for several weeks. Vinegar is added to 1/3 of total product.

Small size peeled and trimmed onions are placed in the fermentation container and salt or brine is added. The onion bulbs are weighted down so that they are submerged in the brine. The onion bulb and salt are placed in alternate layers until the container is three quarters full. Salt requirement is 3 g per 100 g onions. A container with a lid should be used for fermentation process which prevent contamination from dust and insects and maintain at 21°C temperature. If brine is being used, a 15-20% brine solution is prepared by dissolving salt in water. This concentration is measured using a salometer or brine hydrometer. A starter culture of juice from a previous fermentation process may be added to speed up the fermentation. Fermentation begins as soon as brine is formed. It can be seen by bubbles of carbon dioxide gas that are given off by the bacteria. Fermentation takes between one to four weeks depending upon the temperature, pH and strength of the salt solution. It is completed when no more bubbles appear

2. Onion sauce fermentation production method: The method comprises the following steps of:

a. Peeling: Removing the peel, head and root of the onion, cleaning and frying; Frying the onions until they are browned,

b. Add NaCl: Adding NaCl into the crushed onion;

c. Naturally fermenting in a fermenting tank: fermenting the crushed onion in an incubator at the temperature of 30-35 ˚C;

d. Centrifugal filtration: Centrifugally filtering the fermented onion to prepare fermented onion sauce.

e. Storing: Adding beta-cyclodextrine into the fermented onion sauce, and storing at room temperature for later use.

3. Distilled spirit (wine) from onion juice: A process for producing a distilled onion wine is provided which keeps original onion flavor. The process comprises the steps of:

a. Crush the fully washed onion into fine particles after removing the outer skin, roots and stems of onions
b. Add yeast mash (Saccharomyces cerevisiae);
c. Aerobically fermenting crushed onion at 25-30°C for 3 days,
d. Followed by an aerobically fermenting at 15-20°C for 7-8 days;
e. Distill the wine mash under vacuum or atmospheric pressure;
f. Collect distillates with an alcohol concentration of 60-70% (v/v);
g. Store for 6 months or more for aging, followed by bottling.

Conclusion

Onion is very beneficial to human health. Medicinal properties of onion beat those in many drugs, which normally have side effects. Several parts of the plant generally used in traditional medicines. Health benefits of onion include significant relief from number of diseases such as common cold, bacterial infections, respiratory problems, asthma, angina, and cough.

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Food Irradiation: An Insurance to Food in the Present Scenario

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Introduction

Food irradiation is an effective means for minimizing the post-harvest losses, thereby increasing the food availability which ultimately stimulates exports potential of the food. In 21st century, it will be emerged as one of the important techniques in making the Indian agricultural produce globally competitive. Application of radiation processing technology to the food is extending the good benefits to export development authorities, commodity boards, food industry, farmers, traders, and exporters of agricultural commodities.

Food is exposed to controlled source of ionizing radiation in the food irradiation. It may improve the shelf life, reduce food losses, improve microbiologic safety, and/or reduce the use of chemical fumigants and additives. It can successfully reduce the insect infestation in the grain, dried spices, and dried or fresh fruits and vegetables. It can also inhibit sprouting in tubers and bulbs and retard postharvest ripening of fruits. Another advantages of food radiation are inactivation of parasites in meats and fish, elimination of spoilage microbes from fresh fruits and vegetables, extension of shelf life in poultry, meats, fish, and shellfish, decontamination of poultry and beef and sterilization of foods and feeds. It provides a good flexibility for treatment of food as it can be accomplished even after packaging of foods and hence the recontamination during subsequent handling of food will be prevented.

Irradiated foods are found to be safe and nutritious and produces no unusual toxicity as long as best management practices are followed. Irradiation is a counterpart to conventional and established food preservation techniques that can add to food safety, increase shelf life, reduce loss from spoilage, and increase the diversity of foods available to the population. Food irradiation technology is the most intensely studied of all food processing techniques.

In addition to food preservation, food irradiation can also be used to solve the issue of fruit fly infestation in fresh fruit. This disinfection efficacy of the process brings potentially huge benefits for those countries where fruit flies are endemic who wish to export to countries that are free of fruit fly. The United States of America has already accepted this technique as a quarantine treatment for controlling of 11 major species of fruit flies and mango seed weevil.

Food Irradiation Technique

Food irradiation can be achieved by controlled application of energy from ionizing radiations such as gamma rays, electrons, and X-rays for food preservation. Among the different electromagnetic radiation, gamma rays and X-rays are short wavelength radiations. Both of this radiation are having capacity to penetrate deep into food materials and bring about desired effects.

The whole process of radiation processing is carried out inside an irradiation chamber shielded by 1.5- to 1.8-meter-thick concrete walls. Foods after suitable packaging or without any packaging in-bulk are placed in suitable containers and then sent into the irradiation chamber with the help of an automatic conveyor. It is necessary to store the radiation source under 6-meter-deep water when the facility is not in use. The water shield does not permit the radiation to emit into the irradiation chamber, thus permitting free access to personnel to carry out plant maintenance.

For treating food, the radiation source is taking to the irradiation position above the water level. It has to ensure that all the safety devices are in activated prior to treatment is started. The food materials are either placed in aluminium carriers or tote boxes which are then mechanically positioned around the source rack and are turned round their own axis. Turning of the food containing boxes will provide the irradiation to food from all the sides. Dosimeters are placed in a tote box or carrier to check the amount of absorbed dose. The amount of absorbed irradiation dose or energy is measured in terms of Gray, abbreviated as Gy. One gray of irradiation energy is equivalent to 1 Joule per kilogram. Earlier, "rad" unit was used to measure the absorbed radiation dose which is equivalent to 0.001 Gy.

Table:1 The recommended doses of ionizing radiation for different purposes in food preservation:

Dose level	Dose amount	Purpose
Low dose applications	Less than 1 kGy	• To inhibit sprouting in potato and onion (0.03-0.15 kGy). • To delay in fruit ripening (0.25-0.75 kGy). • To disinfect the stored grain, pulses and products from the insect (0.25-1 kGy). • To destruct the parasites in meat and meat products (0.25-1 kGy).
Medium dose applications	1 to 10 kGy	• To eliminate spoilage microbes in fresh fruits, meat, poultry and seafoods (1.5-3 kGy). • To eliminate food pathogens in meat, poultry and seafoods (3-7 kGy). • To hygiene the spices and herbs (10 kGy).
High dose applications	Above 10 kGy	• To sterilize food for special requirements which are shelf-stable without refrigeration (25-70 kGy). • To eliminate the viruses from food materials • To sterilize the hospital diets for immune compromised patients (25-70 kGy). • To sterilize the food for astronauts in space

Low dose irradiation application to food (less than 1 kGy) can completely kill or sterilize the common grain pests and even the eggs deposited inside the grains. Further, the only a single radiation exposure of grains is sufficient for disinfestations. Looking to this, low radiation application is preferably suited for processing of large food quantity and for large-scale operations. Due to this reason, it offers substantial economic benefits. Irradiation has also found to be an effective process for disinfestation of certain processed and pre-packed cereal products like atta, soji (rava) and premixes.

Low radiation can effectively delay the natural ripening process in many fruits. It has been observed that the shelf life of mangoes can be extended up to a week and that of up to two weeks in case of bananas. Thus, the scope of internal trade as well as the export of the commercially important fruits grown in India can be improved drastically with the application of food irradiation. Moreover, gamma radiation can destroy the seed weevil, an insect that lodges deep inside the stone of the mango.

Retention of chemical residues is the main disadvantage associated with the fumigation of spices with chemicals like methyl bromide, ethylene oxide and propylene oxide. Single treatment of gamma radiation to the spice can make it free of insect infection and microbial contamination without any loss or degradation of flavour components. Pre-packed ground spices and curry powders can also be treated by food irradiation for longer preservation and storage.

The existing preservation facilities for fish are inadequate and it cannot cope up with the speedy spoilage of the catch and thereby limit the availability of seafood in the interior regions. The moderate doses i.e. 2 kGy of radiation can destruct the selected spoilage bacteria and increase the acceptability, and, ultimately the marketability of iced fish by about two weeks. Furthermore, it is the only technique through which pathogens from pre-packed frozen product can be removed. This technology can also be applied for hygienization and sterilization of non-food items such as cut-flowers, pet food, cattle feed, aqua feed, ayurvedic herbs and medicines and packaging materials.

Over decades of study the Food and Drug Administration and other international organizations such as the International Atomic Energy Agency and the World Health Organization have reliably concluded the following:
1. Radiation does not produce any radioactive properties in the irradiated food material.
2. The process of food irradiation is found to be effective in decreasing or eliminating disease-causing microorganisms such as Escherichia coli (E. coli), campylobacter, and salmonella from foods.

3. Irradiation can effectively reduce the spoilage caused by bacteria, insects, and parasites.
4. Irradiation prohibits sprouting and delays ripening in some fruits and vegetables.
5. Irradiation does not make any significant changes in the nutritional value of food.
6. Changes occurred in the food quality due to irradiation are as similar as the changes created by cooking and other processing.
7. Thus, the irradiation process under regulatory provision is safe to the food materials.

Food irradiation is now the technique accepted worldwide. Many international organizations like Food and Agriculture Organization (FAO), the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) and the Codex Alimentarius Commission approved this technique for the food treatment. Around 100 countries have approved this technique for application in more than 100 food products. India first approved the food irradiation in the year 1994. By the time, it has been approved to process 20 commodities by the Directorate of General Health Service, under the Prevention of Food Adulteration Act.

Labelling

It has been made compulsory for all the irradiated food to use the label with the international irradiation symbol, the Radura (Fig 1) and the words, "treated by irradiation" or "treated with radiation".

Fig.1. International Radura

Cost of Irradiated Food

The cost of the irradiation for a low dose application such as sprout inhibition of potato and onion, and insect disinfestation in cereals and pulses may range from Rs. 0.25 to Rs. 0.50 per kilogram. Whereas, irradiation processing cost for high dose applications such as treatment of spices for microbial decontamination may range from Rs. 1 to Rs. 3 per kilogram. However, the it can be reduced when the multipurpose facility are available for treating a variety of products around the year.

The Safety of Irradiated Food

The safety of irradiated food has been examined and ensured carefully, both at the national and international levels on the basis of detailed studies with laboratory animals carried out in different countries including India. The international organizations like Food and Agriculture Organisation, International Atomic Energy Agency, world Health Organization and Joint Expert Committee has already recommended that the food processed by irradiation up to an average dose of 10 kGy be accepted as safe for consumption. Such foods do not do not present any toxicological hazards from the health point of view. In fact, the radiation dosed as applied for the food treatment are extremely below this stipulated limit. Therefore, the food irradiation has recognized as a physical process like thermal processing and not as a food additive.

Negligible alteration in the overall quality and nutritional value has been observed in the food treated by irradiation in comparison to other food processing and preservation methods. Further, the extensive scientific studies have shown that this technique has minor effect on the main nutrients such as proteins, carbohydrates, fats, and minerals.

Vitamins have reported varied sensitivity to food processing methods including irradiation. For example, vitamin C and B1 (thiamine) have shown the similar sensitivity to irradiation as well as to heat processing. Vitamin A, E, C, K, and Vitamin B1 in foods are somewhat sensitive to radiation, but riboflavin, niacin, and vitamin D are much more stable during food irradiation.

In 1980, the Joint Expert Committee of the Food and Agriculture Organization (FAO), World Health Organization (WHO), and International Atomic Energy Agency (IAEA) concluded that irradiation does not create special nutritional problems in food. The claim of possibility of development of chromosomal abnormalities by the consumption of irradiated food was also rejected by this committee.

Merits Over Conventional Methods

1. Food irradiation technique has unique advantages over conventional preservation methods like canning, dehydration, salting, etc. because this process does not lead to loss of flavour, odour, texture, and freshness.
2. Irradiation does not leave any harmful toxic residues in food as found after in the food after chemical fumigation. Hence, it is more effective than the chemical fumigation.
3. It is very effective preservation method and can be used to treat pre-packed food items. Food irradiation permits the processing of food even after packaging. Due to high penetrating power of Gamma rays, spices can be irradiated after packaging, irrespective of the size of the carton or box.

Conclusion

Food irradiation can provide the effective insurance to food by reducing the spoilage caused by bacteria, insects, and parasites. Common grain pests and even the eggs deposited inside the grains can be completed eliminated through application of irradiation. It has also ability to delay the natural ripening process in many fruits. It is very much suitable technique to treat the packaged food. There is a little or no adverse effect on the overall quality of the food after it has been irradiated. Thus, this technique can be widely used for food preservation looking to its safety and effectiveness. Now, it has been accepted worldwide for food sterilization.

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Package of Practices in Coleus

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Coleus forskohlii Syn. *Coleus barbatus*, *Plectranthus forskohlii*, belonging to the family Lamiaceae is a well-known plant throughout the country and one of the most significant medicinal crops for its tuberous roots.

The dried roots are found to be a rich source of forskolin and are used for treating hypertension, glaucoma, asthma, congestive heart failures and certain types of cancer. The tuberous roots, resembling a carrot in shape and brown in colour, are the commercial parts. The plant is known as 'Pashanbhedi' in Sanskrit and 'Patharchur' in Hindi. Recent discoveries have indicated that the forskolin is useful against cholesterol and also used in cosmetics.

The species came into commercial cultivation after the discovery of forskolin, a unique adenylate cyclase activating drug which is highly useful in activating the cardio vascular system. The dry roots contain forskolin with content ranging from 0.10 to 0.80 per cent. One of the Indian medicinal plants which were very little known until a few years ago has now been raised as a single medicinal crop of international importance.

Origin and Distribution

The crop has been distributed all over the tropical and subtropical regions of India, Pakistan, Sri Lanka, tropical east Africa, Brazil. In India, it is found in the subtropical Himalayan regions from Kumaon to Nepal. It is cultivated in parts of Rajasthan, Maharashtra, Karnataka and Tamil Nadu. In Tamil Nadu, it is cultivated for more than 25 years.

Area and Production

There are about 10,000 ha are under this crop in the country. The annual estimated production is 2000-ton dry roots/annum

Description of the Plant

The plants produce thick roots in the form of elongated tubers. Radially spread roots are fasciculate, succulent, tortuous with 1.0 to 3.0 cm thickness and 20 cm length.

The inner roots are orange coloured, and has the characteristic pungent odour. The plants have square stems branched where nodes are often hairy. Leaves are pubescent, narrowed into petiole. Though it is a biennial, it is cultivated as an annual.

Cultivation

Soil: *C. forskohlii* thrives better in well drained soils with a pH ranging from 5.5 -7.0. It does not require very fertile soils and can be economically grown under marginal soils.

Climate: Coleus is a crop of the tropics and is found growing well at an altitude of about 2400m under tropical and sub-tropical conditions. It grows well under humid climate with a RH ranging from 83-95% and a temperature range between 10-25^{O}C for its successful growth.

Varieties: A selection, K-8 is reported to give 0.5% forskolin and a higher tuber yield. A new variety 'Aisiri' with forskolin content of 0.7% released from UAS, Bengaluru.

Propagation and Planting

Coleus is propagated by terminal cuttings. Normally, 10-12 cm long cuttings comprising 3-4 pairs of leaves are preferred. These cuttings are either rooted in nursery and then planted in the main field or planted directly in the main field.

The ideal season for planting Coleus is from June to July with the onset of South west monsoon. Before planting, the field is ploughed deep soon after the receipt of pre monsoon showers and brought to fine tilth. The crop loves high amount of organic manure and about 25 t FYM/ha is applied. Ridges and furrows are prepared at 60 cm spacing. The height of the ridge should be 15 cm from ground level. The cuttings are planted at 30 or 45 cm distance depending on the soil type. While planting, care should be taken to see that minimum of two nodes should be underneath the soil. Watering should be done before and after planting.

Under drip irrigation system, raised broad row ridges of 90cm width are prepared at 60 cm interval and planting at 60 cm spacing between rows are planted. The space between two plants should be 45 cm.

Manures and Fertilizers

The crop requires plenty of organic manure. In addition to 25 tonnes of FYM, addition of 1 ton vermicompost, 150 kg of neem cake, 500 kg of gypsum are applied to condition the soil and to improve its fertility by organic means. Many farmers adopt organic farming by avoiding chemical fertilizers and pesticides. 'Panchagavya' 3% organic spray is given along with root drenching. A fertilizer dose of 40 kg N, 60 kg P_2O_5 and 50 kg K_2O per hectare is recommended for Tamil Nadu. Half the dose of N, the whole P and K may be applied as the basal dose followed by the remaining half N, 30 days after planting as top dressing.

Irrigation

The first irrigation is given immediately after transplanting. In the initial phase, the crop is irrigated once in three days and thereafter, weekly irrigation is enough to obtain good growth and yield.

Weeding and Earthing Up

Two or three weedings are given and after the second weeding, earthing up is given. As the roots are shallow, deep digging should be avoided.

Pests and Diseases

Pests: The leaf eating caterpillars, mealy bugs and root knot nematodes are the important pests. The insect pests can be controlled by spraying the plants and drenching their roots with 0.1% Methyl parathion, while nematodes can be controlled by application of Carbofuran granules @ 20 kg/ha.

Diseases: Bacterial wilt is the major disease and can be controlled by spraying and drenching the soil with 0.2% captan solution immediately after the appearance of the disease and later after a week's interval. Procuring planting materials from infected areas may be avoided.

Harvesting, Processing and Yield

The crop is ready for harvest in 180 days after planting. Flowers if any should be nipped-off during the growing period to obtain more root biomass. The roots are harvested either by ploughing using a bullock or by tractor. The tubers can also be manually dug and taken with least damage. The roots are cleaned making free of soil and transported for drying. The roots are cut into small pieces using mechanized rotary motors. The root bits are spread thinly on the cement yard and allowed to dry for 3-5 days. The roots get completely dried and are packed. On an average, a yield of 1500 kg of dried tubers per hectare is obtained. If proper cultivation practices are followed, a yield of 2500 kg of dried tubers can be expected per hectare.

Contract Farming

In Tamil Nadu, the contract production system is in practice. The firms enter into bilateral agreement with the growers and an area of about 4000 ha are being covered under the system. The major areas in Tamil Nadu include Salem and Namakkal districts. The firms offer insurance coverage, timely input supply and technical advice and guarantees buy back.

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Strategies to Reduce Yield Gap through Better Management Practices in Sugarcane Farming System in Bihar

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Abstract

Sugarcane is commercially cultivated in Bihar province on more than 3.0 lakh hectares under fully irrigated systems. It provides not only main stay of sugar industries, but also provides raw materials to many allied industries (alcohol, power, paper, and compost) etc and other bio-based product. It is the source of employment directly or indirectly to the peoples of the state. The present investigation was attempted to examine the input use and output level, to estimate the yield along with factors responsible for the yield gap and the constraints in cultivation of sugarcane.

The study revealed that farmer's field productivity obtained were considerably lower (71.18 t/ha), than those recorded in the demonstration plots (92 t/ha), and research station/trials (150 t/ha) respectively. The study has shown that the yield gap between the demonstration plot and actual farmers field (yield gap-II) was observed to be highest 42.72 per cent in the marginal farms and the lowest 2.72 percent in large farm, hence due to better economic conditions of large farmers which adopt recommended sugarcane production technology.

The most important constraints in sugarcane cultivation were shortage of labour during crucial operation. More than 70 percent of sample farmers opined that the incidence of red rot grassy shoot borer, leaf blight prevented them from achieving greater farm yield in sugarcane crop. Therefore, the study suggests, that the famers should be motivated through visit of sugarcane research institute, demonstration trials, attend in problem-based training programme by KVK, Govt. of Bihar and other communication means to optimal and sustainable use of resource inputs to enhance the productivity of sugarcane with a view to minimize the yield gap.

Introduction

Sugarcane in an important industrial crop of India cultivated in 5.22 million ha area, with a cane production of 400.38 million tons (2018-19) with an average productivity of 77.99 tonnes per hectares. The sugarcane cultivation in the state was 2.74 m ha with production of 18.28 million tonnes and average yield of 60.15 tonnes per hectare (2018-19). The rate of compound growth rate in terms of area and production was increased significantly 2.74 per cent and 5.36 per cent respectively in the state of Bihar. The productivity of the crop depends on the extents of resource use and adoption of recommended technology. Most of the sugarcane growers are not using the recommended level of input, this leads to gap between production and productivity of sugarcane.

The concept of yield gaps in crops originated from different constraints carried out by International Rice Research Institute (IRRI) during seventies, particularly more emphasis in given to yield gap-II. The yield gap comprises two components. The first component yield gap-I is the difference of between experiment/research station yield (potential yield) and the demonstration/progressive farmers farm yield. The potential yield in only hypothesized and cannot be exploitable and narrowed and cannot be directly translated on farmer's field. The second component is yield gap-II is the difference between the demonstration yield and the actual average farm yield. Alam (2006). The yield gap-II is exploitable and was the focus of the study. The yield gap reflects mainly difference in management practices (for example the amount of fertilizer used). However, proper resource mix and appropriate cultivation practices become prerequisite for the adoption and success of new farm technology.

Results and Discussion

East Champaran is the second highest sugarcane growing districts of the state. Sugarcane is grown up as a major crop by majority of the farmers in the district. Therefore, this district was purposively selected for the study. The primary data was collected from sample sugarcane grower by the survey method with the contacted individually for collection of required information. The information on research station yield and yield of field level demonstration plot were obtained from the Sugarcane Research Institute, RPCAU, Pusa (Samastipur) Bihar. The study was confined to a sample of 60 sugarcane farmers from the selected district. In each selected village farmers were classified into three size groups viz. marginal (<1.0 ha), small (1-2 ha) and medium – large (> 2.0 ha) categories based on their operated land holding size.

Among the different source contributing to the yield gap, the difference the production between demonstration field and farmer's field (Actual yield) yield gap –II was observed to be highest 41.79 per cent in the marginal farms and the lowest 2.72 per cent in large farmers (Table -2), hence due to better economic conditions, large farmers adopts timely crop management practice and improved technology like, sowing spacing, irrigation and application of recommended dose of plant nutrients and plant protection chemicals.

Various constraints operating of the farm level may be partially responsible for this yield gap. Hence the opinion of sample farmers on the diffeculties in realizing farmer field yield was collected and presented in table – 3. Shortage of hired labour during planting of cane, weeding and harvesting was a major problem as expressed by three – fourth of the respondents.

Table 1: Yield gap in sugarcane on sample farmers in East Champaran district:

(ton/ha)

Sl No.	Particulars	Size groups			
		Marginal (N* = 20)	Small (N* = 20)	Large (N* = 20)	Overall (N* = 60)
1	Potential yield (Yp)	150	150	150	150
2	Demonstration Yield (Yd)	92	92	92	92
3	Actual/farmer field yield (Ya)	52.70	71.20	89.50	71.18
4	Yield gap-I (Yp-Yd)	58	58	58	58
5	Yield gap –II (Yd-Ya)	39.30 (42.72)	20.80 (22.60)	2.50 (2.72)	20.82 (22.63)
6	Yield gap – III (Yp-Ya)	97.30 (64.86)	78.80 (52.53)	60.50 (40.33)	78.82 (52.54)

Note: figures in the parentheses indicate gap percentage.

Table 2: Different sources contributing to yield gaps in sugarcane cultivation:

(Percent)

Sl No.	Source of yield gap	Size groups			
		(<1.0) (N* = 20)	1.0-2.0) (N* = 20)	(>2.0) (N* = 20)	Overall (N* = 20)
1	Total difference in output (Yield gap – II)	42.72	22.60	2.72	22.63
2	Source of contribution Input use gap				
	(a) Seed	8.55	1.82	-11.83	-1.17
	(b) Nitrogen	29.94	15.16	-57.26	-19.36
	(c) Phosphorus	-11.47	-21.18	-70.59	-34.36
	(d) Potassium	-17.03	-13.12	-75.10	-32.10
	(e) Plant Protection	55.94	48.70	28.84	44.91
	(f) Irrigation	57.36	55.99	51.04	45.20
3	Total estimated gap from all inputs	123.30	87.37	134.42	2.72

Note: 1. Negative sign indicates excess use of inputs.
2. N* - Number of sample farms.

Table 3: Production constraints of sugarcane in East Champaran district:

Sl No.	Constraints	Mean scores	Garret ranking
1	Shortage of hired labour during peak period	82.63	I
2	Infestation of pests and disease	77.10	II
3	Unavailability of loan properly	68.51	III
4	High cost of chemical fertilizers	66.43	IV
5	High cost of plant protection chemicals	61.00	V
6	Poor management of family labour	57.22	VI

The second most significant constraints on the basis of Garrett's ranking technique were infestation of pest and disease (77.10) identified. The other constraints were unavailability of loan properly (68.51), high cost of chemical fertilizers (66.43) and least constraints were poor management of family labour (57.22) respectively.

Conclusion and Policy Implication for Minimizing the Yield Gap

From the study it is seen that several location specific factors had kept the productivity of sugarcane was low thereby increase the yield gaps. Therefore, the following observation cane be accounted for policy planning suitable this region.

1. Sugarcane being a vegetative propagated crop, there is need to change the seed after every 3 to 4 years to maintain purity of the varieties and to avoid the disease and pest spread through the disease.

2. Bio compositing of press mud should be applied after once in three years.

3. Inters with sugarcane controls weeds up to 60 % in the initial stage, help in optimum utilization of land and provide extra income to farmers.

4. The human labour cost constitutes more than 50 % for labour intensive sugarcane crop use of sugarcane planter and interculture implements reduce the labour cost by fifty percent.

5. Sugarcane ratoon crop occupies more than 47.60 per cent of the total sugarcane area. However, contribution to total cane production is only 25-30% reason of low yield due to poo management practices of ratoon crop, with improved ratoon management more ratoon crop can be taken by strengthening of sugarcane production in productivity in the study area.

6. There is an urgent need to strengthen the extension, mechanism by establishing strong linkage between research institutions. Sugar mills and farmers for efficient tractor of improved technologies in sugarcane farming.

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Feminization of Indian Agriculture: Challenges and Developments

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Abstract

Over some 10,000 years ago, women initiated the astounding art of agriculture. While men would go for hunting, women would grow crops and plants for the household works. Whereas nowadays, women are not able to get the major roles in the agricultural working sector due to the gender inequality of today's timeline. Government has supported the women empowerment in many ways. They have analyzed some programs that help to give the opportunity of showing the talents to a maximum number of women in our country. We can alleviate the gender inequality issues starting with a change in ourselves.

Introduction

"Feminism is the espousal of women's right on the face of the equality of genders."

The term feminization of agriculture denotes the measurable increase in amount and participation of women in agriculture. It also means to the increasing shares of women in agri workforce, opportunities, land holdings etc. In the agriculture sector, women's role has increased since the 1960s and is still continuing to grow on. The Food and Agriculture Organization (FAO) says that contribution of women to the Indian agriculture is about 32%, in some states such as hill states, north-eastern states, and Kerala, women's contribution to agriculture and rural community is more than that of men.

About 60-80% of food is produced by only women in agriculture. Thus, National Women's Farmer's Day is celebrated on the 15th of October, every year, for recognizing the multidimensional role of women at every phase in agriculture.

Overview

Long before, there were fewer women who would do agricultural chores. It was due to the over domination of males in the society. Everyone would think that women were designed to give birth to the next generation and men were to do all the muscular hardships. From way of the standpoint, it might have happened due to the occurrence of the same thing with the same gender for a long period of time. Just like brushing our teeth after waking up seems normal because that's what we have been doing every day.

In India 85% of rural women population is engaged in agriculture and activities. According to, economic survey 2017-18, there is 'feminisation' in the sector due to outward movement of men of rural to urban. Women on the other hand, continuously contributing here as cultivators, entrepreneurs and labourers.

Challenges

The work division fior genders soon arose to be a problem which didn't let them live a comfortable life. For some, it felt like a forced thing. And if they'd do what they wanted and didn't follow the gender division rule, they'd be judged by others and sometimes might be punished. Here, women faced the major problems since they were known as the house workers. They weren't even allowed to go outside like men did. And on the other hand, men, who were known as the earners of the house, weren't even allowed to cook by themselves.

Occupation	Men	Women
Ploughing	102.90	55.43
Sowing	90.00	65.00
Threshing	85.06	67.66
Weeding	80.15	68.02
Picking	81.02	66.37

Source: Labour Bureau, RLE Reports onwages and Earnings of Rural LabourHouseholds,2009-10, Shimla and *Price & Wage in Rural India(Newseries) NSSO*

Fig: All India annual average daily wage rates in agriculture

The major problem is illiteracy also. In the present scenario also nearly 54% of women population is not educated. This also contribute to their backwardness and hardships faced by them in the society. There were many challenges faced by women in agricultural sector. Some of them were lack of ownership of land (only 17% of women have their rights on their farm land) which does not allow women farmers to approach banks for institutional loans as banks usually consider land as collateral, lack of property rights where they were not allowed to have the land on their own name, since most of the women are responsible for manual works, innovation of technology in agriculture would create a chaos for them.

Measures Taken

1. Acknowledging the role of women in agriculture India has been the first country in the world to set up a National Research Centre for Women in Agriculture (NRCWA) in Bhubaneshwar way back in 1996.
2. The state cooperative societies have organized cooperative educational programs of women to let women participate in various activities.
3. Governments are required to ensure that more and more women get access to land holdings. A 'Gender in Agriculture Platform for Gender in Agriculture Partnership (GAP4GAP) as recommended by the global conference on agriculture.

Government's Support

1. The government is trying to help the women by giving them prodigious number of opportunities. They are earmarking at least 30 percent of the budget allocation for women beneficiaries.

2. Women under various policies such as organic farming, self-employment scheme, Pradhan Mantri Kaushal Vikas Yojana etc are given preference by the government.

3. Mahila E-haat: It is a direct online marketing platform launched by the Ministry of Women and Child Development to support women entrepreneurs, Self Helf Groups (SHGs) and Non- Governmental Organisations (NGOs) to showcase products made and services rendered by them. This is a part of the 'Digital India' initiative.

4. The "Save the Girl Child" movement was launched on 22 January 2015, it is a joint initiative run by the Ministry of Women and Child Development, the Ministry of Health and Family Welfare and the Ministry

of Human Resource Development,.Beti Bachao, Beti Padhao - The scheme was launched with an initial funding of Rs 100 crores. It mainly targets the clusters in Uttarakhand, Bihar, Uttar Pradesh, Punjab, Delhi and Haryana.

5. STEP: The Support to Training and Employment Programme for Women (STEP) Scheme aims to provide skills that give employability to women and to provide competencies and skill that enable women to become self-employed/ entrepreneurs. Sectors include Agriculture, Horticulture, Food Processing, Handlooms, Tailoring, Stitching, Embroidery, Zari etc,

6. Banks in India have as on March 31, 2010 have assisted exclusively 38,97,797 women SHGs under their SHG-Bank Linkage programme and 25,13,152 women SHGs under the Government sponsored programme, viz. Swarnjayanti Gram Swarozgar Yojana.

Conclusion

For the enhancement of the gender equality, we should boost up the confidence in women. Most women worry about their security and are not comfortable to go out alone. Before strengthening the security, we should change the mindset of the pessimistic peoples so that their families don’t have to worry. In the agricultural sector, women were being looked down upon their strength but nowadays, women have paraded their knowledge and capability of doing the equal of men.

Even when women are getting the chance to reveal their inner power, there are still some labefactions in the process as one third of agricultural workers are women and yet women’s wages are 30% lower than that of men’s. There’s still a long way to go, hope there will be a proper equality of gender, soon in the coming days.

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Pollination Behaviour of Red Delicious Apple

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Abstract
The delicious group of apple cultivars which are invariably cultivated in all the hilly states, are self-incompatible in nature and therefore, self-unfruitful in spite of a heavy bloom. They require cross-pollination for better fruit set and fruit quality (Spiegel and Aliston, 1982). In the old orchards 70 per cent apple plantations have pollinizers below 10 per cent, and even today, it has been observed that orchardists have a tendency to plant only 5-10% pollinizing variety. Thus, to overcome the problem of self-incompatibility in delicious varieties of apple, adequate number of pollinizers along with the placement of bee hives are essentially required, as fruit set and yield is largely dependent on sufficient pollinizers, and activity of pollinators in the orchards.

Keywords: Pollination, Self-incompatibility, Pollinizer, Pollinator, Unfruitful, Red Delicious, Golden Delicious.

Introduction
Apples (*Genus malus*, a member of the Rosaceae family) have been part of the human diet for thousands of years (Hancock et al., 2008). Apple, as one of the most widely cultivated fruit tree crops in the world, unsurprisingly, is a top global commodity. Pollination is a critical step in the production of quality apples. While many environmental factors can lead to poor pollination and lessen fruit set, the genetic makeup of the apple varieties in an orchard and their compatibility are crucial determinants of pollination success. The term pollination in horticulture made a considerable way for the fruit set in fruit plants. The pollination is of two types: self-pollination and cross pollination. In majority of fruit crops cross pollination occurs. Self-pollination means the transfer of pollen grains from anther to the stigma of the same flower, while in cross pollination it occurs when the transfer of pollen grains takes place from anther of one flower from the same plant or different plant to the stigma of another flower (Salaria and Salaria, 2020).

Red Delicious Apple

Red Delicious is a midseason and widely grown cultivar of apple throughout the world. It is evolved as a chance seedling in Iowa, USA. Fruits are large, oblong conical with five knobs like projections at calyx end. Smooth skin covered with red streaks on a plain background. Flesh creamy white, tender, crisp, fine grained, sweet and highly aromatic. Red Delicious cultivar of apple is a self-unfruitful or we can say self-incompatibility. That means when flowering occurs the pollen transfer occurs from the anther to stigma, but the pollen grains do not survive on their stigma, hence the fertilization do not occur and when fertilization do not occur then there is no fruit set as well as no seed formation.

Pollinizer

A pollinizer is a plant that provides pollen. The word pollinator is often used when pollinizer is more precise. A pollinator is the biotic agent that transfers the pollen from anther to stigma, such as bees, moths, bats and birds. Pollinizer is more often used in pollination management for a plant that provides abundant, compatible and viable pollen at the same flowering as the pollinated plant. For example, most crab apple varieties are good pollinizer for any apple tree that bloom at the same time and are often used in apple orchards for the purpose.

The apple cultivars produce very little pollen or produce pollen those are sterile or incompatible with other apple varieties.

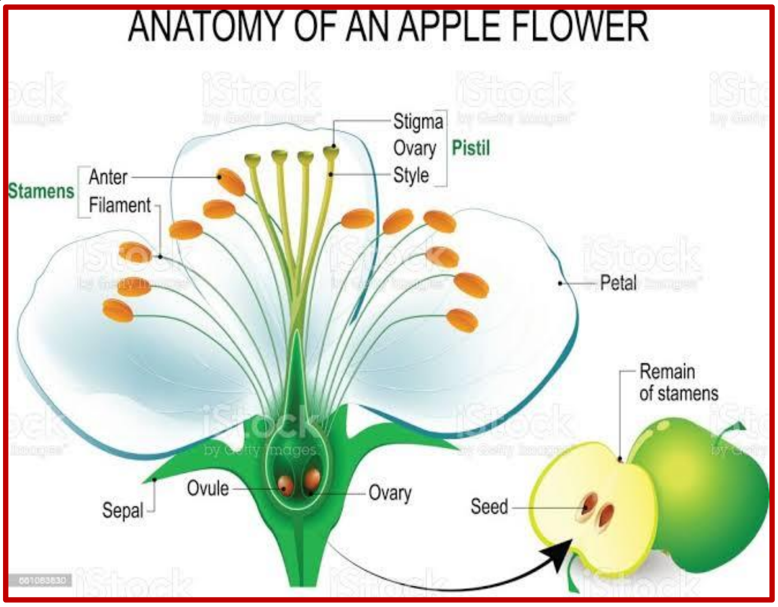
Advantages of pollinizer:

1. It is beneficial to the race of the plant as it introduces new genes into the lineage as a result of the fertilization between genetically different gametes.
2. The seeds produced are good in vigor and vitality.
3. It is the only way of reproduction in unisexual plants.
4. It overcomes the self-unfruitful and self-incompatibility.

Pollinator

The pollinators are the agents of pollen carriers. A pollinator may be an animal, bird, insects etc, these agents move the pollen from the anther of a flower to the stigma. Honey bees (Apis mellifera) are the most important and most commonly used pollinator of apples. The other less commonly used are bumble bees and mason bees. Growers gradually build up their own native populations of mason bees by putting out nesting materials each season and following standard recommendations for keeping the bees cool for overwintering and then bringing them out of cold storage in time to be active for apple bloom. Till now no chemical or any spray had discovered that causes pollination. So, for the transfer of pollen grains from male part of flower to the female part of flower, pollinators play a vital role in the pollination, fertilization, and fruit set (Sharma et al., 2004).

According to a great philosopher Albert Einstein "if the bees disappear from the surface of earth, man would have no more than four years left to live".



The flower of apple contains four parts:
1. Five sepal
2. Five petal
3. Stamen (male part or androecium)
4. Pistil (female part or gynoecium).

Stamen contains two parts anther and filament, while pistil contains three parts stigma, style and ovary. So, the flower of apple is complete that means all the four whorls are present in a single flower, but the pollen of same variety shows self-incompatibility. The flower color of apple is pink and white or pinkish white. Apple blossoms grow in clusters, and each blossom has five petals. The petals grow around the yellow stamen. The fruit develops from the ovary which is at the base of the blossom just above the stem. The apple is a false fruit that means it do not develop direct from ovary, the apple fruit develops from the thalamus, that is why it is referred to as false fruit (Sharma et al., 2006).


Honey bees *(Apis mellifera)* pollinating the apple flower

Best Pollinators for Apple

Cross pollination of apple trees occurs with the help of industrious honeybees. Honey bees do their best work in balmy temperatures of about 65 degrees F. (18^0C) and chilly weather, rains or wind may keep the bees inside the hive-resulting in poor apple tree pollination. Pollination is one of the keys to profitable apple production. As a general rule, apple varieties are not self-fertile and will not set a full crop without a compatible pollinizer. Successful pollination and the formation of many healthy seeds contribute to the eventual size and quality of that fruit. Poor pollination can result in reduced yield and misshapen fruit. It is important to select a good pollinizer variety which has compatible pollen and an overlapping flowering period.

Importance of Pollination

Most apple varieties are not self-fertile and will not set a full crop of fruit without compatible pollinizer, particularly if flowering is sparse, or weather conditions are adverse. Even varieties that do have some self-compatibility will produce a much better crop with a different variety acting as a pollinizer.

Overlapping Flowering

The selected pollinizer must have an overlapping flowering period. While two varieties may be compatible, if the flowering period for one is too late for the other, successful cross- pollination will not occur. Most apples require a certain number of hours of winter chill (below 7.2 ^{0}C) to break dormancy in spring and then produce flower. Select a pollinizer variety with similar chill requirements to help ensure that flowering overlap is consistent from season to season.

Pollen Compatibility

Most apples will pollinate other varieties but there are some important exceptions to this rule. In general, varieties that are closely related (that is with similar parentage) are not the most effective pollinisers for each other. e.g., Cripps Pink is only a fare to average pollinizer of its parents, Lady Williams and Golden Delicious and its sibling Cripps Red (which produces the sundowner apple) (Singh and Misra, 2007).

Pollen- Transferring Insects

For consistent pollination across the orchard to be achieved there must be sufficient numbers of pollen-transferring insects, the most significant being honey bees. If pollination has been poor historically, or feral honey bee numbers seem low, it may be wise to bring in hives from a commercial beekeeper (Sharma et al., 2012). During the flowering period it is essential to avoid applying chemicals that will harm bees and other pollinating insects.

Crab Apples as Pollinisers

Crab apples can be used as an alternative to apple varieties as pollinisers because they flower profusely and produce compatible pollen. They also have some advantages over commercial varieties as pollinisers because they:

1. Are not easily mistaken by pickers for the main variety, which helps prevent accidents and unnecessary work at hand- thinning and harvesting.
2. Have an upright growth habit, enabling them to be inter-planted in rows in some situations.
3. Generally have a long flowering period.
4. Flower on spurs and one year old wood. This means they can be pruned each year without fear of severe reduction in the level of flowering.

Crab apple *(Malus baccata)*

Conclusion

For the pollination of Red Delicious apple, it is recommended that there must be polliniser varieties present in an orchard (Golden Delicious and Crab apple) so that there may be a proper pollination and fruit set in apple. According to the case study that 33% polliniser plants should be present in apple orchard for proper fruit set. So, when all these three things viz. pollination, polliniser and pollinator are present in an orchard only then it is possible to complete the fertilization and seed formation.

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Special Breeding Technique: Mutation Breeding

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Summary of Article
The approach of plant breeding in which new variations of crops with desirable characters are developed with the help of induced mutations is called mutation breeding. Physical or chemical agents used to increase the frequency of mutations. Mainly mutagens are of two types, physical mutagens and chemical mutagens. Radiations are used as physical agents and generally classified into two classes, ionized radiations and non-ionized radiations. UV light is generally used as non-ionizing source of radiations. X-rays, gamma rays, alpha particles, beta particles etc are used as ionizing radiations. The chemical mutagens are mainly of three types i.e. alkylating agents, base analogues and acridine dyes on the basis of their nature of action. At the molecular level induced mutations are additions or deletions of nitrogen bases. The procedure of mutation breeding includes: selection of the material, choice of the mutagen, mutagen treatment, handling of the mutated populations in the case of seed propagated species and handling of mutated populations in the case of clonally propagated species.

Introduction
Conventional methods of plant breeding are old techniques that were developed by farmers. On the other hand, modern methods are improved by the plant breeders with the help of modern scientific tools. New methods of plant breeding are mutation breeding, polyploidy breeding, distant hybridization and biotechnological methods. Mutations are heritable changes of organisms. These changes are the outcome of chemical changes at the genes level. Such changes are able of bringing about new and heritable character variations in crop plants. Such variations can be selected and used for the development of crop varieties with new characters. Mutations occur very slowly in nature. Such mutations are named spontaneous mutations. However, the frequency of mutations can be improved with the help of chemical or physical agents that are called mutagens. Mutations induced with the help of mutagens are called induced mutations. Such mutagens can be used to induce mutations in crops and the desirable variations can be selected. This approach of plant breeding in which new variations are introduced in crops with desirable characters are developed with the help of mutagens is called mutation breeding.

Mutagens and their Mode of Action
Mutagens are the physical and chemical agents used to increase the frequency of mutations.

Physical Mutagens
These are physical agents that are able to cause induced mutations. These are different types of radiations used as physical mutagens. On the bases of energy level radiations can be classified into two types. Low energy level radiations are capable of causing excitations at the level of nitrogen bases of the genetic material, are called non-ionizing radiations. UV light is a most commonly used source of non-ionizing radiations. High energy level radiations are capable of causing both excitation and ionization and called ionizing radiations. Most commonly used ionizing radiations are X-rays, gamma rays, alpha particles, beta particles etc.

Chemical Mutagens
There are chemicals which are used to increase the frequency of mutations. The chemical mutagens are alkylating agents, base analogues and acridine dyes. Alkylating agents induce mutations by adding an alkyl group to the nitrogen bases. Examples of alkylating agents are: Ethyl Methane Sulphonate (EMS), Methyl Methane Sulphonate (MMS), Ethylene Imines (EI) etc. Base analogues are chemicals analogous of nitrogen bases. They can get integrated into DNA at the time of replication and can cause wrong base pairing which leads to mutations. 5-bromo uracil and 2-amino purine are the commonly used base analogues. Other chemicals used for mutation are nitrous acid, hydroxylamine and sodium azide.

Types of Induced Mutations

Induced mutations are additions or deletions of nitrogen bases. These are mainly of three types, transitions, transversions and frame shifts. In transition mutation one purine is replaced with another purine or one pyrimidine with another pyrimidine. Transversion mutation is the replacement of a purine by a pyrimidine or vice versa, and in frame shift mutation the reading frame of the gene is changed by the addition or deletion of nitrogen bases.

Procedure of Mutation Breeding

Five steps of mutation breeding include: selection of the material, choice of the mutagen, mutagen treatment, handling of the mutated populations in the case of seed propagated species and handling of mutated populations in the case of clonally propagated species.

Selection of the Material

The first step in mutation breeding is the selection of the material and nature of variations to be induced. For in vitro mutagenesis, callus is generally selected.

Choice of the Mutagen

Based on the nature of mutation and action of the mutagen, the appropriate mutagen is selected. Chemicals are used for the seed treatment and radiations are ideal for vegetative propagules, pollen etc.

Mutagen Treatment

In the case of chemical treatment, presoaking in water or solutions of some other chemicals improve the effect of mutagens. This is called pre-treatment. Later, the materials are transferred into the mutagen solutions. LD_{50} concentration of the mutagen is considered optimum. In the case of physical mutagens, the mutagen source is kept at a safe distance and the treatment is controlled by remotes. Gamma gardens are protected experimental areas used for the treatment. LD_{50} is the dose of the mutagen causes 50 percent mortality of the treated material.

Handling of the Mutated Populations in the Case of Seed Propagated Species

All the germinated seeds are grown to produce the M1 population. Generally, the mutations will be recessive so, can be selected in later generations. However, dominant mutations can be selected in the M1 itself. The M1 plants are selfed and the seeds are harvested separately and the M2 generation is raised. Oligogenic mutations can be selected at this generation.

Their seeds are grown separately and desirable mutants isolated. Superior and desirable M2 plants are selected and M3 seeds are collected. M3 progenies are raised from the seeds and they are tested for breeding behavior. The seeds of true breeding progenies are bulked together to conduct yield trials. In starting yield trials are conducted in the M4 and later are carried out from M5 onwards.

M8 or M9, are the most promising lines for selection and release. In the case of polygenic traits, inferior plants are rejected at M3 and M4 levels and based on screening the remaining seeds are bulked and used for yield trials and finally released as new varieties.

Handling of Mutated Populations in the Case of Clonally Propagated Species

In vegetatively propagated species mutations are expressed in the form of chimeras. Chimeras are the combinations of genetically different tissues. In the case of vegetatively propagated crops the generation raised from the treated propagules is called the VM1 generation. Plants showing chimeras can be selected and propagated to produce the next VM2 generation. Solid mutants are identified and selected in VM2. In VM3, the mutations identified in VM2 are confirmed. Preliminary yield trials are carried out in VM4 and co-ordinated trials from VM5 onwards and by VM9 the best line is released as a new variety.

Applications of Mutation Breeding

Mutation breeding can be used to develop:
1. Improved crop varieties.
2. To induce male sterility.

3. For the production of haploids.
4. To create additional genetic variability.
5. To improve the adaptability of crops.

Conclusion

Mutations are heritable changes in the phenotypes of organisms. These changes are the results of chemical changes at the level of genes. Such changes are capable of bringing about new and heritable character variations in crop plants. Such variations can be selected and used for the establishment of crop varieties with new characters. Other than improvement of crop varieties mutation breeding can be used for haploid production, male sterility and genetic variation.

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Coriander Seed Essential Oil: A Rising Source of Functional Oil

Article ID: 11348

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Introduction

Coriander (*Coriandrum sativum* L.), one of the important aromatics / medicinal crops, belongs to Umbelliferae / Apiaceae family and extensively cultivated in well drained loamy soils with optimum soil pH range 6 to 8. Reports in the literature suggest that coriander originated in the Mediterranean region and in India has cultivated in Rajasthan, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan and Madhya Pradesh. Coriander is an annual plant, mainly grown for its fruits and for soft green leave. It is a culinary plant being the source of aromatic compounds and essential oil possessing antibacterial, antifungal and antioxidant activities. Cilantro seeds have a hypoglycemic action and influence on carbohydrate metabolism, while the antimicrobial effect exibit both leaves and seeds. The oily composition of ripe fruit consists primarily of petroselinic acid (68.8%), linoleic acid (16.6%), oleic acid (7.5%) and palmitic acid (3.8%). The principal volatile compounds of coriander seed essential oil are linalol, gterpinene, a-pinene, camphor, geranium, decanal acetate, limonene, geraniol camphene, and D-limonene. The composition of the essential oil may vary by variety and depending on soil conditions and environmental factors (Laribi et al., 2015).

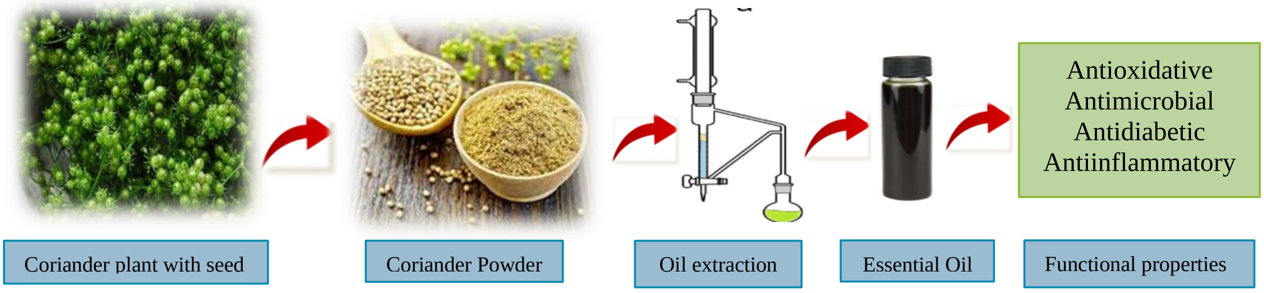

Fig 1: Illustrated diagram of coriander seed essential oil extraction and functional properties

Essentials Oil Extraction Method

A plant consists of hundreds of molecules of which essential oils form part. They serve as a ‘life force’and help the plant to function like a living being. These oils are mostly liquids that are isolated from other plant matter through the removal process (Benyoussef et al., 2004).

1. Hydro-distillation: Essential oils with high water solubility and those which are likely to be damaged by heat cannot be distilled by steam. Most essential oils in commerce are steam-powered volatile, relatively temperature stable and practically insoluble in water; as a result, they are suitable for processing by steam distillation. Essential oils are a mixture of various flavors chemicals, in essence monoterpenes, sesquiterpenes and their oxygenated derivatives, with a boiling point ranging from 150° to 300°C.

2. Soxhlet extraction: Coriander seeds can be extracted by methylene chloride using Soxhlet apparatus. After that solvent is evaporated under vacuum and obtained extract is further dried on 40°C for 24 h.

3. Supercritical fluid extraction (SFE): SFE is carried out on a laboratory-scale high pressure extraction plant. Dry and grounded coriander seeds are extracted with different pressures (100 and 300 bar) while temperature (40◦C), CO_2 flow (0.194 kg/h) and extraction time (4 h) is constant. The separator conditions are 15 bar and 23°C. Extracts are placed in glass bottles, sealed and stored at 4°C to prevent any possible degradation until the analysis.

4. Subcritical water extraction (SWE): It is performed in batch-type high-pressure extractor with internal volume 450 mL and maximum operating pressure of 200 bar and temperature 350°C, connected with temperature controller. Sample to solvent ratio should be 1:10 (w/v) and all extractions are performed on isobaric conditions (30 bar) for 20 min. After cooling of water extract, extraction yield is determined for total extract.

Functional Properties of Coriander Seed Essential Oil

Coriander seed oil has been used for many diseases such as for the treatment of rheumatism, gastrointestinal upsets, insomnia, flatulence, and joint pain in humans (Sahib *et al.,* 2012).

1. Antioxidative activities: Coriander seed oil has 35% and 32.4% of DPPH radical's and galvinoxyl radicals, respectively. This radical scavenging activity is higher than other seed spices seed oil. This radical scavenging activity of coriander oil is due to the unsaponifiables present in coriander oil (Melo *et al.,* 2005).

2. Antimicrobial activity: The essential oil of coriander has potent antimicrobial activity against oral pathogens, and a dental gel formulation. Coriander oil is the good alternative for development of advanced anti-acne formulations. Coriander oil reveals powerful activity against *Bacillus cereus, Enterococcus faecalis, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli, Salmonella typhi,* and *Acinetobacter baumannii* with different degrees of inhibition.

3. Anti-inflammatory activity: Coriander oil shows mild anti-inflammatory effect with good skin tolerance. The topical anti-inflammatory effect of coriander oil was found where 40 human volunteers were tested for the anti-inflammatory effect of a lipolotion supplemented with 0.5% and 1% of coriander oil. Lipolotion successfully inhbited the UV-induced erythema.

4. Antiaging activity: The long chain fatty acids are beneficial in antiaging products for local use, helping to restore barrier properties of the epidermis and prevent moisture loss. Coriander seed oil is very rich in these types of the fatty acids. Coriander seed oil contains ceramides of petroselinic acid as well so act as an anti-irritant and helps to maintain skin texture and tone.

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Organic Farming: Eco-Friendly Agriculture

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Introduction

Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems.

This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system. In 1980, USDA team defined the organic farming as a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives.

To the maximum extent feasible organic farming system rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm, organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests.

Principles of Organic Agriculture

1. The principle of health: Organic agriculture should sustain and enhance the health of soil, plant, animal and human as one and indivisible.

2. Principle of ecology: Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

3. The principle of fairness: Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

4. The 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. These basic principles provide organic farming with a platform for ensuring the health of environment for sustainable development, even though the sustainable development of mankind is not directly specified in the principles.

Essential Characteristics of Organic Farming

The most important characteristics are as follows:

1. Maximal but sustainable use of local resources.

2. Minimal use of purchased inputs, only as complementary to local resources.

3. Ensuring the basic biological functions of soil-water-nutrients-human continuum.

4. Maintaining a diversity of plant and animal species as a basis for ecological balance and economic stability.

5. Creating an attractive overall landscape which given satisfaction to the local people.

6. Increasing crop and animal intensity in the form of polycultures, agroforestry systems, integrated crop/livestock systems etc. to minimize risks.

Fig. 1: Components of organic farming

Advantages of Organic Farming

1. Organic manures produce optimal conditions in the soil for high yields and good quality crops.
2. They supply all the nutrients required by the plant (NPK, secondary and micronutrients).
3. They improve plant growth and physiological activities of plants.
4. They improve the soil physical properties such as granulation and tilth, giving good aeration, easy root penetration and improved water holding capacity. The fibrous portion of the organic matter with its high carbon content promotes soil aggregation to improve the permeability and aeration of clay soils while its ability to absorb moisture helps in the granulation of sandy soils and improves their water holding capacity. The carbon in the organic matter is the source of energy for microbes which helps in aggregation.
5. They improve the soil chemical properties such as supply and retention of soil nutrients and promote favourable chemical reactions.
6. They reduce the need for purchased inputs.
7. Most of the organic manures are wastes or byproducts which on accumulation may lead to pollution. By way of utilizing them for organic farming, pollution is minimized.
8. Organic fertilizers are considered as complete plant food. Organic matter restores the pH of the soil which may become acidic due to continuous application of chemical fertilizers.
9. Organically grown crops are believed to provide healthier and nutritionally superior food for man and animals than those grown with commercial fertilizers.
10. Organically grown plants are more resistant to disease and insects and hence only a few chemical sprays or other protective treatments are required.
11. There is an increasing consumer demand for agricultural products which are free of toxic chemical residues. In developed countries, consumers are willing to pay more for organic foods.
12. Organic farming helps to avoid chain reaction in the environment from chemical sprays and dusts.
13. Organic farming helps to prevent environmental degradation and can be used to regenerate degraded areas.
14. Since the basic aim is diversification of crops, much more secure income can be obtained than to rely on only one crop or enterprise.

Limitations of Organic Farming

1. Organic farming is a time taking process in getting the result, which makes the farmers to neglect this kind of farming.
2. It requires more labour force and should have regular observation compared to conventional farming.

3. Organic farming is a skill-based work and farmers should be trained time to time according to the seasons and the condition of the crops.
4. Low productivity is the major problem in organic farming compared to conventional farming, but in conventional form of agriculture the fertility of soil is decreasing time to time with excess use of chemicals.

Future Prospects

In present world most of the consuming food contains harmful chemicals that are causing various diseases unknowingly or neglected knowingly this can be reduced by organic farming. The agricultural lands are becoming useless to do agriculture; if this continues the next generations will face a serious problem of food production as well as quality food. Thus, there is scope for research on organic farming. There is also need to increase the yield of crops under organic farming to meet the growing demand in the near future.

Conclusion

At present conventional form of agriculture is practiced at larger scale to get the high yield and quick result, but with conventional agriculture the fertility of the soil is decreasing gradually and if this kind of practice continues the land become useless for agriculture. Therefore, to avoid such a serious problem practice of organic farming helps the soil to maintain the fertility and can get good quality of food products, which are also healthier. However, it has some minor disadvantages organic farming is useful and eco-friendly form agriculture.

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Remote Sensing and its Application in Agriculture

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Introduction

Remote sensing is the art and science of gathering information about the objects or area of the real world at a distance without coming into direct physical contact with the object under study. Remote sensing is a technique for monitoring the earth's resources that combines space technology with ground observations to provide greater precision and accuracy. The utilisation of electromagnetic spectrum (visible, infrared, and microwaves) for measuring the earth's properties is the principle behind remote sensing. It is a phenomenon that has numerous applications including photography, surveying, geology, forestry and many more. However, it is in the field of agriculture that remote sensing has found significant use. There are very many applications of remote sensing in the agricultural sector. Below is a summary of these applications.

1. Crop production forecasting: Remote sensing is used to forecast agricultural output and yield across a certain area, as well as to estimate how much of the crop will be harvested under various conditions. Researchers can forecast the amount of crop that will be produced in a certain acreage over a specific time period.

2. Assessment of crop damage and crop progress: Remote sensing technology can be used to penetrate farmland and detect exactly how much of a specific crop has been destroyed and the progress of the remaining crop on the farm.

3. Horticulture, Cropping Systems Analysis: The use of remote sensing technologies has also aided in the evaluation of various crop planting strategies. This technology has primarily been applied in the horticultural business, where flower growth patterns may be examined and predictions produced.

4. Crop Identification: Crop identification has also benefited by remote sensing, particularly in circumstances where the crop under observation is mysterious or has unusual traits. The crop's data is collected and taken to the labs, where many components of the crop, including crop culture, are investigated.

5. Crop acreage estimation: Remote sensing has also proved highly useful in estimating the amount of farmland that has been planted with a crop. Because of the huge extent of the lands being evaluated, this is usually a time-consuming task if done manually.

6. Crop condition assessment and stress detection: The use of remote sensing technologies is critical in determining the health of each crop and the degree to which it has withstood stress. This information is then utilised to assess the crop's quality.

7. Identification of planting and harvesting dates: Farmers may now utilise remote sensing to analyse a range of characteristics such as weather patterns and soil types to estimate the planting and harvesting seasons of each crop due to the predictive nature of remote sensing technology.

8. Crop yield modelling and estimation: Farmers and experts can also use remote sensing to anticipate the projected crop output from a certain field by calculating the crop quality and the size of the field. This is then used to calculate the crop's overall projected yield.

9. Identification of pests and disease infestation: Remote sensing technology can also be used to locate pests in fields and provide information on the most effective pest control methods for eradicating pests and diseases on the farm.

10. Soil moisture estimation: Without the use of remote sensing equipment, measuring soil moisture can be challenging. Soil moisture data is provided through remote sensing, which aids in identifying the amount of moisture in the soil and, as a result, the type of crop that may be produced there.

11. Irrigation monitoring and management: Remote sensing provides data on the amount of moisture in soils. This information is used to assess whether or not a particular soil is moisture deficient, as well as to plan for the soil's irrigation demands.

12. Soil mapping: One of the most popular and essential applications of remote sensing is soil mapping. Farmers can use soil mapping to determine which soils are best for specific crops, as well as which soils require irrigation and which do not. Precision agriculture benefits from this information.

13. Monitoring of droughts: Weather patterns, especially drought trends, are monitored using remote sensing equipment over a defined area. The data can be used to forecast rainfall patterns in a certain area, as well as to determine the time difference between present rainfall and the next rainfall, which aids in drought monitoring.

14. Land cover and land degradation mapping: Experts have employed remote sensing to map out the land cover of a certain area. Experts can now determine which parts of the land have been degraded and which have not. This also aids them in putting measures in place to combat land degradation.

15. Identification of problematic soils: Remote sensing has also been useful in identifying problematic soils that have a hard time maintaining optimal agricultural output throughout the planting season.

16. Crop nutrient deficiency detection: Farmers and other agricultural professionals have also used remote sensing technology to detect the extent of crop nutrient deficit and devise solutions to improve the nutrients level in crops, hence enhancing overall crop production.

17. Reflectance modeling: Remote sensing is the sole tool that can provide information on crop reflectance. Crop reflectance is influenced by the quantity of moisture in the soil and the nutrients in the crop, both of which can have an impact on overall crop production.

18. Determination of water content of field crops: Apart from determining the moisture level of the soil, remote sensing is also useful for estimating the water content of field crops.

19. Crop yield forecasting: Using diverse crop parameters such as crop quality, soil and crop moisture levels, and land crop cover, remote sensing technology can provide reliable estimations of predicted agricultural production in a planting season. When all of this information is incorporated, crop production projections are nearly accurate.

20. Flood mapping and monitoring: Farmers and agricultural professionals can use remote sensing technologies to map out regions that are likely to be flooded and places that lack sufficient drainage. This information can then be used to prevent future flood disasters.

21. Collection of past and current weather data: Remote sensing technology is perfect for gathering and storing historical and current weather data that may be utilised to make future decisions and forecasts.

22. Crop intensification: Crop intensification can be achieved by using remote sensing to capture key crop data such as cropping patterns, crop rotation requirements, and crop diversity across a particular soil.

23. Water resources mapping: The mapping of water resources that can be utilised for agriculture over a given farmland is made possible by remote sensing. Farmers can utilise remote sensing to determine what water resources are available for use on a given piece of land and whether they are adequate.

24. Precision farming: Precision agriculture has benefited greatly from remote sensing. Precision agriculture has resulted in the development of healthy crops that provide farmers with the best harvests in a given period.

25. Climate change monitoring: Remote sensing technology is critical for monitoring climate change and keeping track of climatic conditions, which are crucial in determining which crops may be planted where.

26. Compliance monitoring: For agricultural professionals and other farmers, remote sensing is critical for keeping track of all farmers' farming techniques and assuring compliance. This aids in ensuring that all farmers plant and harvest crops according to the correct processes.

27. Soil management practices: The use of remote sensing technologies in determining soil management strategies based on data collected from farms is critical.

28. Air moisture estimation: The assessment of air moisture, which determines the humidity of the environment, is done using remote sensing technologies. The type of crops that can be cultivated in the location is determined by the level of humidity.

29. Crop health analysis: In the examination of crop health, which affects overall crop production, remote sensing technology plays an essential role.

30. Land mapping: Remote sensing aids in the mapping of land for a variety of uses, including crop production and landscaping. Precision agriculture, in which specific land soils are used for specific purposes, benefits from the mapping technology.

Conclusion

The remote sensing plays an important role within the agricultural sector. Data collected from remote sensing facilitate monitoring weed infestations, damages caused by pests and plant pathogens, thereby making it possible to counteract quickly. The ability to use remote sensing data to determine fertilization needs of plants based on the nutrient content of crops and soils helps to increase yields and improve the quality of harvested seeds and fruits, which is important for improving the crop profitability. Accurate determination of the nutritional requirements of plants at critical stages during the field season helps to optimize fertilization as well as reduce potential adverse impacts associated with offsite transport of agrochemicals. Remote sensing has also been used to assess the water needs of plants and determine the date of commencement of irrigation, making it easier to manage crop production under conditions of water stress.

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Watershed Management: A Sustainable Approach

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Introduction

Watershed is a geo-hydrologic area consisting land, water, forests and manmade environment, which absorbs, stores and discharges water through a common drainage point. Further it is a resources unit, identified accurately according to the drainage pattern. The entire system is closely related to the socio economic situation of the area and a number of watershed areas especially in the tropical countries suffer from an unhealthy situation due to various issues related to the watershed degradation (Perera, 2011). The rain-fed agriculture contributes 58 per cent to world's food basket from 80 per cent agriculture lands (Raju et al. 2008). Because of global population increase, water for food production is becoming an increasingly scarce resource, and the situation is further aggravated by climate change. The rainfed areas are the hotspots of poverty, malnutrition, food insecurity, prone to severe land degradation, water security and poor social and institutional infrastructure (Rockstorm et al. 2007). Watershed management is one such effective tool that addresses all these problems. Watershed is the geographic area through which water flows across the land and drains into a common body of water, whether a stream, river, lake or ocean. All the land on the earth is part of one or other watershed. Watershed is thus the land and water area (Geohydrological unit), which contributes runoff to a common point.

Watershed Management

Watershed management refers to efficient management and conservation of surface and ground water resources and other natural (land, water, plant and animals) and human resources within the watershed. Watershed management emphasises on scientific soil and water conservation in order to increase biomass production. The process of creating and implementing plans, programs and projects to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed boundary.

Objectives of Watershed Management

1. To control damaging runoff and degradation and thereby conservation of soil and water.
2. To manage and utilize the runoff water for useful purpose.
3. To protect, conserve and improve the land of watershed for more efficient and sustained production.
4. To protect and enhance the water resource originating in the watershed.
5. To check soil erosion and to reduce the effect of sediment yield on the watershed.
6. To rehabilitate the deteriorating lands.
7. To moderate the floods peaks at downstream areas.
8. To increase infiltration of rainwater.
9. To encourage restoration of ecological balance.
10. To enhance the ground water recharge, wherever applicable.
11. Promote the economic development of the village community.
12. To improve the socio-economic condition of the resource poor and disadvantaged sections of watershed community.

Types of Watersheds

1. Watersheds are categorised depending upon the size, drainage, shape and land use pattern:
    a. Macro watershed (> 50,000 Hectare).
    b. Sub-watershed (10,000 to 50,000 Hectare).

c. Milli-watershed (1000 to10000 Hectare).
d. Micro watershed (100 to 1000 Hectare).
e. Mini watershed (1-100 Hectare).

2. For easy management generally 500 ha is taken as a watershed unit.

Activities in Watershed (Control Measures)

1. Agronomical measures:

a. Strip cropping: growing of few rows of erosion resisting crops and erosion permitting crops in alternate strips on contour with the objective of breaking long strips to prevent soil loss and runoff.

b. Contour cultivation: Involves all cultural practices such as ploughing, sowing, intercultivation etc. across the slope reduce the soil and water loss. Ploughing across the slope, each ridge and plough furrow and each row of the crop act as obstruction to the run off. Thus reduced soil and water loss.

c. Mulching: Protect the soil from direct impact of raindrop and reducing the sediment carried with runoff. A minimum plant residue cover of 30% is necessary to keep runoff and soil loss within acceptable limits.

d. Conservation tillage: Low intensity tillage favours consolidation of soil and imparts erosion resistance. Practice of minimum tillage and zero tillage along with mulching are ideal for soil and water conservation.

e. Cropping systems:

i. Prevent mono cropping of erosion permitting crops.
ii. Intercropping or crop rotation with erosion resistant crops.
iii. Legumes (cowpea, green gram, horse gram, black gram) are effective for soil conservation due to their smothering effect.

2. Engineering measures (Structural practices):

a. Contour bunds:

i. Construction of bunds on contour to impound runoff water behind them so that it is infiltrated into soil.
ii. Recommended for areas receiving less than 600 mm rainfall and slope up to 6% in agricultural lands.

b. Graded bunds or channel terraces:

i. Rainfall more than 600 mm, where excess rainwater has to be removed safely out of the field to avoid water stagnation.
ii. Water flows in graded channels constructed on upstream side of bunds.

c. Bench terracing:

i. Consists of transforming relatively steep land into series of level strips.
ii. Field is made into series of benches by excavating soil from upper part and filling in the lower part of terrace.
iii. Normally practiced in 16-33 % slope range.

d. Construction of check dams:

i. A check dam is a small, sometimes temporary, dam constructed across a drainage ditch or waterway to counteract erosion by reducing water flow velocity.
ii. In turn, this obstruction induces infiltration rather than eroding the channel.

e. Construction of farm ponds:

i. A farm pond is a large hole dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use.
ii. It has an inlet to regulate inflow and an outlet to discharge excess water.
iii. Ideal size of farm pond 10m X 10m X 3m.
iv. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

f. Percolation Pond:

i. A percolation pond is a small water harvesting structure, constructed across a natural stream or water course to harvest and impound the runoff from the catchments for a longer time.

ii. To facilitate vertical and lateral percolation of impounded water into the soil substrata, thereby recharging groundwater storage in the zone of influence of the pond.

g. Contour trenches: Contour trenching is an agricultural technique to allow for water, and soil conservation, and to increase agricultural production.

h. Micro catchments for sloping lands: Micro catchments are simply ditching that concentrate surface runoff, thus reducing runoff and increasing infiltration to the soil.

Rain Water Harvesting and Artificial Recharge to Ground Water

1. Rain Water Harvesting (RWH) - process of collecting, conveying & storing water from rainfall in an area – for beneficial use.
2. The storage of rainwater on surface is a traditional technique and structures used were underground tanks, ponds, check dams, Reservoirs etc.
3. Recharge to ground water is a new concept of rainwater harvesting and the structures generally used are pits, trenches, dug wells, Recharge wells and Recharge shafts.
4. Rain Water Harvesting - yield copious amounts of water. For an average rainfall of 1,000mm, approximately four million liters of rainwater can be collected in a year in an acre of land (4,047 m2), post-evaporation.
5. Rain Water Harvesting is neither energy-intensive nor labor-intensive.
6. It can be a cost-effective alternative to other water-accruing methods.
7. With the water table falling rapidly, RWH is the most reliable solution for augmenting groundwater level to attain self-sufficiency.

Watershed Development Programmes

1. Watershed development originally managed by national wasteland development board under Ministry of Environment and forest.
2. It is now placed under Ministry of Rural Development and Department of Land Resources.
3. The main objective of these programmes is development of waste lands in non-forest areas, checking of land degradation, putting such waste land into sustainable use and increasing bio mass, availability of fuel wood, fodder and restoration ecology etc.
4. Thus, concept of watershed development is an integrated nurture with multi-disciplinary activities in the area.
5. At present, there are six major projects/programmes in watershed development programme namely,
   a. National Watershed Development Project for Rainfed Areas (NWDPRA).
   b. Watershed Development in Shifting Cultivation Areas (WDSCA).
   c. Drought Prone Areas Programme (DPAP).
   d. Desert Development Programme (DDP).
   e. Integrated Wasteland Development Project (IWDP).
   f. Employment Assurance Scheme (EAS).

Integrated Watershed Management

Involves integration of technologies within the natural boundaries of a drainage area for optimum development of land, water, and plant resources to meet the basic needs of people and animals in a sustainable manner.

This approach aims to improve the standard of living of common people by increasing his earning capacity by offering all facilities required for optimum production (Singh, 2000). It suggests to adopt land and water conservation practices, water harvesting in ponds and recharging of groundwater for increasing water resources potential and stress on crop diversification, use of improved variety of seeds, integrated nutrient management and integrated pest management practices, etc.

Conclusion

Watershed management is used for conservation, Development and optimal utilisation of land and water resources for the benefit of people. Controlling of degradation of land (such as erosion control). Management of natural resources at watershed scale produces multiple benefits in terms of increasing food production, improving livelihoods, protecting environment, addressing gender and equity issues along with biodiversity concerns.

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Wide Hybridization in Cotton: Barriers and Techniques to Overcome the Obstacles

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Abstract
Wide hybridization is a novel method used by plant breeders to create new plant forms or to introduce genes from related wild species into the crop plant of interest. Wide hybridization or distant hybridization is a cross between two different species or genera to move genes and to create new crop species. It comprises the exchange or modification of the genes due to crossing between species from distant gene pools. It is a unique tool to introduce useful traits in a variety of agricultural applications especially beneficial agronomical traits. This technique has been used in several crops for introgression of desirable traits from wild relatives to cultivated crops. Wild species are the products of natural evolution in the centers of diversity, are invaluable sources of resistance to diseases insect pests, temperature extremes, salinity and alkalinity stress, besides rich in nutritional quality. They possess high adaptation and genetic diversity. Several attempts have been made in many crops to transfer these beneficial traits to cultivated varieties.

Keywords: Cotton, *Gossypium* spp., interspecific hybridisation, incompatibility, barriers.

Introduction
Cotton is the leading fibre crop of the World belonging to the Genus *Gossypium*, which consists of 50 species of *Gossypium*. Of which, only four are cultivated species *viz., G. arboreum*, *G. herbaceum*, *G. hirsutum*, and *G. barbadense* and the rest are wild species. Wide range of variations are available in wild species of cotton. Some wild species are having useful characters *viz.,* fibre quality traits, prolific boll bearing, high ginning outturn, source of CMS, fertility restorer, glandless seeds, drought and frost resistance, pest and diseases resistance genes etc. Wide hybridization or distant hybridizations plays a vital role in cotton improvement. The main objective of wide hybridisation is to transfer desirable genes to create genetic variability in cultivated plants.

Types of Wide Hybridization
Wide hybridization is broadly classified into two types *viz*., interspecific hybridization and intergeneric hybridization. Interspecific hybridization refers to crossing of individuals belonging to different species within a genus. This is also called as Intra generic hybridization. Crossing of individuals belonging to different genera of a same family is called as inter generic hybridization. Interspecific hybridization can dramatically widen the available genetic pools so that novel genetic variation can be utilized by plant breeders. Crossing between individuals of different species or genera provides a way to combine diverged genomes into one nucleus. In Cotton, Varalaxmi (*G. hirsutum* x *G. barbadense*) is a first interspecific hybrid released by UAS, Dharwad which made a preamble in changing fibre quality scenario of Indian Cotton. DCH - 32 (*G. hirsutum* x *G. barbadense*) is the interspecific hybrid released from UAS Dharwad during 1981 has characteristic fibre with extra-long staple cotton. TCHB 213, the interspeicfic hybrids released in Tamil Nadu during 1990, has mean fibre length of 32.8 mm, spinning capacity of 80's count having blending properties with manmade fibres and suited for winter irrigated tracts.

Choice of Parents for Wide Hybridization
While choosing parents, species closely related to the cultivated crop should be preferred to obtain good cross ability, gene transfer by normal recombination and rapid improvement. Remotely related species or those belonging to a different genus can be used when the desirable genes are not available in more closely related species. The ploidy of the species chosen should preferably be of the same level as the cultivated variety. High level of expression, durability and simple inheritance of the characters to be transferred are

desirable. Wide hybridisation breaks the species barrier for gene transfer and makes it possible to transfer the genome of one species to other, which results alteration in genotypes and phenotypes of the progeny. It is not always successful, where development of young zygote may be arrested by hybrid breakdown, hybrid sterility and hybrid non viability. Mehetre and Aher (2003) reported that certain crosses with wild species are reported to be incompatability due to failure of fertilization between the species of *Gossypium viz., stocksii x raimondii, stocksii x gossypiodies, sturtii x aridum, sturtii x gossypidies, gossypiodies x davidsonii, gossypiodies x raimondii, raimondii x aridum, raimondii x harknessii, raimondii x thurberi, raimondii x sturtii* and *raimondii x stocksii.*

Barriers in Wide Hybridization

Several wild species are not crossable with the commercially cultivated species due to various barriers. The barriers are pre- zygotic barriers that prevent fertilization and zygote formation or post zygotic in which fertilization takes place, zygotes are formed but they are inviable or give rise to weak or sterile hybrids.

Prezygotic barriers include:

a. Failure of pollen germination.
b. Slow growth of the pollen tube.
c. Inability of the pollen tube to reach the ovary.
d. Arrest of pollen tube in the style, ovary and ovule. These are due to genetic differences or difference in ploidy levels of the crossing species.

Post zygotic barriers include:

a. Hybrid inviability and weakness leading to chromosome elimination, lethality and embryo abortion.
b. Hybrid sterility, which may either be due to development of abnormal gametes or breakdown of meiosis before it is completed (developmental hybrid sterility) or due to abnormal segregation of whole chromosomes, chromosome segments or gene combinations to the gametes (segregational hybrid sterility).
c. Hybrid breakdown with weak or sterile individuals in F2 owing to recombination of the gene complements of the parental species.

Methods to Overcome Crossability Barriers

1. Prezygotic barriers: Prezygotic barriers can be overcome by:

a. Mechanical removal of the style followed by pollination of the exposed stylar end.
b. Bud pollination
c. Use of mentor pollen technique, where in, incompatible pollen grains are mixed with maternal pollen grains killed with ethanol (or) anhydrous methanol or by irradiation.
d. Use of growth hormones like GA_3, IAA, NAA etc.
e. *Invitro* fertilization.
f. Protoplast fusion.
g. Chromosome doubling before hybridization.
h. Adopting bridging species technique.

In *Gossypium* boll shedding is a common feature in wide crosses involving wild species as one of the parents. It was observed that formation of abcission layer, four days after pollination, in the stalk caused boll shedding. This could be overcome by application of a mixture of GA_3 50 mg/ lit + NAA 100 mg/lit to the flowers immediately after crossing.

When crossing between two species is difficult, it is overcome by using a third species as a bridging species. This technique has been employed in *G.hirsutum* to transfer genes causing reduction in the level of gossypol in the seeds. *G.sturtianum* has been used as donor and *G.thurberi* and *G.raimondii* as bridging species.

Stoilova and Saldzhiev (2015) made interspecific hybridization of *Gossypium hirsutum* with the wild diploid species *viz., G. sturtii*, *G. thurberi*, *G. davidsonii*, and *G. raimondii* and reported that 0.1% solution of colchicine were used to overcome sterility caused by incompatibility of the genomes. Also reported to overcome the undesirable qualities that hybrids inherited together with desirable ones from the wild species two- or three-times backcrossing may do in amphidiploids of the *G. hirsutum* × *G.*

sturtii, *G. hirsutum* × *G. thurberi* and *G. hirsutum* × *G. davidsonii*, and trispecific hybrids *G. hirsutum-G. arboreum - G. raimondii*, *G. hirsutum-G. arboreum-G. thurberi* and *G. hirsutum-G. thurberi-G. raimondii*.

2. Post fertilization barriers: Post-zygotic barriers can be overcome by:

a. Chromosome doubling: Ploidy level changes between two crossing species is a major cause for hybrid sterility. It can be overcome by:

i. Increasing the ploidy level of the species with low ploidy level by doubling

ii. By using the species with high ploidy level as pollen parent.

iii. By reducing the ploidy level of the species with high ploidy level by producing haploids.

b. Back cross breeding: The hybrid of *G.thurberi* (AA) and *G.arboreum* (DD genome) was sterile and the amphidiplid (AADD) generated by doubling the sterile F_1 (AADD) when crossed with *G.hirsutum* was partially fertile this shows that backcross breeding can be used to produce fertile hybrids.

Application of Distant Hybridization in Crop Improvement

Improvement in fibre quality has been achieved through interspecific hybridization. High fibre length from *G. thurberi*, *G. raimondii* and G. barbadense has been transferred to *G.hirsutum*. High fibre strength of *G. thurberi* has been transferred to *G.arboreum* and *G. herbaceum*. Wild species in cotton are also important sources of sterile cytoplasm. Sterile cytoplasm from wild species can be transferred to cultivated species through interspeicifc hybridization and back crossing. In cotton, *G.harknessi, G.anomalum* and *G. aridum* are the sources of sterile cytoplasm.

In crop improvement programme, distant hybridization in cotton plays a significant role in a following way,

a. Development of new crop species.

b. Transfer of genes for biotic stress (resistant to insects, diseases, nematodes, etc.)

c. Transfer of genes for abiotic stress (drought, frost, etc.)

d. Transfer of genes for other characters of economic importance.

e. Development of CMS and Restorer lines.

Some of these wild species have an extremely useful for character combination in actual hybridization programme (Gotmare et al.,).

Wild species	Breeding value
G.anomalum Genome –B (2n=26)	Fibre yield, fineness, strength, maturity and length Resistance to rust, mites, jassid, bollworm and bacterial blight resistance
G.sturtianum Genome –C (2n=26)	Fibre strength and fibre elongation, resistance to frost, cold and wilt, insensitivity to photoperiod
G.thurberi Genome –D (2n=26)	Fibre fineness, strength and elongation, Resistant to Fusarium wilt, frost and bollworms, prolific boll bearing, high ginning outturn and better spinning
G.raimondi Genome –D (2n=26)	Fibre length, strength, elongation and fineness Resistance to boll worm
G.armourianum Genome –D (2n=26)	Resistance to blackarm and spotted bollworm, jassids
G.harknessii Genome –D (2n=26)	Resistance to Verticillium wilt, Fusarium wilt, drought, source of CMS, Fertility restorer
G.aridum Genome –D (2n=26)	Resistance to drought, high seed number, seed index, CMS and fibre length
G.longicalyx Genome =F (2n=26)	Fibre finess and fibre strength
G.gossypiodes Genome =D (2n=26)	Resistance to Jassids
G. australe Genome =C (2n=26)	Glandless seeds (delayed morphogenesis of gossypol gland), high GOT and drought resistance
G.tomentosum	Lint fibres fine and strong, resistance to drought and jassids

Genome=AD (2n=52)	

Conclusion

In crop improvement programmes, successful introgression of desirable characters from wild species posed huge challenges to plant breeders and biotechnologist. Several researchers attempted to develop techniques to overcome the incompatability /barriers in wide hybridization. As a result, use of growth hormones like GA3, IAA, NAA etc, Invitro fertilization, chromosome doubling before hybridization, embryo rescue and adopting bridging species techniques are found to break the barriers/incompatibility in crop plants to certain extent. Wide hybridization in Cotton crop has improvement various traits like fibre quality traits, introgression of pest and disease resistance genes in commercially cultivated species of cotton by adopting the various overcoming techniques. Advanced research in wide hybridization programme has immense untapped genetic resources with various beneficial traits like extra-long staple fibre quality, absorbent cotton with surgical properties etc., can be utilized to change the scenario of Indian cotton in international arena.

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Drought Management for Sustainable Agriculture Production in Arid Region

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Introduction

Drought: Drought occurs in high rainfall as well as low rainfall areas. Drought is defined as deficient rainfall, lack of moisture or a dry spell resulting in low crop yields including crop failure. The seasonal variations in precipitation and temperature are much more important in farming than annual averages. Regardless of variability in prospective, it is clear that drought is a normal feature of climate and its recurrence is inevitable. The American Heritage dictionary (1976) defined drought as a long period with no rain especially during planting season. The random house dictionary (1969) defined it as an extended period of dry weather, especially one injurious to crops.

Drought Management

There is ample scientific evidence to suggest that productivity of rainfed regions can be enhanced significantly on sustainable basis, provided the two basic natural resources, soil and rainwater, are managed in a judicious manner. Over the last several decades, researchers have concentrated on methods of increasing crop production under dry land conditions in order to mitigate drought effects at farm level. Simple easily implementable practices were developed for doubling the yields even in dry years over farmer's practices. To meet the weather aberrations, alternate crop strategies to the mid-season correction and crop life saving techniques forms important components.

Generally, drought is divided into three types:
1. Agricultural drought.
2. Meteorological drought.
3. Hydrological drought.

Challenges for Drought

1. Low and erratic rainfall, high evapo-transpiration, extreme aridity.
2. High wind velocity.
3. Scarcity of water, Depletion of water table, frequent droughts and famines.
4. Deep, brackish and declining ground water.
5. Low and fluctuating crop yield.
6. Poverty, illiteracy and conservative society.

Sustainability in Arid Region

Sustainable agriculture is the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving the natural resources

Aspects of Sustainable Agriculture

1. Achieving yield stability.
2. Reducing input use.
3. Conserving natural resources.
4. Changing the environment.

Natural Resource Use for Sustainable Crop Production

1. Physical resource: water, land and material containing crop nutrients
2. Environment resource: precipitation, light and carbon dioxide.

Achieving Sustainability

1. Minimize external input use-water, energy, fertilizer, seed, agro-chemical.
2. Maximize benefits from natural process- Photosynthesis, nitrogen fixation, biomass breakdown.
3. Optimize the use of internal resource- Water, soil, perennials and native crop varieties. programme (Gotmare et al.,).

Points to be Consider at the Time of Drought Management - Soil moisture conservation

1. Improve Infiltration rate: Conserve every drop of rainfall, Tillage practice- reduces runoff and increases soil moisture storage, INM improves structure of soil and improves infiltration and In situ-moisture conservation.

2. Reduce of percolation losses: Water conservation in soil root zone by water retention, Mitigate the problem of drought and Soil Compaction decreases percolation losses and drainage pores, whereas increasing water retention.

3. Land configuration: Sowing across the slope, Dead furrow at optimum distance, Compartment bunding helps in reducing runoff and soil loss, Bund and furrow preparation to conserve soil and water.

4. Selection of crops: Short duration crops, Drought resistant, Cover crops, Hairy and small leaves and Water saver plants.

5. Anti-evaporants: The chemical which check the evaporation of water either from the soil or from water reservoirs are called as anti-evaporants. e.g., Cetyl alcohol, Tallow alcohol, Venyl acetate acryl.

In-situ conservation practices: Ridges and furrow system in cotton

Drought Tolerant Genotypes or Verities in Some Important Crops and Suitability in India

1. Groundnut – Girnar, ICGV-87885, JL-24,TVG-4, SB-11, GG-11, GG-20.
2. Cotton- Eknath, Bharati(MCU-6), G. Cot.hy.-8,G. cot-13,15, LK- 861, AKH-081, AKA-5.
3. Sunflower- Morden, G.Sunflower-1, PKVSH-28.
4. Chickpea- GNG-16, ICCC-37, H-208, Chaffa, Vijay, AKG-46, AKG-1.
5. Soybean- Gujarat-Soya-1,2,3, JS-81-355, MACS-58.
6. Pearl millet- GHB-27, GHB-30, GHB-32, ICMS-7703, ICTP-8203, Mukta, HS-1.
7. Green gram- K-851, GM-1,2,3, G-860612, MCH-26.
8. Black gram-T-9, TVU-4, APK-1, KBG-512, KB-51.
9. Sesamum - Purva-1, Guj-Til-1,2.

Cover Crops

1. Crops are grown primarily to cover the soil and to reduce the loss of moisture due to evaporation.
2. Examples of cover crops- Groundnut, Cowpea, Green gram, Black gram, Gram, Kidney bean etc.
3. Annual shrubs and trees around the crop field sown to create a favorable soil micro-climate and decrease evaporation.
4. Cover crops also produce more biomass, which can be used for soil fertility management.
5. Cover crops down the soil temperature.

Use of Mulches

A practice by which materials such as straw, saw dust, manures, plastic film, vegetative wastes of crop residues are spread upon the surface of the soil. Some commonly used mulches are straw, leaves and green manure crops.

Types of Mulches: Synthetic mulch, Organic mulch, Sand mulch and Dust mulch.

Advantages of Mulching

1. Conservation of moisture.
2. Reduction of soil temperature.
3. Protection of soil from erosion.
4. Reduction in the growth of weeds.
5. Protection roots of crops from mechanical injury.
6. Surface mulches prevent soil from washed away.
7. Reduce evaporation and increases infiltration rate.
8. Soil mulching prevents deep cracking of soil.
9. Increased soil fertility over the long term.

Gliricidia leaf manure in sorghum and castor

Cropping System

Cropping system is most important for mitigate the drought. There are various cropping systems in arid and semi-arid region for escaping the drought:

1. Inter Cropping.
2. Mixed Cropping.
3. Alley Cropping.
4. Relay Cropping.

Antitranspirants

Hardly 1 % water is utilized in physiological activities of plant and remaining water lost through transpiration, it may help maintenance of favourable water balance in plant system. Any material applied for reducing water loss from the plant is known as Antitranspirant.

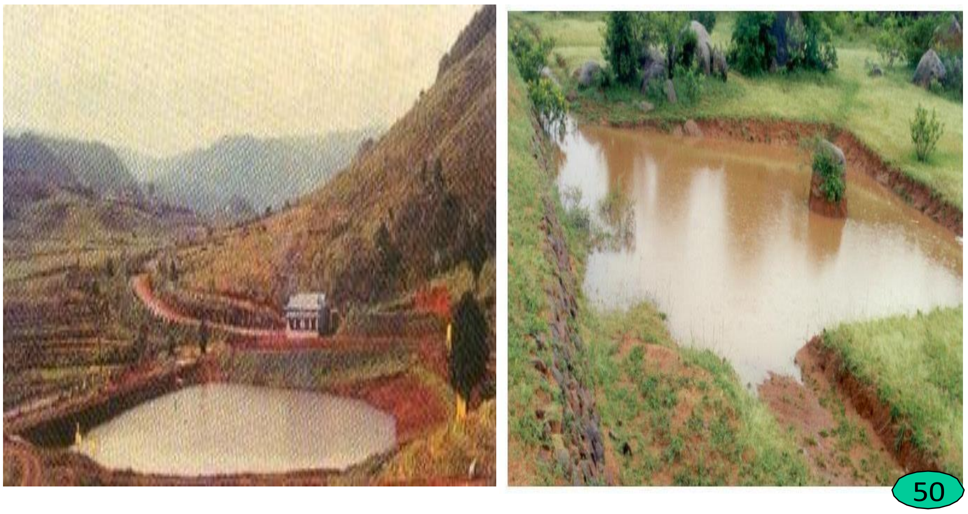
There are four types of Antitranspirant:

1. Stomatal Closing type- e.g. PMA, Atrazine
2. Film Forming type- e.g. Mobileaf, Hexadeconol, Silicone
3. Reflectant type- e.g. Kaolin, Calcium bicarbonate.
4. Growth Retardants- e.g. Cycocel.

Rain Water Management

Water harvesting and recycling- Collection and Storage of rain water, either runoff or stream flow for securing and improving water availability for crop growth under unirrigated condition.

1. On-farm reservoirs or farm ponds.
2. Well recharging through surplus rain water.
3. In situ moisture conservation.
4. Lifesaving irrigation at most critical stages.
5. Macro water harvesting.
6. Micro-water harvesting.



Rain Water Harvesting

Alternate Land Use System

Diversification of land according to land capability classes increase the land use efficiency. Alternate land use system classified as-

1. Agroforestry.
2. Agri-horticultural system. Silvi-pastoral system.
3. Advantages of Alternate Land Use System- Control soil erosion, soil improvement and creating congenial and conductive microclimate.

Agroforestry

A System That Combines Perennial Species and Annual Crops. Are the Important Perennial Components of agroforestry Systems. Agroforestry is technique to control deep percolation. Different trees like *Prosopis cineraria, Acacia Senegal, Acacia nilotica, Zizyphus rotundifolia, Zizyphus mauritiana* if planted in agricultural fields of the arid areas, utilize the deep percolation water efficiently, because of their deep root system.

Conclusion

Tillage, land configuration, mulching etc. play vital role in conserving water, reducing runoff, increasing root density as well as improving physical properties and ultimately enhance the crop productivity. Integrated nutrient management seems to viable option rather than use of chemical fertilizer alone under dryland situations for coping up the drought. Due to rain water management with water harvesting and farm pond, that water is useful in most critical growth stages of crops and more benefit occurs. Alternate land use system is the important option for dry land agriculture.

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Direct Seeded Rice: "Need of an Hour"

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Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops in the world, and staple food for more than 50% of the global population. It meets 43% of the calorific intake of about two-thirds of the population of the Indian subcontinent. It is the backbone of livelihoods for millions of people in rural areas.23% of the total area of grass cropped area is occupied by rice. It contributes about 46% and 43% of cereal and grains production of the country respectively.

In the entire world, India has the largest area covered under rice crop after China. Increasing water scarcity, water loving nature of rice cultivation and increasing labour wages triggers the search for such alternative crop establishment methods which can increase water productivity. One of the considerable and viable alternatives to alleviate stress on unproductive water flow is Direct seeded rice (DSR). Under DSR technology sowing of rice seeds is done directly in the soil where they are to grow rather than transplanting seedlings.

Methods of direct seeding are wet seeding and dry seeding. Improved short duration and high yielding varieties, nutrient and weed management techniques encouraged the farmers to shift from traditional system of transplanting to DSR culture. Lesser use of irrigation water, labour, energy, time and lesser emissions of greenhouse gases are some of the advantages of direct seeding. Large quantity of irrigation water is used in the conventional puddled transplanting system (PTR) which breaks capillary pores, destroys soil aggregates and results in formation of hardpan creating problems for the establishment and growth of succeeding crops.

As profit margins and water resources are shrinking day by day so it is better to shift from PTR to DSR technology. DSR has lesser labour demands in comparison with PTR. DSR is the only way for rice cultivation by seeing the problems of water scarcity which not only saves water but also reduce the cost of labour, emission of greenhouse gases and ultimately increase the profit of the farmers.

Major Reasons for Choosing DSR

1. Increase in cost and scarcity of labour at crucial time: The demand for labour is spread out over a longer period in DSR as compared to PTR, where more labour is required at the time of transplanting thus resulting in its shortage. Increased demand for labour in non-agricultural sectors and rapid economic growth in Asia has resulted in less labour availability for agriculture. In Asia, labour forces in agriculture are declining at 0.1-0.4%, with an average of 0.2% per year.

2. Scarcity of water: According to some reports, 5000 litres water is used to produce 1 kg of rough rice. Rice is a major freshwater user and consumes about 50% of total irrigation water used in Asia and accounts for about 24-30% of the withdrawal of world total freshwater and 34-43% of the world's irrigation water. Due to increasing population, lowering of the water table, declining water quality, inefficient irrigation systems, and competition with non-agricultural sectors, the share of water for agriculture is declining very fast. In the major rice-growing Asian countries, per capita water availability reduced by 34-76% between 1950 and 2005, and is likely to decline by 18-88% by 2050. In case of increasing shortage of water, Dry-DSR with minimum or zero tillage (ZT) enhances the benefits of this technology by saving labour. It is more efficient in water usage and eases the grim water scenario occurring in agriculture due to traditional methods.

3. Early maturity of DSR crops: Apart from economic benefits brought by DSR through the integration of an additional crop (crop intensification) is another reason for the rapid adoption of DSR. Earlier maturity of DSR as compared to PTR fits this crop well in different cropping systems.

4. Zero tillage: Deteriorating resource base, declining/stagnating crop and factor productivity in cereal systems like rice-wheat have led to the promotion of zero tillage. It utilizes crop residue as mulch with improved crop and resource management methods.

Adverse Effects of Puddling and Transplanting Rice

1. Degrading water resource base: At global level 70-80% of fresh water is used in agriculture and rice accounts for 85% of this water, Rice requires about two times as much water as wheat or maize. Conventional rice cultivation needs 3000 to 5000 L of water to produce 1 kg rice. The productivity of water in rice is very low. The declining availability and quality of water, increased competition from domestic and industrial sectors, and increasing costs are already affecting the sustainability of irrigated rice production systems in many parts of South Asia. Many districts in the rice-wheat growing area of Haryana, India, show a water table decline in the range of 3–10 m over the last two decades.

2. Degrading soil resource base: Soil-related causes such as the decline in soil carbon and macro- and micronutrients in rice-rice and rice-wheat systems resulted in yield decline which was observed in long-term experiments in South Asia. Accumulation of phenolic compounds, Fe2+, and sulphides in the rice-rice system; and the increase in soil salinity also increased the yield decline. Intensive use of irrigation water in rice led to a salinity build up. In the short term, salinity built up leads to reduction in yields, whereas, in the long term, it can lead to abandoning of crop lands.

3. Pollution due to pesticides: Modern rice cultivation involves use of pesticides which harms both the environment and human body. The non-judicious use of pesticides has caused large problems of air, water, and soil pollution in many rice-growing regions. Part of the applied pesticide, irrespective of crop, applicator, or formulation, ultimately escapes to the soil, water, and food chain, causing human health problems such as carcinogenicity, reduced life span and fertility, increased cholesterol, high infant mortality, and varied metabolic and genetic disorders.

4. Pollution due to fertilizer: Fertilizers are used to meet crop requirements and also to meet ambitious yield targets. Nitrogen fertilizer for example is often applied in excess of the crop requirement and at inappropriate times in many intensively irrigated rice systems, which increases the risk of poor fertilizer recovery by the rice crop. 65% of nitrogen fertilizer is lost from soil-plant systems into the environment through volatilization, denitrification, leaching, and runoff, thus creating pollution problems.

5. Burning of rice residues: The burning of rice straw is environmentally unacceptable as it leads to the release of soot particles and smoke, causing human health problems such as asthma or other respiratory problems. Rice straw and husk are often not disposed of in an environment-friendly manner. About 60% and 80% of rice straw produced in the north western states of Haryana and Punjab, respectively, is burned in the field. It causes in immense emission of greenhouse gases. Gases such as carbon dioxide, methane, and nitrous oxide, causing global warming; and loss of plant nutrients such as N, P, K, and S. Almost the entire amounts of C and N, 25% of P, 50% of S, and 20% of K present in straw are lost due to burning.

6. Impact on subsequent crop: Physical changes from puddling can be very detrimental to the growth of subsequent non-rice crops such as wheat by causing temporary water logging, poor crop emergence, and restricted root development because of a dense zone of compaction.

Comparison of DSR with Transplanting Rice

1. Water saving: Less frequent irrigation is required during the growing season because DSR establishes deeper roots and is more efficient at using soil moisture. Rice can be established by DSR once 150 mm rain or irrigation water has accumulated compared to 450 mm needed for transplanting. About one third reduction in cost was observed by farmers of Uttar Pradesh in on farm trials of DSR technology. Water saving of 35-55% have been reported for dry seeded rice sown into non-puddled soil with the soil kept near saturation or field capacity compared with continuously flooded (~5 cm) transplanted rice in research experiments in north west India.

2. Labour and cost saving: Due to shortage of labour transplanting costs are skyrocketing, this halts in plantation. DSR avoids to grow the seedling and transplanting, thus reducing the labour requirement for transplanting and nursery growing. It was reported that total labour used was 37 % higher in conventionally planted rice as compared to DSR, which was mainly because of transplanting operation. Conventional practice (CT-PTR) requires much labour in the critical operation of transplanting, which often results in a shortage of labour whereas in DSR demand for labour is spread out over a longer period. The spread-out labour requirement helps in making full use of family labour, and having less dependence on hired labour.

3. Mitigating green-house gas emission and climate change adaptation: Rice production systems impact global warming potential (GWP) primarily through effects on methane but N_2O and CO_2 effects can also be important in some systems. Therefore, rice is an important target for mitigating GHG emissions. One of the major sources of CH_4 emissions is flooded rice culture with puddling and transplantation. It is due to the prolonged flooding resulting in lack of oxygen (anaerobic) in soil. Studies comparing CH_4 emissions from different tillage, and establishment methods in rice revealed that CH_4 emissions were higher in puddled transplanting rice as compared to dry-DSR. The reduction in CH_4 emissions ranged from 30 to 58% in dry-DSR compared with puddled transplanting rice. Aerobic conditions, especially during the early growth stages in dry-DSR and until seedling establishment in wet-DSR are responsible for low CH_4 emissions. The best alternative of conventional puddled transplanted rice having good potential to mitigate and adapt to climate change is DSR. Increase in variability of monsoon rainfall and the risks of early or late-season drought are expected due to climate change. Poor farmers are better equipped with DSR to tackle climate change because it offers a choice of rice establishment methods and by reducing the amount of water required for crop establishment and subsequent crop growth. Farmers can sow rice by using DSR technique with minimal soil moisture, rather than wait for sufficient rainfall for transplanting in case of drought.

4. Avoiding burning of rice straw: By using Happy Seeder machine in DSR technology, seeds can be sown directly on residue retained fields. This will lead to reduction in burning of rice straws which leads to the release of soot particles and smoke causing human health problems such as asthma or other respiratory problems, emission of greenhouse gases such as carbon dioxide, methane and nitrous oxide are the cause of global warming.

5. Effect on succeeding crop: By continuous puddling the soil structure gets destroyed, this can be improved by direct seeding which provides congenial environment for succeeding crops. In a study related to the effect of rice crop establishment methods of rice to improve the productivity and profitability of rice-based cropping systems found that the system productivity of DSR-wheat, DSR-chickpea and DSR-mustard were higher (14.96 t, 14.48 t and 13.48 t/ha, respectively) compared with the transplanting rice-based cropping system productivity (13.53 t, 12.12 t &11.81 t /ha, respectively).

6. Grain yield: Higher yields of DSR can be obtained with good management practices. DSR is both cost and labour-saving technology. In an experiment it was found that because of higher panicle number, higher test weight and lower sterility percentage, higher grain yield of DSR as compared to PTR was obtained. Comparative yields in DSR can be obtained by adopting various cultural practices viz., selection of suitable cultivars, proper sowing time, optimum seed rate, proper weed and water management. A short duration, early maturing cultivar PR 115 was found better than other medium and long-duration varieties.

7. Economics: Due to rising costs of cultivation and decreasing profits with transplanting rice farmer's interests are rising in DSR. A technology that gives higher profit despite similar or slightly lower yield is widely accepted and appreciated by the growers. Practices in which reduced or zero tillage was combined with dry-DSR observed largest reductions in cost. The observed cost reductions were largely due to either reduced labour cost or tillage cost or both under DSR systems.

Conclusion

1. About 40% Labour required for nursery raising, uprooting and transplanting of seedlings is saved.
2. DSR technique eliminates the activities such as nursery raising, puddling, seepage and percolation and results in conservation of 60% of water.
3. Because of application of fertilizers in the root zone fertilizer use efficiency is increased.

4. Early maturity by 7-10 days helps in timely sowing of succeeding crops.
5. About 60% of diesel is saved due in elimination of field preparation for nursery raising, puddling and reduced water application for irrigation.
6. Significant reduction in methane emission and global warming potential.
7. Soil structure is not disturbed in direct seeded rice as occurs in puddled transplanted system.
8. System productivity is enhanced.
9. Sowing can be done in stipulated time frame because of easier and faster planting.
10. More profitability especially under assured irrigation facilities.
11. Comparative yields of DSR (2.2-8.7 t /ha) can be obtained by adopting proper management practices.
12. DSR is technically and economically feasible, eco-friendly alternative to conventional puddled transplanted rice.

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Plant Growth Promoting Rhizobacterial as Biocontrol Agent Against Soil Borne Diseases

Article ID: 11355

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Summary

Soil-borne diseases are responsible for major crop losses worldwide. Diseases caused by plant pathogens adversely affect global crop productivity and account for 20-40 per cent yield losses annually in various cereal and legume crops. In India, 57,000 metric tonnes of synthetic pesticides were used during the 2016-17 to control the plant pathogens and insect pests, whereas the amount of biopesticide consumption was only 6340 metric tonnes. The development of resistance due to continuous use of pesticides in modern farming and increased availability of pesticide residues in vegetables, cereals and grains has generated many problems. Moreover, the unregulated and indiscriminate use of chemical pesticides causes pollution of soil, water and air along with decrease in the soil microflora and fauna. Huge amounts of money are being spent on application of synthetic pesticides to control soil borne diseases worldwide. Alternatives to the use of synthetic chemicals for disease control are increasingly being sought due to among other reasons, the detrimental effects of these compounds on the environment.

Solution to the Problem

Beneficial rhizosphere microorganisms could be exploited to provide sustainable solutions in reducing the application of pesticides for agricultural crop production. Biopesticides offer several advantages including complete biodegradability and water solubility over traditional chemical/ synthesised pesticides. Thus, microorganisms and plant-based biochemicals provide a safe alternative option for plant disease suppression in agriculture system.

Plant growth-promoting rhizobacteria (PGPR) are free-living bacteria able to colonize roots and soil around them that have a positive effect on plant growth, development, and health. One of the mechanisms by which PGPR exert a beneficial effect involves the capacity to control growth of deleterious organisms diminishing or preventing their negative effects on plant health and growth. Pathogen biocontrol implicates diverse features of bacteria; one of them is the antagonism that excludes pathogen due to the ability of some bacteria to colonize faster and more effectively a niche, reducing nutrient availability for the deleterious organism.

Also, some bacteria produce antibiotics, organic compounds that are lethal in low concentration for growth and metabolic activities of other microorganisms. Finally, the ability of bacteria to elicit a defence response in plant, called induced systemic resistance (IRS), involves the induction of synthesis of defence metabolites, but without causing a disease itself, enhancing the plant's defensive capacity. This chapter analysed and discussed PGPR as biocontrol agent and the possibility to use them as ecological alternative to the use of agrochemicals, since they have been proved in different plant species in order to diminish the damage of pathogen and to reduce losses in crops.

What are PGPRs?

We define PGPR as a group of free-living rhizospheres occupying bacteria that enhances plant growth and can also be classified as biocontrol agents, biofertilizers, or biopesticides, depending on their activities/abilities. PGPR as biocontrol agents have certain advantages over conventional chemical control compounds. Firstly, PGPR are beneficial, naturally occurring microorganisms, which are environmentally friendly and nontoxic. Secondly, from an ecological perspective, their application is sustainable (long term). Another advantage of PGPR is the fact that they possess a diverse range of modes of action including antibiosis, production of siderophores, cell wall degrading enzymes, bio-surfactants and volatiles, and also induces systemic resistance in plants. The fact that some PGPR by definition directly enhances the growth of plants is an additional advantage. PGPR as biocontrol agents have certain advantages over conventional chemical control compounds.

Advantages of PGPRs

1. Firstly, PGPR are beneficial, naturally occurring microorganisms, which are environmentally friendly and nontoxic. Secondly, from an ecological perspective, their application is sustainable (long term).

2. Another advantage of PGPR is the fact that they possess a diverse range of modes of action including antibiosis, production of siderophores, cell wall degrading enzymes, bio-surfactants and volatiles, and also induces systemic resistance in plants.

3. The fact that some PGPR by definition directly enhances the growth of plants is an additional advantage. PGPR as biocontrol agents have certain advantages over conventional chemical control compounds.

Mechanisms Involved in Disease Control

1. Root colonization: The pathogens are known to enter in the plant system through their roots, but when PGPRs colonize the roots, they do not allow the pathogens to enter in the system and thus protect the plant from the harmful effect of pathogens.

2. Competition: The PGPRs also compete with pathogenic for nutrition and water supply available in soil and due to the abundance PGPR get selective advantage which reduce the population of pathogens and hence the chance of infection to plants is also reduced. Some PGPRs secrete siderophores, which is a good chelator of iron. These siderophores reduces the availability of iron, which is crucial factor for the growth of pathogens, and hence controls the growth of such pathogens.

3. Suppression through the production of secondary metabolites: The plant growth promoting microorganisms also secrete certain secondary metabolites (such as antibiotics), which act as toxic agent for the pathogens. The secondary metabolite kills or reduces the population of pathogenic elements. Some PGPRs also secrete cell wall degrading enzymes (chitinase, cellulose, protease etc.) which kill the pathogen through their cell wall disintegration.

4. Induced systemic resistance or systemic acquire resistance: Induced systemic resistance (ISR) is the state of defensive capacity developed by the plant when stimulated by diverse agents including rhizobacteria. Once resistance is induced in plants, it will result in nonspecific protection against pathogenic fungi, bacteria, and viruses. PGPR elicit ISR in plants by increasing the physical and mechanical strength of the cell wall as well as changing the physiological and biochemical reactions of the host. This results in the synthesis of defense chemicals such as chitinase, peroxidase, and pathogenesis-related protein.

Example of Some Common Biocontrol Agents are

1. *Pseudomonas fluorescence*
2. *Acenetobacter*
3. *Staphylococcus*
4. *Bacillus*
5. *Enterobacter*
6. *B. subtilis*
7. *B cereus*
8. *Pseudomonas chlororaphis*
9. *Bacillus stearothermophilus*
10. *B. licheniformis*
11. *B. circulans,*
12. *Chromobacterium violaceum*
13. *Brevibacterium laterosporus*
14. *Serratia marcescens*
15. *P. frederiksbergensis* 202

The Outcome (i.e., Success) of a Biocontrol Agent (BCA) Treatment Depends on the Following

1. The method of inoculation/application.
2. The physiological state of the BCA.
3. The concentration and dosage of the BCA.
4. The presence or absence of nutrients.
5. The presence or absence of adjuvants such as adhering or protective agents.
6. The media used for BCA production.
7. The volume of treatment.
8. The plant type and cultivar. Both plant and cultivar specificity has been observed for some BCAs.

Conclusion

In conclusion, as there are numerous examples of effective biocontrol candidates, the future challenge is not to prove that biocontrol is possible, but to improve efficacy and durability of biocontrol in the field. This will only be achieved through a better understanding of the biocontrol mechanisms, plant–microbe interactions and processes as well as microbial ecology in the soil and rhizosphere. The necessary molecular tools for studying these processes and interactions are already Plant Growth Promoting Rhizobacteria as Biocontrol Agents 225available. If this is achieved, the efficacy of biocontrol could conceivably be improved through application of this knowledge to develop improved screening protocols, formulation, and application procedures as well as new innovative integrated disease management practices.

Biotechnology Education in the Context of Socioeconomic Development in India

Article ID: 11356

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Use of Biotechnology in Different Sectors

Biotechnology is the use of advance techniques on any biological entity (may be microbial organism, plant, animal) and its biological system and metabolic process to extract anything better than the existing for the development of mankind. The term biotechnology was first used by Karl Ereky in 1919. Biotechnology evolved to be a panacea for humankind but now a days it has also been used as a bane to create breach of peace. It has been there with us since the first discovery of antibiotics and may have been there even before the neolithic revolution. The current coronavirus pandemic has brought sharp focus on the possible benefits and potential pitfalls of modern biotechnology research. Although biotechnology can be used to countermeasure medical issues to fight diseases and develop healthier crops and livestock, it can also be deployed to produce biological weapons. Even though the current pandemic is highly debated to have originated from natural sources, still the origin of this pandemic does not rule out the possibility that other future infections could emerge from biotechnology laboratories. Similarly, the discovery of CRISPR- Cas's system has also kept the researcher's head high because it has bought endless possibilities to help humanity and even destroy humanity with unethical research. Keeping aside all the negative view on biotechnology, let us know what biotechnology has provided us for the future and also how it has helped in socioeconomic development. Biotechnology has been in the front of daily life from quality food, milk and beverage production (use of techniques such as genetic engineering and fermentation technology), rapid production of pharmaceuticals including vaccines (medical biotechnology), water purification and waste management. It has helped in mitigating hunger (plant biotechnology), treat lifestyle diseases and remediate environmental degradation (environmental biotechnology). Plastic pollution a huge concern for the society can be and is being dealt with modern biotechnology. Many developed countries have kept a stringent regulation on the use of GMOs and also has kept pressure on the food selling industries to sell only anti-GMO food. As part of environmental biotechnology, gene drives have been used to eradicate malaria causing mosquitoes and even bacteria are used in oil spill areas in sea to break down oil. Biotechnology has the potential to revolutionize the societies that humans live in and the organisms that they live alongside. With the modern discovery of DNA and RNA sequencing techniques, scientist is able to know the sequence of any specific part of the genome which can help in better modification of the junk part and make the rest usable part to be introgressed into another biological entity for the betterment of mankind. Even the microbiome of the soil has been tried to be improved using modern biotechnology where plants and microbes can live in a symbiotic relationship which will finally increase the yield of the crops. Herbicide tolerance, heavy metal tolerance, pest and pathogen resistance and all other types of biotic and abiotic stress tolerance in the field of plant biotechnology has brought along a new dawn for the biotechnology well-wishers and researchers. The use of modern medical biotechnology for controversial topics such as gene therapy and stem cell therapy has also opened up a bright future for the researchers ahead. So, there are endless possibilities of biotechnology bought to us both as a boon and as a curse. Now its up to the human's mindset how he/she wants to accept biotechnology as part of his daily life.

Biotechnology Education for Socioeconomic Development in India

For the upliftment of biotechnology sector which has endless possibilities for the future, developed and developing countries has taken several initiatives. There was the formation of many councils and departments for this purpose. Especially in India which harbours a huge population of around 136 crores can be a model country for the world which can show the path for use of biotechnology in economic livelihood. India holds roughly 2% share of the world market in producing quality biotech goods, the leader being USA. The Govt. of India has planned out to support biotechnology education in India by use of its ministries such as Ministry of Human Resources and Development (MHRD), Ministry of Science and Technology (MoST), Ministry of Health and Family Welfare (MHFW), Ministry of Agriculture (MoA) and Ministry of Environment and Forests (MoEF). The Department of Biotechnology under MoST, Govt of India is an apex body responsible for administrating development, promotion and commercialization of biotechnology in India. The department has taken responsibility for human resource development through starting of bachelors, masters and PhD level programmes in colleges and universities of higher education so that people can study biotechnology and set goals for research and development in any suitable area for betterment of humankind. The department have identified centres of excellence with huge fund allocation where students can continue their research and can collaborate with international institutes for further scale up of any process or methodology on which the researcher is interested keenly. Many MOUs have been signed between DBT and foreign govt. funded organisations to help transfer of valuable information in any way. Thanks to the globalization of all enterprises which helped internationalization of biotechnology education. Biotechnology Industry Research Assistance Council (BIRAC) established by DBT is aimed at strategically empowering emerging biotech companies. Many pharmaceutical companies had tied up hands with BIRAC for future investments on vaccine production for highly infectious diseases. BIRAC along with DBT has helped to develop the biotech industry in India from merely $ 1.1 billion in 2003 to $ 62.5 billion in 2019, where the bio-pharma sector (therapeutics, vaccines and diagnostics) holds a major proportion of $ 36 billion followed by bio-agri sector (biofertilizer, biopesticides, BT cotton) which holds $ 12 billion. Association of Biotechnology Led Enterprises (ABLE) is a forum of Indian Biotech Companies which helps to maintain the pace of growth of biotech sector in coordination with Govt. of India. BIRAC along with DBT had arranged biotech finishing schools and biotech industrial programmes in top universities and industries of India to teach the aspiring candidates about the best techniques available to sustain in the global market. Another department i.e. Department of Science and Technology (DST) under MoST has also promoted new areas of science and set up many autonomous institutions for the improvement of human resources. Both the departments also provide with many attractive fellowships and scholarships across genders, castes and religions for skill development. India in the upcoming days will become a major player in the biotech sector as it has a huge population of young minds who are keen in learning new techniques with the help of higher education infrastructure available, which obviously is justified by the good literacy rate of India to 77.7% in 2017-18, which was boosted slowly from 64.8% in 2001. The Govt.of India also passed the DNA Technology (Use and Application) Regulation Bill – 2019 in a landmark decision which is expected to improve the Indian judiciary system, which in itself is a big boost for the biotech sector. Many state Govt.s are also opening up on accepting proposals of projects from young minds and funding them in collaboration with DBT. Tamil Nadu, Delhi, Karnataka, Maharashtra, Telengana are the major states leading the biotech sector. The North Eastern states including Assam has also accelerated to race in the competitve sector and has helped DBT to establish a seperate Biotechnology programme for the North Eastern Region (NER-BPMC) and finally a DBT- North East Centre for Agricultural Bioetchnology (DBT-NECAB) was set up which has already started nurturing young minds from north east to avail better job opportunities. Presently the country allows 16000 plus biotech graduates every year. Endless contributions from the Govt. of India to boost biotechnology education has resulted in many start-up companies which are dream come true for Make in India mission of Govt. of India. The biotechnology sector in India is thus creating skilled people who can generate income by entrepreneurial ideas and also seek job in top companies in country and abroad.

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Production Technology of Brinjal

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Introduction

Brinjal is also called egg plant or aubergine. It is another tropical vegetable believed to be a native of India. (*Solanum melongena* L.) Family : Solanaceae. A deep fertile silt loam or clay loam soil with a pH of 5.5 to 6.0 is the best for growth and development of brinjal. This crop grows very well in a temperature range of 25°-30°C. Very low temperature especially below 15°C will affect the growth of the plant as well as fruit quality. It cannot withstand heavy rains especially during flowering and fruit set.

Varieties

Selection of variety is an important consideration in the cultivation of brinjal as the local preference varies considerably from region to region and even district to district. A variety with a particular colour and size of the fruit fetching premium price in the market, may be totally rejected in another area. Since the ultimate aim of the farmer is to get maximum return for his produce, judicial selection of the type with reference to market demands is very important in this crop.

CO 1

It is a pureline selection. Fruits are oblong and medium sized with pale green shade under white background. The plants are compact and bushy. It has a yield potential of 20-25 tonnes/ha. The fruits are soft seeded even at full maturity. It was developed from the vegetable section of the then Agricultural College and Research Institute, Coimbatore. It is preferred in the markets of southern districts of Tamil Nadu such as Tirunelveli, Ramanathapuram etc., and also Karnataka State.

MDU 1

This was developed at the Department of Horticulture, Agricultural College and Research Institute, Madurai. The plants are vigorous and compact. Fruits are round with large size each weighing about 200-250 g., bright purple in colour and have less seed content. As the fruit matures, the purple colour fades to pale pink. It is a pure line selection from a local type called Kallampatti. It has got a yield potential of 30 tonnes/ha. in a crop duration of 135-140 days. Preferred in Madurai and Trichy districts of Tamil Nadu and also in Kerala State.

Annamalai

This is an aphid resistant variety developed at the Department of Horticulture, Faculty of Agriculture, Annamalai University. The fruits are oblong, deep purple in colour with a characteristic yellowish mark along the calyx border and a few thorns on the calyx surface. This is preferred in Cuddalore, Villupuram, Vellore, Thiruvannamalai and Chemgalpattu districts and Chennai market. It has a yield potential of 20-22 tonnes/ha.

PKM 1

It was evolved at the then Horticultural Research Station, Periyarkulam of Tamil Nadu Agricultural University from a local type called 'Puzhuthi Kathiri' through mutation breeding. It is adapted to rainfed cultivation in Madurai and Anna Districts. The fruits are small and slightly oblong ovate with green stripes.

PLR 1

This is a reselection from a Nagpur ecotype developed at the Vegetable Research Station, Palur of TNAU in Cuddalore district of Tamil Nadu. The fruits are small to medium in size, sometimes borne in clusters, egg shaped and with bright glossy purple colour. It fetches premium price in the markets of Cuddalore, Chengalpattu and Chennai. It has got a shelf life of 8-10 days under ambient temperature. It yields on an average 25 tonnes/ha.

Pusa Purple Long

It was developed at Indian Agricultural Research Institute, New Delhi through pureline selection. Fruits are glossy, light purple in colour, 25-30 cm long and smooth. It has a yield potential of 25-37 tonnes/ha.

Pusa Purple Round

It was also evolved at Indian Agricultural Research Institute, New Delhi. The plants are very tall with a thick stem of greenish purple colour. Leaves are highly serrated and deep green in colour. Fruits are round with purple colour. Each fruit weighs on an average 130-140 g.

Pusa Purple Cluster

It is a cluster bearing type developed at Indian Agricultural Research Institute, New Delhi.

Arka Sheel

It is a pureline selection from a Coorg type developed at Indian Institute of Horticultural Research, Bangalore. Fruits are medium long and deep purple in colour with less seeds. It yields about 39 tonnes/ha in 120 days.

Arka Shirish

An extra-long brinjal cultivar improved from a local type called Irangeri brinjal of Karnataka State. Fruits are very long, light green in colour and the yield is around 45-47 tonnes/ha. in a crop duration of 115 days. It was evolved at IIHR, Bangalore.

Arka Kusumakar

This is another variety developed at IIHR, Bangalore through pure line selection from a local variety in Karnataka. The fruits are medium long, finger shaped and pale green in colour and borne in clusters of 5-7; yield is 45 tonnes/ha. in 120 days.

Arka Neelkanth

Developed at IIHR, Bangalore. Plants are tall (95.5 cm) and are compact. Fruits are short (12 cm length, girth 8.5 cm) with violet blue glossy skin, green purple calyx, tender flesh having slow maturing seeds and free from bitter principle. Each fruit weighs 40g on an average and are borne in clusters in two flushes. Young leaves are dark green with purple leaf base and veins. Stem is purple green. This variety is resistant to bacterial wilt and has very good cooking and keeping qualities. It yields 40 tonnes/ha in a crop duration of 150 days.

Arka Nidhi

It was also developed at IIHR, Bangalore. Plants are tall (90 cm) well branched and compact. Fruits are medium long (20 cm length and 9 cm girth) with blue black glossy skin, green purple calyx, tender flesh with slow maturing seeds, free from bitter principles. The fruits weight on average 43 g and borne in clusters in two flushes; cooking and keeping qualities are good. It is also resistant to bacterial wilt. It yields 48.5 t/ha in 150 days.

Pant Samrat.
Pusa Kranti.
APAU Shyamala.
Pant Rituraj.
Punjab Barsati.
APAU Bagyamathi.
Azad Kranti.
Punjab Neelum.
KKM 1.

Jamuni Gola.
APAU Gulabi.
Aruna.
Kt 4.
Pusa Anmol.
Arka Navneeth.
MHB-1.
MHB-9.
MHB-20 (Kalpatharu).
Pusa Hybrid-5.
Pusa Hybrid-6.
Azad Hybrid.
Hisar Shyamal (H8).

Season

May – June to October
December – January to May

Nursery

Equal quantity of sand and well decomposed farm yard manure are mixed with soil and raised beds of 60-75 cm width and of convenient length are prepared. These beds are treated with a solution of 100g of blue copper dissolved in 40 litres of water. About 380-400 g of seeds (treated with 2g. of Thiram) required to raise seedlings to plant one hectare will be sown in an area of 4 cents nursery. The seeds are sown in lines drawn at a spacing of 5 cm across the beds and covered with top soil. The beds are covered by a layer of paddy straw or dried grass and then watered by rose can. BHC 10% dust has to be applied around these beds to prevent the ants from taking away the seeds. Seeds germinate in 5-7 days. The seedlings are ready for transplanting in 40-50 days.

Preparation of the Main Field and Planting

The field is prepared by ploughing four or five times. At the last ploughing, 25 tonnes of farm yard manure is applied. Ridges and furrows are formed at a spacing of 75 cm. Two kg in each of Azospirillum and Phosphobacteria can be mixed with 40 kg of sieved farm yard manure and applied evenly for one hectare.

Manures and Manuring

1. Basal Dressing:

a. 50 kg of Nitrogen (110 kg of urea) / ha
b. 50 kg of phosphorus (300 kg of Super phosphate) / ha
c. 50 kg of Potash (80 kg muriate of potash / ha.

The fertilizer is to be mixed and applied along one side of the ridges as band and mixed with the soil. Then the field is sprayed with a pre-emergent weedicide such as fluchloralin 1 lit a.i. (Basalin 2 lit. dissolved in 500 lit. of water and used to spray one hectare). Immediately the field is irrigated and the seedlings are planted at a spacing of 50 cm on the side of the ridges where the fertilizers have been placed. Life irrigation is given on the third day of planting. Then the irrigation is done once in a week.

2. Top Dressing: Forty days after transplanting, 50 kg of nitrogen is applied in the form of urea (110 kg of urea) as a band application 5-10 cm away from the seedlings and mixed with the soil. The plants are earthed up and irrigated.

Plant Protection

Fifteen days after transplanting, Temik granules are applied in small holes formed by using a wooden stick 5 cm away from the seedlings and covered with the soil. The field is irrigated immediately after the application of granular pesticides. This should be followed by fortnightly application of endosulfan (1.5 ml / lit.) alternated by sevin 50% WP @ 2 g. / lit. to control shoot and fruit borer (*Leucinodes arbonalis*) and ash weevil which are the major pests of brinjal. White fly is another serious problem especially in the summer season crop. To control the white fly, application of chlorpyriphos 2.5 ml + neem 2 ml dissolved in 1 lit. of water is recommended.

Little leaf is a disease supposed to be caused by mycoplasma like organism. The affected plants will be highly stunted in growth and will start producing very small dissected leaves. The plants will be sterile without producing flowers. The infected plants should be immediately pulled out and burnt.

Root rot caused by Phomopsis can be controlled by drenching Brassicol solution (100 g / 100 lit. of water).

To manage the nematodes viz., both root-knot (*Meloidogyne incognita*) and reniform (*Rotylenchulus reniformis*), inoculation of mycorrhizae (*Glomus mossae / G.fasciculatum*) and nematophagous fungus (*Paecilomyces lilacinus* or *Verticillum chlamydosporium*) spores in the nursery bed in addition to incorporation of neem cake / caster cake / neem leaf / calotropis leaf @ 400 g / m^2 and dipping the colonized seedlings in 5% aqueous suspension of neem leaf mixed with spores of *Paecilomyces lilacinus* or *V.chlamydosporium* for 20-30 minutes before transplanting is recommended by IIHR, Bangalore.

Harvest

The first harvest starts from 55-60 days after transplanting. The fruits should be harvested at right maturity depending upon the variety and market preference. Harvest can be made once in 5 days. The yield ranges from 20-35 tonnes / ha. Depending upon the variety.

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Ocean Farming: New Realm of Smart & Innovative Agriculture

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Introduction

Agriculture and associated industries are undergoing radical and tangible transformations at the global front. It is high time we understand this inevitable transformation and take necessary steps to keep up with the global pace of structural shift in agriculture. The reasons for such a transformation in agriculture can be discussed under three heads. Firstly, the incessant growth of human population across the world will indeed take us to 10 billion people by 2050 (United Nations, 2019) and pandemics like COVID-19 has already created significant disruptions to the global food supply chain. Secondly, global climate change driven by the large carbon foot print of global agriculture in terms of indiscriminate fertilizer and pesticide usage, fresh water mining, deforestation, land degradation, soil fertility degradation and excessive mono-cropping is another factor leading to this transition. Thirdly, this structural agricultural transformation is also being enabled by the novel scientific technologies like nano-fertilizers, precision farming, vertical farming, drones, robotics, satellites, big data, automatic farm machineries and machine learning.

Figure 1. Virtual representation of floating agriculture offshore as a part of ocean farming (Source: Forbes magazine 2020).

Presently, 11% of global land area is used for agricultural production. However, these accounts to only 3 % of the total global surface area. Ocean farming is a concept that opens up 70 % of the world's surface that has traditionally not been used for agricultural production. The scientific adoption of ocean farming also has the larger potential to address food, nutritional security and global climate change (Figure 1). India has a coastline of 7516.6 km viz.; 5422.6 km of mainland coastline and 1197 km of Indian islands spread across 9 Indian states and two Union Territories and has an Exclusive Economic Zone (EEZ) of 2.17 million km2 (equal to 66% of total mainland area) (Sathish et al. 2018). Indian coastal regions are of rich biological productivity and diversity and hence are always hub to extensive human activities. Indian ocean is a source of protein endowed with diverse species fish, sea weeds and many other flora and fauna which, also, are raw materials to hundreds of drugs, cosmetics and household products. Moreover, we have many host ports which are centers of international trade and commerce. Our fish stocks have been reported to be decreasing (90 % in 1974 to 65 % in 2017) due to indiscriminate and unscientific fishing. So, there is an urgent need to exploit other alternative protein sources from our ocean and also consider rehabilitating our poor fisherman community who completely depends up on fish as the primary source of income. Artificial fish farming is one option which has been taken up by many but has its own challenges. Thus, sea weeds and edible halophytes serve as potential alternative sustainable protein sources.

Major Source of Alternative Protein from Ocean in India

Sea weeds: Sea weeds are an integral component of coastal ecosystems that lend invaluable support to the diverse marine life. The economic value of these sea weeds is of significant importance to the resource poor farmers of coastal areas. They are used as a food, feed, but more importantly the phycocolloids derived from it is of significant export value. They are also extensively investigated for their application in bio fuel, neutracuticals, medicines and as food additives. India is home to 844 species of sea weeds out of which 366 species are found along Gujarat and Tamilnadu coasts. The uniqueness of Indian seaweed industry as compared to other south east Asian countries is that it relies heavily on wild harvest for phycocolloid production (Ganeshan et al. 2019). *Gelidiella acerosa and Gracilaria edulis* are two major species harvested for agar production while *Sargassum* spp. and *Turbinaria* spp. are the used for alginate production. The wild harvest is followed by drying on the sea shore and supply to industrial buyers. *Gelidiella* fetches up to 1800 $ USD per dried tonne, while *Sargassum* and *Turbinaria* spp. fetches up to 800 $ USD per dried tone. Considering this success model, more and more sea weed species of economic importance can be brought to cultivation/harvest along the highly rich coastal line of India. Among the Indian coast areas, southeast is preferably the best for seaweed cultivation as it has flat, shallow and wide coastal shore with medium wave action and abundant source of nitrogen and phosphorous. Moreover, the temperature and salinity range are optimal in these coasts making them perfect candidates for year-round cultivation of sea weeds except during the monsoon. All the raw materials required for sea weed cultivation like, bamboo, rope and anchors are also readily available at these sites. It has tremendous potential as a livelihood source to the fisher women group as well which will eventually lead to better social and economic sustenance of these fisherman families.

Halophytes: Another potential source of plant protein from ocean/coastal lines of India is the obligate halophyte *Salicornia* spp. It is commonly found at the edges of wetlands, marshes, sea shores, and mudflats. It is commonly called as pickleweed, glasswort, sea beans and sea asparagus across India. Some species of *Salicornia* can even tolerate and complete its life cycle under 3 % NaCl. In India, this halophyte has been used as an edible crop as well as for non-edible purposes. This plant was a source of soda for glass manufacture since time immemorial. *Salicornia brachiata,* a leafless shrub, was indeed the first source of salt produced from plants in 2003 by Council of Scientific and Industrial Research (CSIR) - Central Salt and Marine Chemicals Research Institute (CSMCRI), Gujarat, India. This vegetable salt, unlike common salt, contains salts of potassium, calcium, magnesium and iron. On farm trials have shown that it has the potential to produce 3-4 tonns of vegetable salt/hectare which can fetch a market of Rs 10-12 per Kg to the resource poor farmers of coastal tracts. Public private partnership-based salt product named "*Saloni*" was also developed on a commercial scale in Gujarat (Jha et al. 2012).

Low content of seed sodium makes it a very good source for human heart, apart from its other medicinal properties against diabetes, asthma, hepatitis, gastroenteritis and cancer. Moreover, the edible oil from its seeds is rich in poly unsaturated fatty acids and similar to safflower in fatty acid profile. It is also used as a green salad in the western areas of India. Antibacterial, antitubercular and antioxidant activities of *Salicornia brachiata* has been previously reported. It is very popular and commonly used by villagers of western and eastern coast as an animal fodder, herbal salt and as a source of oil, while the ash of the whole plant has been reported to be useful in itch treatment. Most recently, prolific study on its polysaccharides and other phytochemical profile for phenolic compounds, oils, proteins, flavanoids, sterols, saponins, alkaloids and tannins are under way and shows promising results. The oligosaccharide profiling of Indian species *Salicornia brachiata* was performed and the results showed this plant to be rich source of dietary supplements. The ecological benefits of large-scale cultivation of this plant along the coasts of India may be summarized as utilization of barren saline lands, up scaling of green belt, coastal development and protection and biodiversity conservation. Finally, the economic benefits are vast export income and private industrial and institutional collaboration. Given these myriad merits, this halophyte needs special mention. Another matter of pride for Indian Council of Agricultural Research (ICAR) is the endorsement of ICAR-CIFT (Central Institute of Fisheries Technology) by world health organization (WHO) to fight COVID-19 pandemic. The research group proposed that sulphated polysaccharide from seaweed can be a potent molecule to fight against the COVID-19 Pandemic, hence, is a candidate molecule to be studied against SARS-CoV-2 (Jha et al. 2020). With continuous marine exploration, there is every possibility of discovering of a lot more flora from the ocean that had been traditionally overlooked but could now be ideal candidates as edible crops. Therefore, identifying such potential plants and cultivating them on a commercial basis could altogether open up new avenues in Indian agricultural system. However, extreme care must be taken to prevent unscientific and over intensive harvest or cultivation and ensuring environmental sustenance.

Under Ocean Agriculture

A group of entrepreneurs have initiated the cultivation of crops on the surface or bottom of the ocean in the United States of America. An Italian scuba diving company initiated a project entitled "Nemo Garden Project" in 2012 and has been experimenting since then by growing crops like basil, strawberries, orchids and lentils in specialized structures in the ocean floor. In this regard, specialized high end autonomous aquaculture equipments have been developed by various research groups across USA, Canada and Italy, thereby helping to define this new concept of ocean farming. Experiments are underway to even test the resilience of rice to the oceans saline conditions and to develop the right machinery that can even stand the frequent storms. The possibility of cultivation of rice on ocean serves the dual purpose of addressing global food crisis and also acts as a source of "blue carbon" as it absorbs both atmospheric and oceanic CO_2.

Conclusion

The most important ecological advantage of ocean farming is the source of blue carbon. It is estimated that one third of all anthropogenic carbon emissions are absorbed by ocean. This amount is increasing very fast as a result of atmospheric saturation. In turn, the ocean is becoming more and more acidic, which adversely affects marine life. Another alarming fact is that the heat trapped in the top ten feet of ocean is more than the entire atmosphere. So, innovative technologies like ocean farming have enormous potential to safely extract this excess carbon for productive purposes and thereby save our ocean. One has to be very careful while implementing such projects on the ocean. It should not negatively affect the marine ecosystem and all precautions have to be taken to prevent any kind of leakage of inputs which can cause damage to the ecosystem of many marine lives. However, there is a long way to go before this technology becomes mainstream. One thing is sure that the idea of floating crop islands and oceanic bottom cultivation offshore is highly innovative and has the potential to complement inland agriculture in future.

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Moth Bean *(Vigna aconitifolia)*: A Gift from Desert for the Healthy Body

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Summary
Moth bean *(Vigna aconitifolia)* commonly known as moth, matki is cultivated in arid regions of Indian sub-continent. Moth bean is rich source of vitamins, minerals, and vital nutritional components and has tremendous health benefits. This article covers the varied health benefit of moth bean.

Introduction
According to world health organization about 54 percent child mortality is a result of malnourished diet, affecting more than 1 million children worldwide either in severe or moderate form of malnutrition. Minor pulses like moth bean with tremendous nutritional and pharmaceutical potential can effectively bring food security and sustainability. Moth bean is cultivated in arid regions of Indo-Pak subcontinent and mostly in states like Rajasthan, Gujarat, Haryana and Maharashtra. Rajasthan solely cultivates about 85% of moth bean produce in India. It contains a whole lot of vitamins, minerals, and vital nutritional components. It is a cheap vegetable protein source and can help to combat nutritional deficiency. Moth bean is consumed as dal, dal muthia, dal moth, bhujiya and sprout. In India, moth bean dal is used for preparation of traditional products like papad, khheechada and sandge.

Medicinal Property
Moth bean seeds have substantial medicinal properties and being used since ages to alleviate various health conditions. It is antipyretic in nature and therefore advised to person suffering from fever. It is also helpful in reducing bleeding disorder and burning sensation. Moth bean is used to prepare popular arid region dish kheech, which has anti- acidic and cooling effect. Moth bean sprouts have high amount of ascorbic acid (good source of vitamin C). Poultice made from its powder has been used by local tribes in treating abscesses (confinement of pus).

Healthy Heart
Protein concentrate extracted from moth bean seeds have hypocholesterolemic effect. It significantly lowers serum levels of triglycerides, total lipids, total cholesterol, low density lipoprotein (LDL) bad cholesterol and increases high density lipoprotein (HDL) (good cholesterol) (Saravanan and Ignacimuthu, 2015). Moth bean have antiatherogenic (prevent an abnormal fatty deposit in an artery) effect. It has bile acid binding ability, cholesterol-lowering and atherosclerosis amelioration (Mayilvaga et al., 2003).

Anti-Cancer
Trypsin inhibitors extracted from moth bean has been shown to have tumor cell-specific activity. Trypsin inhibitor exhibits antiproliferative activity against lymphoma MBL2 cells (Ma et al., 2010).

Strong Bone
Moth bean have high calcium content and aids in providing daily dose of calcium required for healthy body. Calcium is needed for healthy and strong bones, protects against osteoporosis, colon cancer and kidney stones. Moth bean have fair amount of phosphorus, phosphorus strengthens bones.

Energy Booster
Moth bean is loaded with essential nutrients needed to convert food into fuel. It is low in fat and keeps you energetic. Moth bean is rich with vitamin B which plays a vital role in maintaining healthy body equilibrium, body energy level and brain functioning.

Lower Stress

Moth bean have considerable amount of zinc which is known for antioxidant properties which helps to control oxidative stress. Zinc plays important role in immune responses like phagocytosis, cytokine production and intracellular killing.

Easy Bowel Moment

Fiber rich moth bean diet helps in easy bowel moment. Its' protein digestibility is low therefore adds bulk to stool and helps in maintaining healthy gut. Moth bean tannins are known to participate in treating ulcerative colitis (inflammation and ulcers in digestive tract).

Weight Loss

Moth bean sprouts is popular and ideal diet for weight loss as it is high in fiber and low in fat. It enhances metabolic rate and help in burning of calories. Moth bean consumption results in decreases body mass index (BMI), reduces waist circumference and reduces risk of obesity. Moth bean aids in increasing of muscle mass.

Anti-Inflammatory

Inflammatory reactions are responsible for various diseases like metabolic syndrome, cancer, and autoimmune diseases. Trypsin inhibitors present in moth bean have potent anti-inflammatory properties (Singh et al., 2018).

Antidote

Moth bean is shown to have antidote activity against acute lead poisoning.

Antioxidant Activity

Oxidation produces free radicals which results in to reactions leading to cell damage. Free radicals are responsible for various diseases like cancer, cardiovascular disease, aging, neural disorders, Alzheimer's disease, Parkinson's disease. Raw seeds of moth bean have tremendous amount of phenolics and tannins having antioxidant activity. Moth bean pod coat also has good number of natural antioxidants (Rajendran et.al., 2017).

Antimicrobial

Moth bean also has antimicrobial activity against bacterial and fungal pathogens which is largely attributed to flavonoids like kaempferol and quercetin (Tyagi et al., 2004). Quercetin and kaempferol seems to act synergistically in reducing cell proliferation of cancerous cells.

Neurodegenerative Disease

Protease inhibitors are very effective against accumulation and aggregation of abnormal proteins. These misfolded proteins have been known to cause various neurodegenerative diseases like Huntington's disease, Alzheimer's disease, Parkinson's disease and amyo-trophic lateral sclerosis (ALS). Moth beans have good sum of protease inhibitors and thus having activity against malfunctioning proteins responsible for various neurodegenerative diseases. Moth bean reported to have L-Dopa. L-Dopa is choice of drug for the treatment of Parkinson's disease which is characterized by difficulty in walking, difficulty in establishing balance, muscular rigidity, bradykinesia, depression and dementia (Kuber et.al., 2007).

Edible / Biodegradable Films

Moth bean starch films with promising functional properties can enhance the shelf life of fresh lemon up to 12 days. Moth bean starch is a potent natural source of starch which can be utilized for various purposes in the food applications as texture agent, stabilizer and bulking agent (Kumar et al., 2019).

Cosmetics and Pharmaceutical

Moth bean extract alt-retinol is very cheap, safe and herbal alternative for synthetic cosmetics. It has anti-ageing properties; it reduces wrinkles, fine lines, brightens skin tone (anti- melanin), protects against environmental damage, and also prevents premature aging and increase skin firmness. Antioxidants like caffeic acid, ferulic acid, cinnamic acid and kaempferol helps in skin repair mechanism and increases functionality of dermal and epidermal layers of skin. This extract has shown to encourage cellular renewal caused by UV induced DNA damage.

Other Uses

Considering its nutritional value moth bean flour is added in soup preparation, confectionary items, noodles and different snacks. Moth bean snacks like bhujia, papad, mogar and nuggets-based industry has given opportunity to provide employment to rural masses of arid region and further boosting economy of regions like Bikaner. Vidarbha is tropical and rural region of Maharashtra suffering from protein calorie malnourishment. Use of Moth bean based chakli (local fried snack of Maharashtra) has been formulated to fight back malnourishment in this area (Gawande and Rajwade, 2014). The National Bureau of Plant Genetic Resources (India) conserve more than 1500 germplasm accessions of moth bean representing its diversity across Indian subcontinent.

Conclusion

Moth bean is desert's gifts with enormous health benefit for humankind. Amid changing climatic conditions, an energy efficient crop like moth bean is the best suited for practicing sustainable agriculture. Inclusion of Moth bean in our diet will make our food basket more healthy, diverse and dynamic.

(**Note**: The content in the article is generic and for knowledge purpose only. It should not be considered as substitute for the qualified medical opinion. It is advised to consult the qualified medical professional or dietician for any nutritional intervention in the treatment of any disease condition).

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Laser Land Leveller

Article ID: 11360

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Introduction

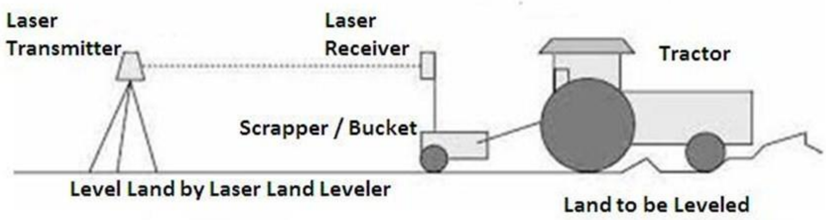
Precision land levelling is the foremost step for judicious use of water. Negative environmental effects related to irrigation are overexploitation of groundwater and poor water management which is leading into dropping of water tables in some areas. Declining water table and degrading soil health are the major concerns for the current growth rate and sustainability of Indian agriculture to arrest this trend of ground water exploitation, there is an urgent need to conserve irrigation water through various on- farm water conservation practices. Land Levelling through Laser leveller is one such proven technology that is highly useful in conservation of irrigation water.

Why Laser Levelling?

Uneven soil surface has a major impact on the germination, stand, and yield of crops due to nonhomogeneous water distribution and soil moisture. A significant amount of irrigation water is lost during its application in the farm due to poor farm designing and uneven fields. Fields that are not levelled properly, have uneven crop stands, increased weed burden and uneven level of maturity in crops. All these factors lead to reduced yield & poor grain quality. Laser land leveller is one such device which could promote efficient utilization of water.

What is Laser Levelling?

Laser levelling is a laser guided precision levelling technique used for achieving very fine levelling with desired grade on the agricultural field. The Laser-controller system consist of a laser transmitter on tripod, a laser receiver on bucket/scrapper, survey receiver for prediction about flat land adjustment, an electrical control panel and a twin hydraulic control valve. A laser transmitter unit that constantly emits 360° rotating beam parallel to the required field plane and is used as the reference datum by the laser receiver mounted on the levelling bucket. The control panel mounted on the tractor interprets the single from the receiver and opens or closes the hydraulic control valve, which raises or lowers the bucket. Levelling requires soil to be shifted from the high points of the field to the low points in the most cost-effective way. Both level grade and slope grade (one way or two way) can be achieved with the help of this precision equipment.



Benefits of Laser Land Levelling

1. Enhances water application efficiency.
2. Precise level, smoother soil surface & better top soil management.
3. Uniform moisture environment for crops.
4. Heavy savings in labor cost and efforts of hiring.
5. Reduced weed in the field.
6. Assist top soil management.
7. Saves fuel/electricity used in irrigation.
8. Better crop stand due to even application of fertilizers and other inputs resulting improvement in crop yield by 5 to 10%.

Conclusions

By using laser levelling farmer can achieve optimized water use efficiency, better crop establishment, less time and water required in irrigation, less effort in crop management. Thus, there is an urgent need to promote the use of laser land levelling. The problem in adopting this technology is, it is very costly for the marginal and small farmers, to overcome this problem government should provide the laser guided leveller machine to farmers at nominal rent either through custom hiring centers or agriculture departments.

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Modern Plant Breeding Methods – A Sustainable Way to Ensure Food Security in COVID-19

Article ID: 11361

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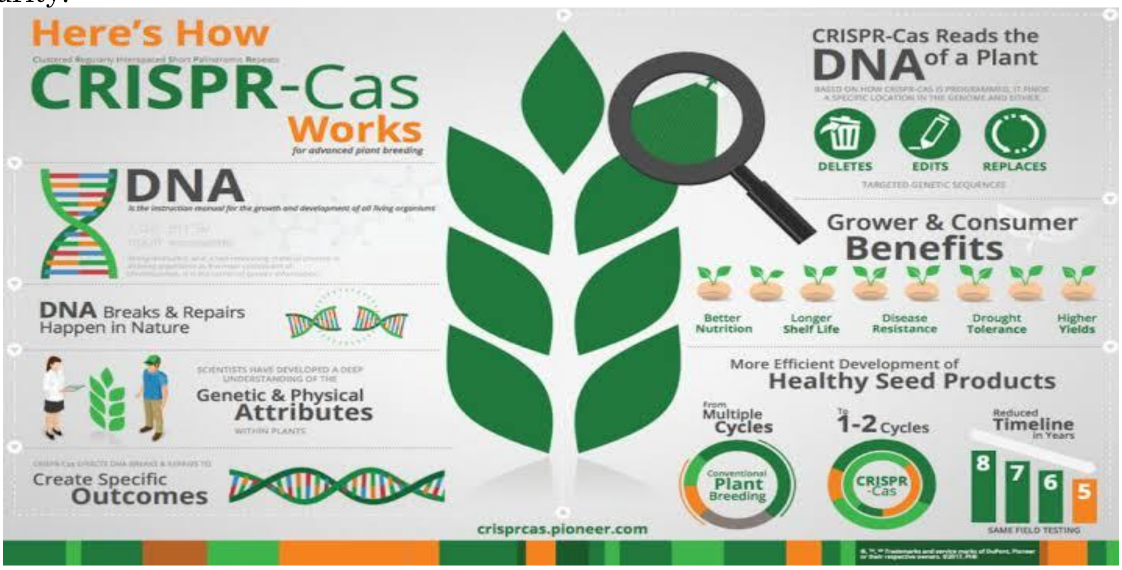
The COVID-19 or Corona virus disease came in 2019 is a novel respiratory syndrome that exist in humans specially in lungs. With the identification of first case in Wuhan, China, the disease has now spread worldwide, leading to an ongoing pandemic. With the increasing severity of this disease, impact on agriculture sector has been shown clearly. The lockdown shutdowns all the agriculture operations from seed production to marketing, which results in shortage of food grains and other agriculture products. An increasing number of states in India are facing growing levels of acute food insecurity. COVID-19 impacts have led to severe and widespread increases in global food insecurity, affecting vulnerable households in almost every state which continues through 2022. According to a survey report by FAO, global food prices have risen by 40% since January 2020. Many agricultural crop prices were rising very rapidly. Increased prices create strong demand along with weather uncertainties. This prevailing situation can only be recovered from sustained improvement in agricultural productivity. In this context modern plant breeding methods like genome editing will be able to contribute substantiality to food security. Conventional methods of plant breeding like cross pollination were successful in improving productivity, but the introduction of GM Crops has led to higher yield, pest and disease resistant crops. Moreover, the technology has adopted wide apart, but still many economies were avoided this technique because of perceived risk. Meanwhile the emergence of new plant breeding techniques may allay fears related to GM crops and sustain the population with secured and plentiful food supply. The advancement in genome editing alters the endogenous genes to improve characters in crops avoiding the transfer of transgenes. In addition, CRISPR-Cas has recently emerged one of the important systems which allows crop genome to edit, with recent results of increasing productivity in rice, wheat and maize. Although genome editing due to its low cost, finds its uses in improvement of staple crops, fruits and vegetables which fulfils the basic requirement of any individual.

Another example is Water Efficient Maize for Africa (WEMA) which is project in which drought tolerant varieties were produced to make them available to small farmers with an intention of fulfilling the potential for food security.



As the technology in plant breeding moves on expanding in exiting ways, Rapid generation advance (RGA) and single seed descent were part of it. Both of the technology minimizes the crop cycle for research on breeding, selects and fixes useful genes. This approach is already contributing maximum for the improvement of various grain crops. The development of these genomic selection which uses genotyping and imputation has also become popular.

In this pandemic era where food supply is must, the production of the crops goes down so far. Ensuring food security to one and all is on the priority. Since cereals are the cheapest source of calories which is the prime requirement of present condition and in order to full fill it, Modern Plant Breeding Techniques emerged out to be the best and sustainable option to ensure food security. These foremost breeding technologies speed up the breeding of new traits and help to modify plants to produce higher yield thus enabling food security. All the New Plant Breeding Technologies paved to increase food production while being more Environmentally-Friendly. Extending the scope of these technologies will definitely come up with positive result and cope up with this pandemic by maintaining healthy and sustainable food security to one and all.

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Permaculture – A Revival of Natural Agriculture

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Many people who are new to small-scale organic farming come in with a lot of expectations and assumptions on how things are going to be. The romantic idea of living off the land and farming within a sustainable community has lured them closer to taking action and getting something going, whether it is a small farm, an off-grid homestead or perhaps just an ambitious garden.

Permaculture is a term used to describe an intentional system of agriculture and settlement that aims to reflect the interrelationships and sustainability of natural ecosystems. Permaculture can be seen in contrast to intensive agriculture, which eventually leaves land unfit for farming, gradually reducing the amount of land suitable for human habitation. Permaculture is an attempt to best use land so that generations in the future can continue to make use of the land in productive manners, allowing for personal subsistence. It draws from several disciplines including organic farming, agro-forestry, integrated farming, sustainable development, and applied ecology.

The term permaculture was coined in 1978 by Bill Mollison, senior lecturer in Environmental Psychology at University of Tasmania, and David Holmgren, then a graduate student at the Tasmanian College of Advanced Education's Department of Environmental Design, who are dedicated to the sustainable use of land. Although they were the first to use the word, the ideals of permaculture in the modern sense have been around since at least the early part of the 20th century, and the practices that make up the core of permaculture date back thousands of years.

At its most basic, permaculture is just a form of agriculture that can be practiced forever. Industrial farming techniques are seen as inherently limited, with an eventual wall past which a piece of land can no longer be used. High-density crops and the use of single crops over large expanses of lands strips away necessary nutrients as generations pass, eventually leaving the land barren. At the same time, artificial fertilizers can build up salts over time, making the soil inhospitable to plants.

Permaculture tries to look at a piece of land in a holistic manner, integrating every animal and plant living on it, and combining that with social structures designed to foster long-lasting agriculture as well. Each element of a food cycle is broken down into what it requires and what it contributes, and then each element is pieced together to form a dynamically self-supporting whole.

Permaculture principles allow us to create a culture that can endure and thrive for generations to come. At its heart are three very simple tenets, or ethics:
1. Care for the planet.
2. Care for people.
3. Fair share (Which also involves returning surplus to the system).

They form the foundation for permaculture design and are also found in most traditional societies. At the same time, permaculture moves beyond simply being a mechanical set of principles for management of all cultures that can be used in designing sustainable systems. Here are twelve principles of permaculture as described by David Holmgren:

a. Observe and interact: Being observant and responding to what we see is really important in moving towards a more ethical and sustainable way of life. We can learn from nature and from other people, observing how others have moved to a greener and more ethical approach, and working with the world around us to succeed in our goals

b. Catch and store energy: Energy is abundant on our planet. Learning how to catch and store that energy – in plants, with renewable energy infrastructure, or in other ways, is key to living a sustainable way of life. Growing your own food at home is a great way to catch and store energy from our sun. Passive solar design also offers opportunities for architects, engineers and designers to make further use of this abundant energy source.

c. Obtain a yield: Ensure that you are getting truly useful rewards as part of the working you are doing

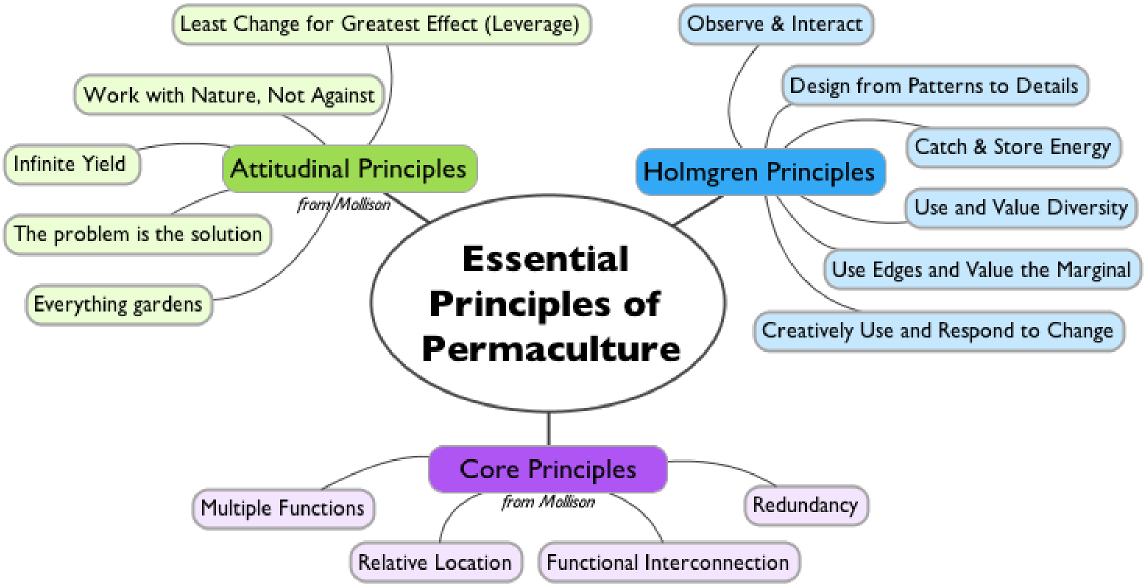
d. Apply self-regulation and accept feedback: We need to discourage inappropriate activity to ensure that systems can continue to function well.

e. Use and value renewable resources and services: Make the best use of nature's abundance to reduce our consumptive behavior and dependence on non-renewable resources.

f. Produce no waste: By valuing and making use of all the resources that are available to us, nothing goes to waste

g. Integrate rather than segregate: By putting the right things in the right place, relationships develop between those things and they work together to support each other.

h. Use and value diversity: Diversity reduces vulnerability to a variety of threats and takes advantage of the unique nature of the environment in which it resides.



As industrial food systems begin to appear threatened by a myriad of factors, from pests attacking monoculture crops to increased prices and dwindling supplies of the fossil fuels necessary to create industrial food and transport it, permaculture is gaining more and more support. Communities are looking to permaculture as a way to ensure not only that the land they are on will remain healthy well into the future, but that their food supply will be sustained even through potential global crises.

What COVID-19 can Teach Plant Breeders about Plant Disease Epidemics?

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First half of 2020 became the year where everyone (!) was forced to learn at least some basic processes of epidemiology of viruses. A field of academic study previously reserved to a limited population of pathology experts. So that is one productive take way from this strange year that is not wasted.

The behaviour of inoculum, droplet dispersal, the importance of hygiene and the effect of distancing hosts in time and space is now common knowledge even for pre-school children. Even how the small virus take advantage of our cell RNA and DNA replication structures to multiply itself. In plants virus attacks look like nutrition deficiency symptoms at first – and then with a mosaic look on the tissue.

Although primarily caused by fungi, plant diseases and plant epidemiology are not so different from those found in humans. We see outbreaks of disease strains that devastate crops. We see that some varieties respond better, with fewer symptoms, than others.

Being susceptible, or not, to disease attack is complex, when we consider plants. Susceptibility is known to be linked to the genetic profile mainly. But age, the nutritional status, and general stress levels of the individual plant and the plant sward are also important for the extent of the outbreak in the area.

Plant breeders can approach disease management by supplying the market with improved genetics, offering a preventive solution to disease management by identifying tolerant or even resistant individuals in the breeding population. If we find a susceptible host plant in the breeding program, we can choose to discard it. In humans there are ethics to navigate that make such selection unreasonable, and preventative measures are preferred. For example, vaccination. Curative measures such as fungicides for turf or antibiotics for bacterial diseases are harder to find for viruses because they mimic our own RNA and DNA (Klaus K. Nielsen, 2020).

Besides the genetic profile of a plant in the field the plant breeder can make some decisions that affect the degree of disease spread. These are factors breeder can play with when optimizing and tweaking management. One is to spread the host and pathogen in space and time. E.g., establish new sowing in the rabi, instead of the kharif/summer, so the plants are mature when kharif inoculum hits. Yup, same reason why distance is effective to break disease chains of COVID-19 between humans (Klaus K. Nielsen, 2020).

Another example is the fungal disease-causing red thread, (a disease found on lawns and other turfed areas in most of the cool climatic countries) (Buczacki and Harris, 1998) that is linked to low levels of nitrogen. But we know that a good practice is to remove the clippings of red thread infected turf and not leave them on the lawn: and that leads us to hygiene, another thing that we now know works to keep epidemics down. True for human pathology, true for plant pathology.

You may wonder; plants do not share fluids by kissing, coughing and touching like we know COVID-19 and other human virus does. How does virus spread in plant populations? Well, there are two ways that virus spread in plant populations. One is linked to clonal propagation of plant material. Potatoes, bananas and many other important crops, plus a lot of ornamental plants, are multiplied by using plant material, seed potato tubers and side shoots that are clones of the original plant, and not true seeds. True seeds are not usually transferring viruses, but the generations from seed are not as true to cultivar or as fast as to take fresh plant parts. This material, if infected, will give raise to a sub-optimal crop.

The other way is spread is via a vector – often an insect. Happily flying from plant to plant tasting the plant sap. A non-colonizing aphid like this is the vector of Potato Virus Y (Edwards, A.R., 1963). Spreading the virus in this tuber propagated crop; a most unfortunate combination. Had it only been a colonizing aphis the damage would be limited. Again, we can draw a parallel: if the infected individuals would just basically stay in one place that is the key to control.

Stay safe.

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Edible Mushrooms - Nutritional & Health Benefits

Article ID: 11364

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Introduction

Mushroom a fleshy, umbrella shaped fruiting body (sporophore) of a certain fungus typically belongs to the phylum Basidiomycota, order Agaricales and also of some other groups. Usually, the term mushroom is used for the edible sporophores and the term toadstool is often used for inedible or poisonous sporophores.

In present era, conscious about diet and health has been increasing day by day. Mushrooms are being considered as future vegetable for its`s nutritional and medicinal properties. Indian diet is primarily based on cereals, so meeting the food for increasing Indian population in the limited land resources is big challenge.

Also, wide spread of malnutrition and other associated diseases are more common among the financially weak population. Non-green resolution also known as mushroom farming is one of the alternative ways for meeting this challenge. These grow on wastes and can be cultivated without requiring extra land.

Different types of mushrooms commonly cultivated and consumed in India are:
1. Button Mushroom.
2. Straw mushroom.
3. Oyster mushroom.
4. Milky mushroom.
5. Shiitake mushroom.

Button Mushroom *(Agaricus bisporus)*

Agaricus bisporus commonly called as Button mushroom belongs to the family Agaricaceae of Basidiomycetes. It is the most important commercially cultivated mushroom variety in the world, we can find them in two colors (white and Brown) when these are white and immature they are called as common mushrooms/ white mushrooms/ Button mushrooms, when immature and brown they are called Swiss brown mushroom/ Roman brown mushroom or chestnut mushroom. It may provide support against malnutrition for its nutritional values.

Paddy Straw Mushrooms *(Volvariella volvacea)*

This belongs to the family Pluteaceae of Basidiomycetes. These mushrooms are famous in coastal states like west Bengal, Orissa, Tamilnadu, Andhra Pradesh and Kerala. These are famous for its taste, flavor, presence of higher protein content and can be cultivated in short period of time compared to other varieties.

Oyster Mushroom *(Pleurotus ostreatus)*

These are considered as nature`s hidden treasure, as they are ignored by many people. These mushrooms are considered safe to be consumed and can be cultivated easily. Research shows that they have full of therapeutic values alongside of nutritional values. The net protein content is higher making an alternative source of protein for vegetarians.

Milky Mushrooms *(Calocybe indica)*

It is a species from India. Milky mushrooms are robust, fleshy, milky white having long shelf life. These mushrooms can be well grown at room temperature and can be cultivated even on unfermented materials. Good point of this mushroom variety over other varieties are easy method of cultivation with less investment and short period of time with long shelf life and more nutritious.

Shiitake Mushroom *(Lentinula edodes)*

This mushroom is a saprophyte (lives on decaying organic matter), grows on dead forest hardwoods in the moist climate. The cultivation of this mushroom has been increasing because of its medicinal and nutritional properties. Analysis of this mushroom revealed that it contains numerous biologically active compounds, when used as a supplement can enhances patients wellbeing.

Nutritional Information of Mushrooms

Indian diet is primarily cereal based which is deficient in protein. Including mushroom recipes to Indian diet will bridge the gap of protein and improves overall health status. Mushroom is a complete food suitable for all age groups.

Mushrooms are rich in protein, dietary fiber, vitamins (B, C and D) and minerals (K, Na, P). These are low in calories and they do not have cholesterol. The carbohydrate profile of mushroom includes starches, hexose, pentose and di-saccharides. These contain ergosterol that acts as precursor of vitamin D in human body.

Nutritive values of different mushroom varieties (per 100g) are as follows.

Varieties	Energy (KCal)	CHO (g)	Protein (g)	Fat (g)	Fiber (g)
Button Mushroom	499	46.17	33.48	3.16	20.90
Paddy straw Mushroom	305	54.80	37.50	2.60	5.56
Oyster Mushroom	265	57.60	30.40	2.20	8.70
Milky white Mushroom	391	64.26	17.69	4.10	3.40
Shiitake Mushroom	387	47.60	32.93	3.73	28.80

Medicinal & Health Benefits of Mushrooms

Mushrooms are valued not only for their nutritional value but for its medical properties. It has antibiotic, anti-viral, anti-inflammatory, anti-diabetic, anti-microbial, anti-hyperlipidemia effect and also good source of anti-oxidants.

1. Improves Heart health: Mushrooms are low in fat content and no cholesterol, low calories. So, this will a good food for heart patient, also helps in treating cardiovascular diseases.

2. Control Blood Pressure: Mushrooms are suitable for the persons suffering with high blood pressure. These contain minimal sodium levels and rich potassium which enhances salt balance and maintains blood circulation.

3. Prevents Cancer: Studies shows that mushroom contains certain compounds restricting tumor activity. They are also capable of preventing prostate and breast cancers.

4. Good for Diabetic patients: As mushrooms are low in calories, little fat, no cholesterol this will be an ideal food for diabetic patients. The protein present in mushroom helps in burning cholesterol in the body and also helps in shredding the extra weight.

5. Strengthens Immunity: Mushrooms have ability to strengthen immune system. These contains antioxidants, polysaccharides (beta-glucans), Vitamins and minerals which helps in building immunity in the body. Specific antioxidants 'Ergothioneine' found in mushroom is necessary for maintain eye health, kidneys, liver and skin.

Conclusion

Mushrooms are delicious sources of food found all over the world. The consumption of mushroom is increasing day by day, as they have high nutrient content twice the number of vegetables and fruits. They have appreciable content of proteins, vitamins (B, C, D) and trace elements. Mushroom can be used as supplementary food item in Indian diet which is cereal based and deficient in protein, helps in bridging the protein gap and improve health of the population. Bringing awareness on mushroom cultivation, it`s nutritional and medicinal values, improves the livelihood through nutritional and economical contributions.

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A Success Story of Front-Line Demonstrations (FLDs) on Kharif Maize in Bundelkhand Region

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Introduction

The present study was undertaken to assess the performance of Front-Line Demonstrations (FLDs) under SCSP on maize was conducted at five villages of Bundelkhand region during kharif-2020. Total 40 SC farmers were selected on the basis of their socio-economic conditions. Front line demonstrations on maize were conducted from seasons Kharif-2020 at various farmers' field's locations under front line demonstration during this period 40 demonstrations were organized of 1 ha /each using short duration improved hybrids i.e., DHM-117 & DHM-121. The main objective of the FLDs to improve the socio-economic condition of the SC farmers in Bundelkhand region, increasing the maize cultivated area during kharif season in Bundelkhand region and also utilization of the kharif fellow land for cultivation of maize crop. Looking to the better performance of Front-Line Demonstration, farmers of the region were highly benefitted and satisfied with FLDs practice in comparison to their own traditional practices. The average yield of maize was recorded 12 quintals per hectare and 40 quintals per hectare from farmers practices and FLDs practices, respectively. The cost : benefit ratios from farmers & FLDs practices was 1.2 & 3.6, respectively.

Lack of suitable high yielding variety as well as poor knowledge about production practices are described as main reasons for low productivity of maize in the district. The Performance of front-line demonstrations on maize in Bundelkhand region productivity of maize per unit area could be increased by adopting recommended scientific and sustainable management practices using a suitable high yielding variety. Taking into account the above considerations, front line demonstrations were carried out in a systematic manner on farmers' field to show the worth of a new variety and convincing farmers to adopt improved production management practices of maize for enhancing productivity of maize.

Resources & Methodology

In the present study performance of improved technologies of maize against local check was evaluated through front-line demonstrations conducted at farmer's field during Kharif season of 2020. A total of 40 demonstrations were laid on 40 ha area in 05 villages namely; Pipra in Jhansi District of Uttar Pradesh, Punchampura, Kunwarpura & Daryan Kala in Tikamgarh District & Sanora in Datia District of Madhya Pradesh in Bundelkhand region during kharif-2020 under Schedule Caste Sub-plan (SCSP) which was funded by Indian Institute of Maize Research (IIMR), New Delhi, Sub-Campus, Punjab Agricultural University, Ludhiana, Punjab. The soils of the study area are mostly sandy loam to clay loam in texture with low nitrogen, medium phosphorus and high in available potassium. The improved technologies include improved varieties viz. DHM-117 and DMH-121, recommended dose of fertilizer and plant protection chemicals were supplied free of cost to the farmers. Crop was sown after receiving sufficient rainfall, between second week of June to last week of July will crop geometry of 60 x 20 cm and seed rate of 20 kg/ha. The total amount of phosphorus and potassium was applied as basal dose along with half dose of nitrogen and remaining dose of nitrogen was top dressed in two equal splits at 30 and 60 days after sowing. Hand weeding was done once at 20-30 days after sowing. The total number of 40 beneficiary farmers were associated under this SCSP programme for maximize the production and double your income as per the suggestions of our Hon'ble Prime Minister Shri Narendra Modi Ji. The FLDs techniques was used as "Hybrid vs. Commercial cultivars (local check)". The demonstration of improved technologies was taken in an area of 1.0 ha of each farmer. In each demonstration one control plot was kept where farmers practices were carried out. The critical inputs such as seed, fertilizers and pesticides were supplied to the farmers free of cost for demonstration purpose. Adoption of improved technology by the farmers and guidance was ensured through regular visits by the RLBCAU scientists to the demonstrations field. Field days and group meetings/ farmers training/ kisan gosthi were organized at the site of demonstration to provide the opportunities for other farmers to see the benefit of demonstrated technologies. The feedback from the farmers were utilized for further improvement in research and extension programme. The crop was harvested between first and second week of October. Data were collected from the FLD's farmers and analyzed with statistical tools to compare the performance of farmer's field and FLD's field. Total 40 Schedule Caste (SC) farmers were selected on the basis of their socio-economic conditions and also on the basis of their own choice for conducted Front Line Demonstrations (FLDs) on maize during kharif-2020 in Bundelkhand region.

Two high yielding single cross hybrids namely DHM-117 & DHM-121 were used for distribution of seed under FLDs on maize during kharif-2020 in Bundelkhand region. Both the hybrids are suitable for growing in Bundelkhand region, because these hybrids were released for zone-IV. The average yield of these hybrids is 45 q/ha. and mature in medium duration (90-100 days). Farmers was used a local commercial cultivar for grain production of kharif maize.



Table-1: Details of the average yield and cost : benefit ratios from FP & FLDs practices.

Sl. No.	Area (ha)	Average yield (q/ha)		Average net returns ('000 Rs/ha)		Average yield gains (%)	Average net return gain (Rs/ha)	Average Cost: Benefit ratio	
		FP	FLDs	FP	FLDs			FP	FLDs
1	1 ha	12	40	15,000	50,000	20-25	35,000	1.2	3.6

The significant average cost: benefit ratio of kharif maize production were recorded 1.2 & 3.6 from both farmers & FLDs practices, respectively. The significant differences were recorded from farmers practices and FLDs practices in several points such as variety, seed rate, seed treatment, time of sowing, method of sowing, fertilizers management, water management, plant protection, threshing, harvesting & marketing, etc.

Conducted Farmers Training Under FLDs on Maize During Kharif-2020

Total 12 farmers trainings has been conducted in 10 selected villages of District Lalitpur (Dhovalkheri, Pachoni & Varkheeria), Datia (Sanora), Tikamgarh (Kunwarpura & Punchanpura) & Jhansi (Roniza, Lakara, Parbai & Dikauli) from both the states Uttar Pradesh & Madhya Pradesh of Bundelkhand region.

150 farmers were benefitted from each villages & total 1500 farmers were benefitted from the training programme.

Conclusion and Way Forward

The Farmers with or without resources keep their land fallow in Kharif and cultivate wheat, gram, linseed and lantil in Rabi. Here we found Kharif Maize a promise crop to increase Cropping intensity in Bundelkhand region. With majority of Scheduled Castes population living in villages under studied area were economically isolated. Those were below poverty line and their livelihood dependant solely on agriculture and livestock rearing the SCSP Plan seems to be boon for uplifting their status.

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Strategies to Enhance Seed Setting and Oil Content in Groundnut and Sunflower

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India is the largest producer of oil seeds in the world and this sector occupies an important position in the agricultural economy of the country. Oil seeds are major crops that are grown in the country apart from cereals. In terms of acreage, production and economic value, these crops are second only to food grains. Oil seeds are rich source of energy and nutrition. The proteins present in some oil seeds and their cakes are edible to humans while the others are useful as animal feeds. Oil seeds also contain carbohydrates, vitamins and minerals. When it comes to the problems of oilseed production, obviously it differs from one crop (oil seed crop) to another and one region to another. By following certain strategies, the seed and oil yield can be enhanced there by achieving the target level.

Importance of Oil Seeds

1. Oil seeds are rich sources of energy and nutrition.
2. The oils and fats present in them are useful as food fats and industrial raw material.
3. The proteins present in some oilseeds and their cakes are edible to humans while the others are useful as animal feeds.
4. Oil seeds also contain carbohydrates, vitamins and minerals.
5. Oil seeds and oil seed meals have an important role in relieving the malnutrition and calorie nutrition of human and animal population.
6. In addition, the vegetable oils are useful as lubricants, surface coatings, cosmetics and as raw material for various industrial products.
7. India has a wide array of oil crops under cultivation in different areas and seasons.
8. The most important annual oil crops are groundnuts, rapeseed-mustard, sesame, sunflower, safflower, soybean, niger, castor and linseed.

Important Oil Seeds Crops

Edible oil seeds: Groundnut, sunflower, rapeseed-mustard, soybean, sesame, safflower Niger.

Non- edible oil seeds: Linseed and Castor.

Groundnut: The groundnut or peanut is one of the important legume crops of tropical and semiarid tropical countries, where it provides a major source of edible oil and vegetable protein. Groundnut kernels contain 47-53% oil and 25-36% protein. The crop is cultivated between 40°N to 40°S of the equator. Groundnut is a self-pollinated crop whereby flowers are produced above ground and, after fertilization, pegs move towards the soil, and seed-containing pods are formed and developed underneath the soil. The productivity of groundnuts varies from 3500 kg/ha in the United States of America to 2500 kg/ha in South America, 1600 kg/ha in Asia, and less than 800 kg/ha in Africa. This is due mainly to various abiotic and biotic constraints. Abiotic stresses of prime importance include temperature extremes, drought stress, soil factors such as alkalinity, poor soil fertility and nutrient deficiencies. Groundnuts grow best in light textured sandy loam soils with neutral pH. Optimum temperature for their growth and development ranges from 28 to 30 °C; the crop requires about 500-600 mm of well distributed rainfall.

The main yield limiting factors in semiarid regions are drought and high temperature stress. The stages of reproductive development prior to flowering, at flowering and at early pod development, are particularly sensitive to these constraints. Apart from N, P and K, other nutrient deficiencies causing significant yield losses are Ca, Fe and B. Biotic stresses mainly include pests, diseases and weeds. Among insects' pests pod borers, aphids and mites are of importance. The most important diseases are leaf spots, rusts and the toxin-producing fungus Aspergillus.

Utilization

Groundnut is an important subsistence food crop throughout the tropics. It is mainly grown for the kernels and the edible oil and meal derived from them, and the vegetative residue. Groundnut kernels typically contain 47-53% oil and 25-36% protein; they also contain about 10-15% carbohydrate and are rich in P; they are also a good source of vitamins B and E.

Groundnuts are used in various forms, which include groundnut oil, roasted, and salted groundnut, boiled or raw groundnut or as paste popularly known as groundnut (or peanut) butter. The tender leaves are used in certain parts of West Africa as a vegetable in soups. Groundnut oil is the most important product of the crop, which is used for both domestic and industrial purposes. About 75% of the world groundnut production is used in extraction of edible oil.

Groundnut oil is the cheapest and most extensively used vegetable oil in India. It is used mainly for cooking, for margarine and vegetable ghee, salads, for deep-frying, for shortening in pastries and bread, for pharmaceutical and cosmetic products, as a lubricant and emulsion for insecticides and as a fuel for diesel engines. The press cake containing 40-50% protein is used mainly as a high-protein livestock feed and as a fertilizer.

Strategies to Enhance Seed Setting and Oil Content

1. Time of sowing: The maturation and harvesting period should not coincide with the rainy season, if it coincides with the rains in-situ germination of pods will take place.
2. Weeding should not be done after 45 days as it may interrupt peg elongation and pod formation.
3. Inter cultivation operations: Inter cultivation operations have to be started as soon as the rows of groundnut seedling are visible and repeat at regular intervals till 45 days. Shallow inter cultivation is adequate.
4. Earthing up should be done simultaneously with intercultural operations (40 days). Earthing facilitates Maximum penetration of pegs and provides a larger spreading area.
5. Apply gypsum @ 80 kg/ acre (200 kg/ha) during earthing up to facilitate peg penetration and to obtain good oil content.
6. Spraying of nutrient solution: pod filling is a major problem especially in the bold seeded verities, to improve pod filling spraying of nutrient solution is to be given.

Sunflower

Sunflower (*Helianthus annuus* L) is the second important source of vegetable oil in the world, after soybean. In India it is mostly grown in the states of Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu with potential scope of growing in non-traditional areas like West Bengal. In West Bengal sunflower is second important oilseed crop after rapeseed mustard during rabi (winter) season. Sunflower being a photoperiod neutral crop has wide scope to bring additional areas of rice fallows. Sunflower was introduced in India during 1969 and to start with four Russian varieties and one Canadian variety were evaluated in various parts of the country. The commercial cultivation of this crop started in 1972. Presently, the crop is cultivated in an area of 20.7 L. hectares with a production of 12.5 L. tonnes. The crop is fourth most important oilseed crop in the country after groundnut, rapeseed-mustard and soybean. The phenomenal increase in area and production of sunflower in the country since its introduction is due to following merits of the crop.

Importance of the Crop

1. Wide adaptability or wide-ranging agro climatic conditions and soil type.
2. Short duration (90-100 days) which enables fitting in different cropping systems.
3. Photo-insensitivity which enables its cultivation in rainy, post-rainy and spring/summer seasons.
4. Availability of varieties/hybrids with diverse duration and high yield potential which enables the crop to fit into multiple and intercropping systems.
5. Easy cultivation and crop management.
6. High seed multiplication ratio of more than 1:80. Drought tolerance and the ability to revive rapidly after prolonged period of drought.
7. Ideal crop for contingency plans. Remunerative market price.
8. Good quality oil with high polyunsaturated fatty acids and non-cholesterols properties.

The increase in the productivity of the crop during the last 7-8 years was mainly due to continuous increase in sunflower area in high productive zones in North India. If one considers the changes in sunflower productivity in traditional areas of Karnataka, Maharashtra and Andhra Pradesh which account for nearly four-fifths of total crop area, the situation is really not gratifying. This is because the crop suffers from several production constraints of different kinds mainly in these traditional areas.

Production Constraints

1. Planting material constraints.
2. Crop adoption constraints.
3. Crop husbandry constraints.
4. Nutrition constraints.
5. Plant protection constraints.
6. Seed setting and filling constraints.

Factors for Low Seed Setting and Filling in Sunflower

1. Genetic factor.
2. Physiological factor.
3. Environmental factor.
4. Agronomic management.
5. Pollination management.

Genetic Factor

1. Low autogamy: Low autogamy is one of the genetic reasons for poor seed setting and filling in sunflower. Therefore, evaluation of hybrids and their parental lines for their autogamy becomes necessary before releasing any genotype or hybrid.
2. Self-incompatibility: Self-incompatibility is the inability of fully functional pollen grains to fertilize and seed set on self-pollination. Self-incompatibility of sporophytic nature is reported in sunflower that is major cause for poor seed setting in the crop.
3. Breeding on the basis of character association: Seed yield is a complex character governed by several contributing characters. Hence, character association study becomes useful to assess the relationship among yield and its components for enhancing the usefulness of selection criterion to be followed while developing varieties.

Physiological Factor

1. Vascularisation: This developmental gradient is due to the poor vascularisation of the central flower head. There are no vascular bundles present in the centre of the flower head (figure-1). Therefore, intermediary and centrally located seeds must receive solutes indirectly by horizontal transport from peripherally located vascular bundles.
2. High photorespiration: Though sunflower is C3 plant there is a degree of wastage of photo assimilates due to photorespiration which can otherwise be utilized for building yields.
3. Effect of source – sink ratio: Poor seed development in sunflower may result from insufficient assimilate supply (source limitation).

Environmental Factor

1. Moisture stress: Productivity of sunflower is often affected by various environmental stresses, of which moisture stress is the most important one. Mohan Reddy et al. (2003) reported that there was maximum decline in LAI and dry matter accumulation in sunflower subjected to moisture stress at flowering stage resulting reduction in yield

2. Intercepted solar radiation: A reduction in intercepted photosynthetically active radiation (PAR) during a short period of seed filling could affect weight per seed in sunflower (*Helianthus annuus* L.) depending when the reduction occurs.

Agronomic Management

1. Pre sowing treatments: Seed invigoration treatment helps to improve the germination and vigour of the seed and ultimately it establishes a good field stand and yields higher.

2. Planting time and planting design: Among several crop production practices; planting date decides the correct expression of a genotype for all morphological characters and physiological processes.

3. Staggered sowing: The problem of non-synchrony is generally observed in sunflower hybrids. The male parent flowers later than seed parent. To avoid this problem sowing male parent early to female parent was suggested.

Pollination Management

Being entomophilous, the pollination of sunflower to large extent is determined by honeybees (*Apis* spp.). The environmental conditions prevailing during flowering period, spraying of bee attractant like Bee-Q and sugar, which attract the bees, are the deciding factors for ensuring effective bee population. The role of boron is also important in sunflower as it helps to increase the pollen viability.

Strategies to Enhance Seed Setting and Oil Content

1. Low autogamy and self-incompatibility are two major genetic reasons for poor seed setting and filling in sunflower. Breeding plants for the characters directly associated with seed setting and filling, producing the self-fertile lines and growing hybrids can improve the yield in sunflower.

2. Poor vascularisation in the capitulum, high photorespiration wastage, uneven distribution of photoassimilate and source limitation are the major physiological causes for poor seed setting and filling in sunflower. Reducing the source-sink or sink-sink competition by physiological manipulation such as reduction in thalamus weight, increasing post anthesis dry matter accumulation and clipping of old leaves would help in better seed set and filling in sunflower.

3. Directed application of TIBA to head has resulted in increased filling and test weight by way of increased translocation of photosynthates to sink hence, use of growth regulator like TIBA would be beneficial.

4. Maintaining optimum plant stands recommended for the region is desirable. Very less plant population per unit area produced large sized flower head, which remained unnourished due to source limitation and ultimately caused poor seed setting particular in the centre of the flower head.

5. Following only recommended fertilizer schedule for the region is beneficial. Sunflower responds profitably to the use of secondary and micronutrient boron. Boron application at ray floret opening stage improved seed set and filling percentage. Hence, application of boron at this stage is suggested.

6. Moisture stress at bud formation, flowering and milking stages drastically reduced the growth and yield attributes. Therefore, avoiding moisture stress at these stages would be helpful in improving seed yield of sunflower

7. Providing supplemental pollination, either by hand pollination or through increasing pollinators (bees) activity has increased the seed set and filling percent in sunflower.

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Contingent Crop Planning for Climate Change

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Concept of Contingency Crop Plan

The changing climate is a major concern for agricultural productivity in general and food security in particular (Brahmanand et al., 2013). This has also resulted in higher frequency of natural disasters like cyclones. Hence, we must be well prepared for sustaining agricultural productivity and this necessitates the concept of contingency crop planning. Contingency plan can be defined as a plan aimed and executed for an outcome other than in the usual or expected plan. In other words, it is frequently used for risk management when an exceptional risk in future. In general, the change in sowing or planting time of crops, change in seed rate, change in schedule of fertilizer use, use of short duration varieties, improved crop genotypes form the core component of contingency crop planning. In case of cyclone and its associative flood events, we may recommend use of water logging tolerant rice varieties such as Varshadhan, Hanseswari, Durga for better resilience. However, in case of flash floods, the use of swarna sub-1 should form the core component of contingency plan. Similarly, the use of over aged rice seedlings of 45 days and 60 days old are recommended for cyclone and flood prone areas. The development of community nursery and seed bank is critical in supply of seedlings of rice in case of cyclone damage. At least seed bank should be developed for 10% of the area under each block which can be utilized for transplanting in post cyclone period. Increasing food demand and changing food habits of growing population should have stable agricultural production. Livelihoods of nearly 2/3rd of Indian population are associated with the agriculture sector and its contribution to the current GDP is about 14%. The current food needs for cereals, fruits and vegetables, milk, potatoes and meat are 199, 160, 104, 37 and 9 million tonnes respectively and by the year 2030, the demand for cereals, fruits and vegetables, milk, potatoes and meat are projected to increase by 13, 30, 40, 24 and 88%, respectively. However, the stability of food production and required growth rate are affected by weather aberrations. Timely onset and distribution of rainfall are critical for achieving optimum crop yields at farm level, particularly during kharif (rainy season) along with required inputs, labour and technology. Frequent droughts, cyclones, unseasonal rainfall, hailstorms, heat wave and combination of these weather aberrations happening in some region or the other pose major challenges to food security of the country.

Major Weather Risks for Indian Agriculture

Break monsoon: The Indian summer monsoon exhibits substantial inter-seasonal variations, associated with a variety of phenomena such as passage of monsoon disturbances associated with active phase and break monsoon periods whose periodicities vary from 3-5 and 10-15 days respectively. The Indian summer monsoon rainfall varied from 604 to 1020 mm. These inter-seasonal variations cause floods and droughts, which are the major climate risk factors in Indian Agriculture.

Floods due to cyclones: The main causes unprecedented floods in India are due to movement of cyclonic disturbances from Bay of Bengal and Arabian Sea on to the land masses during monsoon and post-monsoon seasons – and during break monsoon conditions in some parts of Uttar Pradesh and Bihar. The thunderstorms due to local weather conditions also damages agricultural crops in the form of flash floods.

Droughts: Drought is a normal, recurrent feature of climate associated with deficiency of rainfall over extended period of time to different dryness levels describing its severity. Drought being subtle, its progress is insidious and its affects can be devastating. During the period 1871-2009 there were 24 major drought years, defined as years with less than one standard deviation below the mean All India Seasonal Rainfall (the deviation below –10%): 1871,1873, 1877, 1899, 1901, 1904, 1905, 1911, 1918, 1920, 1941, 1951, 1965, 1966, 1968, 1972, 1974, 1979, 1982, 1985, 1986, 1987, 2002 and 2009. The most recent major drought in 2009 expressed 50 country's continued vulnerability to droughts and the food-grain production in kharif is likely to fall by 1-015 million tonnes.

Heat waves: Heat waves generally occur during summer season where the cropped land is mostly fallow, and therefore, their impact on agricultural crops is limited. However, it will have deleterious effect on orchards, livestock, poultry and rice nursery beds. The heat wave conditions during 2003 May in Andhra Pradesh and 2006 in Orissa are recent examples that have affected the economy to a greater extent. Also occurrence of heat waves in the northern parts during summer is common every year resulting in quite a good number of human deaths. Further, the water requirements of summer crops grown under irrigated conditions increase to a greater extent.

Cold waves: The Northern states of Punjab, Haryana, U.P., Bihar and Rajasthan experience cold wave and ground frost like conditions during winter months of December and January almost every year. The frequency of such weather-related events has significantly increased in the recent past due to reported climatic changes at local, regional and global scales. Site-specific short-term fluctuations in lower temperatures and the associated phenomena of chilling, frost, fogginess and impaired sunshine may sometimes play havoc in an otherwise fairly stable cropping/farming system of a region.

Weather Aberrations and Impacts on Food Production in India

Extreme weather events like heat wave, cold wave, untimely and high intensity rainfall, hailstorm and frost are increasingly being experienced in different parts of the country.

1. Deficit monsoon in kharif 2014 posed several challenges to agriculture sector across the country.
2. Only 24% districts received normal or above in June, 2014 whereas till September about 36% districts received deficit and 12% districts received scanty rainfall.
3. Deficit rainfall during crop growing season followed by Hud-Hud cyclone, in north coastal Andhra Pradesh affected the rice, horticulture and fishery sectors besides severe damage to infrastructure in 2014.
4. Severe droughts in 2002, 2009, 2012 and 2014 impacted negatively the growth of agriculture sector, including field crops, horticulture, livestock, poultry, and fishery particularly in rainfed regions of the country. In 2009, heavy rainfall in Raichur district of Karnataka, Kumool and Mahabubnagar districts of Andhra Pradesh damaged standing crops in lakhs of hectares due to floods and sand casting on river banks of Krishna and Tungabhadra. During the same year, the areas affected by drought initially were also affected by flood later in the season resulting in contingency measures being taken up by respective district authorities. It is to be noted that the maximum expected flood limit in 100 years for Krishna River exceeded during the same year due to very intense rainfall events of more than 250 mm per day in the catchment.
5. Tsunami in 2004 affected shrimp hatcheries, loss of equipment and infrastructure in the east coast. Alappuzha and Kollam districts were severely hit by the tsunami and the estimated loss to the marine fisheries sector was assessed at Rs.1000 million with the mechanized sector accounting for 64% of the total loss. Nearly 10,880 fishing craft (18% of the craft operating in the state) were destroyed or damaged.
6. Heat wave during February-March in North India caused an estimated loss of 6 million tonnes of wheat in 2002-03. A decline in production of 39% in cocoa, 60% in rapeseed and 50% in linseed was observed in Himachal Pradesh due to heat wave in March 2004.
7. The super cyclone in Orissa (ODMM, 1989) during October1989 killed more than 3 lakhs each of large and small ruminants and more than 18 lakhs of poultry birds in 12 affected districts. The per day milk collection under the impact of the cyclone saw a 25% fall.
8. Drought during 1987 in Banner district of Rajasthan (Livestock Census, 1989) resulted in reduction in population of cattle by 52%, buffaloes by 15%, sheep by 58% and goats by 44%.
9. Hailstorm frequency has become serious problem all over India in the past decade damaging horticulture sector in several states particularly Maharashtra and southern Andhra Pradesh.
10. Another alarming situation in the last decade is occurrence of extreme events such as drought, cyclones, floods, hailstorm and heat wave simultaneously in different parts of the country or in same regions one after another.

Relationships of Food Production and Weather Aberrations in India

The sharp fluctuations in agricultural growth are mainly attributed to the vagaries of weather. Southwest monsoon exerts a strong influence on kharif food grain production in the country. Among all the weather aberrations, rainfall and its distribution play a crucial factor influencing agriculture production. Aberrations in south-west monsoon such as delay in onset, long dry spells and early withdrawal, all of which affect the crops, strongly influence the productivity levels. Rainfall is predicted to be highly erratic with fewer rainy days but with greater intensity. Though most rainfed crops tolerate high temperatures, rainfed crops grown during rabi are vulnerable to changes in minimum temperatures. A combination of higher average annual temperatures and water stress (excess or deficit) can have serious implications for crop production in the tropics. Farmers need to intelligently adapt to the changing climate in order to sustain crop yields and farm income. Enhancing resilience of agriculture to climate risk is of paramount importance for protecting livelihoods of small and marginal farmers dependent on agriculture, horticulture, livestock, poultry and fishery sector.

Climate-Change Scenario for India

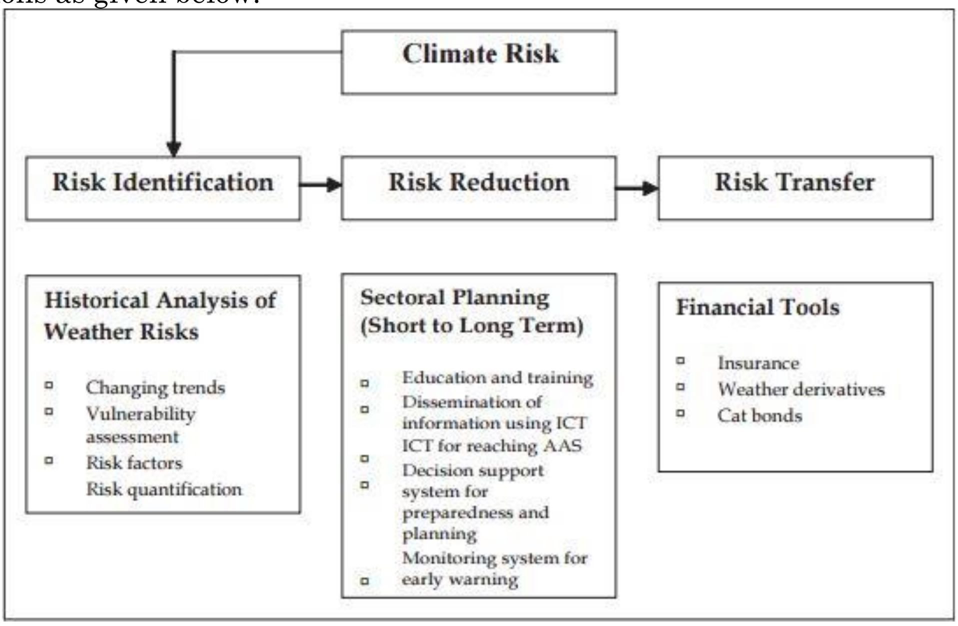
Simulation of future climate in India under A2 scenario by Indian Institute of Tropical Meteorology (IITM), Pune, and Hadley Centre, UK, indicate that by the last quarter of the present century the mean annual temperature in the country will most likely increase by 3-5°C. The spatial average for the increase in annual rainfall during the period is 7-10% (Rupakumar et al., 2006). There will be high disparity in the changes in distribution of rainfall and temperature. North India is expected to be warmer than the south but more importantly, night temperature and winter temperature would register higher of 5°C increases over the most part. It is also predicted that by 2071 the overall summer monsoon rainfall in India will increase by 20%, extreme rainfall events would rise sharply especially in parts of Gujarat, Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh. Incidence of tropical storms in the Arabian Sea coast is also likely to increase. The onset of summer monsoon could become more variable. Overall, the changes are likely to have more adverse effects than benefits. Increase in temperature is likely to be less during the rainy (kharif) season and more during the winter (rabi) season, whereas the rabi rainfall will be more uncertain. The kharif rainfall is likely to increase by 10%. The likely changes in temperature and rainfall in the country from the present are presented in Table 1.

Table 1. Expected changes in temperature and rainfall in India:

Year Season	Year Season	Temperature change (°C)		Rainfall change (%)	
		Lowest	Highest	Lowest	Highest
2020	Annual	1.00	1.00	2.16	2.16
	Rabi	1.08	1.08	1.95	1.95
	Kharif	0.87	0.87	-1.81	5.10
2050	Annual	2.23	2.23	5.36	9.34
	Rabi	2.54	3.18	-9.22	3.82
	Kharif	1.81	2.37	7.18	10.52
2080	Annual	3.53	5.55	7.48	9.90
	Rabi	4.14	6.31	-24.83	-4.50
	Kharif	2.91	4.62	10.10	15.18

Climate Risk Management in Agriculture

Risk management strategies (Sivakumar, 2008) involve avoiding damages, preventing / reducing the frequency, developing adaptation measures, transferring risks, responding appropriately to incidents and rehabilitation as soon as possible. Climate risk management in agriculture involves a wide range of decisions and actions as given below:



Identifying risk for a farmer involves defining the time period during which risk is prevalent, and identifying a measurable weather index that strongly correlated to farmers' losses on particular crop. This is followed by risk reduction which requires a consortium approach where all the organizations, institutions, NGOs etc. that can alert, prepare and educate the people in general and the farmers in particular. The risk transfer further supports the farmers to shift the crop loss burden to the insurers.

Contingency Crop Planning

Contingency crop planning can be defined as a set of procedure that describes how a crop will continue or recover its critical function in the event of an unexpected disruption to normal activity. It allows to assess alternate crop management options to determine how well the options can function that protects the nation's food security and farmers economy when the critical inputs either are not available or delayed considerably. While preparing contingency plans for different agroclimatic regions, one should make use of traditional wisdom of farming community and input from research findings for the respective region.

India being primarily an agrarian based nation, the influence of monsoon rains on country's agricultural production is well recognized. Many ICAR Institutes and State Agricultural Universities and few NGOs have developed location-specific plans in view of annual variations in monsoon rainfall both spatially and temporarily. Still 60 percent of the net sown area in the country is rainfed and about 40-45 percent of total food grain production in the country comes from these regions. The monsoon system consists of timely onset, movement of low pressures from Bay of Bengal to over land surface which brings in copious rains, location of monsoon trough across the country (Head Bay to NW India) and its northward movement towards Himalayas cause break in rainfall conditions, early withdrawal of monsoon system is some of the major weather constraints that affects the agricultural production. Therefore, contingency plans for early commencement or delayed monsoon, intermittent breaks, early cessation or continued wet spells, spatial and temporal distribution of rainfall need to be developed. Some of the crop contingency measures in view of aberrant weather conditions are:

1. Resource inventories inclusive of weather, water, land, cropping systems, livestock, literacy and infrastructure facilities need to be prepared for efficient planning and execution of relief measures.
2. Renovation of existing water storage structures, water conveying system to meet the water deficit both the crops and humans.
3. In situ water harvesting to increase the rainwater use efficiency of crops through water conservation techniques such as compartment bunding, ridges and furrows, double cropping, strip cropping, mulching and vegetative barriers for improving soil moisture need to be strengthened.
4. Watershed development is the key to success for sustainable and improved agricultural output from rainfed areas.
5. Rainwater harvesting through farm ponds for supplemental irrigation and recharging dead open dug wells for increased availability of ground water as well as enhancing agricultural productivity.
6. Practicing improved irrigation methods such as drip and sprinkler to conserve and improving the efficient water resources for food security.
7. Crop diversification with less water demanding crops for efficient use of water.
8. Alternate land use system such as bush farming, agri-silvi-culture, agri-horticulture.

Drought

1. Drought in rainfed condition: Drought is a recurrent phenomenon resulting from deficit in soil moisture and or water both in rainfed and irrigated areas. The drought in rainfed situations is dealt for the following scenarios.

- a. Early season drought (delay in onset of monsoon by 2, 4, 6 and 8 weeks).
- b. Normal onset of monsoon followed by early, mid-season and terminal drought.
  - i. Early season drought due to 15-20 days dry spell after sowing.
  - ii. Mid-season drought at vegetative and reproductive stages of crop.
  - iii. Terminal drought.

The contingency measures suggested against the normal crop/ cropping systems are in the form of alternate choice of crop / cropping systems, appropriate cultivars, and changes in agronomic practices along with suggested linkages with ongoing governmental schemes/ programmes in the district.

2. Drought in irrigated situation: Contingent plans for irrigated crops are developed for the following 5 scenarios:

a. Delayed release of water due to low rainfall in catchment areas.
b. Limited release of water in canals due to low rainfall.
c. non-release of water in canals under delayed onset of monsoon in catchment area.
d. Lack of inflows into tanks due to insufficient/delayed onset of monsoon.
e. Insufficient ground water recharge due to low rainfall.

Unusual Rains (Untimely and Unseasonal)

In the recent past, continuous high rainfall in a short span leading to water logging and heavy rainfall coupled with high-speed winds are being experienced at various growth stages of annual and perennial crops leading to serious crop losses, outbreak of pests and diseases and sometimes total crop failure. These events at post-harvest stages lead to huge economic losses due to low prices and marketing of poor quality or damaged produce. Recent unseasonal rainfall during March-April 2015 caused heavy losses to food/horticulture crops across the country. The livestock and poultry sector also suffered due to short supply of quality feed and fodder.

Suggested contingency measures include re-sowing, providing surface drainage, application of hormones/ nutrient sprays to prevent flower drop or promote quick flowering/ fruiting and plant protection measures against pest/ disease outbreaks with need-based prophylactic/ curative interventions. At crop maturity stage, suggested measures include prevention of premature germination and harvesting of produce. Post-harvest measures include shifting of produce to safer place for drying, maintaining the quality of grain / fodder and protection against storage pest/disease damage.

Floods

Floods are common in river basins and coastal areas of the country leading to physical loss of crop, human and livestock population. Also, serious land degradation is an after effect which requires considerable effort to reclaim the land for cultivation. Heavy rainfall results in flash floods in streams and rivers, breach of embankments leading to transient water logging and continuous submergence of crop lands and entry of sea water into groundwater in coastal districts. Crop/field management depends on nature of material deposited during floods. In sand deposited crop fields/ fallows, ameliorative measures suggested include early removal or ploughing in of sand (depending on the extent of deposit) for facilitating rabi or next kharif crop.

Heat Wave

Extreme weather events like heat wave, cold wave, frost, hailstorm and cyclone are climatic anomalies which have major impact on food, commercial and horticultural crops. In regions where the normal maximum temperature is more than 40°C, if the day temperature exceeds 3°C above normal for 5 days it is defined as heat wave. Similarly, in regions where the normal temperature is less than 40°C, if the day temperature remains 5°C above normal for 5 days, it is considered to be experiencing heat wave. Eastem Uttar Pradesh, Punjab, eastern Madhya Pradesh, Saurashtra and Kutch in Gujarat are highly heat prone areas and heat waves were experienced in recent years during 1998, 2002, 2003, 2004 and 2007. Generally affected crops due to heat wave are wheat, mustard, rapeseed, linseed and vegetables.

Cold Wave

In regions where normal minimum temperature remains 10°C or above, if the minimum temperature remains 5°C lower than normal continuously for 3 days or more it is considered as cold wave. Similarly in regions where normal minimum temperature is less than 10°C, if the minimum temperature remains 3°C lower than normal it is considered as cold wave. The adverse impacts observed are on growth, flowering, fruiting, delay in ripening and mortality of young and aged orchard plants. Poor growth rate is observed and disease outbreaks are experienced in case of livestock and fisheries. Jammu & Kashmir, Rajasthan, Uttar Pradesh, Haryana and Punjab are identified as frequent cold wave prone areas. Recently cold wave was experienced during 2000, 2001, 2003, 2005, 2006, 2007, 2008, 2011, 2012, 2013 and 2014.

Crop damage estimates due to cold wave during 2002-03 was 10-100% depending upon crop and variety within the crop. In Hoshiarpur, Punjab about 40-100% damage was recorded in mango and litchi. In Jodhpur, Rajasthan about 20-30% damage in tomato and 5-10% damage in chilli was recorded. In Hisar, 15-25% damage was recorded in mustard. Mostly horticultural crops (eg. mango, papaya, banana, litchi, pomegranate etc.) are affected by cold wave. Suggested measures include proper selection of fruit species

/varieties which are cold tolerant, use of windbreaks or shelter belts, frequent smoking in the orchard and covering young fruit plants with thatches or plastic shelter.

Frost

It is a condition that exists when the temperature of the earth's surface and earthbound objects falls below zero degree (freezing). Frost is mostly experienced in the month of January. Himachal Pradesh, Punjab, Haryana and Madhya Pradesh are frost prone areas. Crop damage due to frost in Madhya Pradesh was 100% in pigeonpea sown in about 6990-hectare areas in 2011. Suggested measures include preference of frost tolerant varieties, change in planting time to avoid sensitive stages coinciding with frost periods, adopting shelter belts, shade trees, and use of mulches as ground cover to prevent loss of heat etc.

Hailstorm

Hailstorm frequencies are highest in Assam valley, Uttaranchal, Jharkhand and Vidarba, and its occurrence was noticed during 1997-98, 2005-06, 2007, 2011, 2012 and more recently in 2015. About 0.46 million ha cropped area in the states of Haryana, Punjab, Himachal Pradesh, Rajasthan, Uttar Pradesh, Maharashtra and Andhra Pradesh was badly hit during the year 1994-95 by hailstorms. In Andhra Pradesh alone, hailstorm caused a huge loss in 77,000 ha area in 2005-06. In March, 2007 heavy rains accompanied by hailstorm damaged wheat, sugarcane and oilseed crops in thousands of hectares in Punjab and Haryana. Generally affected crops are wheat, apple, litchi and other fruit crops. Suggested measures include use of anti-hail guns andanti-hail nets, use of damaged fruits in preparation of processed foods, crop insurance etc.

Cyclone

Cyclone starts as a tropical low-pressure depression, created by oceanic temperatures rising above 26°C and usually occurs between April-May and also between October-December in the country. The entire coast is affected by cyclones with varying frequency and intensity. Thirteen coastal states and Union Territories (UTs) in the country are affected by tropical cyclones. Four states viz., Tamil Nadu, Andhra Pradesh, Odisha and West Bengal and one UT (Pondicherry) on the east coast, and Gujarat on the west coast are more vulnerable to cyclone hazards. Plantation and horticultural crops are most vulnerable as the cyclones cause extensive uprooting resulting in total crop loss and irreparable physical damage. Loss of livestock is common while in case of the fisheries sector, loss of lives of fishermen, damage to infrastructure and equipment, loss of stock and harvestable produce is observed. Inundation of cropped areas and sea water intrusion are associated with cyclonic events.

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Role of Cover Crops in Nitrogen Dynamics

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Introduction

All plants require N for growth and survival, and most obtain N, by taking up mineral N from the soil. However, some plants have a symbiotic relationship with rhizobium. Rhizobium are bacteria that have the ability to fix nitrogen gas (N_2) from the atmosphere. Legumes act as a host for rhizobium and use the N fixed by these bacteria to grow. Cover crops that are legumes include cowpea, vetches, clovers, alfalfa etc. Legumes are often used in a system as the rhizobium are able to fix N from the atmosphere and use that to help in growth, consequently there is the potential to reduce the amount of N being added to the system through fertilizer or manure. When a legume crop is incorporated into the soil, the N in the biomass becomes available as SMN during decomposition through a process called mineralization and adds to the overall inorganic nitrogen content of the system.

Addition of Nitrogen to the System

Some plants, via rhizobia, are capable of fixing N from the atmosphere to provide some of the necessary amount of N for growth. However, most plants are unable to fix N from the atmosphere, and there is may not be enough N in the soil for proper growth and development. N can be added to the system through the process of deposition, whereby nitrogen oxides can be deposited into the system. The amount of nitrogen oxides in the atmosphere have increased due to fossil fuel combustion and agricultural fertilizer use. N is often added to the system by farmers through fertilizer and/or manure. Cover crops are alternative methods of adding N to the system.

Immobilization and Mineralization

Material such as straw or corn stalks have a high C:N ratio (above 25) and do not contain sufficient nitrogen to support the microbes responsible for decomposition. Microbes can take up mineral N from the soil to meet their Nitrogen requirement and in doing so there will be less N in the soil for use by a plant. The process, of converting mineral N to be used by microbes in decomposition is known as immobilization. On the other hand, legumes, such as clover and alfalfa, often have lower C:N ratios (below 25) and therefore there is N in excess of soil life requirement and some of the N is released into the soil as NH_3, thus increased N that is available for plant uptake. The process by which N becomes available through decomposition is known as mineralization.

Nitrogen Dynamics in Cover Crop Systems

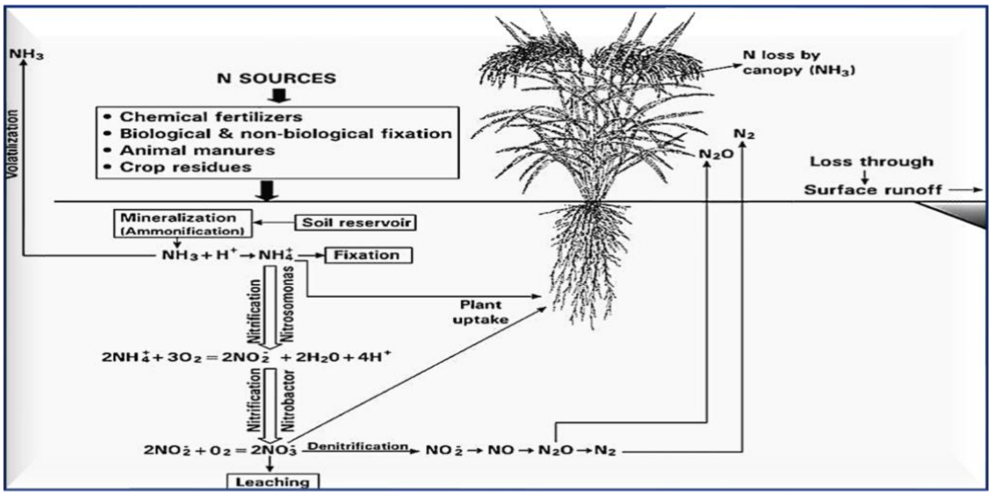

Fig. 1 Nitrogen Cycle

Cover crops can have multiple effects on the N cycling within a cropping system and if managed properly they can immobilize and mineralize nitrogen at key times during the subsequent crop growing season. cover crops, compared to no cover can effectively conserve N throughout the usual fallow periods (fall to spring) when losses are typically high. During the following season, the N immobilized by cover crops can become available for uptake by the following crop. There are several key points of loss and input in the N cycle and by adding cover crops into a cropping system, these losses and gains can be altered to improve overall N use efficiency.

What is a Cover Crop?

A crop whose main purpose is to benefit the soil or other crops in one or more ways, but is not intended to be harvested for feed or sale.

A cover crop is any crop grown primarily to protect, maintain or enrich the soil.

A cover crop is a crop planted primarily to manage soil erosion, soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in an agro ecosystem.

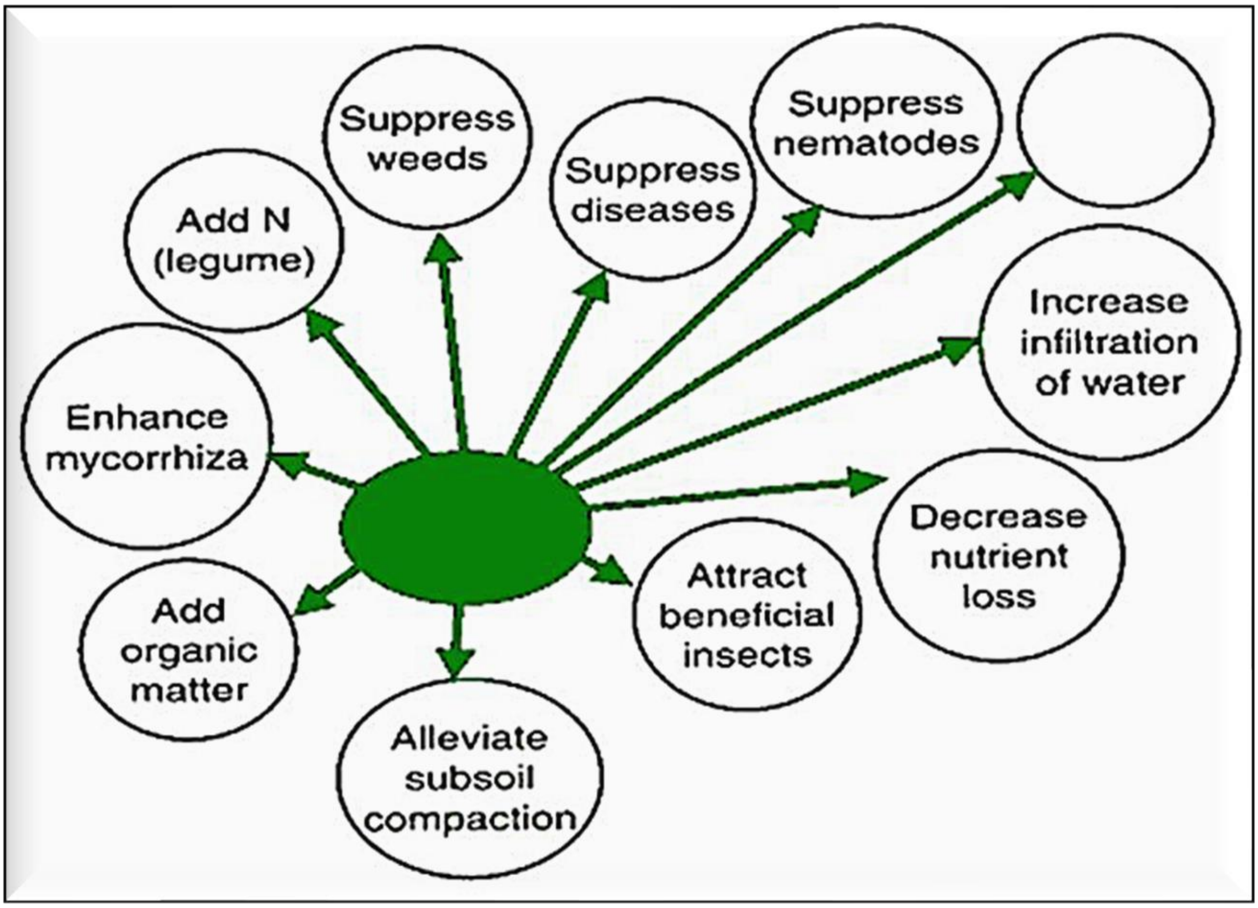

Fig. 2 CCs affect many agronomic factors simultaneously

C: N Ratio

Organic Material/plant source	C:N ratio	Nitrogen available when?
Crimson clover and Hairy vetch	10: 1 to 25:1	Soon: weeks
Young Rye	14:1	Soon: weeks
cowpea	18:22	Soon: weeks
Mung bean	10:15	Soon: weeks
alfalfa	11:13	Soon: weeks
Flowering rye	30:1	Moderately soon: months
Corn stalks	60:1	Long time (1 or 2 years)
FYM	100:1	Long time (1 or 2 years)
Sawdust	250:1	Long, long time (many years)

Cover Crops Compliment

1. Manure.
2. Compost.
3. Crop rotation.
4. Fallow land or resting the soil.
5. Intercropping.

When to Use a Cover Crop

1. Reduced root growth.
2. Low nutrient availability.
3. Low ability to hold or drain water.
4. Soil is highly erodible.
5. Excessive pest populations.

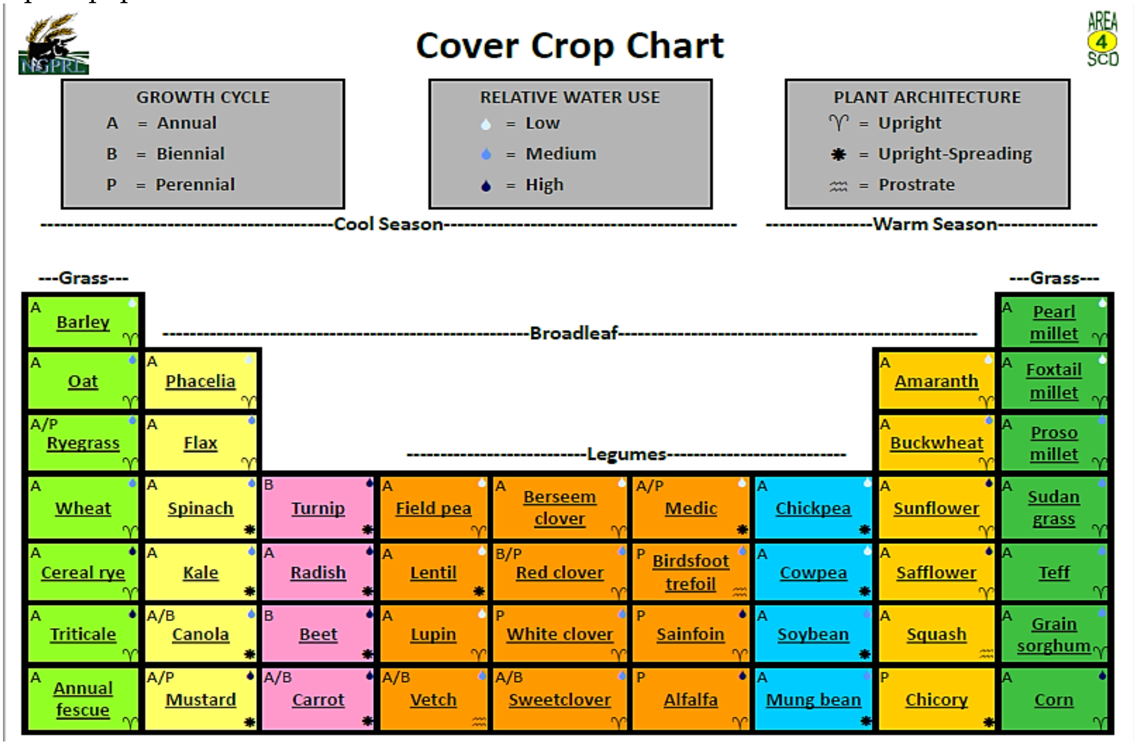

Fig. 3 Cover crop chart

Killing the Cover Crops

1. Before the crop is planted, the cover was killed.
2. When cover reached flowering Herbicide is needed to aid in the kill.
3. The killed cover is left on the soil surface to decompose and act as a mulch for the rest of the season. It adds nutrients and organic matter to the soil, and suppresses weeds throughout the season

Goal: Increase Nutrient Availability

Cover crops can increase nutrient availability by:

1. Residue breakdown - releases nutrients into soil solution or incorporated in soil microbes.
2. As a source of readily available C cover crops stimulate microbial activity and increase the breakdown of soil OM.
3. If cover crop is deeper rooted than preceding crops it can recycle nutrients from deeper in the soil and return them to the upper soil when residue is incorporated.
4. Cover crops rather than bare fallow reduce nutrient loss by capturing nutrients vulnerable to leaching and preventing soil erosion.

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Integrated Crop Management Techniques for Yield Maximization

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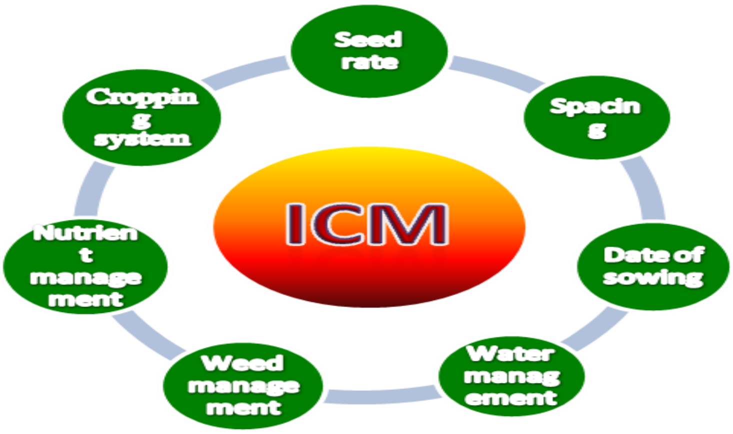
Integrated Crop Management

It is an environmentally sensitive and economically viable production system or process which uses the latest available techniques to produce high quality food in an efficient manner. It is based on a good understanding of the interactions between biology, environment and land management systems.

Components of ICM

1. Variety selection and conservation.
2. Seed quality and health.
3. Integrated Pest Management (IPM): prevention of pest outbreak, including insects, diseases, weeds and vertebrates, and sustainable management with emphasis on natural control.
4. Integrated Disease Management (IDM): prevention of disease outbreak and sustainable management
5. Integrated Nutrient Management (INM): soil health, disorder analysis and improvement, fertilization.
6. Water management and conservation.
7. Cultural practices.
8. Harvesting.
9. Post-harvest handling and storage.
10. Marketing.



Aims of Integrated Crop Management

1. Low-cost maintenance of soil structure and fertility.
2. Improvement of soil fertility.
3. Cheap and sustainable plant protection.
4. Prevent build-up of pests, disease and weeds.
5. Prevent damage to soil, water, plant animal and human health.
6. Avoid loss of biodiversity and damage to habitat.
7. Reduce production costs and environmental damage.

Integrated Weed Management

1. An integrated weed management may be defined as the combination of two or more weed-control methods at low input levels to reduce weed competition in a given cropping system below the economical threshold level.

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2. It has proved to be a valuable concept in a few cases, though much is still to be done to extend it to the small farmer's level.
3. Integrated Weed Management (IWM) approach aims at minimizing the residue problem in plant, soil, air and water.
4. An IWM involves the utilization of a combination of mechanical, chemical and cultural practices of weed management in a planned sequence, so designed as not to affect the ecosystem.
5. The nature and intensity of the species to be controlled, the sequence of crops that are raised in the rotation, the standard of crop husbandry, and the ready and timely availability of any method and the economics of different weed-management techniques are some of the potent considerations that determine the success for the exploitation of the IWM approach.

Advantages of IWM

1. It shifts the crop-weed competition in favour of crop.
2. Prevents weed shift towards perennial nature.
3. Prevents resistance in weeds to herbicides.
4. No danger of herbicide residue in soil or plant.
5. No environmental pollution.
6. Gives higher net return.
7. Suitable for high cropping intensity.

What is INM?

Integrated Nutrient Management refers to the maintenance of soil fertility and plant nutrient supply at an optimum level for sustaining the desired crop productivity. This is done through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

Integrated nutrient management is defined as the judicious mix of organics, inorganics and biofertilizers to promote soil fertility and farm productivity without causing much deterioration in the nutrient status of soil.

Components of INM

<table>
<tr><td></td><td></td></tr>
<tr><td>Inorganic Fertilizers</td><td>Organic Manures</td></tr>
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<tr><td>Biofertilizers</td><td>Green manures</td></tr>
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Integrated Pest Management

1. A pest management philosophy that utilizes all suitable pest management techniques and methods to keep pest populations below economically injurious levels.
2. Each pest management technique must be environmentally sound and compatible with producer objectives.

Basic Principles of IPM

1. Thorough understanding of the crop, pest, and the environment and their interrelationships.
2. Requires Advanced Planning.
3. Balance's cost/benefits of all control practices.
4. Requires routine monitoring of crop and pest conditions.

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Apomixis: A Boon to Plant Breeding

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Summary
Apomixis is the formation of seed without fertilization. There are mainly two types of apomixis. Apomixis have many benefits for crop improvement and agriculture. It permits vegetative reproduction through seed.

Apomixis made easy the process of commercial hybrid seed production without the necessity of development and maintenance of parental lines, and of field isolation.

Transgenic methods will be helpful to change normal mode of sexual reproduction in plants by the use of regulatory genes which are involved in somatic or zygotic embryogenesis and haploid parthenogenesis, also those genes that affect meiosis or signalling of plant hormones. Whereas the knowledge of molecular apomixis is not available yet.

Introduction
Term Apomixis is derived from two words viz., apo = detached/separate and mixis = union/combination. This term was introduced by Winkler in 1908, which means that seeds are formed but the embryos develop without fertilization (Nogler, 1984).When sexual reproduction occurs, the apomixis is termed as "Facultative apomixis", ex. Blue grass, Pearl millet and Sorghum. When sexual reproduction is absent, it is known as "Obligate apomixis", ex- *Panicum maximum*. Apomixis is commonly found at a higher ploidy level. It is a complex and co-ordinately regulated cascades of events controlled by one or a few genes (Savidan 2000). Apomixes is controlled by large section of DNA in which recombination is suppressed (Bicknell et al., 2000).

Types of Apomixis
There are two types of apomixis (Stebbins, 1950) viz., Sporophytic and Gametophytic:
1. Sporophytic apomixis: A sporophyte is the diploid multicellular stage in the life cycle of a plant. It develops from the zygote produced when a haploid egg cell is fertilized by a haploid sperm and each sporophyte cell therefore has a double set of chromosomes, one set from each parent.

Types of sporophytic apomixis (Bashaw, 1980):

a. Adventive embryony: Also called sporophytic apomixis, sporophytic budding, or nucellar embryony, megagametophyte in the ovule, but the embryos do not arise from the cells of the gametophyte; they arise from cells of nucellus or the integument. e.g., citrus, mango, jamun etc.

b. Parthenogenesis: The type of asexual reproduction in which growth and development of embryos occur without fertilization. In Haploid parthenogenesis there is haploid eggs are not fertilised by the male gamete and develop into the haploid individuals. e.g., Solanum nigrum, Nicotiana and Maize. In Diploid parthenogenesis, the embryo development is from unfertilized diploid eggs e.g., Grasses like Taraxacum

c. Apogamy: The asexual development of a sporophyte from a cell or cells of the gametophyte other than the egg. e.g., Allium sps.

2. Gametophytic Apomixis: Where the maternal seed embryo develops from the egg cell of a well-developed embryo sac, without fertilization.

Types of gametophytic (Bashaw, 1980):

a. Apospory: Apospory is the development of 2n gametophytes, without meiosis and spores, from vegetative, or non-reproductive, cells of the sporophyte. e.g., Malus, Crepis, Paspalum, Pennisetum, Poaceae, Ranunculus, Sorghum.

b. Diplospory: Diplospory is an apomeiotic pathway where a diploid embryo sac develops from an unreduced megaspore mother cell. e.g., Ixeris, Antennaria Tripsacum, Eragrostis, and Taraxacum.

Application of Apomixis

1. Fixation of heterosis.
2. Production of homozygous line.
3. Production of vybrids.

Advantages of Apomixis

1. Apomixis helps to give higher multiplication rate of superior genotypes, which includes hybrids, as clones in form of seed.
2. As apomictic hybrid seeds are clones; they can multiply forever. This will reduce the price for industry and breeding companies and seed costs for farmers apomictic hybrid seeds. Apomictic hybrids will not need cytoplasmic male sterility and fertility restorer systems, which means much shorter and easier hybrid development procedures.
3. Easy in storage and planting
4. Suitability for machine planting
5. Usage of less seed material
6. Less bearing of diseases with those of propagation by clone (maintaining genetic structure and fixing superior genotypes after crossing).
7. "Boutique Breeding" approach to develop specific hybrids for microproduction areas (Jefferson, 1994).
8. Yield increases of 20%–50% can be expected from hybrids in self-pollinating major crops such as rice and wheat (Tester and Langridge, 2010) as a result of apomixis technology.
9. In self-pollinating crops no need for six or seven selfing generations to make segregating loci homozygous allow the development of new varieties with one cross.
10. Apomixis for plant breeding will increase the survival of interspecific crosses. Apomixis is known to facilitate the survival of hybrids from wide species, at least under natural conditions (Bashaw and Hanna, 1990).
11. Apomixis will allow multiplication of clonal propagation material in the form of seeds in crops such as potato (Spillane et al., 2004) and cassava (Freitas and Nassar, 2013).

Disadvantages: Apomixis genes could escape into wild relatives and cause genetic erosion. Gene transfers from apomictic crops to sexual wild relatives, both of which might have the same ploidy level.

Agricultural Benefits of Apomixis and its Social Impacts

Apomixis have many benefits for crop improvement and agriculture. It permits vegetative reproduction through seed, so have major effect in crops which reproduce vegetatively via seed. Apomixis can maximize crop production by the fixation of hybrid vigor in food, forage, and fiber crops. It can enhance the breeding of new varieties, avoid losses in fruit and grain crop which are related to pollination difficulties, and assist in effective and regular production of high-quality seeds, fruits, and vegetables (Jefferson 1994, Hanna 1995).

Apomixis made easy the process of commercial hybrid seed production without the necessity of development and maintenance of parental lines, and of field isolation. The land which required for hybrid seed production would be significantly reduced. Like this, plant breeding could become speedier in answer to customer and farmer needs. In food crops such as rice using apomixis to fix hybrid vigor would have a major impact on food production around the world (Virmani et al. 1982, Khush et al. 1994).

Apomixis would let breeders to engineer plants very accurately, as it would allow one to develop and fix distinctive genotypes with traits, for instance quality, responses to management and maturity, that are highly reproducible from field to field and year to year. Simultaneously, many numbers of apomictic genotypes with required traits could be pooled together to boost genetic diversity for completing a specific objective (Hanna 1995). Apomixis would lesser costs of seed production for industry and breeding companies and for farmers it may minimise the seed costs.

Problems in Apomictic Species

There might be an outcrossing problem, especially when facultative apomixis is present in produced apomictic cultivars, because in a particular environment the apomicts would have higher fitness than sexual plants. Regarding the control of rights for the breeding material and germplasm to the industry, the issue could be solved through patents (Grossniklaus et al. 1998a: Bellagio declaration), since apomictic cultivars are vegetatively propagated through seeds. Further, endosperm imbalance is the problem of apomixis, especially in cereals (Morgan et al. 1998) and it is yet to overcome for apomixis utilization in crop improvement.

Conclusions

The major approach for harnessing apomixis will be by using molecular genetic methods, including mutation induction and appropriate breeding of apomictic strains. These are required to understand the genetic regulation of apomixis, and to isolate and transfer genes which are controlling apomixis to important crops. Transgenic methods will be helpful to change normal mode of sexual reproduction in plants by the use of regulatory genes which are involved in somatic or zygotic embryogenesis and haploid parthenogenesis, also those genes that affect meiosis or signalling of plant hormones. Whereas the knowledge of molecular apomixis is not available yet. The genes which shed light on apomictic developmental pathways have been discovered in *A. thaliana* (Chaudhury et al. 1997, Ohad et al. 1996, Grossniklaus et al. 1998, Luo et al. 1999). By understanding of molecular regulation of ovule development and embryo sac formation may open new means for introduction and control of apomixis. A major problem in cereals is to study the endosperm imbalance problem (Morgan et al. 1998).

For genetic engineering of apomixis, there is a requisite for well understanding of mechanisms that activate apomixis. Additional research is required to increase the information on genetic control of apomixis. The isolation, cloning, and characterization of genes for various apomictic processes in megasporogenesis and development of female gametophyte for example altering the course of meiosis and parthenogenetic development of embryo and endosperm, will significantly help in gene transfer and manipulation of apomixis. These might also provide valuable information on the function and expression of apomixis at the diploid and polyploid levels and on the alterations among induced and natural apomixis.

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Production Technology Tips of Strawberry

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Introduction

Strawberry *(Fragaria x ananassa)* is a scrumptious fruit known for its characteristic aroma and flavor, juicy texture, and sweetness. It belongs to the rose family, Rosaceae. The word 'strawberry', is derived from a farmer's practice of mulching the plant with straw for retaining the moisture, deterring the growth of pests, and keeping the berries neat and fresh for picking. It is a complete fruit with 98 % edible portion. Strawberry is consumed in both fresh and processed form i.e., jam, jelly, juice, candy, frozen, dried and many others. The cultivation of this crop has been gradually expanding to non-traditional areas.

Nutritional Benefits

Strawberry fruit contain sugar, acid, dietary fibers and aromatic compounds. Its fruit are rich in vitamins(C and K), minerals (K, Ca, P and Mg) and antioxidants. The unique flavor and fragrance of strawberry fruits appeal to its consumers. Artificial strawberry flavorings and aromas used widely in a variety of manufacturing, including foods, beverages, confections, perfumes and cosmetics. An organic compound 'Furaneol' is considered an important component of the fragrance of strawberries.

Botanical Description

It is herbaceous perennial and stoloniferous that means, plant spread through stolons or "runners". The leaves are trifoliate and arise from the "crown" (a reduced stem in the center of the plant). Leaflets are ovate or broadly oval, obtuse, dentate or coarsely serrate. The runners produce "daughter" plants at every other node. Flowers are white, with 25-30 yellow stamens and 50-500 pistils on a raised, yellow, conical receptacle.

The strawberry is an accessory fruit, since the edible portion is non-ovarian in origin (it is largely swollen receptacle tissue). The true fruits which contain the seed of the strawberry are achenes, which are numerous, tiny, ellipsoid specks that cover the fruit surface. Fruit matures rapidly ripening occurs in 20 to 50 days after pollination.

Varieties

Strawberry varieties vary widely in terms of size, shape color, flavor, degree of fertility, season of ripening etc. Important strawberry cultivars cultivated in India are Chandler, Tioga, Torrey Selva, Belrubi, Fern, Pajaro, Sweet Charlie, Pusa Early Dwarf. Other cultivars of strawberry include Premier, Red cost, Local Jeolikot, Dilpasand, Bangalor, Florida 90, Katrain Sweet, Festival, Camarosa, Blakemore.

Source of Materials

Climate and Soil: The various environmental parameters like temperature, photoperiod and light intensity play important role in successful cultivation of strawberry. It requires optimum day temperature of 22^0C to 25^0C and night temperature 7^0C to 13^0C. In cold climate, frost as well as winter injury seriously reduce yield of strawberry. It prefers well drained soil rich in humus because of 70-90 % of its roots were found in the top 15 cm soil. The soil should be slightly acidic with pH from 5.7 to 6.5.

Plant propagation: Strawberry is propagated through runners. Runner produces true to type plant, but it may also lead to viral transmission. Thus, for virus free runner production, a separate bed should be used. The virus frees tissue culture plants also used for planting.

Planting: Planting in month of October and November is best time. Runners are set 20-25 cm apart in twin rows, 30-35 cm apart and distance of 90-120 cm are between twin rows.

Mulching: The commonly used mulch materials include paddy straw and black polythene gives good weed control, advances early cropping, increases total yield and save the fruit from rotting.

Pruning: In the first year, pick off blossoms to discourage strawberry plants from fruiting. This leads healthy growth and root development. The yields will be much greater in the second year with quality fruits. Remove daughter plants as needed.

Manure and Fertilizers: The judicious application of manure and fertilizers is important to obtain maximum benefits. 100:60:140 kg NPK/ha in three split dose is recommended. 20:40:40 kg NPK /ha along with 20 tonnes FYM should be given as a basal dose and rest in two equal splits. Manures and fertilizers should not be mixed too deep since roots of strawberry go hardly 20-30 cm deep. In addition, foliar application of Urea (2%), $ZnSO_4$ (0.5%), $CaSO_4$ (0.5%) and Boric acid (0.2%) is beneficial for higher and better yields.

Irrigation: Regular irrigation rather than a few heavy ones favours the crop, avoid excess irrigation. Trickle/drip irrigation is the best method to irrigate strawberry for best produce and minimizing the amount of water required for its cultivation.

Insect Pest Management

1. White grubs and Cut worms: Cut the root and stem of young plants. Deep ploughing and drench the soil with Chlorpyriphos @ 2ml/l water.

2. Root weevil: Feed on the rootlets, make deep tunnels in the crown base and finally the plants collapse. The application of Carbofuran (6-10 kg/ha) and Parathion (0.017 %) around the plants can effectively control the insect.

Diseases Management

1. Strawberry leaf spot: The initial symptoms are small, brown spots which, as they grow, turn grey white and are encircled by a red and brown border. Spot of different shapes and sizes appears on the leaves during rainy season, which results in drying and defoliation. 3-4 sprays of Carbendazim (100g/200 L water) at 21 days intervals.

2. Viral diseases: Stunting of plants and marginal yellowing and upwards curling of young leaves. Use of virus free runners, isolation of infected plants and control of aphid vectors with systematic insecticides and use of virus vector tolerant cultivars reduces the problem.

Physiological Disorder

Albinism (lack of fruit colour during ripening) is a physiological disorder in strawberry. Fruits remain irregularly pink or even totally white and sometimes swollen. It is probably caused by certain climatic conditions and extremes in nutrition. Albino fruits are acidic in taste, less firm and often damaged during harvesting and are susceptible to fungal infection and decay during storage.

Harvesting and Yield

Fruits should be picked at the pink or three-fourths coloured stage. Harvesting should be done either early in the morning or late in the evening. Pre cooling should be done immediately after harvesting. The strawberries are packed in plastic punnets and are placed in the corrugated fibre trays or ventilated cardboard boxes. Average yield of strawberry is 15 tonnes / hac with good management.

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Food Security Arising Due to Civil Unrest and War

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Introduction

On May 24 2018, the United Nations (UN) Security Council unanimously passed a resolution condemning the use of food insecurity and starvation as a tactic of war. It was the first time the Council had ever addressed the issue, acknowledging a threat to the lives of tens of millions of people. Aimed at countries currently engaged in international or civil wars, the resolution implores all parties to leave food stocks, farms, markets, and other distribution mechanisms intact. It demands parties in conflict permit humanitarian aid workers unimpeded access to populations in dire need and states that "using starvation of civilians as a method of warfare may constitute a war crime."

Explanation

Ending hunger and extreme food insecurity features among the UN's Sustainable Development Goals, adopted in 2015. Worldwide, the number of hungry and malnourished people had been declining for at least two decades but began rising after 2015. Experts believe conflicts and wars, along with weather events associated with climate change, are the main reasons for this setback. Among the 815 million people suffering from chronic malnutrition in 2016, 60 percent lived in are affected by armed conflict. Wars are inherently violent and harmful, but destruction of resources can sometimes create more catastrophic harm than bombs and bullets. Warring parties may plunder an enemy's food supply, deliberately destroying farms, livestock, and other civilian infrastructure. Conflict can cause food shortages and the severe disruption of economic activities, threatening the means of survival of entire populations. Additionally, wars commonly trigger the displacement of huge numbers of people, cutting them off from their food supplies and livelihoods. Refugees are often vulnerable to acute food insecurity as well as disease. Alternately, if people remain in their homes, surrounding armies can trap people inside a village, city, or neighborhood and deprive them of food, medicine, and other vital resources until they surrender. Many conflict zones desperately need humanitarian aid, but increasingly, one or both parties in a conflict may block relief operations from reaching starving populations or even carry out attacks against humanitarian organizations.

Armed conflict can certainly bring about dangerous conditions of food insecurity, but some scholars argue the reverse is also true: Food insecurity can precipitate violent political conflict. Most often, it is only one among several causal factors, but a sudden change in the availability or price of basic foodstuffs can trigger an explosion of social unrest. A famous example is the French Revolution of 1789, which was fueled in large part by poor grain harvests and economic pressures that led to sharp increases in the price of bread. More recently, the Arab Spring uprisings of 2011 took place during a period of historically high food prices in North Africa and the Middle East.

The history of warfare is filled with examples of military tactics deliberately used with the intent of starving enemy armies or civilian populations. During the United States Civil War, Union soldiers fought under rules of engagement known as the Lieber Code, which allowed them "to starve the hostile belligerent, armed, or unarmed." Nazi Germany drew up a "Hunger Plan" during World War II that, had it been implemented, could have resulted in the starvation of some 20 million people or more in territory controlled by the Soviet Union. Hundreds of thousands did starve to death during the German siege of Leningrad (St. Petersburg), Soviet Union, between 1941 and 1944. Among contemporary wars, three examples serve to indicate the nuances of the problem of hunger in conflict zones:

South Sudan: A civil war broke out in South Sudan in 2013. The fighting led to 400 thousand deaths and drove four million from their homes and food sources. Conflict and poor harvests contributed to a hunger crisis in 2017.

Syria: The brutal Syrian conflict, which began in 2011, has displaced more than 12 million people from their homes, with more than six million displaced within Syria as of July 2019. By 2016, Syrians fleeing the fighting contributed to the largest global refugee crisis since the end of World War II.

Yemen: A 2018 report by the UN's World Food Programme (WFP) referred to the situation in Yemen as "the worst human-made disaster in the modern history of the world," one that "starkly demonstrated the unequivocal link between conflict and hunger." A rebel movement known as the Houthis captured the nation's capital in 2014 and ousted its government. A coalition led by Saudi Arabia and the United Arab Emirates (UAE) intervened, ostensibly to restore the deposed government.

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2. **Video:** Vice on HBO: "Inside the World's Worst Humanitarian Crisis."

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Use of Biofilm for Enhancing Nutrient Use Efficiency

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Introduction

Microbes are most abundant organisms on earth by many orders of magnitude, and their biomass is equal to that of all multicellular organisms combined. They are critical to the sustainability of life on earth. Most organic growers know that a huge number of living organisms are found in just a spoonful of soil. But this diversity is not evenly distributed. Plant Growth Promoting Rhizobacteria are bacteria that colonize plant roots, and in doing so, they promote plant growth and/or reduce disease or insect damage. Certain microbes attach to biotic or abiotic surfaces and differentiate to form complex, multicellular communities called Biofilms (Swarnalakshmi et al., 2013). Microbes and biofilms ("scurf") were first reported by Antonie van Leewenhoek in 1684., that he found in plaque scraped from his own teeth which has significant importance in our daily lives, industrial processes and more recently in agriculture. According to Costerton, “the father of biofilm,” a biofilm is defined as “a structural community of bacterial cells enclosed in a self-produced polymeric matrix and adherent to an inert or living surface”. Biofilm formation is known to be a dynamic and fine-tuned orchestrated process, involving quorum sensing and signalling, which leads to successful attachment and colonization. Beneficial biofilms, including those comprising fungi/cyanobacteria/bacteria growing attached to the plant roots of crops, are known to facilitate the cycling of nutrients and also aid in the bio control of pests and disease, thereby improving use efficiency of nutrients and crop productivity.

Biofilms in that context have proved better competitors, especially in bioremediation and several medical applications; however, in Agriculture they have been less exploited (Haggag and Timmusk 2007). Biofilms formed by nitrogen fixing bacteria and phosphate solubilizing bacteria and fungi may prove beneficial for crop growth. Incorporation of a N2- fixing rhizobial strain to the fungal bacterial biofilm to form fungal-rhizobial biofilms (FRB) has potential applications in N- deficient settings and in the production of biofilmed inocula for biofertilizers and biocontrol in plants.

The composition of the self-produced polymeric material is mainly exo polysaccharide, protein, lipid, and DNA etc. (Romanova et al. 2006) observed that the presence of polysaccharides, proteins, nucleic acids and other substrates in the EPS., helps to protect the biofilm from various environmental stress factors such as UV radiations, extreme pH conditions, osmotic shock, dehydration, antimicrobial substances and predators.

Components of Biofilms

Components	Percentage of matrix
Microbial cell	2-5%
DNA and RNA	< 1-2%
Polysaccharide's	1-2%
Proteins	< 1-2% (including enzymes)
Water	Up to 97%

Diversity and Function of Soil Biofilms

Succession of microbial populations on any surface, but especially in soil or rhizospheres, is a complex process and influenced by a number of physical, chemical and biological factors. Most of the biofilms in nature are mainly composed of bacteria attached to the surface of soil or water environments. But other microorganisms like fungi, algae, and protozoa also play important roles in the establishment of bacterial/polymicrobial biofilms (Stoodley et al 2004). Biofilms play a significant role in the degradation of organic material in the soil, since this degradation is chiefly dependent on the extracellular enzymes elaborated by soil microbes. Various enzymes elaborated chiefly by heterotrophic populations like fungi and heterotrophic bacteria, degrade a variety of organic matter. Lignolytic and cellulolytic microorganisms also play a specific role. Such processes in biofilms are enhanced due to altered growth rate and physiological capabilities. Thus, nutrient turnover, mineralization, and soil fertility are directly under the control of microbial activity in biofilms. Another important function of biofilms in soil is their ability to bio remediates metal and organic pollutants, and the bioremediation potential of mixed microbial consortiums or multispecies soil biofilms has been evaluated by several investigators.

Biofilm Formation Carried Out by Following Steps as

1. Attachment to the Surface: Initial stage of biofilm formation is the attachment of planktonic cells to a surface. This process of attachment is reversible and dynamic. During this stage, bacteria may rejoin or detached from the surface (Banin et al., 2005; Wu and Outten, 2009). This process is facilitated by repulsive and weak interaction forces. Eventually, the attachment of cells to surface gets irreversible. In some cases, pili are involved in attaining the irreversible attachment to the surface.

2. Formation of matrix and microcolonies EPS: The Extracellular polymeric substances (EPS) provide strength and hydrodynamic environment to the biofilm. EPS of biofilm are very complex in nature and it is composed of humic substances, polysaccharides, lipids, proteins and nucleic acids as given in previous section. It imparts the three-dimensional structure to the biofilm as well as formed matrix around the colony. EPS of biofilm are act as diffusion barrier, which prevents the penetration of any type of harmful substance inside the biofilm (Donlon, 2002).

3. Maturation: Microcolony is converted into mature form by multiplication and secretion of polymeric substances. Quorum sensing also plays a very important role in the maturation of biofilm. Aeruginosa which formed stalks, while the motile subpopulation formed mushroom-shaped caps on these stalks by migration with type IV pili.

4. Dispersal of biofilm cells: There are several factors which are responsible for the dispersal of biofilm such as oxygen, nutrient depletion condition and presence of toxins. Biofilm can be dispersed in the form of bulk, clumps and in individual form from the attached surface. Nutrient depletion can also be a cause of dispersal in Pseudomonas species (Prasanna et al., 2014). Secondary messenger molecule cyclic-di-GMP plays a pivotal role in the formation of biofilm, whereas the reduced level of these molecules switches the sessile form to planktonic form.

Factors Affecting Biofilm Formation

pH: Variations in the external pH can have a detrimental effect on the microbes; however, many bacteria counter these pH changes by regulating their activity through cellular processes such as proton translocation, amino acid degradation etc. . Adherence properties of biofilm forming bacteria are affected by variations in temperatures and pH during biofilm development. Biofilm formation in Haemophilus influenzae was influenced by pH. Extreme temperatures and pH affected biofilm development in Sinorhizobiummeliloti.

Temperature: However, increase in the temperature can affect the stickiness (viscosity) of these polysaccharides, which can affect biofilm attachment. The hydration capacity of bacterial alginate of Pseudomonas aeruginosa biofilms increases due to acetylate duronicacids. Changes in temperature also affect biofilm formation; an optimum temperature supports normal enzyme activities, nutrient metabolism, and subsequent biofilm formation , decrease in temperature can reduce the adhesive properties of the bacterial polymers . Temperature fluctuations in environment affect the bacterial appendages; since, these appendages play a major role in adhesion during biofilm formation, changes in the external temperature influences biofilm development. Many microbial polysaccharides are stable at lower temperature.

Nutritional factors: The nutrient status of the plants greatly influences its association with the inoculated microorganisms as biofilms. Variation in nutrient release and exudation pattern in different parts of the plants have significant effect on biofilm growth and structure. Moist and nutrient rich environment supports bacterial aggregation and biofilm formation. The amount of carbon sources in the medium influences the quantum and quality of EPS produced, thereby regulating the biofilm formation. High levels of iron repressed the genes involved in P. aeruginosa biofilm formation.

Conclusions

Application of biofilm as a biofertilizer has remained limited worldwide due to the establishment failure of these microbial inocula in the rhizosphere. The biofertilizer biofilms are also likely to be more successful as applied products if they include indigenous microbes present in the rhizosphere as they will be able to maintain site specificity traits effectively. Extracellular polysaccharides secreted by the microbes play major role in the biofilm formation. Biofilm other than enhancing NUE, increases photosynthesise and legheamoglobin percentage in plants.

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Tools for Smart Postharvest Management of Perishables

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Introduction

Worldwide, postharvest losses have been estimated to be as high as 24% in developed countries and even 50% in developing tropical countries. Reducing these losses globally is considered an important solution to improve food security. The susceptibility of fresh harvested produce to postharvest deterioration increases during extended storage, as a result of physiological and pathological changes occurring during storage and marketing. Losses caused by postharvest spoilage of fruits and vegetables have been controlled so far primarily by applying chemicals, but which due to health and environmental hazards are steadily being banned from use. Storage at low temperature is an efficient practice to prolong postharvest life of perishable crops however, its application is limited since it is cost intensive and requires uninterrupted power supply. Alternatives need to be developed and investigating different biological aspects of postharvest utilizing physiological, biochemical and molecular research tools should improve our understanding of the biological processes involved and mode of action of treatments known to improve overall postharvest quality of produce.

Tools for Postharvest Management

In produce senescence research, identification and characterization of enzymes related to the process of macromolecules catabolism which is highly induced in advanced stage of senescence could be explored by investigating the function of the senescence-associated nucleases and ribonucleases and also the molecular mechanism governing the senescence-specific expression of their encoding genes. The molecular mechanism underlying senescence-specific gene expression is studied by detailed analysis of promoter sequences, interacting protein factors and mutations affecting this senescence-specific regulation. Elevated concentration of carbon dioxide, in the range of 5 to 10% (Fig. 1 & 2), is known to be main factor in the delay of postharvest senescence which plays a major role in modified atmosphere packaging (Fig. 3) of fresh produce and, its effect is very significant in certain commodities.

Fig.1: Controlled atmosphere (CA) chamber.

Fig.2: Cold/low temperature storage.

Fig.3: Modified atmosphere packaging (MAP) in banana and tomato.

Chilling sensitivity, in some fruits and vegetables, is a major limitation in the use of low temperature storage for fresh produce storage, especially in tropical or sub-tropical crops. Chilling injury (Fig. 4) is manifested by membrane collapse, superficial browning and/or texture changes. However, by investigating the physiological, biochemical and molecular basis for the acquirement of resistance toward chilling by different postharvest treatments or by genetic variation, produce shelf life will be enhanced.

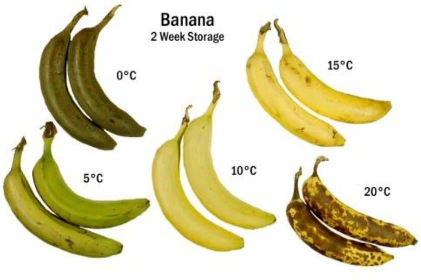

Fig.4: Chilling injury symptoms in banana.

Contact-active antimicrobial surfaces and packages approach involves durable (usually covalent) attachment of an antimicrobial agent to the material surface. Being surface linked, the antimicrobial agent is not consumed or released, offering an important advantage in terms of human and environmental safety (Fig. 5). In addition, the material can be reused contributing to sustainability that is relevant to the food industry. Contact active materials with beneficial activity involving surface modifications of various industry relevant materials viz. polypropylene, polystyrene, other synthetic and natural polymers, glass and stainless steel.

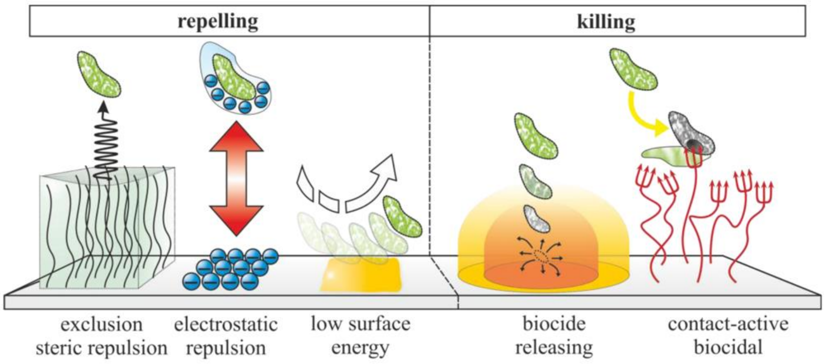

Fig.5: General principles of antimicrobial surfaces.

Active edible coatings and packages protect agricultural produce from physiological and microbial damage, improve appearance, prolong storability, enhance quality and respond to consumer demand for a more natural food. Utilization of nanotechnologies and Layer-by-Layer approaches to control the coating and package properties to encapsulate antimicrobials, nutraceutics and aroma compounds into package films and coatings (Fig. 6). Nanoparticles and nanoemulsions protect agents and allow controlled delivery and release. In addition, nano-scale systems introduced into the natural film or coatings improve their mechanical and physical properties. Another area is the development of new smart responsive nanostructures based on biodegradable nature-sourced polymers. These prepared nanostructures will be utilized specifically for delivery of nutraceuticals (in food products), antimicrobial and anti-insects' agents (in food storage room) and, nutrients and fertilizers (in field).

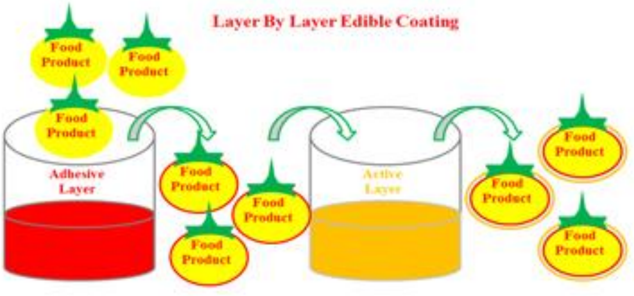

Fig.6: Schematic representation of agricultural products coated by Layer-by-Layer edible coatings.

Conclusion

The large potential of the future which will impact in postharvest applied science is the use of biotechnology to develop new varieties with improved postharvest qualities. The fundamental step in the development of biotechnology approach besides the use of identified genes for improvement of agricultural important crop plants is the identification and selection of key genes involved in postharvest-relevant responses of plants. These genes could be used in marker-assisted selection of improved varieties via classical genetic programs for the development of new varieties which will have improved postharvest qualities.

Ancient Liquid Organics Panchagavya and Kunapajala:- Production and Potential to Improve Soil Health and Productivity

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The indiscriminate use of agro-chemicals has had a negative impact on soil fertility, crop productivity, agriculture quality, and natural products, especially the environment, over the last five to six decades. Organic liquid formulations have been used in India for centuries. Vedic literatures (Vrikshayurveda) have clearly outlined a systematised agricultural practise that emphasised the use of panchagavya and kunapajala to improve crop plant biological efficiency. The liquid organic manures Panchagavya and Kunapajala have a strong potential as manure to boost the physical, chemical, and biological properties of soil, which contributes to increased soil fertility, crop production, and food grains that are free of health hazards. They can also be used as a substitute for chemical fertilisers and pesticides.

Introduction

The current global scenario stresses the importance of adopting environmentally friendly agricultural practises for long-term agriculture sustainability. Chemical agriculture has harmed the health of not only the soil, but also the beneficial soil microbial populations and the plants grown in these soils. This has resulted in a strong demand for organic produce among today's health-conscious population, and farmers all over the world are making intermittent attempts to detoxify the soil by converting to organic farming and avoiding the use of chemical fertilizers and pesticides. Chemical fertilisers increase yield, but they also pose serious health risks to humans, especially children, pregnant women, and nursing mothers.

Inorganic fertiliser costs are skyrocketing, pushing small and marginal farmers out of the market. Crop yield is improved by combining plant and animal by-products. Organic liquid manures are essential for plant growth and immunity. Cow dung, faeces, leguminous tree leaves, neem leaves, fish waste, caster leaves, and other medicinal plant parts are used to make liquid manures. Organic fertilizers/organic liquid manures aid in the rapid decomposition of organic wastes and the enhancement of humus content in the soil, both of which are essential for the continued existence of microorganisms and other life forms in the soil. These are prepared locally and can help to alleviate a variety of concerns, as well as improve productivity and mitigate a variety of nutritional disorders in soils and crops.

Preparation of Panchagavya

Panchagavya is prepared by following procedures:

Ingredients: cow dung 7 kg, cow urine 10 litres, cow milk 3 litres, curd 2 litres, ghee 1 litre, water 10 litres, tender coconut water 3 litres, jaggery 3 kg, and well-ripened bananas 12 in number.

In an 80 L plastic jar, cow dung and ghee were mixed and thoroughly stirred both in the morning and evening hours and then kept aside for three days. After 3 days, add cow urine and water to the mixture and blend twice a day for 15 days. The remaining materials are added after 15 days. After proper sieving through a fine cloth, the panchagavya will be ready in 30 days.

Preparation of Kunjapala

Ingredients: 10 kg of Bombay duck fish, 4 kg of ground sesame oil cake, 4 kg of rice husk, 4 kg of molasses, and 30 L of fresh cow urine.

The Bombay duck *(Harpadon nehereus)* was chosen because it is inexpensive, scale-free, and easy to decompose. These ingredients were placed in an 80-liter plastic container, thoroughly mixed, and fermented aerobically in the shade for 60 days with occasional stirring. The preparation was sieved thoroughly with a fine cloth after 60 days.

Panchagavya as Potential Organic Manure to Improve Soil Fertility and Crop Productivity

Panchagavya is made from five cow-derived products: dung, urine, milk, curd, and ghee. When these ingredients are properly combined, incubated for the recommended time, and the resultant fermented solution is ready, it has a miraculous effect on crops. The preparation is high in nutrients, auxins, gibberellins, and microbial fauna, and it serves as a tonic to enrich soil, induce plant vigour, and produce high-quality crops. Panchagavya is a powerful plant growth stimulant that improves crop biological production. It is used to initiate biological reactions as well as protect plants from disease. Nutrient status of Panchagavya organic liquid manures is given in Table 1. Panchagavya contains a variety of nutrients, including macronutrients like nitrogen, phosphorus, and potassium, as well as amino acids, vitamins, growth regulators including Auxins and Gibberellins, and beneficial microorganisms including pseudomonas, azetobacter, and phosphobacteria, all of which affect yield.

Parameter	Content
Soluble salt	1.88 dsm^{-1}
Nitrogen	1000 ppm
Phosphorus	175.40 ppm
Potassium	194.10 ppm
Zinc	1.27 ppm
Copper	0.38 ppm
Iron	29.71 ppm
Manganese	1.84 ppm
pH	6.82

Table 1. Nutrient status of Panchagavya organic liquid manures

Panchagavya Effect on Soil Fertility is Listed Below

1. Panchagavya boosts soil fertility by increasing macronutrient levels.
2. Micronutrients and beneficial microorganisms improve soil health.
3. Since it serves as an organic fertiliser, it increases the water holding ability of soils.
4. It promotes the reproduction and growth of beneficial soil microorganisms.
5. It improves plant growth while increasing nutrient uptake.
6. It boosts plant immunity, making them more resistant to pests and diseases. It also boosts the production of beneficial metabolites including organic acids, hydrogen peroxide, and antibiotics, which are effective against a variety of pathogenic microorganisms.

Kunapajala as Potential Organic Manure to Improve Soil Fertility and Crop Productivity

Some of the earliest written records of liquid organic manures like Kunapajala and Shasyagavya and their uses in ancient India can be found in Vedic literature. Kunapajala (water with a corpse odour) is derived from the Sanskrit words 'Kunapa' which means corpse and 'Jala' which means water. Cow dung, cow faeces, animal waste (flesh, marrow, etc.) and water are mixed in 1:1:1:2 ratios to make this liquid manure. Kunapajala is a fermented product made from readily available ingredients such as Sesamum indicum L. (Tila), bone marrow, flesh (from sheep, goats, and fish), milk, black gram (Vigna mungo), ghee, and honey. Macro and micro nutrient content of Kunapajala is given in Table 2.With plant-based compost, there is always the risk of transmitting dormant pathogens to fields. Kunapajala, on the other hand, avoids this because its ingredients are cooked and fermented. As a result, it is concluded that using kunapajala boosts vegetative growth, resulting in higher yields and improved disease resistance in organic farming. Synthetic fertilzers can be replaced with kunapajala.

Kunapajala aids in the breakdown of manure into simpler forms, making it more readily accessible to plants than typical organic matter. Compost nutrients are also released gradually, enabling them to remain in the soil for longer periods of time, increasing microbial activity and allowing the soil to absorb and hold water and nutrients more effectively. Since it is a liquid, it is quickly accessible to the roots.

Parameter	Content
N(mg/dm3)	4690
P (mg/dm3)	517.717

K(mg/dm3)	1873.543
Ca(mg/l)	614
Mg(mg/l)	88
S(mg/l)	719
Fe(mg/l)	72
Zn(mg/l)	17.75
Cu(mg/l)	8.53
Mn(mg/l)	2.06

Table 2. Macro and micro nutrient content of Kunapajala.

Conclusion

With the increased use of organic inputs in the farming of high-value crops, the use of such growth promoters by soil drenching and foliar spraying would be an efficient and cost-effective option for farmers. Organic management methods have the ability to improve soil quality and crop yield over time. Panchagavya and Kunapajala are liquid organics with the potential to boost soil fertility, crop productivity, and quality for sustainable agriculture, human health and nutrition, bio-fertilizer production, non-conventional energy production, and ecosystem biodiversity. By virtue of its action as a plant growth regulator, Panchagavya and Kunapajala are readily available as a simple compost manure, demonstrating their potency in increasing leaf area, higher yield of flowers and fruits, and phyto-constituents. All of these conventional agricultural inputs have a lot of potential for use in agriculture and food production.

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Glomalin: A Key in Soil Health Sustenance and Resilience

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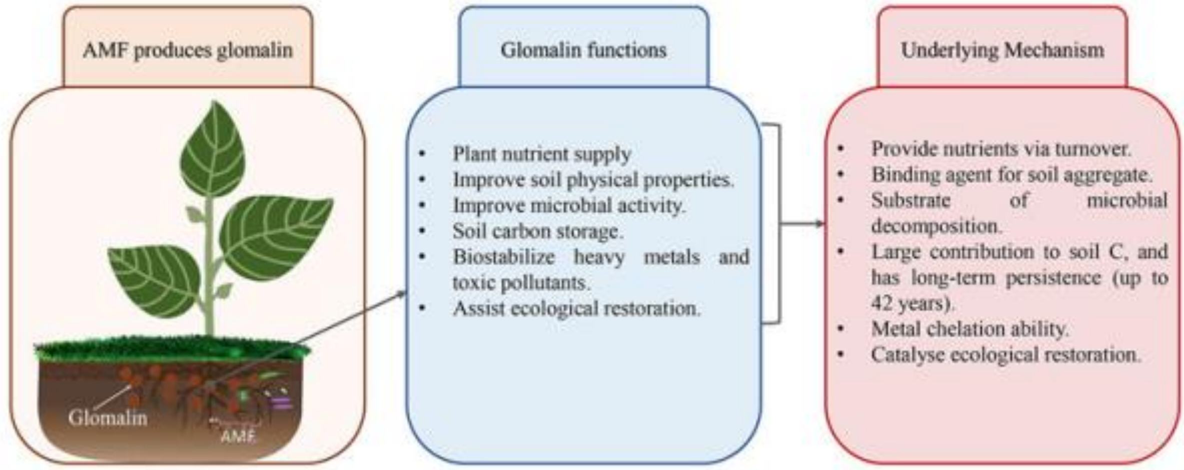
There is a direct link between the increasing human population and soil degradation that raises current and future food security concerns. Naturally occurring soil organic compounds stabilize potentially toxic elements (PTEs). Soil amelioration using beneficial microorganisms, particularly Arbuscular Mycorrhizal Fungi (AMF), is essential and pragmatic. The rhizosphere may be defined as the "heart of the soil" as it is the zone under the direct influence of plant roots and with high populations of active microorganisms (Napoli et al. 2008). AMF produces glomalin that also contributes in development of soil physical, chemical and biological properties and plays a vital role in mitigation of soil degradation too.



Glomalin a specific protein refers to the gene product by AMF. Since the discovery of glomalin in the 1990s (Wright & Upadhyaya, 1996), three decades of research revealed multiple glomalin functions in soil (Figure 1). Glomalin was thought to be exuded by the living fungus (Wright and Upadhyaya 1996) until Driver et al. (2005) found that glomalin is only released by an AMF into the soil environment during hyphal turnover and after the death of the fungus. This section considers different environmental problems associated with soil degradation and the importance of glomalin as a potentially sustainable solution to cope with these environmental problems.

Characteristics of Glomalin

Glomalin, is not chemically defined, and it is N-linked glycoprotein composed of 3 to 5% N, 36 to 59 % C, 4 to 6 % hydrogen, 33 to 49 % oxygen, and 0.03 to 0.1 % P. Glomalin also contains 0.8 to 8.8 % Fe, which may be responsible for the reddish color of glomalin extracts. Glomalin is a stable compound, insoluble in water and resistant to heat degradation. Because it is glue like in nature and glomalin is hydrophobic in nature. Apart from the Glomeromycota, no other fungal group produces this glycoprotein in significant amounts.

Role of Glomalin in Soil Aggregation

The long-term effect of AMF on aggregate stabilization may partly be credited to glomalin production by the fungi showed that the direct effect of GRSP on aggregate stability was higher than the total (direct and indirect) effect of hyphae on soil aggregate stability, but similar to the total root effect. Since soil aggregation governs water, nutrient content, and gaseous exchanges in soil, glomalin could play a crucial role in soil aeration and drainage, plant nutrient uptake, and productivity. AM fungal colonization, spore density, and glomalin have a distinct spatial distribution pattern, which is influenced by soil factors. Soil urease, available N, and organic carbon are principal soil factors affecting the distribution of AM fungi and glomalin (Guo et al. 2012). Therefore, the distribution pattern of AM fungi and glomalin can be useful to monitor desertification and soil degradation.

Role of Glomalin in Carbon Storage

Glomalin facilitates soil C storage, found that glomalin accounted for 4 to 5 % of total C and N and reported the contributions of the glycoprotein to total C were greater than microbial biomass C. In soil C and N content due to AMF suppression and related it to significant decreases in AMF hyphae and GRSP concentrations. They speculated that decreases in AMF hyphae and GRSP concentrations led to the losses of C and N protected in macro aggregates by reducing aggregate stabilization. Nevertheless, not much is known about the direct influence of glomalin on organic C storage, since most of its relation to C storage is by virtue of stabilizing aggregates.

Role of Glomalin in Stress Tolerance

Glomalin has been linked with heat shock protein 60 (hsp60), which are proteins produced by eukaryotic and prokaryotic cells when under environmental-related stress conditions, such as increased temperatures, pH change, and starvation. Relating glomalin with heat shock protein clarifies how stress imposed by heavy metals may rapidly increase glomalin production by AMF and GRSP concentrations in polluted soils. Unfavorable growing conditions enhance glomalin production by AMF. It is conceivable that glomalin performs a protective function in a living fungus, since AMF allocates many of its resources (mainly C and N) to glomalin production.

Role of Glomalin in Reduction of Greenhouse Gases

Currently, the atmospheric concentration of CO_2 has risen above the 370 ppm. Because CO_2 emissions from soil are mainly due to poor management practices that destroy the soil structure, any practice that promotes aggregate formation and stabilization will reduce soil C losses. It is interesting to note that the desirable effects of minimum tillage on soil structure have been linked to higher glomalin concentrations in these aggregated soils. The high number of hyphae produced by AMF is correlated with significant increases in the aggregate stability of soils, modifying the soil's ability to mobilize nutrients, water content, as well as root penetration in soil and soil erosion potential. In this sense, mycorrhizal networks can create indefinitely large numbers of fungal linkages connecting together many plants in a community and suggests that AMF formation could be an important element in the plant succession of ecosystems and reduction of greenhouse gases.

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Role of miRNA and siRNA in Biotic Stress

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Summary

miRNA and siRNA are the non-coding sequences of the RNA which play important role in the mitigating biotic stresses in the agricultural crops. Plants use RNA silencing machinery to facilitate effector triggered immunity and pathogen associated molecular pattern-triggered immunity to fight against pathogen attack and to increase resistance against pathogens associated with various diseases. Small RNA machinery makes use of protein complexes like DICER (endonuclease) that act as a portal for gene silencing, ARGONAUTE (AGO, helicase with RNase motif) and HUA ENHANCER (HEN) for stabilizing the processed small dsRNAs and ultimately associates with RISC (RNA Induced Silencing Complex) for silencing or repressing the gene expression. Thus, understanding the regulation of gene expression via small RNAs will enable researchers to explore the role of small RNAs in biotic stress responses and will provide an opportunity to manipulate this small RNAs in favours of plants growth and development.

Introduction

Biotic stresses affect metabolism of crops by inhibiting the expression of genes that are responsible for high yield of several agricultural commodities from agricultural crops. As profitability of agriculture depends on productivity the biotic stresses become obstructions for cost management of seasonal cultivation of crops and also in livestock management. The irruption of biotic stresses in crops is genetically controlled depending upon level of tolerance to pests (bacteria, insect, virus, fungi and nematodes etc.) in their hosts. In general, crops are lost to the tune of 25% due to insects, due to diseases including that of nematodes up to 20%, vertebrate pests including rodents about 6-8% etc.

RNA Silencing

The discovery of RNAi (RNA interference) in mid ninety's added a new dimension in the regulation of gene expression by different types of RNA. It is a phenomenon in which double stranded RNA (dsRNA) is the initiating factor in post-transcriptional gene silencing. It is a process in which the introduction of a double stranded RNA (dsRNA) in the cells causes the specific degradation of an mRNA containing the same sequence. The inhibition of gene activity could take place at the transcriptional level (transcriptional gene silencing, TGS), or at the post transcriptional level (post transcriptional gene silencing, PTGS). The discovery of RNAi was preceded first by observations of transcriptional inhibition by antisense RNA expressed in transgenic plants, and more directly by reports of unexpected outcomes in experiments performed by plant scientists in the United States and the Netherlands in the early 1990s.

In an attempt in plant to alter flower colours in petunias, researchers introduced additional copies of a gene encoding chalcone synthase, a key enzyme for flower pigmentation into petunia plants of normally pink or violet flower colour. The overexpressed gene was expected to result in darker flowers, but instead produced less pigmented, fully or partially white flowers, indicating that the activity of chalcone synthase had been substantially decreased; in fact, both the endogenous genes and the transgenes were down regulated in the white flowers. Soon after, a related event termed quelling was noted in the fungus *Neurospora crassa*, although it was not immediately recognized as related. Further investigation of the phenomenon in plants indicated that the down regulation was due to post-transcriptional inhibition of gene expression via an increased rate of mRNA degradation. This phenomenon was called co-suppression of gene expression, but the molecular mechanism remained unknown. Craig C. Mello and Andrew Fire's 1998 Nature paper reported a potent gene silencing effect after injecting double stranded RNA into C. elegans. Fire and Mello's discovery was particularly notable because it represented the first identification of the causative agent for the phenomenon. Fire and Mello were awarded the Nobel Prize in Physiology or Medicine in 2006 for their work.

The effector RNA molecules of RNAi consist of ~20–30 nucleotides. They are complexes with the protein components of the RNA-induced silencing complex (RISC). Its catalytic core in plants and animals (with the exception of single-celled organisms) is AGO2, a member of the highly conserved Argonaut protein family. These small RNAs can silence gene expression by two mechanisms: post-transcriptional gene silencing (PTGS), and transcriptional gene silencing (TGS). PTGS can, in turn, be divided into two main mechanisms: direct sequence-specific cleavage, and translational repression and RNA degradation. Direct sequence-specific cleavage occurs when the targeted mRNA is perfectly complementary to the siRNA and is degraded after site-specific cleavage by the RISC. Translational repression and RNA degradation occur when the small RNA guide sequence has only limited complementarity to the target in the 'seed' region (nucleo tides 2 to 8 from the 5′ end of the guide strand), with base-pairing usually occurring in the 3′ untranslated region (UTR).

Dicer and RISC

The dsRNA and siRNAs alone cannot degrade mRNA, but require the assistance of two enzymes namely, Dicer and RISC. Dicer, which was first discovered by Bernstein et al. (2001) in Drosophila, is a complex enzyme belonging to the RNase III family. A closer look at the enzyme reveals that it has four different domains each with a very specific task. They are:
1. An N-terminal helicase
2. dual RNase III motifs
3. C-terminal dsRNA binding domain
4. PAZ (Piwi/Argonaute/Zwille) domain.

The PAZ domain is believed to physically interact with the corresponding PAZ domain of the RISC complex. The dual RNase III motifs perform the actual cutting of the dsRNA, hence the characteristic 5' phosphate and 3' hydroxyl residues on the resulting siRNAs. RISC is the component of the RNAi machinery that uses siRNAs to track down and degrade the complementary mRNAs. First discovered in Drosophila, RISC consists of both protein and RNA. The protein component of the complex has ribonuclease activity with the ability to cut RNA. In addition to the ribonuclease activity RISC also contains a PAZ domain. Additional RISC components include two RNA binding proteins, Vasa intronic gene and dFMR proteins. There are still other components of RISC yet to be identified.

Mechanisms of RNA Silencing (RNAi)

1. The entry of long double stranded RNA, such as an introduced transgene, a rogue genetic element or a viral intruder, triggers the RNAi pathway of cells. This results in the recruitment of the enzyme Dicer.
2. Dicer cleaves the dsRNA into short, 2025 basepairs long, and fragments, called small interfering RNA (siRNA).
3. An RNA-induced silencing complex (RISC) then distinguishes between the two siRNA strands as either sense or antisense. The sense strands (with exactly the same sequence as the target gene) are degraded.
4. The antisense strands on the other hand are incorporated to the RISC. These are used as guide to target messenger RNAs (mRNA) in a sequence specific manner.

Messenger RNAs (mRNA), which codes for amino acids, are cleaved by RISC. The activated RISC can repeatedly participate in mRNA degradation, inhibiting protein synthesis.

Salient Features of RNAi

1. Double stranded RNA rather than single-stranded antisense RNA is the interfering agent.
2. High degree of specific gene silencing with less effort.
3. Highly potent and effective (only a few double stranded RNA molecules per cell are required for effective interference).
4. Silencing can be introduced in different developmental stages.
5. Systemic silencing.
6. Avoids problems with abnormalities caused by a knocked-out gene in early stages (which could mask desired observations).
7. Silencing effects passed through generations.

Optimizing RNA Silencing for Commercial Development

Experimentally, dsRNA derived from IR has been proven far more efficient than antisense or sense transcripts in inducing RNA silencing. This can be adequately explained by the established RNA silencing mechanism. Transgenes that contain IR elements are now routinely used to silence endogenous genes in plant research. Although they can be delivered as parts of modified viral genomes through either agro infection or simple rubbing inoculation, most silencing transgenes are constructed similarly to protein coding transgenes. They contain preferred promoters and PolyA signals and are inserted into T-DNA for stable transformation mediated by Agrobacterium. For application purposes, the transgenes must trigger RNA silencing in gene-specific and sometimes in tissue-specific manners to avoid agronomic and regulatory concerns during product development. In addition, the silencing phenotype needs to be stably inherited over subsequent generations.

Potential Uses of RNA Silencing for Plant Biotechnology

Although most biotech plants currently grown commercially were developed by the expression of transgenes, several employing RNA silencing have been approved by governmental regulatory agencies. Recent intense research efforts in the area will likely give rise to more biotech plants based on RNA silencing technology.

Virus/Insect Resistance

Virus control: Virus resistance is one of the earliest biotech traits that entered commerce. Virus-resistant papaya and squash lines deregulated in 1990s are still being cultivated today. Although the expression of virus-derived protein (coat protein- mediated resistance; CPMR) was thought to be the viruses upon infection before the viruses establish and exert their inhibition on the plants' RNA silencing mechanism.

Insect control: RNA silencing is known to occur in insects, it can be used as an alternative mode of insect control mechanism. Transgenic corn plants expressing dsRNAs corresponding to western corn rootworm (WCR) V-ATPase A showed a significant reduction in WCR feeding damage in a growth chamber assay. This example demonstrates the potential of RNA silencing applications in insect control, which would be valuable for managing the emergence of insect resistance against Bt proteins. RNA silencing was also reportedly providing resistance to nematodes in transgenic Arabidopsis and tobacco plants.

Small RNAs Induces HIGS i.e., Host-Induced Gene Silencing in the Obligate Biotrophic Pathogens like *Blumeria graminis*

Obligate biotrophic plant pathogens, such as powdery mildew and rust fungi, represent a large group of organisms that together cause diseases on thousands of plant species.

Silencing of Fungal Avra10 Gene

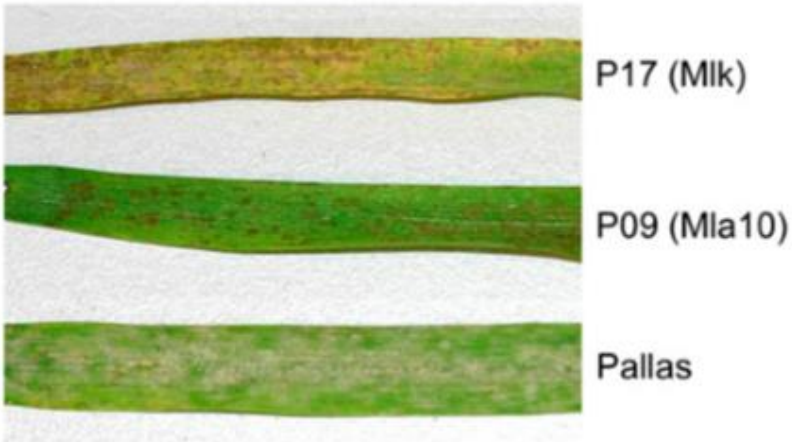

Fig. The *B. graminis* isolate used in a study (CH4.8) expresses both Avrk1 and Avra10 effector genes that are recognized by resistance genes Mlk1 and Mla10 in Pallas BC lines P17 and P09, respectively. Effector recognition triggers a defense response, including cell death, which is seen as small dark flecks in the P17 and P09 lines. Lack of Avr recognition produces a susceptible phenotype, seen in the Pallas line as white fungal pustules.

B. graminis appears to deliver the putative effector proteins Avra10 and Avrk1 into host cells where they may support the establishment of disease. These proteins are recognized by the matching resistance (R) gene products MLa10 and MLk1 in some barley genotypes, which leads to hypersensitive cell death stopping fungal invasion. Overexpression of Avra10 and Avrk1 in barley lacking the corresponding resistance genes was found to increase fungal invasion, suggesting indeed a role of the encoded proteins as effectors. The transfer of dsRNA or siRNA from host plant cells into powdery mildew fungi; these RNAs can disturb the host–pathogen interaction by inducing silencing of fungal housekeeping genes or genes required for development or virulence. RNAs have been found to move systemically in plants, including, for example, the movement of viruses via plasmodesmata and phloem.

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Kerosene Fungus - *Amorphotheca resinae*

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Introduction

The Ascomycete *Amorphotheca resinae* Parbery (1969) is widely known by the anamorph name *Hormoconis resinae* (Lindau) Arx & G.A. de Vries or its obligate synonym *Cladosporium resinae* (Lindau) G.A. de Vries. It grows in hydrocarbon-rich substrates like jet fuel, diesel, petroleum, and wood preserved with creosote or pitch. In the 1960s, the ascomycete *A. resinae* was reported together of the foremost common fuel-deteriorating microorganisms. This species is understood colloquially because the kerosene, petroleum, jet fuel, or creosote fungus. It utilizes aliphatic and aromatic hydrocarbons, also as alcohols and acids. The processes involved in n-alkane uptake and metabolism by *H. resinae*. Its growth can cause serious biodeterioration of the ultimate product quality, the formation of sludge, and deterioration of pipework and storage tanks, both within the refinery and at the end-user facility. *H. resinae* features a broad distribution and is usually found in soil or water that would be potential sources of contamination for petroleum tanks, resulting in biodeterioration and economic loss.

Lansdown, writing in the Royal Aeronautical Society's Journal in 1965, has listed specific problems associated with microbial growth in aviation gasoline and kerosene. These include fuel pump failures and corrosion, filter clogging and fuel tank corrosion. It has now become apparent that microbial contamination is widespread in aircraft fuel supply systems, both ashore and in aircraft carriers, where serious clogging of equipment filters has occurred.' the matter, although worse within the tropics, seemed to be world-wide. It has now been shown that among the fungi the 'kerosene fungus' is that the organism most often implicated, e.g. It was present in 78% of all fuel samples from aircraft tanks examined in Australia and in 80% of all fuel samples examined in California (Engel and Swatek, 1966). It is probably the foremost important micro-organism in contamination of fuels and in corrosion at this time.

The problem of microbial contamination of jet fuels was first observed within the American Air Force during 1956 (Leathen and Kinsel, 1963). Results of studies by Bakanauskas (1958) indicated that micro-organisms were present within the sludge from the fuel tanks. Analyses of sludges from aircraft based at a Tropical Air Force base showed that sludges contained additionally to micro-organisms, microbiological debris and metallic products, break-down products of the hydrocarbons, iron oxides, surfactants, chlorides, metallic salts, water, silica and other extraneous materials. Many of those contaminants had probably entered the fuels in handling between the refinery and therefore the consumer — foreign matter like soil, sand, dust and dirt, metal chips, cellulose fibres and metal oxides. Others were the results of corrosion within the equipment.

The problem was greatest in tropical environments. Ward (1963) reports that the C-130 fleet has had aircraft with holes corroded completely through the lower skin from integral fuel tank corrosion. Corrosion ranged from isolated pits and little areas of exfoliation to extensive pitting and exfoliation covering complete panels. The wing tank skin was made from aluminium plates and stringers of extruded, integrally stiffened aluminium alloy panels. No corrosion-resistant coatings were provided for the tanks at that point. The shape of the tanks made it virtually impossible to empty off water and sludge.

Method of Attack by Micro-Organisms

Sea water has often been deliberately introduced to fuel tanks to seal off leaks at rock bottom of the tank, to flush out the fuel from less accessible parts of the system and to act as ballast in tanks. For example, it has recently been claimed that at least 20% of the world's tanker fleet discharges 600,000 tons of oil during tanker cleaning — the equivalent of five Torrey Canyons (Anon., 1970a). The sea water within the tanks will provide inorganic salts and possibly biological contaminants.

Even within the absence of sea water fuels may contain fungal spores and bacteria presumably derived from the air or soil as contaminants during handling. These are not removed by normal filtration. Some of these organisms will reach the interface between fuel and water: the fuel provides the source of energy; the water provides dissolved oxygen and trace materials. In vented aircraft and fuel tanks air is drawn in to replace fuel used and airborne fungi and bacteria can thus enter and may settle in the fuel. In gasometer-type storage tanks (with a floating roof) rain water carrying microbial contaminants may enter the tanks.

Microbial attack is additionally shown by the formation of sludge or solid matter which can clog downstream parts of the equipment, particularly filters and screens. There is some doubt on whether bacterial slime has sufficient mechanical strength to dam filters but there's little doubt that fungal mycelium can block filters, screens and other small apertures, maybe even the drain points of fuel tanks. Pump screens partly blocked by fungal growth are found by Hazzard (1963).

Fungal growth may also become attached to the fuel tank walls Fungal hyphae can readily attach themselves to solid objects such as fuel tank walls and may exert a mechanical pressure which may allow penetration of the linings and prove difficult to dislodge during cleaning operations. therefore, that the fungus *C. resinae* is undoubtedly the foremost important and dangerous contaminant of aviation fuels.

Methods of Control

1. Regular removal of water, which is important for growth, and periodic washing out of tanks to get rid of microbial growth.
2. Addition of a biostat which prevents reproduction, or biocide which kills micro-organisms.
3. Use of resistant tank coatings in order that the metal walls of the tanks can't be reached by the micro-organisms or their metabolic products.
4. Filtration to get rid of all bacterial and fungal growth.
5. Removal from fuels of fractions essential for microbial growth.

A combination of ‘good housekeeping’ with good aircraft design ensuring well-located drain points, tank linings which are immune to fungal penetration, and an endeavour to stay fuel as clean and dry as possible remains absolutely essential if trouble is to be avoided within the future.

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Exploring Induced Resistance Approach for Plant Disease Management Using *Trichoderma* spp.

Article ID: 11379

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Trichoderma spp. are very common saprophytic soil-fungi, capable of rapidly decomposing soil organic matter. Many species have the ability to parasitize other fungi and have the ability to colonize plant roots and rhizosphere. Due to their anti-fungal properties, many *Trichoderma* spp. like *T. asperellum*, *T. atroviride*, *T. harzianum*, *T. hamatum*, *T. koningii*, *T. virens* and *T. viride* are used widely as biocontrol of plant diseases incited by fungal pathogens. The observation that *Trichoderma* spp. colonize plant roots and induce systemic resistance against a wide range of fungal, bacterial and viral pathogens has been considered a breakthrough in biocontrol research. Induced resistance is the phenomenon in which a plant, once appropriately stimulated, exhibits an enhanced resistance upon "challenge" inoculation with a pathogen.

Systemic Acquired Resistance (SAR) vs Induced Systemic Resistance (ISR)

Systemic acquired resistance (SAR) and induced systemic resistance (ISR) are two forms of induced resistance wherein plant defences are preconditioned by prior infection or treatment that results in resistance against subsequent challenge by a pathogen or parasite. In contrast to SAR which is triggered by the accumulation of salicylic acid, ISR instead relies on signal transduction pathways activated by jasmonate and ethylene. Induced resistance can be triggered in plants by the infection of pathogens, in response to insect herbivory, or upon root colonization by certain rhizosphere mutualistic microbes.

SAR is a mechanism of induced defence that confers long-lasting protection against a broad spectrum of microorganisms. SAR requires the signal molecule salicylic acid (SA) and is associated with accumulation of pathogenesis-related proteins, which are thought to contribute to resistance. SAR is one such SA-dependent response. SAR is a long-distance signalling mechanism that provides broad spectrum and long-lasting resistance to secondary infections throughout the plant. This unique feature makes SAR a highly desirable trait in crop production.

Success of Induced Resistance Using *Trichoderma* spp.

Plant disease management has been successfully reported in many instances using different secies/strains of *Trichoderma*. Inoculation of roots of cucumber seedlings with conidia of *Trichoderma harzianum* T-203 (*T. asperellum*) in an aseptic hydroponic system resulted in induction of defense responses. Electron microscopy of ultra-thin sections from *Trichoderma* treated roots revealed penetration of the mycoparasite into the roots, restricted mainly to the epidermis and outer cortex. *Trichoderma* colonization resulted in strengthening of the epidermal and cortical cell walls and deposition of newly formed barriers, these typical host reactions being found even beyond the sites of potential fungal penetration. The inoculation of *Trichoderma* initiated increased peroxidase and chitinase activities, both in roots and leaves. Later on, it has been demonstrated that inoculation of cucumber roots with *Trichoderma* induced an array of PR proteins. Inoculation of cucumber roots with *T. asperellum* reduced the inoculum load of *Pseudomonas syringe* pv *lachrymans* to the extent of 80%, when the pathogen was inoculated on leaves, thus providing direct evidence on induced defense-mediated protection of crop plants in response to *Trichoderma* inoculation. The protection afforded by the biocontrol agent was associated with the accumulation of mRNA of two defense-related genes: the phenylpropanoid pathway gene encoding phenylalanine ammonia lyase (PAL) and the lipooxygenase pathway gene encoding hydroxyperoxidase lyase (HPL).

With the advancement in research, the gene knockout approach was explored and it was demonstrated that a hydrophobin TasHyd1 has been involved in root colonization by *T. asperellum*. In a significant finding, Shoresh *et al*. (2006) identified a MAPK (TIPK- *Trichoderma* induced MAPK) in cucumber, antisense-mediated silencing of this gene made plants susceptible even after inoculation of roots with *T. asperellum*. It was thus been proved that *Trichoderma* exerts its positive effects on plants through the activation of a MAPK gene involved in signaling pathway of defense response. In studies with *T. virens*, it was demonstrated that seed treatment of cotton with the antagonist or, application of the culture filtrate to seedling radicles induced synthesis of much higher concentrations of the terpenoids deoxyhemigossypol, hemigossypol and gossypol in developing roots than those found in untreated controls. All these compounds were toxic to *R. solani*. Biocontrol activity was highly correlated with induction of terpenoid synthesis in cotton roots by *Trichoderma*. *T. virens* also induced significantly higher levels of peroxidase activity. Subsequently, an 18 kDa protein (a serine proteinase) was identified from *T. virens* that stimulated terpenoid and peroxidase activity in cotton radicles. A definite role of phytoalexin induction in biocontrol has also been demonstrated where it was showed that the "P" strains of *T. virens* failed to stimulate phytoalexin synthesis in cotton and were ineffective as biocontrol, while the "Q" strains that stimulated phytoalexin biosynthesis, were effective. This difference was attributed to the ability of "Q" strains to produce the 18 kDa elicitor protein. In 2006, Djonovic *et al*. identified a homologue of SnodProt proteins, named Sm1, from *T. virens*. Purified Sm1 protein triggered the production of reactive oxygen species in rice and cotton and induced expression of defense-related genes both locally and systemically in cotton. Pre-treatment of cotton cotyledons with this protein also produced high levels of protection to the foliar pathogen *Colletotrichum* sp. These results indicated that Sm1, is involved in the induction of resistance by *Trichoderma* spp. through the activation of plant defense mechanisms.

Conclusion

Since induced resistance as a biocontrol mechanism of some *Trichoderma* strains has only been explored in last two decades (as compared to the mechanisms of mycoparasitism or antibiosis), our understanding of the mechanisms and mode of action of biocontrol *Trichoderma* strains and other beneficial microorganisms is still narrow. Further studies geared towards understanding the mechanisms and mode of action of biocontrol *Trichoderma* strains and other useful microorganisms are vital, not only to the development of an integrated understanding of complex plant–*Trichoderma*–pathogen interactions, but also for the expansion of rational strategies for enhancing plant resistance using *Trichoderma* and other beneficial microorganisms. Since induced resistance is host mediated, its expression under natural field conditions may be influenced by a number of factors, including the environment, genotype, crop nutrition and the extent to which plants are already induced; we still need to broaden our understanding of the impact of these influences on the expression of induced resistance. The rapid advances in molecular biological techniques will certainly help us to gain deeper insights into these mechanisms that regulate the complex interactions between plants, plant pathogens, and biocontrol *Trichoderma* strains; and in effect increase the efficiency of our existing biocontrol strategies and plant disease management programs.

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Disease Resistance in Cucumber (*Cucumis sativus* L.) – Crop Improvement

Article ID: 11380

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Cucumber (*Cucumis sativus* L.) is one of the popular members of this family with a chromosome number of 2n= 14. It is grown for its edible tender fruits preferred as salad ingredients, dessert fruit and also pickled forms. It is useful for preventing constipation and beneficial for people suffering from jaundice and allied diseases. It has originated from the wild progenitor *C. hardwickii* in the Himalayan belt of Indo Chinese centre of origin.

It is extensively cultivated in diverse agroclimatic conditions ranging from tropical to subtropical regions of the world. However, it cannot tolerate freezing temperature and prefers warm weather with moderate to low humidity for better growth and high yield. The U.S. National Plant Germplasm System holds more than 1320 *C. sativus* var. *sativus* and *C. sativus* var. *hardwickii* accessions including elite cultivars, breeding lines, heirloom varieties, collections from the centers of diversity, and exchange accessions from other collections.

Molecular marker analysis of 3000 worldwide cucumber accessions (Lv *et al.*, 2012) revealed that, three distinct populations like population-1 includes germplasm from East Asian excluding for the semi-wild Xishuangbanna cucumber, population-2 includes those from Eurasia and Americas and lastly, population-3 includes germplasm from India and Xishuangbanna of Southwest China.

Cucumber crop exposed to different diseases throughout the growing season and to control these diseases, growers are choosing the chemical method of disease management most of the time, which leads to increase the chemical residues, resistance of pathogen and also increasing the cost of production. Under these situations, exploiting of plant disease resistance is the best and economical alternative to achieve better yields and quality of cucumber.

In India cucumber genotypes have the highest genetic diversity and contains variable resistance source for different fungal diseases. Out of which, downy mildew is the major divesting disease in cucumber. Cucumber downy mildew is mainly caused by *Pseudoperonospora cubensis* which is a foliar disease of cucumber.

Prior to 2004, the disease was controlled through a single recessive gene '*dm-1*' identified in a cucumber Plant Introduction (PI) accession collected in India (PI 197087) (Vliet and Meysing 1974). After 2004, the '*dm-1*' gene was less effective in maintaining resistance to the pathogen in production regions of US. Additional sources of resistance have been identified in several cucumber accessions originated from India and Pakistan including 197085, PI 330628, PI 197088 and PI 605996.

However, each of these sources of resistance has undesirable fruit quality traits for slicing, pickling and European greenhouse markets (Criswell *et al.*, 2010; Call *et al.*, 2012). Among the PI lines examined, PI 330628 and PI 605996 were more resistant longer in the season than other cultigens (VandenLangenberg and Wehner 2016).

Their overall vigor and large plant size may give them the ability to outgrow the disease. It is concerning that the resistant accession PI 197088 appears to develop disease symptoms faster than other resistant PI accessions since it is currently being used for the development of commercial cultivars with high levels of resistance.

As the world population grows, there is an increasing demand for healthy food. This demand needs to be addressed in a sustainable manner by developing new varieties with valuable traits, such as higher yield and enhanced disease resistance/tolerance in cucumber.

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Micro Greens - A Pack of Nutritional Punch

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Micro greens are the first true leaves produced from a seedling of vegetables and herbs that are about 2-3 inch tall. There are so many varieties of plants like turnips, radishes, broccoli, cauliflower, carrots, celery, chard, lettuce, spinach, amaranth, cabbage, beets, parsley and basil can be grown as a micro green for a wholesome and nutritious addition to daily meal. The tiny leaves of most of the micro greens get ready for harvest in 12 to 14 days and are packed with nutrition and intense flavours imitating their mature counterparts. Micro greens contain considerably higher levels of vitamins and carotenoids - about five times on an average - than their mature counterparts. Such soaring levels of nutrients help lower the risk of cancer, Alzheimer's, osteoporosis and boost heart health.

Different Types of Micro Greens

The most popular varieties are produced using seeds from the following plant families.

1. **Brassicaceae family:** Cauliflower, broccoli, cabbage, watercress, radish and arugula.
2. **Asteraceae family:** Lettuce, endive, chicory and radicchio.
3. **Apiaceae family:** Dill, carrot, fennel and celery.
4. **Amaryllidaceae family:** Garlic, onion, leek.
5. **Amaranthaceae family:** Amaranth, quinoa swiss chard, beet and spinach.
6. **Cucurbitaceae family:** Melon, cucumber and squash.

Cereals such as rice, oats, wheat, corn and barley, as well as legumes like chickpeas, beans and lentils, are also sometimes grown into microgreens.

Health Benefits of Micro Greens

Micro greens contain similar and often greater amounts of these nutrients than mature greens. As such, they may reduce the risk of the following diseases:

1. heart disease: Micro greens are a rich source of polyphenols, a class of antioxidants linked to a lower risk of heart disease. Animal studies show that micro greens may lower triglyceride and “bad” LDL cholesterol levels.

2. Alzheimer’s disease: Antioxidant-rich foods, including those containing high amounts of polyphenols, may be linked to a lower risk of Alzheimer’s disease.

3. Diabetes: Antioxidants may help reduce the type of stress that can prevent sugar from properly entering cells. In lab studies, fenugreek micro greens appeared to enhance cellular sugar uptake by 25–44%.

4. Certain cancers: Antioxidant-rich fruits and vegetables, especially those rich in polyphenols, may lower the risk of various types of cancer. Polyphenol-rich micro greens may be expected to have similar effects.

Easy Step-By-Step Instructions to Grow Own Batch of Fresh, Flavoursome and Healthy Microgreens

1. The first step is filling the tray/container with soil. Since the roots of micro greens do not reach that deep, 3-4 inches soil height should be good enough.
2. After the soil is ready, micro green seeds are to be spread on the soil surface. The spacing between the seeds does not need to be completely even, so hand sprinkling works fine.
3. Then cover the seeds with a very thin layer of soil and gently pat the surface in order to make the seeds settle well in the container.
4. Next Step would be making the soil damp with water. Spray enough water over the soil surface in order to make the surface completely moist, but do not flood it with water.

5. The container can be kept at room temperature for about two days until germination occurs. Then choose a sunny spot to place the plant, where it receives a good amount of sunlight for at least 3-4 hours in a day.
6. Sprinkle a little water over the growing greens, twice a day. In 3-4 days', time, we will observe small leaves growing over the soil with little shoots at the bottom.
7. After a week, we will be thrilled to see your container full of healthy micro greens. Once the plants are 2-3 inches taller, they are ready to be harvested. One can wait a little longer as well if prefers taller shoots.
8. Harvesting micro greens is pretty hassle-free too. We can take a pair of scissors or a sharp knife and cut the micro greens, holding them vertically, from just over the roots.
9. After collecting micro greens, wash them with cold running water and they are ready to enhance the taste of meal! Micro greens provide the best of nutrition when consumed fresh, right after the harvest. We can also dry them after washing and store them in a paper wrap in fridge, for further use.
10. It's super easy, we can enjoy growing our own micro greens and once we have got the hang of growing these, we'll love having them as a healthful ingredient in salads, smoothies, and sandwiches.

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Role of Integrated Farming System in Resource Conservation and Soil Health

Article ID: 11382

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Abstract

In agriculture, an integrated farming system is very significant. In today's world, where natural resources are depleting on a daily basis, the Integrated Farming System (IFS) is regarded as a powerful tool that holds the key to ensuring income, employment, livelihood, and nutritional security in a sustainable model for small and marginal farmers, who account for 84.97% of total operational holdings and operate 44.31% of the area. The integrated system achieves its objectives by combining numerous uses of natural resources such as land, water, nutrients, and energy in a complementary manner, allowing for a year-round sustainable income from a variety of businesses. One of the most successful strategies is to recycle agricultural leftovers for sustainable development, whose adoption leads to increased input efficiency, risk reduction, and job creation, all of which lead to increased farm income. It's known as residue recycling, and it's an important aspect of the agricultural system (Issac et al. 2015). In Jammu and Kashmir, Himachal Pradesh, Maharashtra, sections of Uttar Pradesh, and Sikkim, horticulture (fruit)-based systems have potential, whereas in the Andaman and Nicobar Islands and Kerala, plantation crops (coconut, arecanut) dominate (Ravishankar et al. 2018).

Introduction

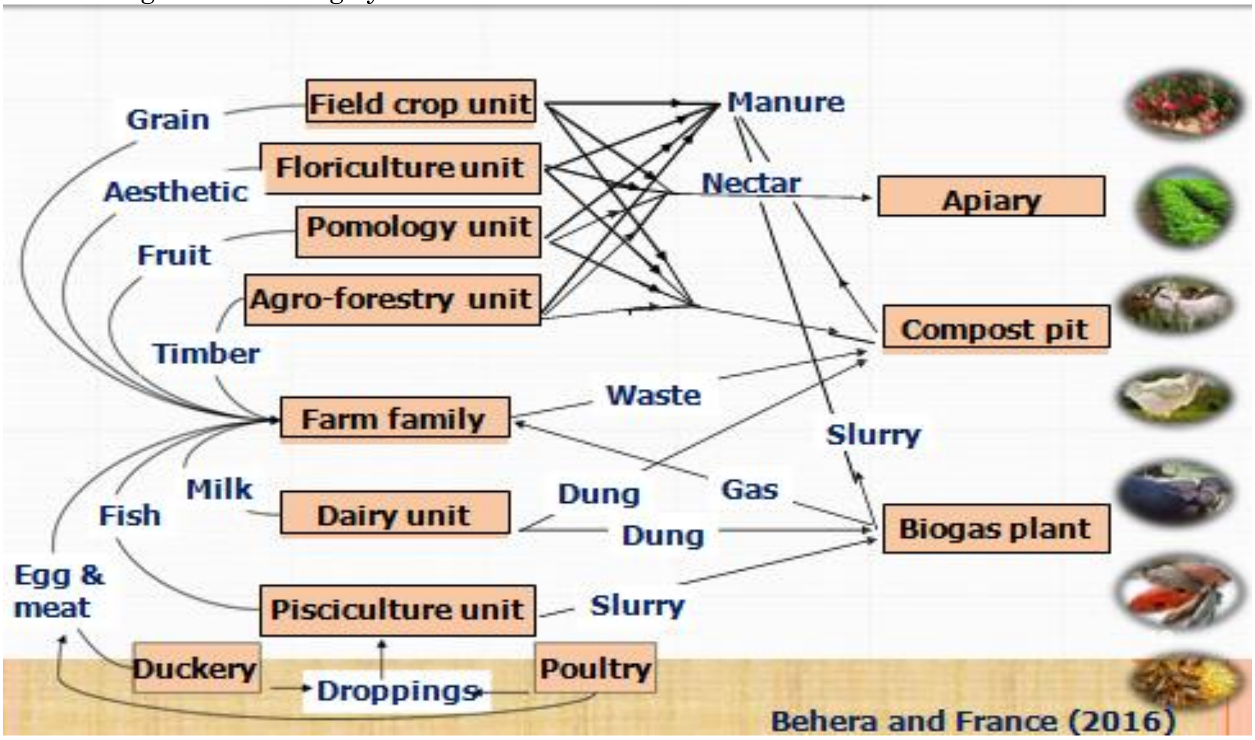
Cropping, animal husbandry, fishing, forestry, poultry, and other agricultural operations are all integrated into the IFS. Cropping enterprises benefit from a well-balanced mix of any one or more of these. Food security, livelihood security, water security, natural resource conservation, and environmental preservation have all become serious challenges in recent years. The level of pressure on Indian agriculture can be seen when compared to data on the world's people and livestock population (18% humans and 15% livestock) and accessible natural resources (2.3% land, 4.2% water, 1% forest, and 0.5% pasture and grazing land).

Seven Pillars of IIFS (Intensive Integrated Farming System)

1. Soil-health care.
2. Water harvesting and management.
3. Crop and pest management.
4. Energy management.
5. Post-harvest management.
6. Choice of crops, farm animals, and other components of farming system.
7. Information, skill, organization, and management empowerment.

Role of IFS in Resource Conservation

The integrated farming system plays an essential role in resource conservation and optimal resource utilization through resource recycling. Ideally, farmers should reduce their spending rather than increasing their investment in fertilizers and insecticides. Farmers should use the output of one business as an input for another. IFS help to save the environment by decreasing soil erosion. Effective residue management in the rice-wheat cropping system. Water, air, soil nutrients, soil moisture, and other elements are all conserved in integrated farming systems.



Role of IFS in Soil Health

By enhancing the nutritional content of the soil, the integrated farming system helps to improve soil health (Walia and Kour, 2013). The addition of livestock manure to the soil enhances the organic matter content, which improves water infiltration, water retention capacity, and cation exchange capacity. The pH of manure and urine rises, hastening the breakdown of organic matter. In an integrated farming system, the populations of soil microflora and microfauna are higher. Soil microorganisms improve soil health and speed up the process. IFS promotes soil health by adding farm waste to it. By safeguarding the soil, IFS decreases soil erosion.

Conclusions

An integrated farming system is beneficial for getting diverse and long-term income without disrupting the ecological balance throughout the year. Adopting the Integrated Farming System can help to alleviate the problem of unemployment. Most importantly, it effectively recycles and conserves natural resources while also ensuring farm self-sufficiency. In addition, scientific studies show that an Integrated Farming System can achieve the ultimate goal of soil health.

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Insight of Gains from Trade through Ricardian International Theory

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Abstract

Some countries are specialized in some resources and scare in other resources due to their geographical location and climate conditions. This scarcity of resource makes a country to import specific commodities from other country. Hundreds of years ago, the prehistoric people have invented a barter system for free exchange of goods and services in the market Eventually, as the world starts progressing, the monetary system came into role and prices are fixed to commodity. The trade strengthens the good relationship among the nations. The best thing happened about trade is that the countries start having some mutual negotiations, agreements and helping each other during calamities, famines. Generally, absence of trade barriers enhances the economic integration in the world. There are many trade theories given by many philosophers starts from mercantilism to modern theories but the Ricardian theory of comparative advantage which was coined in 19th century has its own importance in today's world. The main idea of theory goes around labour hours deciding the commodities to be export and import among the nations.

Introduction

There are so many trade theories discovered by many economists. Among all , it is necessary to know about a Ricardian theory of international trade which states some assumptions and also give idea of how trade happens among countries through labour value theory. Ricardo suggested that, countries should become specialise by allocating their scarce resources to produce goods and services for which they have a comparative cost advantage. The country should specialise for commodity which has low opportunity cost for producing it. Opportunity cost is the forgone benefit that would have been derived by an option which is not chosen or alternative best foregone. Comparative advantage is an economies or nation's ability to produce a particular good or service at a lower opportunity cost than its trading partners. It gives a nation's the ability to sell goods and services at a lower price than its competitors.

Some assumption the theory considers are mentioned below.

1. It also generally known as 2 ×2×1 model where two countries X, Y, two commodities A, B and one factor of production i.e. labour L . The capital is not considered in this theory.
2. Existence of Full employment, perfect competition and constant returns to scale in economy.
3. Free commodity trade and static state in which supply of labour, technology remains same and unchanged.
4. Country X is specialization of commodity A and country Y is specialized in producing another commodity B.
5. One country has absolute advantage in both commodities and other country has absolute disadvantage in both commodities and also similar tastes should exists in both countries.

Table 1: Hypothetical Example showing principle of Comparative Advantage:

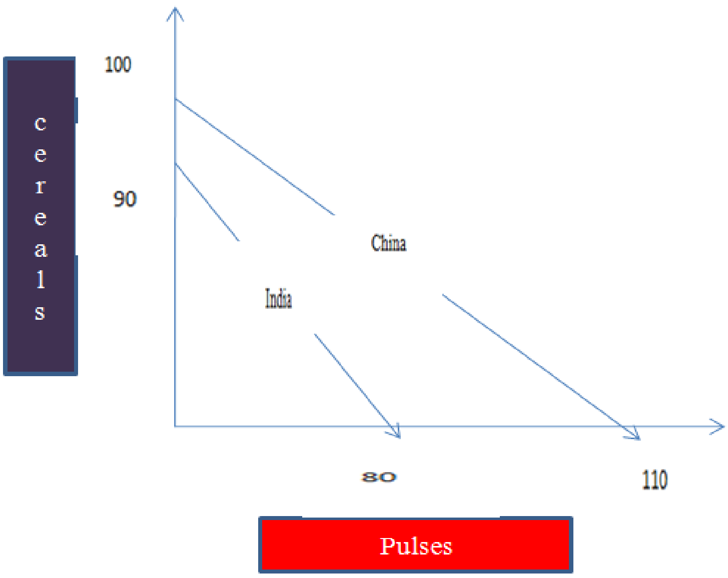
Country	Commodity (Kg per labour hrs)	
	1 unit of Cereals (A)	1 unit of Pulses (B)
China (X)	100	110
India (Y)	90	80

Source (Author's own example)

In order to understand how the concept of comparative advantage might be used, we can consider the hypothetical example of two countries China (X), India (Y) producing only two goods cereals (A) and pulses (B). The units expressed for commodities quantity is in Kilogram and labour engaged to produce commodities can be expressed in labour hours. As shown in the table no.1, India has absolute advantage in both commodities and comparative advantage in producing pulses. While, China has absolute disadvantage in both commodities and comparative advantage in producing cereals. In this situation, on what criteria, the countries X Y choose the exporting product.

How the Trade happens Between the Countries

As shown in Graph 1, China requires 100 labour hours to produce 1 kg of cereal and 110 labour hours to produce 1 kg of pulses. While, India requires 90 labour hours to produce 1 kg of cereal and 80 labour hours to produce 1 kg of pulses. India chooses to produce and export pulses as it requires only 80 labours hours while China chooses to produce and export cereal as it requires only 100 labour hours when compared to pulses. This is how, on the basis of comparative cost and opportunity cost the trade happens between the countries. Country Y should specialize in Pulses, leaving Country X to produce cereals.



Graph 1: Showing how principle works

Conclusions

Through the Ricardian principle , a country is being able to produce goods by using fewer resources, at a lower opportunity cost, that gives countries a comparative advantage. The model shows the basic pattern of nation trade, even if it is becoming less relevant in a today's world and criticised by some modern theories of international trade. The economic theory suggests that, if countries apply the principle of comparative advantage, combined output of resources will be increased in comparison and thereby the two countries will become self-sufficient and allocate resources towards production of goods.

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Artificial Pollination in Date Palm - For Better Fruiting and Quality

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Introduction

Date palm (Phoenix dactylifera L.) is one of the oldest arid and semi-arid fruit crops of the Middle East and other African countries. The Indian states like Rajasthan, Gujarat (Kutch and Banaskantha) and part of Karnataka has emerged as an important date palm cultivating states. It is one the important income-generating fruit crop in the arid and semi-arid regions of India, which has potential to enhance earnings and livelihoods of the farmers. Pollination means transfer of male pollen to the stigma of female flower wherein pollen germinate to form a pollen tube and anthers riches to the ovary where fertilization take place and ultimately development into fruit. Among various orchard operations, artificial pollination is one of the most important orchard operations that determine yield and quality of date plam fruit. Since date plam is emerging dry land fruit crop in India and majority of date plam growers do not bear efficient pollination techniques therefore the stipulated information could be useful to the date growers.

Why Artificial Pollination?

Date palm is a cross-pollinated fruit crop. The male plants are unproductive for commercial production as they only can produce pollen (Bekheet and Hanafy, 2011). Though, the pollination in date palm occurs naturally by the wind, honeybee, and birds, but the natural pollination is an ineffective and produces inferior quality fruit. Natural pollination needs to maintain large no of (> 50 percent) male plants in the orchard. Thus, the female plant population eventually gets half, resulting low production form unit area. Therefore, for the commercial production, artificial pollination is the only way to ensure enough fruit setting and qualitative produce. In date plam hand pollination has been practiced since ancient times.

Flowering and Fruiting Behaviour

Being a dioecious species, male and female flowers are borne separately in individual plants. The flower stalks are produced from the axils of the leaves. The male inflorescence consists of a shorter and wider spathe, contains many floral branchlets which are waxy white colour. While the female inflorescence is long and slender borne in clusters having yellowish in colour. A mature female palm produces 15 - 25 spathes that contain 150 to 200 spikelets each. The flowers of male plants produce massive amounts of pollen, which is used to pollinate the fruit buds on female plants.

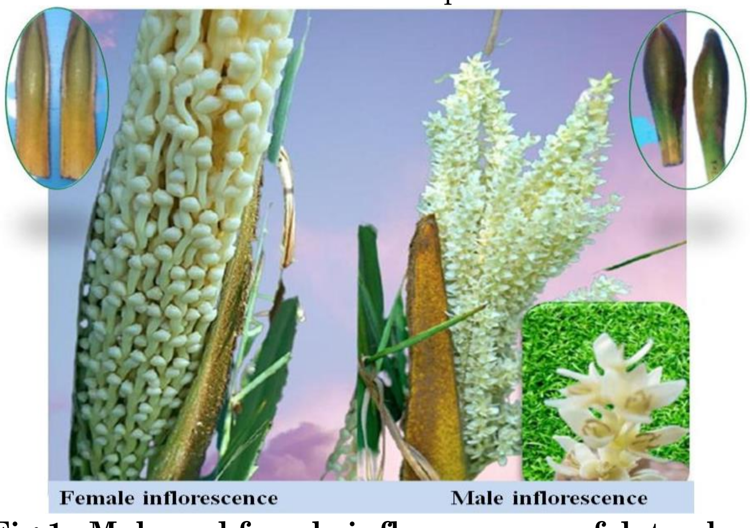

Fig 1. Male and female inflorescences of date plam

Pollen Collection and Storage

The process of extracting and processing the pollen takes many days. When the male spathe start splitting then removed from the sheath and hung upside down to dry. Once the flowers are dry, then the pollen extraction should be carried out by banging, shaking and beating the flowers till the pollen is turned into a fine powder. Morning is the best time to collect pollen. Date plam pollens can be stored up to three months under room temperature; however, in the freezer they can be stored up to a year.

When to Pollinate?

Normally date plam flowers in Jan –Feb month. While, the female inflorescences are receptive to pollination between the months of March-April. The female inflorescence is receptive to pollen for three to twelve days after emergence, depends on the variety and species. When female flowers begin to split then only the pollination should be carried out. The female flowers need to pollinate within two to three days on its opening. Sometime the time of receptivity is differed due to climatic conditions and varietal variation. Each female inflorescence should be pollinated two to three times for effective pollination.

How to Pollinate?

Pollination in date palm can be done using any one of these methods:

1. Strand's placement: This is the most common and simple technique which is largely used by date plam growers. Take 2-3 stands of fresh male spathe and dust it over well opened female in inflorescences and keep the strands within the female bunch in an inverted position. Tie the female strands after pollination along with male strands just to ensure that the male strands will remain within the female bunches for some time.

Fig 2. Flow diagram of strand placement pollination technique

2. Pollen dusting: This method is quite tricky but can be used for effective pollination. In this method extracted pollen are swapped using cotton roll and smeared over the open female spathe. The mechanized duster can be used to reduces the labour cost, time and make it more effective.

Fig 3. Pollen dusting technique of pollination

3. Pollen suspension: In this method pollens are mixed with water and spray on the open female spathe. Pollen grain-water suspension sprays with the optimum amount of pollen grains are required to be mixed. It is a labour intensive and effective pollination technique used by the farmers. However, more research work is needed to justify the optimal concentration of the grain-water suspension for maximum efficacy.

Fig 4. Pollen suspension technique of date palm pollination

Impact of Improper Pollination

If flowers are improper pollinated or not pollinated, fruit will remain small size, seedless and will not attain maturity.

Precautions while Pollination Practice

1. In case of heavy wind or unexpected rains immediate after pollination or within 24 hours then the pollination should be repeated.
2. The male spathe contain pollen should be kept in shady place for drying avoid keeping in direct sun light.

Conclusions

Pollination is considered as one of the most important process in successful date production, since fruit yield and quality depend on the correct application of pollen. Effective and appropriate pollination practices are a prime concern for achieving high yield and quality fruit. The advantage of artificial pollination is that a single male tree can pollinate 40 or 50 females, allowing us to dilute the male tree population and focus on nurturing the females.

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Wide Hybridization: A Crop Improvement Method in Plant Breeding

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Summary
Conventional methods of plant breeding are still used mostly to develop new varieties of crop plants. However, in additions to those methods of generating genetic variability and advancing the population, a number of non-conventional methods have come up in the recent past. This has been possible because of development of innovative methods of generating and handling breeding material is described in this chapter. These are lumped together as innovative methods of crop breeding.

Introduction
In crop improvement programme, the parents used in hybridization are mostly different varieties of the same species i.e., intervarietal cross. In such cases F1 hybrids are fully fertile, hybridization and handling of segregating generations does not present any problem. But when desired characters are not available within the same species, crosses are made with parents from different species or genera. This is called wide hybridization. It includes interspecific (between species of same genus) e.g., *Oryza sativa* x *O. glaberrima*; or intergeneric (among different genera of same or different family) e.g., wheat with rye (*Triticum aestivum* x Secale cereal).

Barriers to Wide Hybridization
1. Failure of fertilization: Pollen may not germinate on the stigma or pollen tube may not grow through the style or may burst into the style or male gametes do not penetrate the embryo sac to fertilize the egg cell. Thus, fertilization may fail due to various incompatibility reactions.

2. Failure of zygote formation: Even if fertilization take place, zygote may not be formed due to various genetic or physiological reasons.

3. Failure of zygote (embryo) development: In many cases fertilization takes place and zygote is formed but the embryo does not develop beyond certain stage i.e., embryo abortion. This may be due to:
   a. lethal genes, as in Aegilops.
   b. genotypic disharmony between the genomes of the two parental species, as in Gossypium.
   c. chromosome elimination, as in Hordeum and Nicotiana.
   d. cytoplasmic incompatibility.
   e. endosperm abortion.

4. Failure of seedling development: Some embryos do develop to full seed stage but seedlings fail due to weakness, hybrid chlorosis or necrosis. Interspecific and intergeneric F1 hybrids of wheat show both chlorosis and necrosis, which is often lethal. Chlorosis refers to improper chlorophyll development resulting in variable degrees of chlorophyll deficiency. In some cases, it is possible to rescue the seedlings.

5. Sterility in distant hybrids: Even if cross has been successful and healthy seedlings have been obtained, still the hybrids may prove sterile. In case of asexually propagated plants like sugarcane, potato etc the hybrid can be multiplied vegetatively. But in case of seed propagated crops, sterility poses a major hurdle. The sugarcane x maize hybrid produced at the SBA, Coimbatore, is completely sterile but being maintained by clonal propogation. The strerility of hybrids caused by cytogenetic, genetic or cytoplasmic factors.

Use of Distant Hybrids in Plant Breeding
parents of distant hybrids differ in many genes and thus in F2 very wide range of segregants are expected. Many of the segregants may look very different from those of the two parental species. Thus some of useful

segregants may be developed as variety for cultivation. Crops like wheat, oat, sugarcane, cotton, potato etc are allopolyploids have evolved through distant hybridization.

1. Disease resistance: it is by far the most common characteristic transferred against rusts in wheat, late blight in potatoes, bacterial wilt, bacterial canker, curly top virus and mosaic virus in tomato, and against many insects and diseases in sugarcane.

2. Wider adaptation: wild species have served as useful sources of genes for earliness and wide adaptation. Cold tolerance has been transferred from wild relatives to wheat, onion, potato, tomato, grape, rye etc.

3. Mode of reproduction: genes affecting the mode of reproduction have been transferred from wild relatives to the cultivated species. Self-incompatibility genes from *Brassica campestris* have been transferred to the self-compatible *B. napus* for the production of hybrid seeds.

4. Yield: contrary to the general belief, wild relatives of many crop species are excellent sources of the much needed 'yield genes.' There are evidences from inter-specific hybridization in chickpea (*Cicer arientinum*).F2 from the cross *Cicer arientinum x C. reticulatum* showed very large transgressive segregation for yield and yield components. F6 progenies showing up to 40% improvement in 100 seed weight and 30-40% increase in seed yield per plant over the *Cicer arientinum*.

5. New varieties: The cotton *Varlakashmi* is an inter specific hybrid between *Gossypium hirsutum* and *G. barbadense*. All present varieties of sugarcane (2n= 100-125) are complex interspecific hybrids involving *Saccharum officinarum* (2n= 80) and *Saccharum spontaneum* (2n= 40-218) and other species of genus *Saccharum*. Mostly cultivated rice variety Mahsuri is a hybrid derivative between *indica* and *japonica* subspecies of *Oryza sativa*.

New Crop Species

Interspecific hybridization followed by chromosome doubling of the sterile hybrids produces allopolyploids that may become a new crop species like *Triticale*, or serves as bridging species to facilitate further wide hybridization as in Tobacco. F1 of a cross between *Nicotiana tabacum* (2n= 48) and *N. glutinosa* (2n= 24) is sterile. But by doubling the chromosome number of the F1, a fertile species *N. glutinosa* (2n= 72) was created, which serves as a bridging species to transfer genes and chromosomes from *N. glutinosa* to *N. tabacum*.

Achievements

Distant hybridization has been most commonly used fir the transfer of characters not found in the cultivated species like resistance to abiotic (heat, drought and submergence tolerance) and biotic (disease and insect-pests) stresses to cultivated species from its wild relatives. Examples are given of rust resistance in wheat, drought tolerance and perenniality in rice. Distant hybridization has also been used to transfer sterile cytoplasmic (WA= Wild Abortive) from wild *Oryza spontanea* to *Oryza sativa*. This gave the first ever male sterile (A line) used for producing hybrid rice seed. Many novel characters have been transferred to sugarcane from its wild relatives. Distant hybridization has created a new cereal Triticale (*Triticale hexaploide)*. Some other examples are *Raphanobrassica, Triticum- Agropyrin, Triticum- Aegilops* and *Festuca-Lolium* hybrids.

Conclusions

Wide hybridization is the foremost method of plant breeding for crop improvement. It takes use of all wild species of crops. Helps in transfer of resistant genes from wild to cultivated one. Helps in removal of crossing barrier and development of new plant species.

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Role of Nematodes as Biopesticides

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Summary

The term biopesticides refers to compounds used to control agricultural pests through certain biological effects rather than the use of chemical pesticides. Biopesticides are specific types of pesticides found in natural substances such as animals, plants, bacteria and certain minerals. Biopesticides include natural pesticides (biochemical pesticides), microorganisms that control pest (microbial pesticides), and pesticides produced by plants that contain additional genes (plant protectors).

Entomopathogenic nematodes (EPNs) are known as insect-parasitic nematodes, which are obligatory in nature and associated with symbiotic bacteria which are responsible for the rapid killing of host insects. Due to the mutualistic relationship with pathogenic bacteria, these nematodes are called as “entomopathogenic nematodes”.

Introduction

EPNs belonging to the families Steinernematidae and Heterorhabditidae have worldwide distribution. However, biotic and abiotic factors are the cause of differences in the distribution of EPNs in the different regions of the world. EPNs are used as biocontrol agents against insects of the orders Lepidoptera, Coleoptera, Hemiptera, Dictyoptera, and Orthoptera. To date, 61 species (check this value) have been described for *Steinernema* and *Neosteinernema longicurvicauda*, while 16 species have been described for *Heterorhabditis* (https://entnemdept.ufl.edu/nguyen/morph/steinsp1.htm).

Life Cycle

EPNs are outstanding biocontrol agents for soil dwelling stages of insect pests and they act quickly on the insects and kill the target insect pests within 24 - 48 h. EPN are observed to be safe on most of the non-target organisms and to the environment. Moreover, they are easy to apply and are compatible with most of the agricultural chemicals. EPNs belonging to the families Steinernematidae (*Steinernema* spp.) and Heterorhabditidae (*Heterorhabditis* spp.) are registered as potential nematodes as they are highly virulent due to their symbiotic association with the bacteria *Xenorhabdus* and *Photorhabdus* spp. Symbiotic association of EPN with specific bacteria facilitates the successful pathogenicity and multiplication of nematodes into the insect hosts.

Life cycle of EPN includes egg stage, four juvenile stages and an adult stage. Both *Steinernema* and *Heterorhabditis* spp. have a free-living third stage juvenile (J3), termed a dauer juvenile, which is considered as the infective stage. EPNs, generally cause death of the insects in a three-step process. In the first step, nematodes migrate in search of the target insect host. In the second step, nematodes need to penetrate into the host body through their natural openings, such as anus, mouth, spiracles, and / or through the cuticle. In the final step, the nematode–bacteria complex plays a key role in the suppression of insect’s immune system and for the development of new generations of nematode juveniles.

Mass Production of EPN

A key factor in the success of EPN, as biopesticides is their amenability to mass production. The soil environment is the perfect location for EPNs and insects. The soil is a natural reservoir for these nematodes. EPNs can be mass-produced by both in vivo and in vitro methods. These nematodes were initially cultured more than 70 years ago and now they are commercially produced using those methods through in vivo and in vitro solid and liquid cultures. In the in vivo process, an insect serves as a bioreactor, while in the in vitro process, artificial media will be used for culturing.

Commercial Products of EPN

Nematode	Product Name	Country
Steinernema carpocapsae	Boden-Niitzlinge	Germany
	Mioplant	Austria
	Nemabakt	Russia
	Biosafe	Columbia
	Biovector	Columbia
	Green Commandos	India
	Bouncer	India
	CAPSANEM	Netherlands
	Carpocapsae- System	Canada
	Sanoplant	Switzerland
	Helix	Canada
	X-GNAT	USA
S. feltiae	Nemasys UK	UK
	Entonem	Netherlands
	Owinema SC	Poland
	Exhibit	Switzerland
	Stealth	UK
	Magnet	USA
S. scapterisci	Proactant Ss	USA
S. riobrave	Biovector	Columbia
S. kushidai	SDS biotech	Japan
Heterorhabditis bacteriophora	Otinem	Switzerland
	Soil Commandos	India
	E-Nema Gmbh	Germany
H. megidis	Nemasys	UK
	Larvanem	Netherlands
	NovoNem	Germany
H. indica	Soldier	India

Conclusion

EPNs have a lot of advantages over other control agents to combat insects. They can be applied along with other conventional spraying methods. EPNs can be easily mass produced and stored for a longer period under appropriate conditions. They have a potential in inundative and inoculative release and have insignificant effects on non-target organisms. Moreover, they are mobile in the soil environment and can persist for years which will give a long-lasting control on insects.

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Herbicidal Action of Auxin

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Summary

Auxin is well known for its basic role in cell elongation in plants. Apart from this, it takes part in apical dominance, root development, reduction of fruit drop, and many more. it is being used also as a well-accepted herbicide since the 19th century as well. There are many groups having pyridine or phenoxy or benzoic functional group. But the common thing among them is they work on broadleaved dicot weeds. The mode of action says it mimics a higher concentration of Indole acetic acid, which encourages ethylene biosynthesis and huge Reactive Oxygen Species(ROS) production and eventually cell death. In the market, these are available in various names. Also, the toxicity values are different. The article shows the whole picture comprehensibly.

Introduction

Auxin is one of the largest as well as oldest plant growth regulator groups. It is highly popular among farmers and being used globally. A major part of synthetic auxins is the oldest known herbicide group, including the phenoxy group of auxins such as 2,4-D and MCPA, earliest commercialized globally in 1945 and 1946 respectively. The pyridine group of auxinic herbicide, Picloram was first commercialized in 1964, followed by Clopyralid in 1975. Herbicides of this category are typically effective chiefly on several broadleaf plants, with a significantly minor amount of activity on monocot species. They are well established among the agrochemicals as they are often used for the selective removal of non-grass weeds from cereal crops and grassland pastures. A novel collection of synthetic auxins called Arylpicolinates has been commercialized in the mid-2010s with the launch of halauxifen.

Si. No.	Group	Herbicide	IUPAC name
1.	Pydine	Halauxifen	4-Amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid
		Aminopyralid	4-amino-3,6-dichloropicolinic acid
		Clopyralid	3,6-Dichloropyridine-2-carboxylic acid
		Fluroxypyr	4-Amino-3,5-dichloro-6-fluoro-2-pyridyloxyacetic acid
		Triclopyr	[(3,5,6-Trichloro-2-pyridinyl)oxy]acetic acid
		Picloram	4 - amino - 3,5,6 -trichloro - 2 - pyridinecarboxylic acid
		Clopyralid	3,6 - dichloro - 2 - pyridinecarboxylic acid
2.	Phenoxy	2,4-D	2,4 -Dichlorophenoxyacetic acid
		2,4-DB	4-(2,4-dichlorophenoxy)butyric acid
		MCPA	4 - chloro - 2 - methyl phenoxy acetic acid
		MCPB	4 - (4 - chloro - 2 - methylphenoxybutanoic acid
		2,4,5 - T	2,4,5 - Trichlorophenoxy acetic acid
3.	Benzoic	Dicamba	3,6-dichloro-2-methoxybenzoic acid

Table 1: groups of Auxinic Herbicides and their chemistry.

2,4-D, being a member of the phenoxy group of auxinic herbicides, was the first successful selective herbicide formulated. It was introduced in 1945 and fast became the most extensively used herbicide on the globe. Even after 60 years of discovery, 2,4-D is still the third most commonly used chemical against weed in the United States and Canada. Its major uses in agriculture are on the crops on which it is used mainly, are wheat, sorghum, corn, rice, sugar cane, as well as pasture. According to a current expert review (Dost 2003), 2, 4-D is possibly the most comprehensively researched among all pesticides, and the data have been examined by an unusual number of advisory committees and working groups.

Another devastating use of this herbicide is "Agent Orange". It is far and wide known for its use by the United States military as part of its warfare program, in the Vietnam War from 1961 to 1971. It is a blend of two herbicides, 2,4,5-T, and 2,4-D in a proportion 1:1. It acted as a defoliant and caused the loss of huge vegetation (Nwanaji-Enwerem et al., 2020).

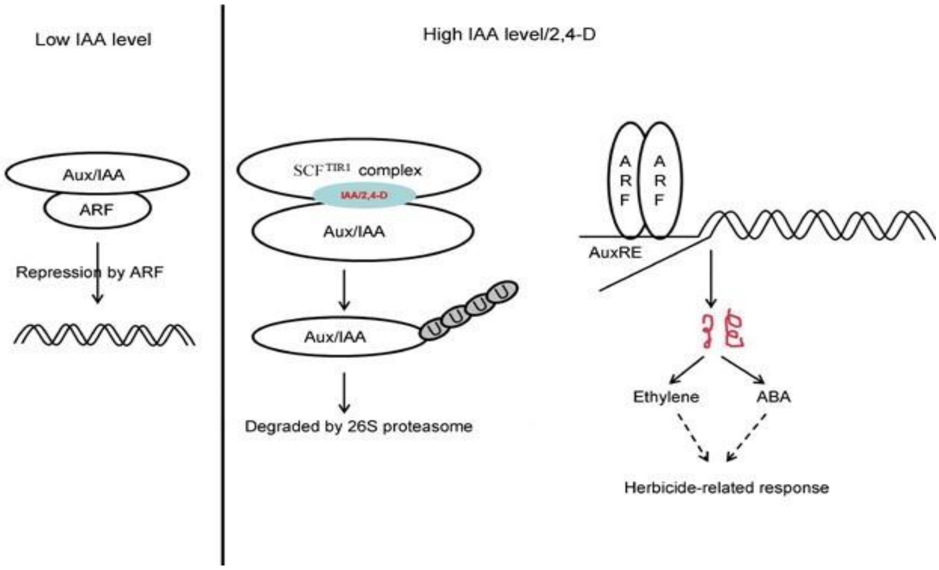
The objective to write this article is to gather information regarding the auxinic herbicides and their categories, their approach of action, and their application in farmers' fields.

Mode of Action

Early investigations have projected that the selectivity of auxinic herbicide headed for dicot weeds is for the reason that either partial translocation or hasty degradation of exogenous auxin changed vascular anatomy or transformed the perception of auxin if compared with monocots (Monaco et al., 2002; Kelley and Riechers, 2007; DiTomaso 1999). According to some scientific communities, auxin transport is influenced by plant vascular systems (Mattsson et al., 1999; Scarpellaet al., 2006). The difference in vascular tissue structure between dicots and monocots may be responsible for the selectivity of auxinic herbicides. In monocot stems, the phloem and xylem tissues are dispersed in bundles, and short a vascular cambium; in dicot stems, the vascular tissues are arranged in a ring fashion and acquire a cambium.

2,4-D is an "auxin mimic" or synthetic auxin. This category of herbicide kills the target weed by mimicking the plant growth hormone auxin (Indole Acetic Acid), and when administered at effective doses, causes uncontrolled and messy plant growth that leads to plant death.

Molecular Mechanism Model of 2,4-D Action

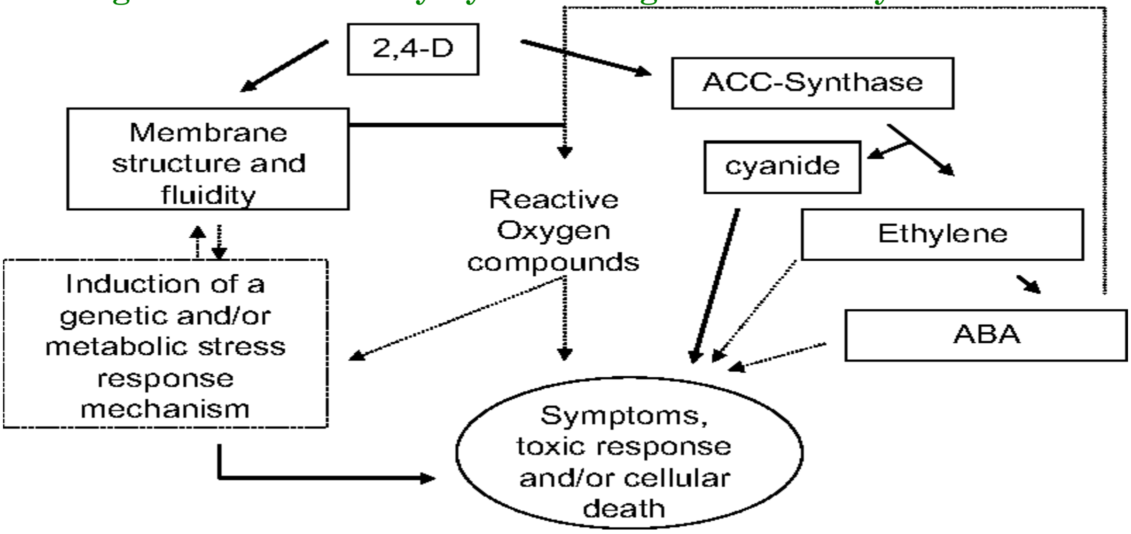


Molecular mechanism model of 2,4-D action (Song, 2014)

It is believed to acidify the cell walls which allows the cells to lengthen in an uncontrolled manner. Low concentrations of 2,4-D can also encourage RNA, DNA, and protein synthesis leading to abandoned cell division and growth, and, eventually, vascular tissue destruction. In contrast, elevated concentrations of 2,4-D can slow down cell division and growth. Plant death typically occurs within three to five weeks subsequent application (Tuetal.,2001). When optimal levels are exceeded in a specific tissue, there is an enhanced ethylene production, production of hydroxyl radicals, and closing of stomata which reduces the ability of plants to photosynthesize and ultimately leads to growth inhibition and plant death (Cobb & Reade, 2010) (Goggin, et al., 2016).

IAA binds to auxin-binding proteins located within the cell membrane, the endoplasmic reticulum, cell nucleus, and the cytoplasm. Levels of IAA require careful balancing within the plant, with IAA synthesis and degradation being carefully regulated (Hall, et al., 1999). Introduced synthetic auxin herbicides disrupt the IAA balance at a cellular level. It is believed that binding of these herbicides to auxin 'repressor' proteins results in unregulated auxin production, inducing a cascade of unregulated growth in susceptible plants within minutes after application (Dow AgroSciences, 2016).

2,4-D Controlling Cellular Death by Synthesizing Aba and Ethylene



Initial symptoms after treatment, appear as twisting, epinasty, stem thickening at the nodes, and rapid elongation of new growth, which is very similar to exogenous ethylene application effects. Auxin at higher concentration improves the activity of ACC-Synthase, an enzyme that is responsible for ethylene biosynthesis (Lee and Yoon, 2018). Ethylene is responsible for enhancing the biosynthesis of ABA (Fedoroff, 2002). Both the phytohormones lead the cell towards senescence and death through huge ROS production (Harrison, 2012). Apart from this as an auxinic compound 2,4-D also follow the acid growth hypothesis, the herbicide will be protonated in the more acidic environment outside the cell (pH ~5.5). This upsurges lipophilicity and makes it easier for the herbicide to travel across the plasma membrane into the cell via diffusion. Once inside the cell (pH ~7.5), which causes membrane fluidity and upshots an uncontrolled growth, ultimately loss of energy.

S. No.	Herbicide	Trade name	Associated crop
1.	2,4-D	2,4-D	Wheat, Corn, Rice, and other cereal crops
2.	2,4-DB	Caliber 625,Cobutox625, Embutox 625	Alfa-Alfa, Peanuts, Soybean
3.	Clopyralid	Lontrel360	Pea, Sunflower, Tomato
4.	Dicamba	Banvel, Oracle dicamba	Grain crops
5.	Fluroxpyr	Attain	Small grain cereals, Maize, and Pastures
6.	MCPA	MCPA	Cereals, Flax, Rice, Vines, Peas, and grasslands
7.	MCPB-MCPA	Clovitox plus, Topside, Tropotox plus	Peanut, Soybean, Seedling forage legumes
8.	Picloram	Tordon 22 K	Wheat, Rice, Barley, Sugarcane
9.	Triclopyr	Remedy EC	Rice, turf, landscaping, and lawn care

Table 2: Auxinic Herbicides used in field crops.

Herbicide Uptake and Translocation

Auxinic herbicides move inside plants next to foliar application, mostly through leaves or stems. The ester formulation rises the pace of uptake of these compounds through the cuticle of leaves. Amine and salt formulations are absorbed more unhurriedly and can be more easily washed from the leaves by rain. Amine and salt formulations are more easily taken up by roots than the ester forms. Once indoor the leaf cuticle, synthetic auxins go across the cell membrane and into the cells utilizing two main processes: firstly, auxin binding proteins positioned in the cell membrane bind the herbicide and move it across the plasma membrane. Auxin influx carriers shift herbicide from the free space outside the cell with auxin efflux carriers then moving herbicide from cell to cell. Secondly being weak acid herbicide will lose a proton, turn into more hydrophilic, and therefore happen to trapped inside the cell. However, it may still progress from cell to cell via the auxin efflux carriers (Hall et al., 1999).

Herbicide Toxicity

The following table shows the acute toxicity of auxinic herbicides. The higher the number, the less toxic the compound:

Common Name	Trade Name	LD_{50} (male rats' mg/kg)
2,4-D	2,4-D	762
2,4-DB	Caliber 625, Cobutox 625, Embutox 625	1,603
Clopyralid	Lontrel 360	>5,000
Dicamba	Banvel, Oracle Dicamba	2,629-3, 512
Fluroxypyr	Attain	3,738
MCPA	MCPA	1,160
MCPB-MCPA	Clovitox Plus, Topside, Tropotox Plus	1,212-3,500
Mecoprop	Mecoprop-P, Compitox	650 - 1050
Picloram	Tordon 22 K	>5,000
Triclopyr	Remedy EC	>5, 000

Table 3: The acute toxicity of auxinic herbicides

Other Functions of 2,4-D

The key job of 2,4-D at low concentrations mimics auxin to encourage cell division and elongation, and as an herbicide at high concentrations to control broad-leaf growth. In tissue culture, 2,4-D can put back IAA as a hormone complement for normal cell development in plant-cell culture mediums. Low doses of 2,4-D induce a strong defensive reaction upstream of the jasmonic acid and ethylene pathways (Zhou et al., 2009) and significantly increases trypsin proteinase inhibitor activity and volatile production. 2,4-D sprayed on rice attracted the brown planthopper *Nilaparvata lugens* and its main egg parasitoid *Anagrus nilaparvatae* (Xin et al. 2012).

Conclusion

They can be kept, stored, and traded in the form of an ester, amine, or salt formulations, as these formulations affect uptake by plants, rain fastness, and water quality interactions. One of the best characters of these herbicides is their capacity to translocate both upwards to the leaves and downwards to the roots. This ability to translocate permits the herbicidal program on perennial weeds. Ester formulations should be used if water has elevated levels of dissolved salts. Auxinic herbicides have an excellent ability to translocate and can be effective on perennial broad-leaved weeds. Translocation ability is enhanced, if herbicides are applied following bud initiation of perennial weeds. Residual soil activity is limited by rapid microbial degradation.

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Vegetable Peels: Strong Natural Source of Antioxidants

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Introduction

As a result of growing education level among the consumers, they have become more concerned about the nutritional quality of the food they are having. This has resulted in an increasing demand for healthy and nutritious products that requires a continuous assortment of new and more differentiated food products. Vegetables comprise an essential part of human diet as they are the major source of dietary nutrients of great importance. Consumption of vegetables has been found to counteract many of the chronic diseases including cancers and cardiovascular diseases. Therefore, recommendations for a balanced diet must include the consumption of fresh vegetables (da Costa et al., 2000).

Sources of Vegetable Wastes

The waste generated from vegetables and fruits include peels, shells, leaves, pomace, scrapped portion of vegetables and slurries. Around 42% of the food waste is produced during the household activities and around 39% of the food loss occurs because of the food manufacturing industry and around 5% of the agro-industrial waste produced in the food industry is because of the distribution phase (Kumar et al., 2017).

Problems of Vegetable Wastes

Significant waste and losses in the agro-processing industry are becoming a serious economical, nutritional and environmental problem. If the untreated waste is dumped into the waterbody, it will cause hidden dangers of pollution to the soil, water and air which makes the mosquitoes and flies breed, spread bacteria and damage the environmental hygiene and human health (Mirabella et al., 2014).

Nutritional Quality of Vegetables

The nutritional constituents obtained from the horticultural crops are one of the main components required for a healthy diet; water carbohydrates, vitamins, fats, proteins, organic acids, pigments, fibres and antioxidants are the major constituents obtained by the human body from various vegetables. Vegetables are considered as an amazing source of selected minerals, antioxidants, and fibre. Indeed, research and development has reported that fruits and vegetables are relatively low in calories, fats, have no cholesterol and are a good source of vitamin C and carotene. It has been found in some of the research that vegetables are rich in potassium and have relatively low amounts of sodium and because of all these amazing health benefits, vegetables have a unique contribution to a healthy diet.

Natural Antioxidants from Food Processing Wastes

Figure 1: Potato peel

1. Potato as a natural antioxidant: Potato as a natural antioxidant Potato peel (*Solanum tuberosum* L.) is considered as an excellent source of polyphenols, around 50% of the total phenolics are found in the peel itself and the adjoining tissues. Potato peel extract tends to have high phenolic content (70.82 mg of catechin equivalent/100 gm) and chlorogenic acid (27.56mg/100gm of sample). The antioxidant Figure 1: Potato peel activity of potato peel extract was found to be highly significant in the raw (aqueous and purified) and were obtained for the inhibition of accelerated oxidation in pork fat.

2. Antioxidants in cauliflower: The antioxidant activity of the edible parts of the cauliflower is widely studied and it has been found that, the edible cauliflower parts are rich in flavonoids and phenolic compounds. The inedible parts of cauliflower (*Brassica oleracia* var. botrytis) which mainly include stems and leaves are rich in health promoting phytochemicals, phenolic compounds, vitamin C, antioxidants and glucosinolates. Vegetables of Brassicaceae family are the derivatives of hydroxycinnamic, caffeic, chlorogenic, ferulic and synapic acid as well as flavonols and anthocyanins, which are mainly found in red cabbage. The dried cauliflower green leaves are highly nutritious and are rich in beta carotene-43.11mg, Iron-60.38mg, Copper-1.55mg and Manganese-5.86mg (Pankar and Bornare, 2018).

Figure 2: Cauliflower peel

3. Antioxidants in the carrot: Carrot (*Daucus carota* subsp. *sativus*) which is widely distributed throughout the world is known for its excellent health benefits. Carrot contains a huge amount of antioxidant such as vitamin A, vitamin E and vitamin C. The antioxidants present in carrot helps in maintaining the level of free radicals in the body (Ahmad et al., 2019).

Figure 3: Carrot peel

4. Antioxidants in Cabbage: The outer leaves of white cabbage (*Brassica oleracia* L. var. *capitata*) which is the by-product of cabbage processing plant, have enormous potential of being transformed into dietary fibre powder, is an excellent source of antioxidants. Sinapic acid and isofuralic acid are the most abundant phenolic acids present in the cabbage. Cabbage is a rich source of vitamins, provitamins such as folic acid and a wide variety of phenolic compounds and organo-sulfur compounds. Cabbage has higher antioxidant content than any other vegetables such as capsicum, carrot, cucumber (Tanongkankit, 2015).

Figure 4: Cabbage peel

5. Antioxidant activity of pea: Peas (Pisum sativum) are a valuable source of proteins, several phytochemicals including phylates, saponins and oxalates. Higher concentrations of phenolic compounds are found in the outer seed coat of the peas, mainly in the dark seed varieties. Examination of the seed coat and cotyledon in two dark-coloured pea varieties revealed that the seed coat contained glycosides of quercetin, luteolin and apigenin, along with a variety of simple phenolics and proanthocyanidins. Peas also contain several minor constituents like saponins and phytates, which have positive health benefits on humans as they exhibit hypocholesterolaemia and anticarcinogenic activities. The peel of pea *(P. sativum)* is widely used as a traditional medicine for the treatment of several diseases in Tunisia (Dahl et al., 2012).

Figure 5: Pea peel

Vegetable Peels for Therapeutic Purpose

Noncommunicable diseases or chronic diseases are the leading cause of deaths globally. Chronic diseases are responsible for around 71% of deaths every year (WHO, 2021). Atherosclerosis is responsible for the growing rate of cardiovascular diseases. There are several evidences that antioxidants have the potential to prevent atherosclerosis, by inhibiting the activity of reactive oxygen species (Stanner et al., 2004).

Diabetes mellitus is a noncommunicable disease that has reached the dimension of epidemic, mainly due to the worldwide explosion of obesity. The daily dietary intake of vitamin E, that could be in the form of vegetable oils, fruits, green leafy vegetables, is inversely related to the risk of having type 2 diabetes (Dhandevi and Jeewon, 2015).

Cancer is thought to arise from DNA damage in excess of ongoing DNA repair and/or the inappropriate expression of critical genes. Because of the important roles played by folate in DNA and RNA synthesis and methylation, it is possible for folate intake to affect both DNA repair and gene expression with the consumption of at least five servings of fruits and vegetables per day, which it is associated with a diminished incidence of cancer (Milman, 2012).

Conclusion

Because of increasing threat of infectious diseases, the need of the hour is to find natural agents with novel mechanism of action. The waste materials such as peels, seeds and stones produced from the vegetable processing unit can be successfully used as a source of phytochemicals and antioxidants.

However, a key obstacle, which has hindered the promotion in use of vegetable peels in the developed countries, is no evidence of documentation. Therefore, there is a need for the record of all the research work carried out on treatment of vegetable peels in the form of documentation.

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Role of Next Generation PGRs in Vegetable Crop Production

Article ID: 11389

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Introduction

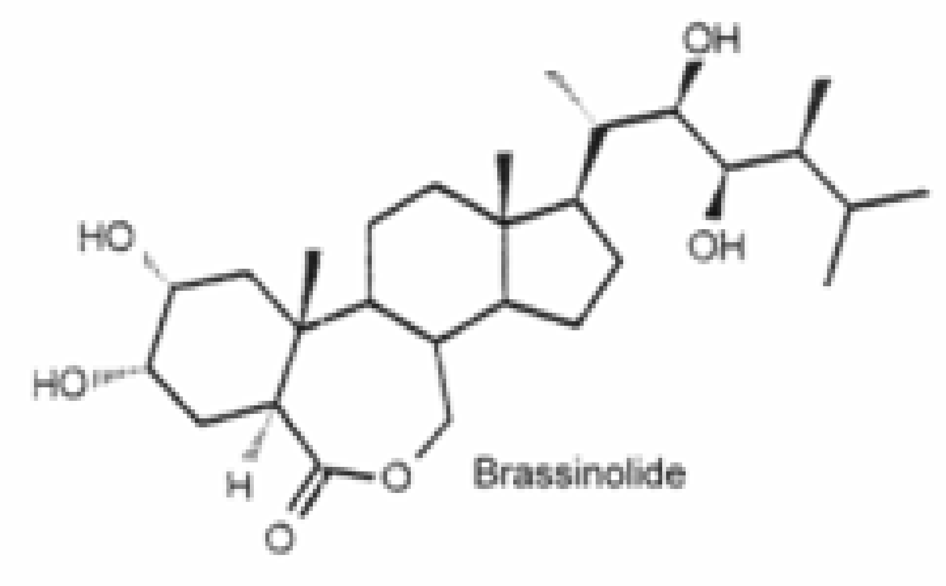
Plant Growth Regulators (PGRs)- These are small organic substances, which are synthesized in minute quantities by specific plant cells/tissues (one part of plant body) and transported to another part where they influence specific physiologic processes(promote or inhibit growth and development), active in low concentration. Hormones are synthesized or stored in regions of transduction. Hormones travel within phloem or from cell to cell after reception of appropriate stimulus.

The New Generation of Plant Growth Regulators

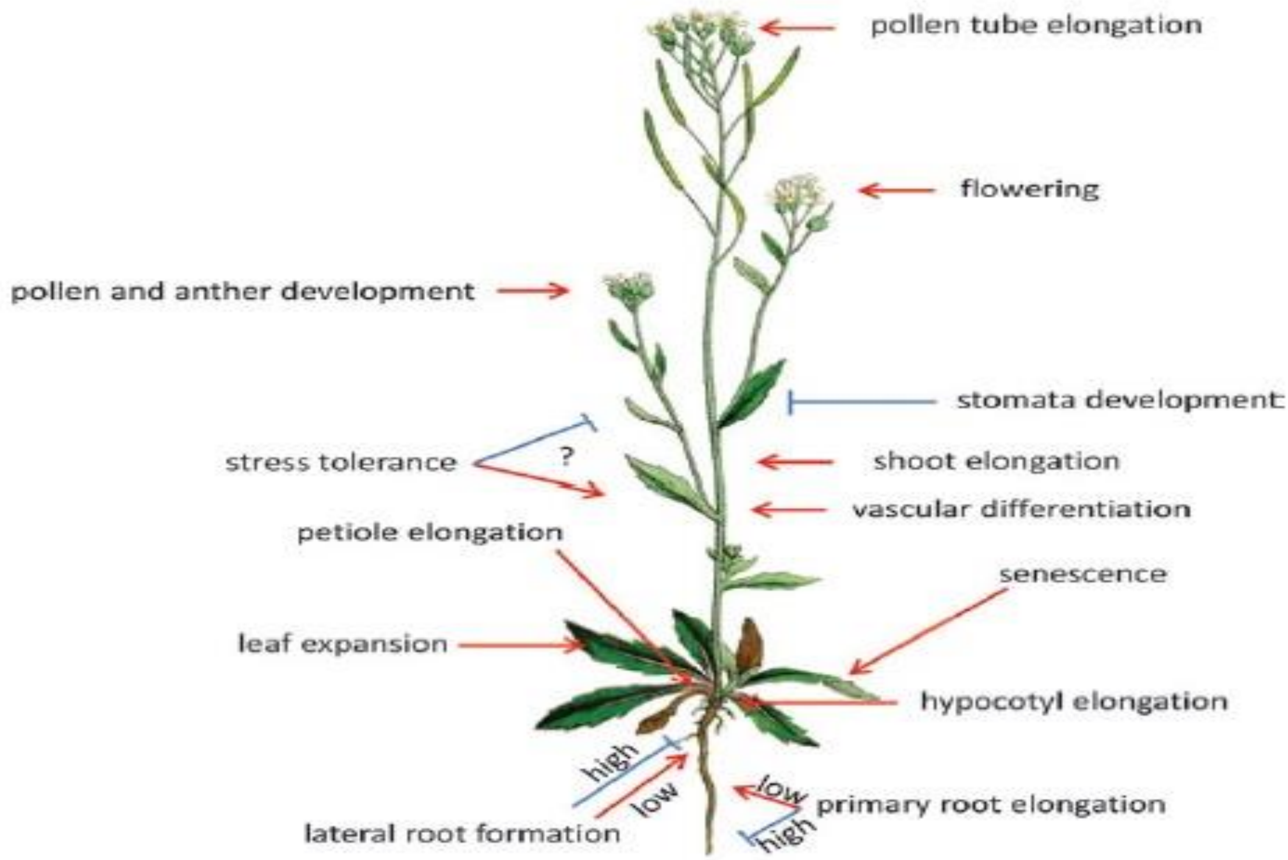
1. Brassionosteroids (BRs).
2. Jasmonic acid (JA).
3. Salicylic acid (SA).
4. Polyamines.
5. Strigolactones (SL).
6. Karikkins.

Brassionosteroids (BRs)

1. BRs are class of plant poly-hydroxysteroids.
2. Sixth class of plant hormone.
3. Occurrence - almost every part of plants.
4. BRs compound promote cell elongation and cell division.
5. BRs are biosynthesized from campesterol.
6. precursor- teasterone.



Roles of BR s in Regulating Plant Development

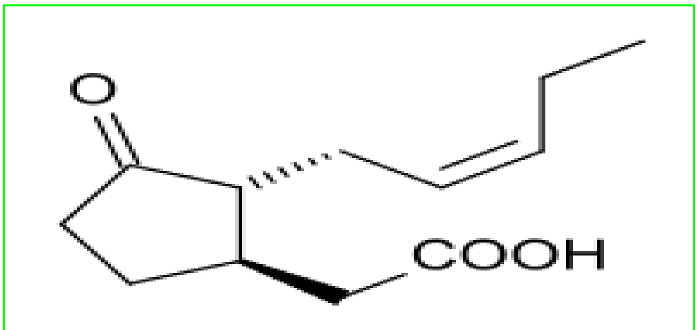


The Cellular Mechanisms of BRs Regulating Plant Development

1. At cellular levels, BRs can regulate- cell elongation, cell division and cell differentiation
2. At whole-plant levels, BRs can regulate- Hypocotyl elongation, Root and shoot development, Leaf development, Male fertility, Leaf Senescence and Responses to biotic and abiotic stresses.

Increase response of BRs in vegetable crops		
Crop name	**Compound**	**Response**
Potato	Brassinosteroids	Tuber yield
Commercially available BRs for vegetable crops		
Trade name	**Country**	**Recommended crops**
Biobras-6	Cuba	Potato, onion
Biobras-16	Cuba	Onion
DAA-6	Cuba	Potato, tomato
Double	India	All major crop plants

Jasmonic Acid



1. Precursor for JA Biosynthes is linolenic acid.
2. Methyl Jasmonate - 1st isolated from the essential oil of *Jasminum grandiflorum*.
3. JA & its volatile methyl ester (MeJA) – class of cyclopentanone compounds.
4. Regarded as endogenous regulator.

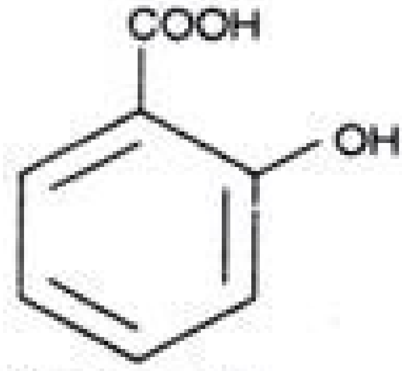
Role of Jasmonic Acid

In pest control: When plants attacked by insects, they respond by releasing JA , which activates the expression of protease inhibitors. (These protease inhibitors prevent proteolytic activity of insects 'digestive protease or salivary proteins there by stopping them from acquiring the needed nitrogen in the protein for their own growth).

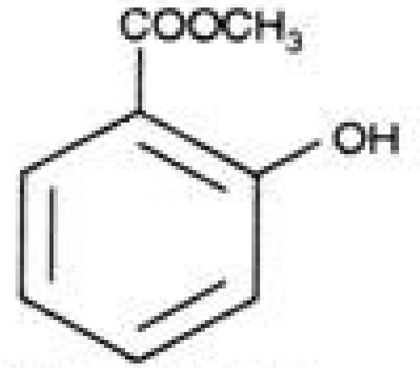
As hormone: Senescence, tendril coiling –stimulation, flower development, leaf abscission, trichome induction- Tomato, adaptation to environmental stress and tuberization- Potato, yams, and onions.

Salicylic Acid

1. Natural phenolic compound.
2. Colorless crystalline organic acid.
3. Derived from - A monohydroxy benzoic acid.
4. Role in physiological and biochemical processes including, photosynthesis, ion uptake, membrane permeability, enzyme activities, flowering and growth and development of plants.



Salicylic acid



Methyl salicylate

Role of Salicylic Acid

1. Post-harvest storage of fruits.
2. Fungitoxicity- Reduce lesion diameter of fruit caused by fungi.
3. Inhibit fungal growth & spore germination in vitro.
4. Induce Phenylamine ammonialyase, SOD activities during storage.
5. Delay fruit ripening (By inhibiting Ehylene biosynthesis).
6. Exogenous application (expression of defense genes during storage).

Polyamines (PAs)

1. Occurance- cytoplasm, mitochondria, chloroplasts and vacuoles
2. Sources for commercial isolation of polyamines- Cucumber (*Cucumis sativus* L.) and Radish (*Raphanus sativus* L.).
3. Derived from – Amino acid
4. Types of Polyamines:
    a. Putrescine (PUT).
    b. Spermidine (SPD).
    c. Spermine (SPM).

Polyamines Associated with Regulating Many Physiological Processes

1. Organogenesis.
2. Embryogenesis.

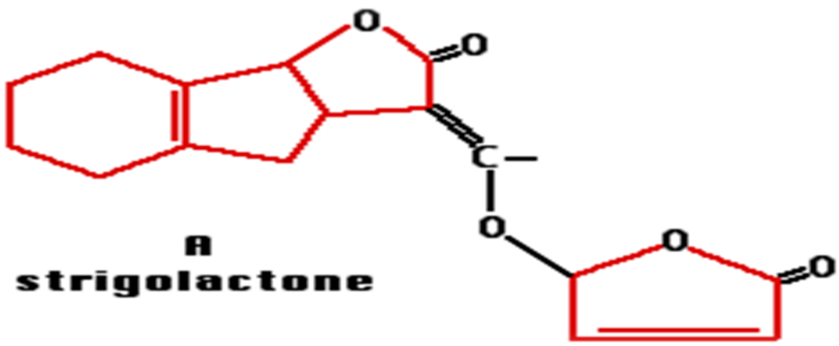
3. Floral initiation and development.
4. Leaf senescence.
5. Fruit development and ripening.
6. Abiotic and biotic plant stress responses.

Polyamines are Implicated in Growth and Development Process Such as

1. Breaking of dormancy in potato tubers.
2. Adventitious root formation & growth in Phaseolus.
3. Somatic embryogenesis (eg. Carrot).
4. Development of floral organs in tomato.
5. Adaptation to resist chilling in cucumber seedlings.
6. PAs have been considered as antisenescence agents.
7. Polyamines play an important role in the improvement of the shelf life of fruit.

Strigolactones

1. Endogenous hormones to control plant development.
2. Stimulate seed germination.
3. Regulation of lateral shoot branching and root development.



Role of Strigolactones

1. It is use to suppress adventitious rooting in Arabidopsis and Pea (The synthetic strigolactone GR24 was added exogenously).
2. Strigolactones are positive regulators of light-harvesting genes in tomato.

Karrikins

1. Chemically defined family of PGR discovered in smoke from burning plant material.
2. Smoke from burning plant material elicits a striking increase in seed germination under field conditions in over 1200 species from 80 genera
3. Karrikins are potent in breaking dormancy of seeds of many species adapted to environments that regularly experience fire and smoke.
4. The recent discovery that karrikins trigger seed germination and control seedling growth.

Role of Karrikins

1. Karrikins enhance light responses during germination and seedling development in *Arabidopsis thaliana.*
2. Karrikins: Regulators Involved in Phytohormone Signalling Networks during Seed Germination and Seedling Development in *Arabidopsis thaliana.*

Conclusion

1. Plant hormones are endogenous organic compounds active at very low concentration, produced in one tissue, and translocated to another point in the plant where their effects on growth and development are manifested.

2. All Phytohormones not only play a central role in growth & development of plants but also boost up their immune system against any stressful condition.
3. Brassinosteroids promote apical dominance, formation of xylem and leaf senescence, enhances seed germination, increase production of ethylene, increase resistance to freezing.
4. Major function of JA is regulating plant responses to abiotic and biotic stresses as well as plant growth and development processes including growth inhibition, senescence, leaf abscission, tendril coiling, flower development, enhance shelf life of vegetables & also reduce the chances of their post-harvest disorders.
5. Salicylic Acid can be used to develop SAR to protect plant against different stresses by involving the endogenous signalling, mediating in plant defence against pathogens.

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Role of Mycorrhiza in Agriculture

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Abstract

Mycorrhizas are one of the most common and ancient symbioses on the planet. Most plants benefit from these plant–fungus relationships in terms of nutrition and water interactions. Mycorrhizae are important components of soil fertility, play a role in soil structuring and stabilisation, and store carbon below ground. It is a unique perspective of mycorrhizal research advances at the interface of biological, soil, and earth sciences as well as in crop field.

General Information

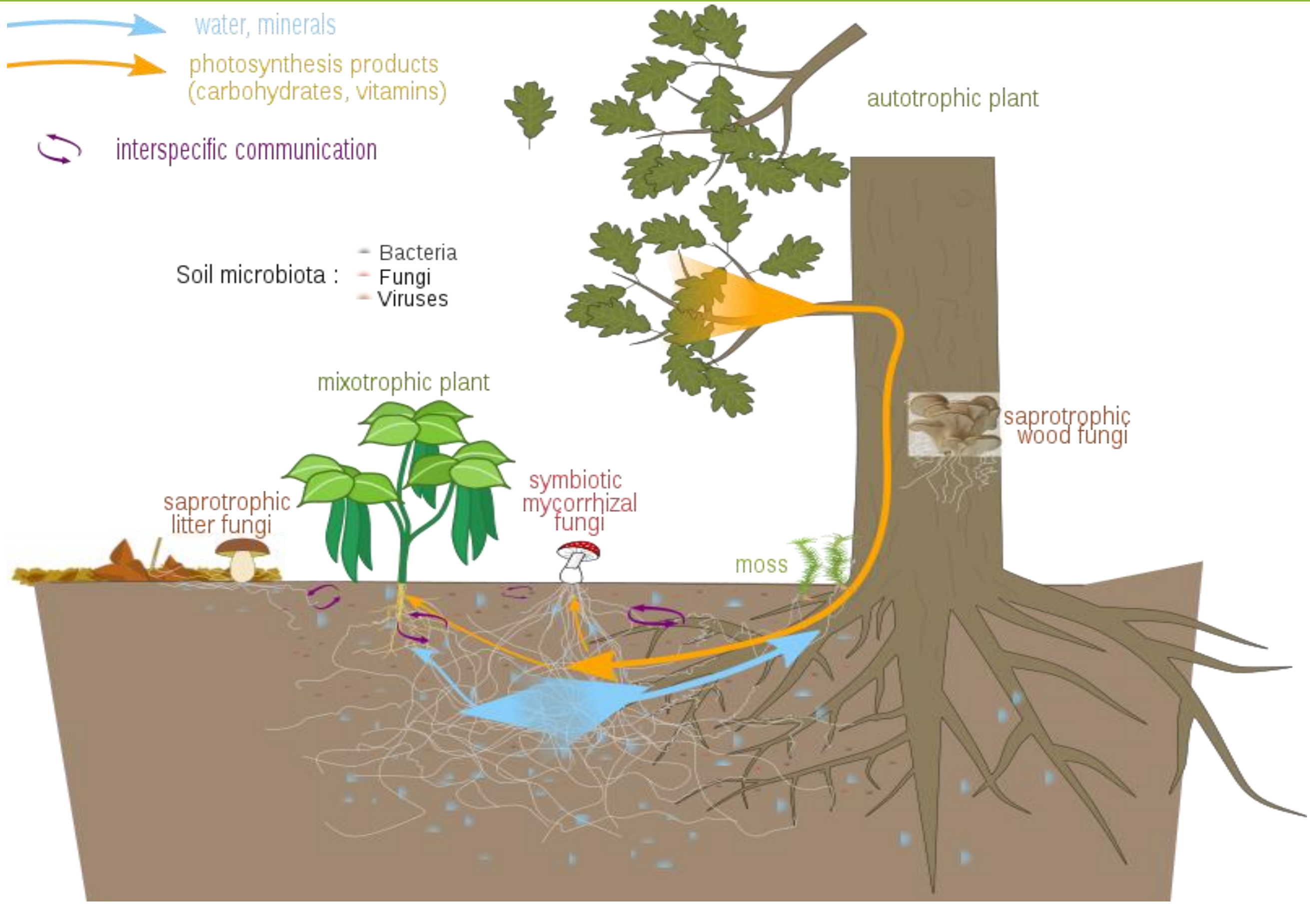
Mycorrhiza is derived from the Greek words "myco" and "rhiza," which mean "fungus" and "root," respectively. The fungus and the roots of field crops and forest trees form a symbiotic relationship. The fungus colonises the root tissues of the host plant in a mycorrhizal relationship, either inner side of the cell (intracellularly) as in arbuscular mycorrhizal fungi (AMF) or outside the cell (ectomycorrhizal fungi). In general, the association is mutualistic and, in these mechanisms, the plant receives solar energy through chlorophyll and transfers it to the fungus, while the fungus provides the plant with water and vital mineral nutrition elements. Some families, such as Brassicaceae and Chenopodiaceae, do not have this type of association. The arbuscular form is the most widespread and found in 70 percent of plant species, including important field crops like wheat and rice. The Amanitaceae, Bolataceae, Cortinariaceae, Russulaceae, Rhizopogonaceae, Sclerodermataceae, and Sclerodermataceae families of ectotrophic fungi are mostly connected with tree taxa such as pinus, populus, alnus, fagus, carpa, and salix. The endotropic fungi or arbscular Mycorrhizae is mainly associated with most of the agronomic and horticultural trees. Mycorrhizae (plural) are divided into two types: ectomycorrhiza and endomycorrhiza. This classification is primarily based on the penetration of hyphae. The hyphae of ectomycorrhizal fungi do not penetrate into the root cell, but the hyphae of endomycorrhizal fungi penetrate into the cell.

Mechanisms

Mycorrhiza improves nutrient absorption in both physical and chemical ways. Physically, they provide a larger surface area for absorption. Chemically, they may secrete an organic acid that dissolves the nutrients, chelate a large number of ions, or ion exchange to liberate them from minerals.

Ectomycorrhizae fungi mechanism: A fungal sheath, or mantle, surrounds the roots of the host plant in this association, which is similar to the structure of ectomycorrhizal associations. The hyphae of the fungal hyphae also create a hartig net in the outer cortical cells. The hyphae form coils within the cells, allowing nutrients like phosphorus to be transferred from the fungus to the plant and vice versa. The mechanisms by which endomycorrhizae convert insoluble phosphorus into a usable form can be summarised as follows: insoluble Phosphorus in soil→ fungi hyphae→ fungal sheath →hartig net →cortex cell of roots → P to vasculal bundal in plant

Endomycorrhizae fungi mechanism: Endomycorrhizal fungi's hyphae not only develop inside the plant's root, but also enter the cell walls and become encased in the cell membrane. The presence of arbuscules and vesicles distinguishes the endomycorrhizae fungi. Vesicles serve as a reserve organ, releasing mineral elements to the plant or exchanging nutrients.



Benefits of Arbuscular Mycorrhizae (AM)

1. Increased root absorption capacity as a result of morphological and physiological changes in the plant, as well as increased nutrient mobilisation from the soil to the plant (P, N, S, Cu, Zn, etc.).
2. Better proliferation of P solubilizing bacteria in the rhizosphere enhanced nodulation and atmospheric nitrogen fixing ability in legumes.
3. Antibiotic secretion suppresses disease and reduces root sensitivity to soil-borne pathogens. Mycorrhizas produce enzymes that are harmful to soil-dwelling creatures like worms.
4. Increased production of PGR such as cytokinins and gibberellins.
5. Plant adaptation to adverse environmental conditions such as drought and heavy metals; mycorrhizal fungus detoxify the environment for plant growth when heavy metal concentrations in soil are high.
6. Glomalin, a glyco sugar protein, increases soil particle aggregation, which enhances soil structure and function by boosting aeration and water interactions. Glomalin is resistant to rapid decomposition, allowing for increased organic matter content in soil, which could be one of the most important carbon storages in the system.
7. Increase's water retention and percolation; improves plant nutritional status while lowering fertiliser costs.
8. Mycorrhizal fungi colonise plant roots and help them absorb mineral nutrients from the soil.
9. Arbuscular mycorrhizal fungi alleviate the salt stress condition in the soil.

Mycorrhizae Role in Forestry

1. Mycorrhiza plays an essential role in the establishment of forest in inhospitable environments such as barren land, wastelands, and so on.
2. Trees with facultative endotropic mycorrhiza operate as first invador in plant succession in wastelands.
3. Using mycorrhizal fungi on forest trees promotes the creation of a mycorrhizal connection, which prevents the fungal root pathogens. This approach is particularly successful against Phytophthora cinnamon infection in the root of Pinus clausa.
4. Mycorrhizae give nitrogenous substances to plants, which aid plant growth, particularly in acidic soils.

Conclusion

The agriculture sector is one of the most important application areas for mycorrhiza, particularly for wheat, oat, barley, maize and for most of other agricultural crops. Mycorrhiza is suitable for a variety of seed coating methods, including traditional seed coating and film coating. It is applied to agricultural seeds and provides considerable benefits to crops, such as increased yield, improved environmental stability, and a reduction in the use of chemical fertilisers.

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Crop Residue Management in Black Soil for Higher Productivity and Soil Health

Article ID: 11391

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Introduction

In the recent past systems approach has gained importance in Agriculture. As farmers are cultivating different crops production technology or management practices should be developed keeping in view all the crop grown in a year or more than one year. So, the crop residue management in black soil needs an attention.

Crop Residue

"The portion of a plant left in the field after harvest of the crop that is (straw, stalks, stems, leaves, roots) not used domestically or sold commercially".

Need of Crop Residue Management

1. Effective nutrient management involving available organic source including wastes and crop residue.
2. The deficit of nutrients to meet crop demand has to come from source other than chemical fertilizers.
3. Demand for fertilizer will increase by 10 to 15 mt in near future.
4. So in order to meet these demands effectively on alternative way like CRM in need to be addressed sincerely.


Crop Residue Management

1. Use of the non -commercial portion of the plant or crop for protection or improvement of the soil.
2. CRM, a cultural practice that involves fewer and/or less intensive tillage operations and preserves more residue from the previous crop, is designed to help protect soil and water resources and provide additional plant nutrients and environmental benefits.

Availability and Resource Benefits of Crop Residues India

1. Gross Sown Area : 68%
2. Total Crop Residue : 392.58 Mt
3. Based on calculations, the total N, P_2O_5 & K_2O removed by crop residues amounts to approximately 2.321, 0.732 and 4.898 M t per year (total 7.951 M t per year).

4. Of the total crop residue production (392.58 M t), more than 2/3rd of total residue production comes from rice (33.55%), wheat (27.91%), and oilseed crops (12.65%) and less than 1/3rd from other crops like sugarcane, pulses and other millets
5. About 57% is produced during kharif and 43% during rabi. Rice produces half of the kharif residue whereas wheat and sugarcane together contribute nearly 2/3rd of the rabi crop residue.

Factors Affecting Decomposition of Residues

1. Time of incorporation.
2. Size of the residue.
3. Shredding and Blending.
4. Size reduction of crop residue.
5. Number of residues.
6. Decomposition of residue by micro-organisms.
7. Decomposition of residue in Tropical / sub-Tropical soil.
8. Tillage and residue Decomposition.

Practices of Crop Residue Management

1. In situ incorporation.
2. Composting of crop residues.
3. Crop residues as surface mulch.
4. Cover crops.
5. Green manuring.

In Situ Incorporation

Many field experiments have demonstrated the beneficial role of straw incorporation on the yield of crops in comparison to removal of residue.
1. Crop residues are incorporated in soil before sowing of succeeding crop.
2. Period available for decomposition of crop residues is important so as to ensure mineralization of nutrients.
3. Crop residues having wide C: N ratio decomposes slowly in the soil.
4. Besides the C: N ratio of the plant material , initial N concentration, lignin, polyphenols and soluble C compound present in residues are also the key indicators of decomposition.
5. Decomposition is highly influenced by soil properties, temperature and moisture regime.

Crops Suitable for in Situ Incorporation

1. Cowpea.
2. Dhaincha.
3. Sunhemp.
4. Greengram.
5. Berseem.
6. Blackgram.

Composting from Crop Residues

In situations, disallowing adequate decomposition period for the soil incorporated residues; the residues should be managed through composting during the crop season.
1. C:N ratio of raw material is most favorable for efficient composting.
2. With wide C:N ratio such as in residues of wheat, paddy, sorghum, pearl milet, maize, sugarcane trash, stalks of cotton, jute and sawdust , microbiological activities diminish, as they do not get sufficient amount of nitrogen. Consequently, several cycles may be required to degrade carbonaceous materials, prolonging the period of composting.
3. If C:N ratio is low i.e., less than 30, the proportion of nitrogen is in excess of the requirement of microorganisms, consequently, the process of decomposition is faster.

Crop Residue as Surface Mulch

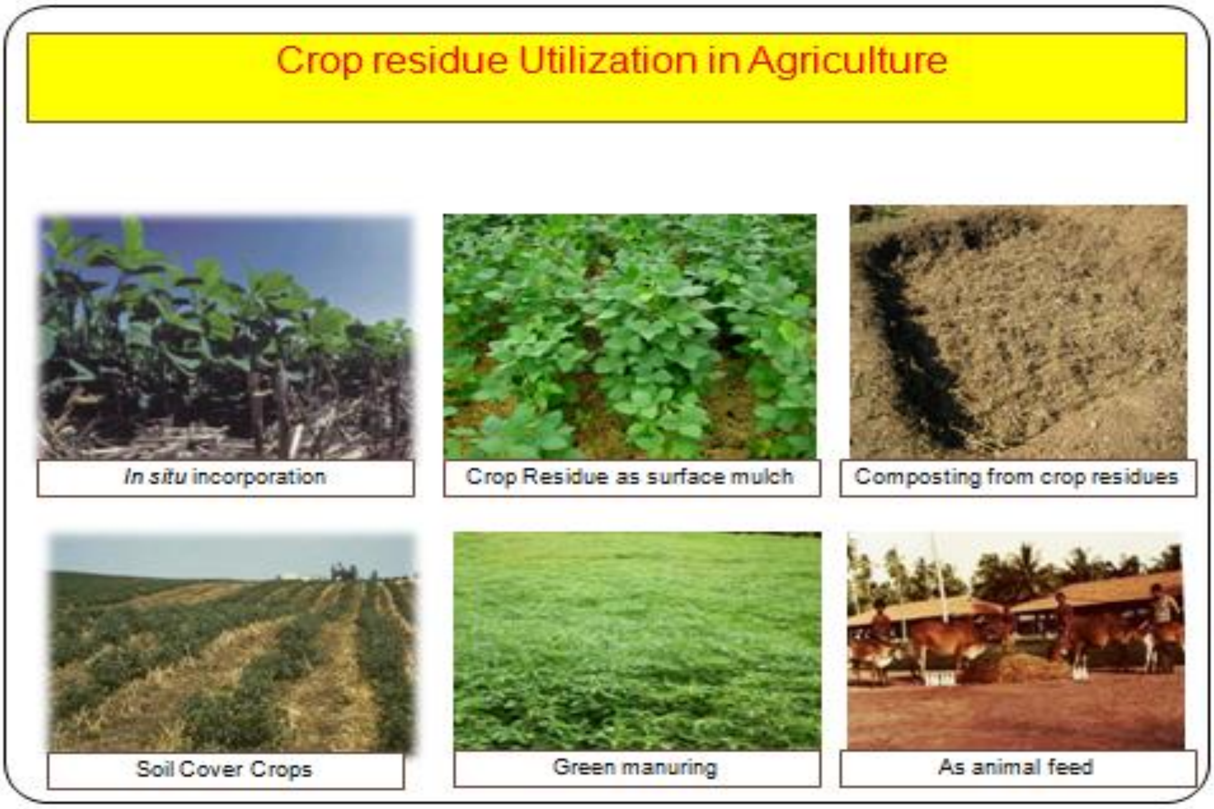
1. Mulch also improves the soil water storage capacity and reduces evaporation losses.
2. Beneficial effect of crop residue mulch on soil and temperature change, effects different plant process like seed germination, seeding emergence and root growth which in turn determine growth and yield of crops.
3. Crop residue is an effective mean for reducing runoff, erosion and transport of sediment to stream.

Cover Crops

Plant material: Moderate temperature increases water penetration and storage enhances soil aeration maintains soil structure, prevents erosion by softening the impact of falling raindrops.

Green Manuring

It is a farm practice of incorporating into the soil live plant materials called, green manures, to improve its fertility and physical structure. Eg. Sunhemp, Mung beans, black gram, Cluster beans.



Conclusion

Organic material is dynamic material changing/improving physical, chemical and biological properties of soil effectively , on sustainable basis over a long period. Crop residue management has great water storage in the soil, reduced soil erosion, moderating soil temperature, runoff losses and soil surface evaporation losses.

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Incubation of EGG

Article ID: 11392

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Introduction

Hatching means production of baby chicks from fertile eggs. The term "Hatching" is also known as Incubation. The process of incubation/hatching seems nearly magical because by means of this process, within a period of 21 days (in case of chicken), a fertile egg is converted into a chick, which is capable of walking, eating and expressing its needs by its voice and action. Nowadays, hatching of eggs is taken as a business, and it is known as hatchery enterprise. The whole venture of hatchery enterprise includes procurement of fertile eggs, their hatching, and finally, selling of chicks to the poultry farmers.

Incubation Period of Various Poultry Species

The period between setting of eggs and hatching is known as incubation period. It varies from one species of bird to the other.

Species od bird	Incubation period (days)
Chicken/Fowl	21
Duck	28
Geese	28
Guinea fowl	28
Japanese quail	17-18
Turkey	28

Methods of Hatching

The method of hatching of eggs are of two types, viz.,
1. Natural hatching (with the help of live bird/broody hen).
2. Artificial hatching (with the help of machine/incubator).

Natural Hatching

It is a very primitive method of hatching of eggs for production of chicks. This method is popular with the small poultry keepers in remote rural areas in many parts of our country. The requirements of this method are discussed below-

Selection of broody hen: The hen should be thoroughly broody and broodiness may be tested with dummy eggs. She should be healthy, quiet and a good sitter, and have a good body size with all feathers in her body. The ordinary deshi hen is ideal for this purpose.

Nest: Nest should be roomy, fairly dark, cool and well-ventilated, readily accessible and easy to clean. An earthen pot, about 15 inch in diameter and 8 inch deep may be used for this purpose. The nest may be made up of fine soft hay, straw or dry leaves and placed on the ground.

Best time to set hen: The best time to set hen is at because,

a. Broody hen is more likely to settle down on the eggs at night
b. Chicks are more likely to appear on the night of 21st day and will have the whole night to take rest and grain strength.

No. of eggs under a hen: It depends on the size of the hen. Maximum 10-15 eggs can be placed under one hen.

Care of setting hen: The setting hen should be provided with warm water and feeds regularly. Cold clean water should be provided at least two times a day and whole grains are desirable feeds for sitting hen. The hen should be taken out from the nest at least two times a day for about 30 minutes to be fed and watered. Exposure of hatching eggs to the fresh air during this time is also beneficial.

Advantages of Natural Hatching

1. It requires no capital investment for purchasing any machine and it is profitable for small number of chick production
2. There is no need of skilled person
3. No need of brooder/brooding management and broody hen will care the newborn chicks.

Disadvantages of Natural Hatching

1. It is not suitable for large scale production on commercial basis.
2. It is not always possible to get broody hen as and when required.
3. Some eggs may be broken due to faulty sitting of broody hen.
4. Hens do not lay eggs when they are engaged in hatching business and thereby the total number of egg production will be less.
5. Some diseases may be transmitted from broody hen to newborn chicks.
6. The broody hen may sometimes leave the eggs before completion of hatching. All the eggs get spoiled in such a case.

Artificial Hatching

Artificial hatching is done by means of a machine known as egg incubator or setter or hatcher. The necessary micro-environment is created by this machine. Time required for artificial hatching is the same as that of natural hatching. The following arrangements should be present in an incubator:

1. Fan for circulation of air.
2. Arrangement for automatic heat control for maintaining temperature.
3. Arrangement for maintaining humidity.
4. Thermometer for temperature/humidity reading.
5. Automatic turning device.
6. Egg tray and chick tray.

The most important conditions for successful hatching of eggs are maintenance of optimum temperature and humidity, proper ventilation and turning of eggs. These conditions very from one species of poultry to other. In case of hatching of chicken eggs, the favourable conditions are (a) 37.5-37.7°C temperature, (b) 60-70% relative humidity, (c) circulation of fresh air containing 21% oxygen, and (d) turning of eggs, required during first 18 days of incubation during the first 18 days of incubation.

Advantages of Artificial Hatching

1. Large number of eggs can be hatched at a time.
2. Hatching may be done as and when required without broody hen.
3. The rate of hatching is very high and it is profitable from economic point of view.
4. It is most useful for the hatchery business.
5. There is no diseases transmitted in case of artificial hatching, as brooding of newly hatched chicks is also done artificially.

Disadvantages of Artificial Hatching

1. Incubator and brooder are needed, which involve large capital investment
2. It requires skillful management, otherwise the whole programme will be upset
3. The machinery defects at any time of incubation leads to heavy loss
4. The newly hatched chicks need special nourishment. The broody hen performs this function in case of natural hatching
5. Disease may transmit through incubator if cleaning and fumigation is not done properly.

Role of Indoor Plants in Improving Internal Atmosphere

Article ID: 11393

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Introduction

Humans evolved on and have walked the earth for tens of thousands of years and throughout this time plants have played a vital role in human lifestyle. The evolutionary links with plants are deeply rooted in our genes and even today this manifests itself in a variety of ways. In the modern world we increasingly spend more time indoors either at the work place or at home. The internal environment can be improved with plants included as a component in the interiorscape of the buildings. They not only increase the aesthetic value of the interior, but also help in improving the internal environment.

Interior Plants Apart from Looking Good have been Proven to have Significant Health and Wellbeing Benefits

This is because of two major effects:

1. Physical - the cleaning, purification and conditioning of the air we breathe.
2. Psychological - the very presence of plants has been shown to increase positive feelings and reduce feelings of anxiety, anger and sadness.

Why Indoor Plants?

1. Indoor plants can be very beneficial in homes and workplaces.

2. They purify and renew stale indoor air by filtering out toxins, pollutants and the carbon dioxide we exhale - replacing them with life sustaining oxygen.

3. One can use plants in home or office to improve the quality of the air to make it a more pleasant place to live and work - where people feel better and perform better.

Plants can remove a variety of toxic air emissions including ammonia, formaldehyde, carbon monoxide, benzene , xylene and trichloroethylene

4. Indoor plants act as filters for air pollutants - Air pollutants are generated by computer equipment, furniture, paint and air conditioning. The air pollutants are circulated in the air in the office.

5. Indoor Plants make the work environment livelier.

6. Indoor plants make every office look great and have been shown to reduce illness and increase productivity.

7. Studies have shown that, hospital patients who face a window with a garden view recovered more quickly than those who had to look at a wall

8. NASA research on indoor plants has found that living plants are so efficient at absorbing contaminants in the air that some will be launched into space as part of the biological life support system aboard future orbiting space stations.

9. NASA study states that common house plants could improve air quality. In fact, they reported that houseplants were able to remove up to 87 percent of air toxins in 24 hours.

Some Added Advantages of Indoor Plants

1. Increased positive feelings and reduced feelings of anxiety, anger and sadness.
2. Reduction of sound levels.
3. Reduction of stress levels.
4. Control of humidity to the within the optimum levels for human health.
5. Cooling effect.
6. Absorption of carbon dioxide and emission of oxygen refreshing the air.

TOP 10 Plants Most Effective in Removing: Formaldehyde, Benzene, and Carbon Monoxide from the Air (Acc to NASA)

1. Bamboo Palm – *Chamaedorea seifritzii*
2. Chinese Evergreen - *Aglaonema modestum*
3. English Ivy - *Hedera helix*
4. Gerbera Daisy - *Gerbera jamesonii*
5. Janet Craig - Dracaena "Janet Craig"
6. Marginata - *Dracaena marginata*
7. Mass cane/Corn Plant - *Dracaena massangeana*
8. Mother-in-Law's Tongue - *Sansevieria laurentii*
9. Pot Mum – *Chrysantheium morifolium*
10. Peace Lily - *Spathiphyllum*
11. Warneckii - Dracaena "Warneckii"

Plants Suitable for Indoors

1. Climber: *Ficus pumila, Ficus radicans variegata, Asparagus plumosus, A. springeri, Hedera helix, Philodendron elegans, P. laciniatum, P. melanochrysum, Scindapsus aureus (Pathos), S. aureus Marble Queen, S. aureus Tricolor, Syngonium podophyllum.*

2. Trailers: *Chlorophytum comosum variegatum, Fittonia verschaffelti, Tradescantia fluminensis, T. f. variegate, Zebrina pendula, Z. purpusii (Tradescantia purpurea).*

Flowering House Plants

1. Climbing and training types: *Begonia glaucophylla, B. glabra, Passiflora caerulea, Trachelospermum jasminoides.*

2. Bushy and upright types: *Aphelandra squarrosa, Begonia maculata, B. manicata, Beloperone guttata, Bilbergia nutans, B X windii X Impatiens petersiana, Saintpaulia ionantha (African Violet).*

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Application of Artificial Intelligence (AI) in Plant Protection

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Summary

Artificial intelligence, the intelligence clinched by machines are now being applied as a contemporary tool in the field of agriculture to identify pests and diseases. With increased global demand for agricultural crops to feed for rapidly growing population, production has been increased through the integration of many technologies such as genetically modified crops, improved cropping systems, modernized tools, new generation pesticides and etc.,

These technologies, besides increasing crop production, brought about the evolution of many new pests, diseases and nematodes which pose significant menace to the global food security. Traditional pest and disease identification approaches mainly rely on agricultural specialists.

However, in developing countries with inadequate human infrastructure capability, these methods are limited. Early detection of pests and diseases leads to a prompt interruption of food supply chain, resulting in reduced impacts of them on crop plants.

With the help of Artificial Intelligence (AI) enabled technology, precise data on the incidence of pests and diseases can be acquired from the photos acquired by drones / satellites, which aids in forecasting pest and disease outbreaks based on specific meteorological conditions.

Introduction

Destruction caused by pests and diseases in crops is estimated to be in the billions of dollars. These pests and diseases are estimated to destroy between 20 to 40 per cent worldwide agriculture output each year, according to United Nations Food and Agriculture Organization (FAO).

Farmers, generally require specific information on the outbreak and control of pests and diseases at specific time in order to avoid crop losses and to accelerate economic growth. Many smallholder farmers rely on empirical knowledge to overcome farming issues, which is ineffective (Hillnhuetter et al., 2008).

Proper identification of pests and diseases is the first step in pest and disease control, which can be accomplished with the use of Artificial Intelligence (AI) assisted tools.

AI in Crop Protection

AI based technologies were used to detect pests and diseases in a variety of crops. As a result of application of AI in agriculture, visible improvements in crop protection can be realized on a long-term basis. Nematodes, which are tiny in nature, are also difficult to identify using traditional taxonomic keys. Through CNN (Convolutional Neural Networks) models, AI aids in the identification of nematode species diversity.

State-of-the-art technologies such as AI, robots, satellite reporting, cloud computing and machine learning will become an indispensible instruments in near future, allowing agriculture to be modified more intelligently. In this connection, development of AI models with advanced features which analyze the pests and diseases by recognizing the visual symptoms of the crops at field level will help the farmers to avoid the crop losses during the early stages of pests and diseases infestation. Early identification of crop diseases or pests can lead to faster interventions which results in reduced impacts on food supply chains. AI with deep learning models help in detecting plant diseases based on the visual symptoms of the plants (Camargo and Smith, 2009).

Many AI based apps for smart phones are now available to diagnose pests, diseases and their associated symptoms, which alert the farmers to take proper action to control them. Smartphone-based AI apps might alert the farmers and expedite disease diagnosis, thus preventing the possible outbreak of pests and diseases (Mohanty et al., 2016). Even though, many farmers of developing countries do not have access to these advanced tools, smart phone penetration offers new potential for in field crop disease diagnosis.

Many mobile based apps provide a free solution to assist farmers in minimizing crop losses. With photographs collected from the damaged crops, these apps assist farmers in diagnosing insect and disease damage, as well as nutritional deficiencies. Users can talk about probable causes and solutions with each other or with specialists in order to keep track of infestations and propose scientifically proven solutions.

One of the main challenges in digital app is to maintain its accuracy, since detection success in digital apps are estimated to be at 85 per cent accuracy only. Pests and diseases are recognized to be evolved throughout the cropping period and hence updating the information regarding the pests and diseases should be the continuous process of digital apps to provide intangible benefits to the farmers (Ruparathanam, 2020).

Earlier investigators have validated AI based recognition of crop diseases in wheat (Siricharoen et al., 2016) and cassava (Ramcharan et al.,2017). Although, many computers visioned approaches for automated crop disease detection and classification have been reported, but still, a detailed exploration of real time pest and diseases recognition is lagging.

To build robust and more practical detection models, plenty of healthy and diseased images should be taken from different infected parts of the plants growing under different environmental conditions. These images subsequently need to be labeled and pre-screened by plant pathology experts. Until now, existing crop disease detection models have mostly focused only on leaf symptoms. Unfortunately, many symptoms are also appearing in other parts of the plants and the best example is banana pest and disease linked symptoms.

There are approaches that use satellite data or images from drones and there are some prototype robots that roam around the fields looking for pests, having accurate efficacy in the identification of pests. Knowledge on initial arrival of pests in the field is important to predict further growth and development of the same in the field.

Farmers mostly use pesticides to control the infective larvae present in the soil. If they know more exactly which stage of larvae is present in the field, they can take suitable control methods rather than using hazardous pesticides. Real time data obtained through AI based techniques and the dynamic economic threshold model available in the database for each insect pest and crop will aid the farmers to take protective measures against crop pests.Since, we live in the digital age where we have literal drones to do our bidding and there are apps for anything and everything, these digital marvels aid in the protection of agricultural crops.

Drones in the Field of Agriculture

Drones are small, lightweight remote-control aircraft with an attachable camera that have a variety of functions. When their movement and camera are linked to certain software or programmes, extremely precise data can be generated. In recent days, many pest control companies are exploring the use of drones. Drones offer crystal clear images of difficult to reach locations. When a carefully designed drone hovers over crop fields row by row, it can detect pests and disease spots from afar. It can label the problematic regions of the plants and can indicate whether the problem is plant related or deeper underground. For industrial agriculture, where no one has time to walk every field, gathering the knowledge on pests and diseases is crucial. Drones with high-definition cameras can detect differences as small as a single bug. Hence, farmers can use this technology to detect problems early and to stop the spread of crop death before it becomes an epidemic.

Conclusion

Artificial intelligence has undoubtedly aided massive agricultural operations in a significant way. Picture the drones swooping quickly over a lawn or field can be used to decide the treatments to be imposed for the particular problem. Future applications of AI are virtually limitless. While there is no way to entirely automate pest treatment, technology can undoubtedly assist. Artificial intelligence, which is now utilized in the field of agriculture, can be applied to home pest treatments as well, to make them more cost effective for both owners and customers.

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Will Setting Up a Layer Farm in India be Profitable?

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Introduction

Poultry farming has a very ancient history and was in practice as backyard farming during the past. Growing of domestic fowl like hens, geese, ducks, turkey etc. in a commercial basis or in household backyard for the purpose of getting meat and eggs is called poultry rearing. Poultry rearing is also a part of agricultural sector. Even though there are many sources of meat, most of the consumers prefer buying poultry meat. So many large-scale entrepreneurs, are commercially rearing poultry fowls, in order to meet the needs of consumers and are flourishing in this business. Mostly poultry farms are privatized in nature. They are getting a very good margin by selling poultry meat. So, setting up a broiler or layer unit will strike you rich.

Poultry meat and eggs are rich in proteins, minerals and vitamins. In recent times there is availability of hybrid layers which are able to lay more than 275 eggs per annum with high feed conversion efficiency. Depending on the size of the farm and effective supervision it can worth its weight in gold. It can give the farmers year-round income. Apart from this the poultry waste can also be used as rich manure for crops.

Scope of Setting a Layer Farm

Poultry sector is a very fast-growing sector in India. India is the third largest producer of eggs in the world. The annual egg production is 103. 32 billion eggs /annum. The annual growth rate in egg production is 8.5%. The annual per - capita availability of eggs is 79 eggs per person per year. But the ICMR recommendation is 180 eggs per capita per annum. So, we have not reached even half of the per capita recommendation in egg production.

Now a days value added products are also being prepared from poultry eggs. After the productive period the layers can be culled and sold to meat shops. The farmers are now raising hybrid layers rather than setting up farm using unknown non - descript layers. Growing hybrids ensures faster growth, good live ability, high feed conversion, high egg production and high profits to the farmers.

High quality chicks, equipment, vaccines and medicines are available now through both the public and private sectors. Both technical and professional guidance is made available to the farmers. The disease and mortality incidences have also reduced to a greater extent by using hybrid chicks. There is also a huge support from the government.

Investment and Profit

Imagine we are setting up a layer farm growing 20000 layers per annum. We are raising the birds as two batches coming out with 10000 birds per batch. We are procuring day old chicks and they are raised till grower stage in deep litter system and then they are reared in cages.

The fixed cost here includes construction of brooder cum grower house and layer house and purchasing equipment for both the houses. For rearing 20000 birds we will need a capital amount of approximately sixty-six lakhs.

The variable cost includes purchase of chicks, feed requirement during laying, medical expense and miscellaneous expenses up to laying, insurance of sheds and equipment and insurance of birds and labour charges. They nearly cost about forty-five lakhs.

Totally we will need a capital amount of approximately 12 million rupees or 1. 2 crores. The net present value for the project will be nearly 65 lakhs. We can approach the bank for loan with clearly prepared project proposal. And for every one rupee we invest we will be getting a return of 1. 09 rupees. It will take nearly 11 months to produce eggs commercially from the scratch.

Marketing Channels

We can market our eggs to the local yokels directly if we are producing eggs in a small scale. We can also sell it to the local retailers nearby our farms. If we are producing the eggs in large scale then we can go for contract farming by making contracts with the government schools for midday meal scheme, with local hotels and also with wholesale egg sellers.

Conclusion

If we are setting up a layer farm, we get a profit of 0.9 rupee for every rupee we invest. It is also easy to run a layer farm and we don't need special training or skills for this business. The important aspects needed to run this farm successfully is frequently visiting our farm and being vigilant and not compromising the quality of our product. If we are ready for the above said things then we can make much profit by doing this business.

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Direct Marketing in Agricultural Sector

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Introduction

Global agricultural production contributes 39.4% of the GDP & in that 43 % of exports includes the agricultural commodities. In India, agriculture contributes 17% to 18% to GDP giving primary source of income for half of population and shows 11 % of annual growth rate in the past 14 years. Marketing of agricultural commodities plays a major role in the development of agrarian community. Traditional marketing has so many issues such as like exploitation of farmers by middlemen, poor infrastructure facilities, high transportation cost and informal network of traders. Policy makers found that direct marketing would solve these issues in some extend and various states started implemented in regard of farmers as well as consumers welfare.

Direct Marketing

It is defined that the sale of agricultural goods and products from the farm straight to the consumer, without intervening distributors or retailers. The importance is it that it helps to achieve sustainable agriculture and food systems by increasing farmer profitability, promoting the local economy, and providing consumers with higher quality and healthier products. It offers new and unique opportunities to build relationships and adds value. Complete elimination of middle men and commission agents who charge high level of commission fee from the agriculturists/farmers coming to the market yards for selling their produce and then artificially inflate the retail prices. Direct Marketing was experimented in the country through Apni Mandies in Punjab and Haryana. Later this concept with certain improvements is popularized by different states.

Successful Models of Direct Marketing

There are different successful models of direct marketing are listed below:

Farmers markets: A great way of selling the produce directly to the consumers which has benefit of good infrastructure for selling, building customer loyalty, getting direct feedback. There are different local names in various locations such as Uzhavar Sandhai in TN, Rythu Bazar in AP, Apni Mani in Punjab, Shetkari Bazar in Maharashtra, Raitha Santhe in Karnataka.

Roadside markets: It allows the farmers to stay on or near the farm, minimizing transport to market and infrastructure cost. Location and less competition are advantages to it when compared to farmers market.

Community Supported Agriculture (CSA) or Subscription Farming

Meeting a farmer & purchasing a CSA share before growing season → Farmer uses the funds of customer for initial costs such as seed and labor → Farmer grows a variety of healthy food for CSA members (registered customers or shareholders) → Getting a fresh fruit & veggies every week from a farmer whom we purchased the shares.

U-Pick or Pick-Your-Own

In this model, customers come to the farm, do the harvesting, and transport it to home. In this, farmers need to be prepared for the potential crop damage and the possibility of someone getting injured on the farm. The major difference between the CSA and U- pick is customers can be introduced to the farm thereby helps generating farm stand or agrotourism sales in latter one.

Less Common Models

Web and Mail order sales: Selling and buying of produce through Apps, websites and mails as it is easy to pay online and thereby getting produce at doorstep or at a certain point.

Agritourism: When visiting farms, families often look to be entertained and educated as well as to buy local foods. Corn mazes, hayrides, festivals, petting farms, and musical events are among many things that can be added to the fun of a farm experience.

Impacts of Direct Marketing

Rajasthan has issued more than 1,100 direct marketing licenses to processors during lockdown period. Out of more than 550 PACS declared as market-yards in rural areas, 150 PACS have become functional for direct marketing and village traders are performing trade transactions successfully.

Due to market fee waiver in TN, it is observed that traders have preferred to buy the produce from farmers from their farm gate/ villages. In UP, direct linkages have been established by FPOs with farmers and traders thereby supplying their produce to consumers in cities which saved wastages and directly benefitted the farmers.

Conclusion

Direct Marketing has so many benefits but some limitations are also there. Upcoming models are likely to include more advanced technologies and empowering the farmers also but still there are issues, so for that government & farmers should work together to bring efficiency.

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How Useful is Demic in Agricultural Marketing Sector

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Introduction

Marketing is becoming more competitive in the era of globalization. The impact of competition compelled the organization to expert in collecting the knowledge of the market.

The marketing environment is changing at an accelerating rate, so the need for real time market intelligence and information has never been more pressing. The unconnected piece of information is called data whereas the information is known as increased knowledge derived by understanding the relationship of data.

Marketing intelligence is organizing the information to fully appreciate the implications and impact on the organization. Agriculture sector is a crucial sector to the domestic economy and agribusiness continues to be a strong lever of growth for the Indian economy.

Despite technology improving the efficiency of all sectors in the new millennium, a majority of Indian farmers continue to deploy antiquated agrarian crises. Fluctuation in agricultural price, spiralling inflation, burgeoning imports and multiple challenges faced by the agricultural sector. Domestic and Export Market Intelligence (DEMIC) is established to give solutions to the problem through market intelligence.

Need for Establishment of DEMIC

Frequent fluctuations in prices affect the farm income adversely and increase risk. Since farmers have no authentic source from which they could get the information on future changes in prices, they decide the area under various crops mostly by the price level prevailed in the previous seasons.

This results in glut and scarcity frequently. After harvesting the crop, the farmers do not have any information on how the prices would move in the near future; they are not able to decide the best time of selling their produce even for the commodities that can be stored for short periods in the farm itself.

So there is an urgent need to establish a permanent mechanism for market intelligence-DOMESTIC AND EXPORT MARKET INTELLIGENCE CELL.

Establishment of DEMIC

Domestic and Export Market Intelligence Cell (DEMIC) was established in November 2004 at Centre for Agricultural and Rural Development Studies (CARDS) in Tamil Nadu Agricultural University (TNAU), Coimbatore with the financial assistance from Tamil Nadu State Agricultural Marketing Board, and Department Agricultural Marketing and Agri Business. DEMIC helps the farmers, traders, processors and other stakeholders of agriculture to get market information, price information, export opportunities and related information at the right time. Since 2013, DEMIC has got financial support under NADP for providing commodity price forecasts for the following 25 crops including maize, sorghum, Cumbu, Ragi, Blackgram, Greengram, Bengal gram, Ground nut, Gingelly, Sunflower, Copra, Cotton, Turmeric, Chilli, Coriander, Tomato, Brinjal, Bhendi, Carrot, Beetroot, Small onion, Tapioca, Potato, Coconut and Banana.

Activities of DEMIC

Main activity of DEMIC is to Establish and maintain Uzhavar Santhaigal for the benefit of farmers as well as consumers. It also creates marketing opportunities for small and marginal farmers.It monitors the establishment and maintenance of regulated markets in order to facilitate buying and selling of agricultural produce for the benefit of the farming community.Also sets up modern cold storage facilities to enable the farmers to store and sell their produce at favourable price level (Cold chain from farm to market). Historical prices from Regulated Markets, Farmer's markets and other institutions are collected and analyzed with econometric tools. The results are compared with market surveys conducted in selected markets and then price forecasts are developed for various crops before sowing and before harvest. Then the price forecasts are disseminated through both print and electronic media.

Objectives of DEMIC

1. To forecast the supply and demand of important agricultural commodities in Tamil Nadu.
2. To forecast future prices of major agricultural commodities.
3. To study the state and national market related to important commodities.
4. To support policy measures to the Govt. of Tamil Nadu.
5. Providing other market intelligence such as product qualities, high price markets for the different commodities.

Schemes Under DEMIC

1. National horticulture mission: Since the climatic conditions prevailing in Tamil Nadu are favourable for cultivation of horticultural crops. The National Horticultural Mission was implemented in Tamil Nadu with the vision of expanding the cultivation area of fruits, vegetables, flowers, medicinal and aromatic plants and thereby increasing the production of horticultural crops. This scheme is implemented with 85% of financial assistance by the central government and 15% of financial assistance by the respective state government in the tenth five-year plan.

2. Uzhavar santhaigal: Uzhavar santhaigal (Farmers Market) for the benefit of farmers as well as the consumers have been set up in the urban areas in Tamil Nadu. This Department has opened all the 28 closed Uzhavar Sandhai and rejuvenated the existing 75 Uzhavar Santhais. At present in total 103 Uzhavar Sandhai are functioning to ensure farmers get a better price for their produce and to enable the consumers to get the commodities at a lesser price than in open market.

3. Agri export zones: To promote Agri Horticultural Produce Exports from Tamil Nadu, four Agri Export Zones for specific commodities have been established as detailed below:

a. Agri Export Zone for Cut Flowers at Hosur comprising of Dharmapuri and Krishnagiri Districts.
b. Agri Export Zone for flowers in Nilgiris District.
c. Agri Export Zone for Mangoes in Theni District.
d. Agri Export Zone for Cashew in Cuddalore District.

4. AGMARK grading: Grading under "AGMARK" has already become a symbol of quality. In order to help the consumer to get quality food products, one Principal Laboratory, 30 State Agmark Grading Laboratories and 15 Agricultural Officer (Marketing) Centers are functioning in the State. Agmark grading is done for centralised and decentralised commodities by the technically qualified staff. Agmark labels are issued to the authorised packers under the direct supervision of the staff for certifying the quality and purity of the food products.

5. IAMWARM Project: The IAMWARM Project is a World Bank assisted project. Agricultural Marketing plays an important role in marketing the agricultural produce and this department along with other line Departments will strengthen the sub basins. This project will be implemented in the selected 63 sub basins over a period of 6 years. In the first year, this project will be implemented in the 9 sub basins at a cost of Rs. 8.30 Crores. The Projected cost for 63 sub basins is Rs. 28.48 Crores.

6. Food processing industries: Food processing is gaining momentum as food processing industries ensure steady and better prices to the farming community as well as availability of the commodities in processed form to the consumer throughout the year. During the financial year 2006-07, 21 proposals worth Rs.25.17 crores to establish food processing related projects have been forwarded to the Ministry of Food Processing Industries, Government of India with recommendations for grant of Rs.5 Crores.

Conclusion

DEMIC has created its own way to help farmers in price forecasting and also marketing their produce. Avoiding distress sale, it is aiding farmers to move towards profits. Different schemes under DEMIC are aimed to provide farmers with suitable facilities right from sowing to marketing in a hope to ease farming.

They are also serving farmers by providing the right certification and AGMARK grading to their products. They also encourage farmers towards post-harvest management by linking them with food processing industries. By this way demic is playing a major role in helping farmers move towards profitable agriculture.

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Status of Wholesale Markets in Indian Agricultural Sector

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Introduction

Agriculture plays a very important role in Indian Economy. At present the share of agriculture in GDP increased by 19.9% in 2021 from 17.8% in 2020. Nearly 57 per cent of population are engaged in agriculture activities. During this lockdown other sector brought down the GDP per cent except Agriculture sector. Major problems facing by farmers are, fluctuations in the market prices, lack of storage facilities, perishable nature of agriculture produce, lack of fair price, lack of timely procurement of produce from the farmers by government, transportation costs, lack of market situation like demand, prices etc.

Wholesale Market

Wholesalers are none but middlemen who buy products from distributors (wholesale/retail) and sell them to retailers. In most cases, the retailers come to the wholesalers to buy products to replenish their stock. However, wholesalers may also sell to end consumers, but such sales are minimal. Wholesale markets are of 3 types, they are;

1. Primary Wholesale Markets: These markets are periodically held, either ones or twice a week. These markets deal in the sale of fruits, vegetables, food grains, all household requisites etc. Village market comes under primary markets.

2. Secondary Wholesale Markets: These are also known as mandis. These are situated generally at district or taluka headquarters. District and taluka market comes under secondary markets.

3. Terminal Markets: These are the markets in which the produce is either finally dispose of, direct to consumer or processors or assemble for shipment to foreign countries. Eg. Big Basket etc.

Traditional Markets Versus Unified Market Place (UMP)

In traditional market, traders in the mandi visit commission agent shops, examine the quality of the commodities, and engage in auctions or direct negotiations to purchase the commodities of interest. First, lack of transportation and storage capabilities limit farmers' sales channels to the local mandis nearby. Second, since traders need to apply for a separate license for each mandi, there are typically a small number of traders participating in each mandi. Third, the price-setting process in the mandis is done through handwritten tender slips and is not documented. It is subject to collusions among traders and also often involves private negotiations between the commission agents and the traders.

In UMP, First, the open outcry ascending auction is replaced by the online first-price sealed-bid auction. Traders must submit their (private) bids for all of the lots they want to purchase on UMP by a preannounced cut-off time. Once the submission window is closed, all bids for the same lot are compared by the computer and the highest bidder is declared the winner. Second, all lots arriving at any of the integrated mandis are recorded on UMP and visible to all traders. Furthermore, the government enacted a single-license system so that traders need only one license to trade in all mandis within the state. Finally, to increase price transparency for farmers, the government. Installed computer kiosks where farmers can check prices in major mandis across the state and started sending short message service (SMS) messages to farmers informing them of the winning bid for their lots.

e-NAM in PAN India

e-NAM is managed by Small Farmers Agribusiness Consortium (SFAC) under the Department of Agriculture, Cooperation and Farmers Welfare. It links agricultural produce market committees (APMCs) across all states with online trading of commodities. Agriculture produce worth Rs.91,000 crore has been traded through the e-NAM platform so far and the figure is soon expected to reach Rs.1 lakh crore. Currently, 841 mandis across 16 states and 2 UTs have been integrated on the platform. More than 1.70 crore farmers and 1.63 lakh traders have registered.

e-NAM works as administration of agriculture marketing is carried out by respective states according to their agri-marketing regulations, as agriculture and markets are state subjects under the Indian constitution. Each state has its own APMC Act, with varied provisions. The lack of uniformity and compatibility has led to the fragmentation of agricultural markets, where each state functions as a separate market. Every state is further divided into several market areas. These separate areas formed will be administered by a separate Agricultural Produce Marketing Committee (APMC), which imposes its own marketing regulation. This fragmentation of markets even within the state level hinders the free flow of agri-commodities between different markets. Multiple handling of agri-produce and multiple levels of mandi charges lead to escalated price for the consumers without equivalent benefits for the farmers. These challenges are addressed by e-NAM by creating a unified market via online trading platform both at the state and at the national level.

e-NAM mandates changes in the agricultural marketing laws of states by, provide for electronic trading, provide single trading licences that are valid in all mandis in a state, provide a single-window levy of transaction fees, only the states/UTs that have completed these pre-requisites will be eligible for assistance under this scheme also, the state marketing boards/apmcs must enable the promotion of e-auction platform. Warehouse-based trading modules in e-NAM software will enable trade from warehouses according to e-NWR (electronic negotiable warehouse receipt). Farmers Producers Organisations (FPOs) trading module in e-NAM enables FPOs to trade their produce from their collection centres without bringing the produce to APMC.

Conclusion

e-NAM has a huge potential to increase the farmer's income and prevent exploitation of by middlemen. As three farm bills are introduced in India, Government should take steps like Guarantee in MSP, negotiating with state governments to allow other state farmers for selling produce, not to remove produces from the essential act, making transportation available to the marginal and small farmers. Farmers have to be in Farmers Produce Organization (FPO), by which protection will be given to farmers. Farmers have to first follow the laws then only they have to protest the laws; they should know the market rules and regulations thoroughly. All these make the sound marketing systems to farmers of India in marketing their produce.

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Agricultural Produce Storage and Warehousing in India

Article ID: 11399

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Introduction

Today's agriculture was started 10,000 years ago in our mother planet. This has been found by using the stored seeds and large areas were constructed for storage of grains and agricultural commodities have been found on the civilization sites. Thus, storage and warehousing play an important role from ages.

Storage includes proper management of the commodity from the production to purchase. The term storage and warehousing were used synonymously but in warehousing the storage is done in a larger volume with a specified commodity and are being marketed as and when required.

Traditional Vs Modern Warehouse

Current Scenario

The Indian Warehousing is expected to be an estimated growth of % 19.5 billion by 2025 from $ 12.2 Billion in 2020. The warehousing market is driven by the country's flourishing sectors of manufacturing, retail, FMCG and logistic sectors. Supportive government policies including the establishment of logistic parks and free trade zone except the spur in market growth through 2025. Our country is endowed huge production of food grains (303. 34 MT of total food grain production of 2021) with the total cultivable area of 179.9 Mha and a key player global agriculture market. Total agricultural warehouse capacity of India is 91 MMT among which State owned warehouses accounts for 41% and the remaining are with the Private and the farmer cooperatives. Agricultural warehousing accounts for 15% of the warehousing market in India and is estimated to be Rs 1,050 billion in 2020. It is expected to be expand at 14.86% CAGR (2021 to 2025), and may reach to Rs 2028.86 billion by 2025.

Cold Storage System

Produce obtained from the plant and animal source such as fruits, vegetables, milk, fish and meat were highly perishable in nature and they have to be kept under refrigeration. 8,186 numbers of cold storages with the capacity of 374.25Lakh MT is available in the country for storing horticultural produce like fruits and vegetables. Cold storage facilities for the farmers and the traders are not centrally maintained by the Ministry and there is no real-time monitoring system.

Major Agencies/ Player for Storage & Warehouse/ Institution

Food Cooperation of India- FCI is not work public it is only for the Government.

1. State Warehouse Co-operations: separate warehousing were setup for the state government for the separate use.

2. Central Warehousing Co-operation: CWC is mainly used by the central government but sometimes. It is used by the state government.

These warehouses can be operated in different ways including the Public warehouse, Government warehouse, Cooperative warehouse, Bonded warehouse, Import and export, Cold storage, Private warehouse, Environmentally control warehouse, Agriculture warehouse, Field warehouse and Distribution centers or warehouse which used to perform the functions such as Storage of goods, Protection of goods, Risk bearing, Identification of goods, Financing and processing.

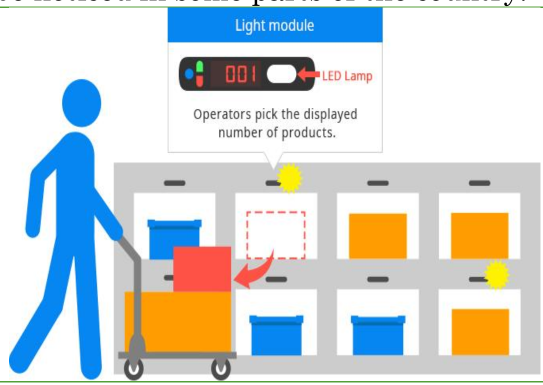
Merits And Demerits of Warehouse Construction

Sl. No	Merit	Demerit
1.	Maximum market coverage can be achieved.	Huge investment is needed
2.	Post harvest losses can be mitigated.	Chances of stock-out situation is high
3.	Facilitates space for bulk storage	Huge land availability in a same piece is difficult to found
4.	Bulk storage cost is minimum compared to maximum	Storage of goods at one warehouse from another require additional transportation costs
5.	Initiate for the development of cooperatives	Lack of co-ordination can harm the system

Modern Trend

1. Just in time: system facilitates the delivery of produce directly to consumers without any warehouse
2. Retail use of warehouse led to development of retail stores in a warehouse manner.
3. In online market retail or wholesale shops may be absent but without the warehouse its unimaginable.
4. Warehousing companies now provides almost more than 50% of logistic services. Additional technological developments such as:
    a. Radio Frequency Identification(RFID)
    b. Transportation Management System
    c. Pick- To-Light technology
    d. Voice activated receiving and packaging can also be noticed in some parts of the country.

Voice activated receiving and packaging



Pick- To-Light technology

Conclusion

Though there are so many possible ways utilize the storage and warehouses of the India, still farmers face a lot of struggles in cracking the difficulties. It is not the sole responsibility of the individual or the government to ease the process but the united way can create a progress.

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Desi Cotton *Gossypium arboreum* L.: An Absorbent Surgical Cotton

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Introduction

Cotton is one of the most important fibre and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material (cotton fibre) to cotton textile industry. India is the only country in the world where all the four cultivated species are grown on commercial scale. They are *Gossypium arboreum, G.herbaceum, G.hirsutum* and *G.barbadense*. The first two species are diploid (2n=26), desi cotton, evolved in India millions of years ago and are native to old world. They are also known as Asiatic cottons because they are grown in Asia. The last two species are tetraploid (2n=52) and are also referred to as New World Cottons. Two cotton species *Gossypium arboreum* and *Gossypium herbaceum* and are commonly referred as Desi cotton species.

Gossypium arboreum is under commercial cultivation only in India and Pakistan. Due to introduction of *Bt* cotton in India, the area under diploid cotton species *G. arboreum* and *G. herbaceum* was declined drastically. Area under surgical cotton cultivation in India was 97 percent in 1947, it fell to 42 percent in 1990, 28 percent in 2000 and about 1 percent in 2012, and it is now estimated to be much less than 1 percent. But they are still under cultivation in some part of India as farmers believe the sustainability of the yield in marginal soil and less management practices as compared to tetraploid cultivated cotton *G.hirsutum* species. Desi cotton *G.arboreum* are good yielders and require fewer chemical inputs *viz.,* fertilizers and pesticides to obtain good yield as compared to *G.hirsutum*. The absorbent cotton varieties are now confined to marginal lands, saline tracts, and drought prone areas.

Why Desi Cotton?

The diploid desi cotton has inherent ability to adapt adverse climatic conditions and evolved to tolerate and resist a wide range of diseases, insect pests, drought, water- logging, salinity and many adverse environment conditions. Varieties of *G. arboreum* naturally produces high yield of non-spinnable short staple, coarse, high water absorbing fibre with low ash content. These traits comprise ideal requirements for the manufacture of absorbent cotton. Desi cotton *G. arboreum* perfectly suited for the manufacturing of absorbent cotton.

Properties of Absorbent Cotton

Absorbent cotton would be ideally suited for medical purposes and would have great prospects for domestic markets and also huge demand for exports. Desi cotton offers hygroscopic short fibre with high micronaire, which makes it an ideal choice for a wide range of applications. The fiber of Surgical/Absorbent cotton is very elastic. It consists of 98%-99.5% of cellulose which has a diameter of 16.30 and a length of 12-40 mm. Surgical cotton manufacturers in world look forward to procuring this cotton as it has almost all the characteristics required for good quality surgical cotton like liquid absorbency, fiber quality (strictly 18 inches), minimum wax and micronaire value of 5.

Presently, the cotton lint which may or may not genetically possess the desired quality traits for absorbent cotton is being processed through chemical or enzymatic process to induce the property of absorbent cotton. Since absorbent cotton comes in direct contact with the human body, its quality should satisfy certain pharmaceutical standards. The absorbency is an important trait because the absorbent cotton used during surgery must be able to absorb body fluids very quickly in order to perform effectively and draw exudates from the wound site. The ash content is also an important trait which determines the softness of cotton. The sinking time is also important trait to absorb the body fluids quickly.

Categories of Desi Cotton Varieties

Desi cotton varieties can be categorized into two groups like spinnable and non-spinnable fibres that comprise 60% rainfed tracts of the cotton area of India. One type is the short and coarse fibre varieties that are suitable for absorbent cotton, surgical, denims, mattresses, technical textiles etc., whose demand is growing and the market is very high. Other category pertains to desi varieties that produce good quality spinnable fibres. There are some newly improved varieties with very good fibre traits that are equivalent to American cotton varieties. Currently, comber noil (short fibres waste of spinning mills) is generally utilized for absorbent cotton all over the world. However this is significantly inferior to the Desi short staple cotton for absorbent purposes.

Research Evidences about Desi Cotton

Meena *et al.,* 2016 reported that the promising genotypes, hybrid CICR 2 and varieties *viz.,* CISA 17-93, CISA 614, LD 694, HD 432 having good yield with superior absorbent properties. Several Desi varieties such as Lohit, LD-133, RG-8, LD-327, DS-21, LD-491, HD 107 and HD-11 have fibre quality parameters ideally suited for absorbent surgical cotton. Recently, a variety, Phule Dhanwantarya was developed by MPKV Rahuri, which has good yield along with excellent fibre properties required for absorbent cotton. Hence, high yielding desi cotton (*G arboreum*) genotypes having inherent absorbent properties which will help in boosting the surgical industry by reducing the time and cost involved in processing (Kranthi, 2013). Genotypes PA 255 possess best fibre quality traits, especially fibre length, fineness and better uniformity percentage. The fabric produced from improved *G arboreum* cotton shows comparatively higher toughness and appears to possess optimum rigidity. The improved *G .arboreum* cotton fabric records markedly higher values for dye uptake and air permeability as compared to *G. hirsutum* cotton fabric. These fabrics are suitable for the designated end use i.e., men's winter wear. The improved *G. arboreum* can be a viable and suitable alternative to the medium long staple *G. hirsutum* cotton particularly with regard to the yarn count range 8-25s and for specific end uses like denim and twills. Also, the *G. arboreum* genotypes are well known for their inherent resistance to biotic and abiotic stresses and widely considered as a potential source for organic cotton. (Kranthi, 2015).

Uses of Absorbent Cotton

1. It is employed as surgical dressings.
2. It is used in the textile industry to prepare a wide range of fibres.
3. It is invariably employed as its derivatives to be recognized as the most versatile adjunct in pharmaceutical formulations, like Microcrystalline cellulose – as Tablet Disintegrant, Carboxymethyl Cellulose (CMC) – as Binder and thickening agent, Purified 'Rayon' – as Surgical aid; Pyroxylin – as an ingredient in the preparation of Collodian and nail polishes.
4. It is used as a filtering medium and also as an insulating material.
5. Pharmaceutical grade cotton seed oil is used as an emollient and in the preparation of Steroidal Hormone Injections.

Market Potential of Desi Cotton

The demand for surgical/ absorbent cotton is growing at the rate of 10 percent per annum across the world. The current demand in India is estimated to be 3.4 lakh M tonnes (i.e) 2 million bales (of 170 kg each) per year. The price of surgical cotton is high because of the shortage of short staple absorbent cotton. Besides the Indian market, there is enormous export potential too. Japan, USA and EU countries import absorbent cotton from India with specific standards. It is estimated that within next 5 years, 30-35 lakh bales will be required to fulfill the domestic market and more would be needed to plan for the export market.

Conclusion

Due to high fluid absorbency power of Desi cotton, there is a big demand for short staple length surgical cotton in hospitals, nursing homes, dispensaries, making sanitary napkins and at beauty parlors *etc.* High yielding desi cotton (*G arboreum*) genotypes having inherent absorbent properties will boost the surgical industry. It reduces the pollution caused due to chemicals used in conversion of normal cotton to absorbent cotton. One important property present in the varieties of *G. arboreum* is absorbent cotton, which was not found in other species. Hence, exploitation of this property in *G. arboreum* is highly essential. Due to the low cost of production, suitability for marginal soils and the possibility of obtaining high yields, there is immense scope for the promotion of Desi cotton varieties for sustainable cotton farming in the country. Market exploitation is the biggest challenge faced by the surgical cotton growers in India. Another factor affecting the surgical cotton growers is the lack of proper ginning machinery suitable for short staple cotton, especially the *Gossypium arboreum* race from cernuum. Besides the Indian market, there is enormous export potential for surgical cotton to countries such as the USA, European countries and Japan. In order to meet the growing demands of domestic and international absorbent cotton requirements, research on improving the qualitative traits of desi cotton, designing proper ginning machineries for short staple cotton and creating awareness among cotton farmer to grow desi cotton varieties for sustainable cotton farming in the country.

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Logistics in Agriculture Marketing in India

Article ID: 11401

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Introduction

Agriculture is a backbone of the Indian economy and also a major source of livelihood for a rural population. The country becomes self-sufficient in food production because of advanced technologies, the introduction of resistant varieties, disease-free seedlings, or other than plant production like Improving livestock breeds and some modern agriculture technologies, logistics also play an important role, as there every new generation of consumers demands a regular supply of perishable products with conditions such as right kind of product, at the right place at right quality and quantity at the least possible cost. As Agri-logistics is the backbone of Agri-business, which enables connectivity between production & consumption centers over both space & time with minimal loss of quality as well as quantity. The Agri-logistic services will enable Farmer Producer Organizations, Traders, Processors, Exporters, and Corporates to safe-keeping of their produce and fast-track the delivery to markets.

Market Infrastructure

Marketing infrastructure has two broad dimensions- quantity and quality. As India is lagging in the establishment of enough markets, it is also lagging in enough markets, it is also lagging in improving the quality of the existing markets. To enhance the marketing prospect for the farmers, a seller-driven supply chain in marketing becomes mandatory. In the case of perishable horticultural commodities like fruits and vegetables, the production plan should be preceded by a marketing plan.

Key to Efficient Agriculture Marketing

Transportation / Logistics: To ensure even distribution of agricultural output across the country, transportation facility is essential. There is a transition in retailing from production or technology push to market pull which required producers and suppliers to increase flexibility and focus on the speed and reliability of delivery. There is increasing attention given to product quality, for which a significant component was determined by the inbound and outbound logistics. At present, 2/3rd of fruits and vegetables is transported by roads in the country.

How transport enables agriculture: In essence, agricultural marketing is the simple procedure of buying and selling farm produce, and transportation is that key element that enables the product to reach the consumer.

On the contrary, if an efficient transport system exists, and the agricultural produce is handled with care, the farmer can get the best possible returns. Many farmers are cash-strapped and would like to dispose of the produce at the earliest. This means that even if the harvest is plenteous, the farmer can still be left in the lurch if the product cannot be reached beyond the boundaries of his town. His produce also needs to reach the consumer at a reasonable price and within a reasonable time.

Logistics management: Logistics management in the agricultural industry is the process that ensures the optimal and continuous flow of agro-goods from manufacturers/suppliers to producers and, eventually, to consumers. The activities in this process must be effectively managed to guarantee customers' demands are met on time and the maximum value of the cultivated products is achieved. Moreover, it is essential to minimize distribution expenses, improve the circulation of agricultural goods, reduce unnecessary losses, and strive for environment-friendly and compliant logistics.

Agriculture Logistic and Warehousing in India

The issue of food wastage is central to India's efforts in combating hunger and improving food security. While the focus has been on improving production, reducing the food supply chain, losses remain a relatively unaddressed problem till very recently. It is hard to put a figure on how much food is lost and wasted in India today due to lack of adequate infrastructure, however, a 2011 report by a UN body, FAO, puts wastage in fruits and vegetables as high as 45% of produce (post-harvest to distribution) for developing Asian countries like India.

Supply Chain Management

It has been found that 30%–40% of fruits and vegetables are wasted due to post-harvest losses. There is a lack of basic as well as specialized infrastructure such as cold storage, reefer vans, cool chains, ripening chambers, etc. India is short by 10 million tonnes of cold storage capacity due to which over 30% of agricultural produce goes waste every year, more than 20% of produce from fields is lost to poor post-harvesting facilities and lack of cold chain infrastructure.

Warehousing

Although the warehousing segment constitutes only 15%-35% of the total logistics costs, its importance cannot be ignored concerning the role it plays in the smooth functioning of a supply chain network. Warehousing, which forms 20% of the total logistics market, was traditionally used as godowns to store goods from the time of production till the time of consumption. Currently, almost three-fourth of the organized warehousing sector is being controlled by government PSUs, such as FCI, CWC, and SWCs. The current capacity of the organized warehouses, controlled by PSUs, cooperatives, and the private sector is 126.97 million tonnes, of which the private sector has only 18.97 million tonnes.

Schemes

1. Kisan Rath and Kisan Udan: Kisan Rails are the first-ever multi-commodity trains. Any farmer or any other interested party can directly book their consignments in trains, without any lower limit on the size of the consignment.

2. Kisan Rath: The Kisan Rath app is a mobile app for farmers to help transport their produce in times of lockdown. It will aid in both primary and secondary transportation.

3. PMGSY: This scheme plays an important role by connecting villages with all-weather roads which helps in the seamless transport of agriculture commodities.

Conclusion

These logistics-related improvements are possible in developed and developing countries. The transport system brings down the enormous wastage of fruits and vegetables and allied products, poultry, fish, meat, milk, and dairy products. In India, less than one percent of the 105 million tons of perishable goods are transported via the 30,000 reefer vehicles that ply its roads. And the loss due to this amounts to Rs. 1 lakh crore. In the U.S., 85% of fruits and vegetables are transported through a cold chain, and in Thailand, it is 40%. You can see that in comparison, it is negligible in India. If such reefer vehicles or refrigerated transport is available in India we can extend our possibility of achieving in marketing and also reduce the loss for perishable goods.

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Crop Modelling and their Application in Fruits Crops

Article ID: 11402

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Abstract
Crop modelling, the computerized simulation of dynamic crop systems, was born about 30 years ago, when systems analysis and modern computers presented a new technique to crop scientists. The data used in crop models include daily weather data, such as solar radiation, maximum and minimum temperatures, rainfall, as well as soil characteristics, initial soil conditions, cultivar characteristics, and crop management. Crop models are a formal way to present quantitative knowledge about a crop that grows in interaction with its environment. Since then, crop modelling has gone through a number of developmental stages, similar to those of living organisms. From its infancy, crop modelling seemed to promise a well-behaved, elegant surrogate for ambiguous and cumbersome field experimentation. Indeed, some of the earliest models proved to be among the most notable achievements to date.

Introduction
Modelling is the use of equations or sets of equations to represent the behaviour of a system. In effect crop models are computer programs that mimic the growth and development of crops (USDA, 2007). Modelling represents a better way of synthesizing knowledge about different components of a system, summarizing data, and transferring research results to users (France & Thornley, 1984). Models are used extensively in research, in the social sciences (e.g., economics) as well as in the physical, chemical and biological sciences. As a preliminary definition one could think of a model as an attempt to describe a certain process or system through the use of a simplified representation, preferably a quantitative mathematical expression, that focuses on a relatively few key variables that control the process or system.

The predecessors of the currently available agricultural crop models may be found in two areas:
1. Climate based models: These were designed to correlate a specific biological phenomenon with climate data, mostly temperature data using cumulative heat or chilling units to predict spring growth and phenology, to predict fruit ripening dates or to predict the satisfaction of chilling requirement in perennial dormancy and their more sophisticated descendants belong to this category.

2. Ecological systems: Models were designed for tools in the hands of ecologists in their efforts to identify and quantify the state variables which affect the ecosystem and the interactions of its components. Agri systems have many features in common with ecosystems but they are much simplified, heavily managed, often limited in interactions amongst species and as such are outside the scope of ecologists.

Types of Crop Modelling in Fruit Crops
1. Empirical Models: These are direct descriptions of observed data and are generally expressed as regression equations and are used to estimate the final yield. This approach is primarily one of examining the data, deciding on an equation or set of equations and fitting them to data. Examples of such models include those used for such experiments as the response of crop yield to fertilizer application, the relationship between leaf area and leaf size in a given plant species and the relationship between stalk height alone or coupled with stalk number and/or diameter and final yield (Oteng-Darko et al., 2012).

2. Mechanistic Models: A mechanistic model is one that describes the behavior of the system in terms of lower-level attributes. Hence, there is some mechanism, understanding or explanation at the lower levels (eg. Cell division). These models have the ability to mimic relevant physical, chemical or biological processes and to describe how and why a particular response occurs (Oteng-Darko et al., 2012). Mechanistic models, explain not only the relationship between weather parameters and yield, but also the mechanism of these models. These models are based on physical selection.

3. Stochastic Models: In Stochastic models, a probability element is attached to each output. For each set of inputs different outputs are given along with probabilities. These models define yield or state of dependent variable at a given rate. When variation and uncertainty reach a high level, it becomes advisable to develop a stochastic model that gives an expected mean value as well as the associated variance.

4. Statistical Models: These models express the relationship between yield or yield components and weather parameters. In these models' relationships are measured in a system using statistical techniques. Statistical models of crop responses to climate change, based on historical datasets of crop and climate variables have recently been used to address climatic change impacts on food security in developing countries.

5. Simulation Models: These form a group of models that is designed for the purpose of imitating the behavior of a system. Simulation models involve Computer models with a mathematical representation of a real-world system. One of the main goals of crop simulation models is to estimate agricultural production as a function of weather and soil conditions as well as crop management. These models use one or more sets of differential equations, and calculate both rate and state variables over time, normally from planting until harvest maturity or final harvest (Murthy, 2002)

6. Deterministic Model: These models estimate the exact value of yield. It makes definite predictions for quantities without any probability, variance or random element.

7. Dynamic Model: Time is included as a variable. Both dependent and independent variables are having values which remain constant over a given period of time. After which these variables change due to change in independent variable.

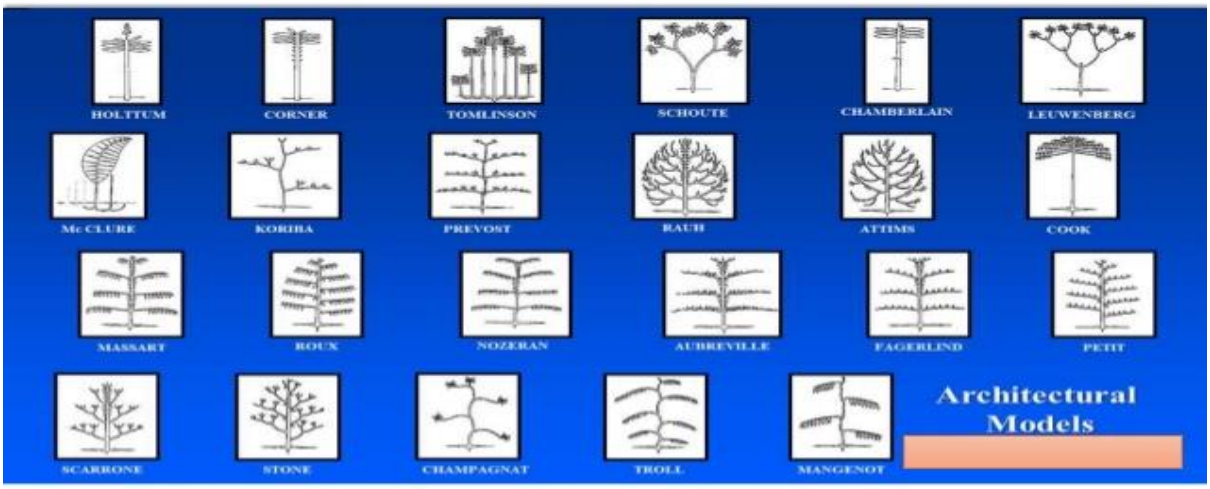
8. Explanatory Model: This consists of quantitative description of the mechanisms and processes that cause the behavior of the system such as leaf area expansion, flowering, fruiting etc. as crop growth is a consequence of these processes.

9. Phenological Model: These models predict the crop development from one crop growth stage to another. The Prediction is generally based on accumulated Heat units.

Architectural Modelling of Fruit Crops

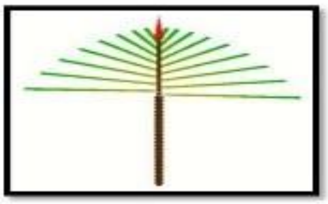
Architectural analysis was introduced by Hallé and co-workers (Hallé and Oldeman 1970; Hallé et al. 1978). Based on the concept of "axis differentiation" in five main morphological criteria all related to the meristem activity they have formed "23 architectural models" and are dedicated to famous botanists.

Growth direction: (Plagiotropic or Orthotropic).
Growth rhythm: (Continuous or Rhythmic).
Branching mode: (Monopodial or Sympodial).
Sexual differentiation of meristems: (Terminal or Auxiliary).
Polymorphism of axes: Short (Brachy blasts), Medium (Mesoblasts), long shoots (auxi-blasts).



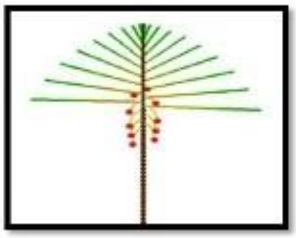
Holttum Model

1. Holttum model is consisting only one meristem due to it is not branched
2. This meristem will convert into inflorescence.
3. This plant eventually dies.
4. This model mostly used in Banana plant.


Corners Model

1. In this crop model trunk is single, Monopodial and orthotropic in nature
2. Indeterminate in growth and auxiliary inflorescence is seen
3. This model is mostly used in Papaya and Date palm etc.

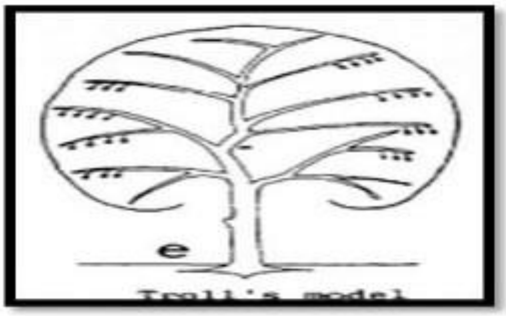




Rouh Model

1. Trunk is monopodial, orthotropic in nature.
2. Lateral flowering is seen.
3. This model is mostly used in Apple.


Trolls Model

1. This model is sympodial and plagiotropic in nature.
2. This model is mostly used in Annona squamosa.



Conclusion

Crop modeling in fruits provides knowledge about behavior of fruit trees to various architectural modifications such as effect of root stock, training, pruning, thinning and plant growth regulators along with interaction related with environment. As a research tool, model development and application can contribute to identifying gaps in our knowledge, thus enabling more efficient and targeted research planning. Concerning fruit quality, this new generation is really needed to accompany the advances in fruit genomics (Baxter et al., 2005). An intensely calibrated and evaluated model can be used to effectively conduct research that would in the end save time and money and significantly contribute to developing sustainable agriculture that meets the world's needs for food.

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Agricultural Marketing Situation-Developing Vs Developed Countries

Article ID: 11403

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Introduction

Agricultural marketing plays an important role in the growth and development of farming and agricultural outputs essential for the rural development in India. The scope of agricultural marketing can be defined through the functions served by it in pursuit of achieving the sustainable economic growth and development. India, world's largest producer of fruit and vegetables but inadequate post-harvest storage and transportation cause losses of around 30%-40%, only 7% value addition takes place, and only 2% of production is processed commercially.

Main Problems in India

The marketing strategy faces certain issues in its smooth run. Firstly, the inadequate transportation facilities, the malpractices existing in Mandis ,lack of credit, lack of availability of market information. Unregulated weights and measures with the sources and also lack of srandardization and grading techniques.

Comparison between Developing and Developed countries:

Developing Countries	Developed Countries
Middle Men: • Farmers are exploited by middlemen who offer low prices for their agriculture produce. • They block the progress of the farmers. Supply Chain: • No smooth supply chain and not well planned. Agrifood chains and networks play an important role in providing access to markets for producers from developing countries, as well as for local, regional and export markets. Information Asymmetry: • The information of land records often fail to reach the higher ends in the agriculture sector. This happens either when farmers do not get their land records submitted Technology: • Farmers are not enlightened about online marketing apps like e-nam,ITC-Portal • Still following the traditional methods of practice in agriculture and are not educated enough how to sell their produce in a different platform. Marketing Channels: • Many hurdles arise till the produce reaches the consumers • Low marketable surplus of Agricultural goods	• In USA, farmers eliminated middlemen • Smooth supply chain and well planned • Information asymmetry declines due to trust between seller and buyer • Use of technology to full extent in every aspect • Hurdles are minimised in developed countries • Foreign aid that increases agricultural productivity boosts incomes throughout the economy and increases demand for U.S. exports. The end result is more jobs for Americans producing goods and services for export, and more income in the American economy. • In the agriculture and food sector, the spread of mobile technologies, remote-sensing services and distributed computing are already improving smallholders' access to information, inputs, market. Digital technologies are creating new opportunities to integrate smallholders in a digitally driven agrifood system • Developed countries are leading on implementing national level strategies on digital agriculture. In some cases, this is by integrating the agrifood sector as a key focus within existing national digital

• The number of small and marginal farmers is more in India. These farmers hardly produce for the market. The market, therefore, depends more on big farmers. The output of these few big farmers will have to reach different markets. The net result is that the quantity of agricultural goods available will be inadequate in relation to the demand. Digital marketing: • Low marketing education: Digital marketing education is still generally low in developing countries. • In emerging economies and rural areas, weak technological infrastructure, high costs of technology, low levels of e-literacy and digital skills, weak regulatory framework and limited access to services mean these areas risk being left behind in the digitalization process. • Yet, developing economies may also have the advantage of being able to 'leapfrog' older agrifood technologies and models in favour of a digital agriculture revolution. Implementation: • In developing countries, most of the e-Agriculture services are embedded within e-government or ICT strategies where the main objective is to provide basic e-Agriculture services such as early alert notifications and general information. • Processing the agri-waste: • In developing countries many farmers from rural areas are not aware how to contact these processing industries.	strategies that aim to transform wider industry and society. • In developed countries, over ripened fruits are sold to beverage industries or processing industries.

As economic development proceeds, the share of agriculture in GDP and total employment changes being high but declining in developing countries, and low but more stable in developed countries. The position of agriculture within the economy seems more important in developing countries and less important in developed countries.

Challenges Faced by Developing Countries

Network coverage in rural areas remains limited. Developing countries are often the ones with the least capacity to manage the process. Success also varies by sector and, in many countries, the agricultural sector – a major employer in rural areas – lags behind. Smartphones have become a major way for consumers to access internet. Falling handset prices and innovations such as pay-as-you-go plans mean that mobile devices are increasingly affordable and accessible, including for rural communities

Conclusion

Our country stands on pair with other countries in many aspects.So it's the need of the hour to overcome the challenges in agriculture like lack of storage facilities,transportation,inability to provide marketing information promptly,inadequate finance and also failure in processing agri-waste. Hence government should provide more awareness to the farmers on marketing their produce effectively and take a stand for them as agriculture is the back bone of our country.

Livestock Marketing in India

Article ID: 11404

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Introduction

A number of the foremost dynamic markets both globally and India are for livestock and livestock products. This may well be often being driven largely by demand thanks to growth in purchasing power, but other factors play employment likewise. Livestock product markets in India remain largely traditional and unorganised or informal, delivering raw, or minimally processed products to the bulk of consumers. Managing these changes requires balancing regulatory interventions with economic forces in ways within which are effective both for increased supply of quality products, further as providing livelihoods and rural development opportunities through these growing markets.

Role of Livestock in Indian Economy

India is World's highest livestock owner at about 535.78 million. About 20.5 million people depend on livestock for his or her livelihood. Livestock contributed 16% to the income of small farm households as against a mean of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP.

Live Animals Market

India is First within the entire buffalo population within the globe (109.85 million), and second within the population of goats (148.88 million), and third within the population of sheep (74.26 million), and fifth within the population of ducks and chicken (851.81 million), and tenth in camel population within the earth (2.5 lakhs).

Live animals are mostly sold in lots in livestock fairs, periodical markets and daily markets. Each animal is assessed individually by the client supported the scale, age, meat, milk yield, breed, sex, quality, locality and season. The Govt. Of India established marketing cells in various states to manage these markets and organize co-operative markets to facilitate marketing of products, to form market surveys, to assemble and disseminate market news, and to advise better marketing methods and adoption of grading procedures.

Marketing of Milk

Milk production in India placed the country on top within the planet, but also represents sustained growth within the provision of milk and milk products for the growing population of the country. Concentrated dairy products like milk still be the foremost important item of export, which together accounts for nearly 78% of net milk and milk product exports. The following figure depicts the milk flow from the farm to the consumer in organized sector.

Marketing of Value-Added Products

Local livestock breeds cannot compete in quantity of milk production with industrial livestock systems, so as that they consider their unique qualitative aspects. District Milk Plants also makes, packages and markets Value Added products like afters. Cream, Curd, Cheese, Paneer etc. Similarly, meat factories can make ready-to-cook and even ready-to-eat Value Added products.

Marketing of Poultry and Eggs

Table eggs and broiler meat are the foremost end products of the poultry sector in India. The organized sector of poultry industry is contributing nearly 70% of the output therefore the remainder 30% within the unorganized sector in India. 100 billion eggs and over 4 million metric many poultry meat produced in India in step with the year 2019.

Problems in Livestock Marketing

Rural farmers are facing a great challenge in marketing their produce poor connectivity of road and transport facilities. Hence, they sell their produce to the local traders or meeting the demands of rural people at marginal profit.

Lack of infrastructure facilities and scattered population in rural areas , the processing industries could not reach them for their needs. Poor connectivity of information technology is also major constraints to know the proper market price for the produce. Lack of farmer producer organization for the livestock produce and malpractices of middlemen are keeping the farmer’s income as low.

The farmers are not encouraged for value addition for their produce since there are lot of challenges and difficulties availing the credit facilities from banking sector. The government initiative welfare programmes are not reaching the farmers well.

Major Challenges Faced by Livestock Sector

Improving the animal productivity is major challenge of Indian breed. The outbreak of disease has happened often and it disturbs the marketing of the produce. And also, majority of the greenhouse gas emission is contributed by huge number of Indian ruminants. Adopting the mitigation strategies in rural areas are the major challenge to the government.

The livestock is not getting little attention in getting insurance coverage as well as information technology. The research study said that India is a deficit in dry fodder by 11 per cent, green fodder by 35 per cent and concentrates feed by 28 per cent. The market for livestock produce is unregulated , uncertain and lack of transparency. Similarly, slaughtering technology is poor and the facilitation is very poor in India. Major share of the meat and meat products are outcome of unregistered slaughterhouses.

The transaction cost of livestock produce contributes around 15-20% of their sale price. Accessing the good quality of the water by livestock is also major challenge due to the depletion of water resource in the country and its adulteration. The quality of semen is deteriorating past a decade due to the limited availability of good breeding bulls.

Conclusion

The share of livestock produce in agriculture GDP has been increasing faster than the share of crop sector. Compared to the livestock census 2012, the livestock population is increased 4.2% in 20th livestock census. Due to urbanization, awareness on nutrient based consumption and income elastic nature is increasing the demand of the livestock products.

The global market for animal-based product is expanding so fast. The process of liberalization increased the activities of exports of livestock products at peak showing from higher returns in livestock trade. There is a need to understand of the huge investment on the livestock sector will shoot up the growth which leads to reduce the malnutrition and poverty of the country. The government should restructure and revitalize the institutional set up to enhance the effort of start ups and Farmer producer organization in the sector. The government should also involve linking the organic produce production of the small holders with large industries to get the appropriate market.

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A Study of Contract Farming Invasion in India

Article ID: 11405

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Introduction

With total agricultural commodities export of 3.50 billion us dollars in March-June 2020, India stands seventh largest agricultural exporter worldwide and the sixth largest net exporter. As per 2018-19, agriculture employed above 55% of work force and contributed 17-18% of country's GDP. Though there is a keen downfall in all sectors due to pandemic effect on financial aspects, yet the agricultural sector shown increase in its contribution at 1-1.5%. As of 2011, India's arable land area of 159.7 mha, which is the second largest in the world, after the United States. As per FAO, India is the largest producer of fresh fruits like banana, guava, papaya, lemon and vegetables like chickpea, okra milk and medicinal plants.

Why Contract Farming is a Major Practice?

With steep rise in population, almost India is going to reach the top of the most populated country in the world by 2023 and it's very urgent to increase the agricultural production and its marketability. For this, commercial method of contract farming is aiding practice. Also, majority of farmers comes under marginal and small farmer group of holding one hectare or less than two hectares respectively. It's too difficult for them to overcome obstacles of making their produce to reach consumers. Also, the margin of middle men is more in the consumer rupee. Research data says that middlemen earn as margin of 28-38% in wholesale price. To overcome all these problems, contract farming paves a wonderful way to the farmers.

What is Contract Farming?

Contract farming is defined as a system where a central processing or exporting unit purchases the harvests of independent farmers and the terms of purchase are arranged in advance through contracts (Baumann, 2000). Contract farming involves different institutions like processing firms, financial institutions, input providing companies, and the farmers themselves. When you see the history of contract farming, it entered India truly in 1989, when PepsiCo set up a plant in Hoshiarpur to procure tomatoes for processing. This paved a triple time increase in tomato yield from 7.5 tonnes to 20 tonnes per acre. Chilli yields increased from 2.5 mt to 9 mt. Contract farming also moved to other crops like ground nut, basmati and non-basmati paddy. It is further extended to exotic vegetables such as baby corn, bell peppers, jalapenos, gherkins etc.

Current Contract Farming Scenario

According to the doubling farmers' income committee report on august 2017, contract farming can address many traditional ill practices like lack of market connectivity, long chain of market intermediaries, ignorance about the buyer demands etc. Contract farming is the place where farmers are allowed to vertically integrate with specific and organised market channels. In an article published in National Institute of Agricultural Economics and Policy Research in 2009, Sukhwinder Singh summarised various studies conducted across the country. It was found that contract production gave higher gross and net returns compared with that from the traditional crops.

Some of live examples of contract farming companies includes Agrilogix procuring guar from Andhra Pradesh, Hindustan Lever Ltd (HLL), Rallis and ICICI jointly promote contract farming in wheat in Madhya Pradesh, McCain (I) Ltd procuring sesame seeds and potato from Gujarat, Punjab, Himachal Pradesh, Jain irrigation procuring white onion from Maharastra. The Agri-firm also involve contract farming for veterinary purpose like, Gowardhan dairy procuring fodder for 3500 cows from Pune, Ambegoan taluk; Sri Venkateswara hatcheries and Suguna poultry procuring broilers from various states like Maharastra, Gujarat, Punjab, west Bengal, Karnataka etc.

There is a positive hand towards the arising trend of contract farming in India where an average about 70% of farmers under marginal farmers category had been engaged in contract farming for the past four years. The overall coverage area is highest in Andhra Pradesh in case of horticultural crop (upto 70%). Also the participation of farmers through FPOs farm produce organisation, Non- governmental organisations (NGOs), co-operatives and self-help groups has enhanced firm-farm coordination and negotiation power among parties. Currently on an average the value of output price gained per acre cross 50,000. While segregating state wise the output value crosses 90,000 in case of Andhra Pradesh including Telengana, 70,000 in case of Karnataka and followed by Punjab, Haryana etc.

Advantages of Contract Farming

Farmer friendly approach of Appachi Cotton Company (ACC), the ginning and trading house in Pollachi under the name Integrated Cotton Cultivation (ICC), established backward and forward integration between the `grower' (farmer) and the `consumer' (textile units). The contract assures the farmers easy availability of quality seeds, farm finance at an interest rate of 12% per annum, door delivery of unadulterated fertilisers and pesticides at discounted rates, expert advice and field supervision every alternate week, and a unique selling option through a MoU with ACC. Introduction to appropriate technology, easy skill acquirement, guaranteed and fixed pricing, time bound payment, proper timely delivery of produce. In case of firms, definite quality and quantity of produce is procured, dissemination of selected variety and finally appealing society in case of Corporate-Social Responsibility (CSR). However access to farm loan and crop insurance occurs promptly. One can engage with NABARD's Initiative of developing special refinance packages in contact farming in case of Agricultural economic zones (AEZ) for commercial and medicinal crops like Stevia, Aswaganda etc.

Challenges in Contract Farming

Contract farming is absolutely a bottle neck game of gambling. There is a wide chance of risk at ends of both the parties in case of delayed payment for the produce for which government has declared the farmers (Empowerment and protection) agreement of price assurance and farm service bill, 2020 that firm must pay 2/3rd the decided payment at the time of procurement. Other constraints include inability of farmer to give his produce on specified time due to natural calamities like scarcity of water, erratic power supply or quality degradation, varietal manipulation etc.The nature of monopsony with the corporates takes the upper hand over the produce and so on.

Impact of Farm Bill 2020 on Contract Farming

The second farm bill, The Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020which gives power to farmer for engaging with processors, wholesalers, aggregates, wholesalers, large retailers, exporters and others in a very competitive environment. Price assurance will be given to the farmers even before the sowing of crops.

In the case of higher market prices, farmers will be entitled to this profitable price much above the minimum price. It will shift the risk of market unpredictable from the farmer to the financially powerful sponsor. Due to prior price determination, farmers will be shielded from the volatility of market price farmers are protected from volatility of market prices.

It will give access to the farmer to adopt modern technology, better seed and other inputs. It will mitigate the cost of marketing and enhance the income of the farmers. An effective dispute resolution mechanism has been facilitated with distinct timelines for redressal.

There is scope of government support to the farmers for introduction of new research and technology to do progress in the lagging agriculture sector.

There is a diaspora of corporate dominating the market and the farmer may lose his right to fix prices according to their will, in few years. But under contract farming, farmer will have absolute power to determine prices for their produce.

10000 farmer produce organization are coming to existence across the country. These FPOs will bring together small and marginal farmers to ensure remunerative pricing mechanism for farm produce. In case of disputes, there will be availability of local dispute redressal system.

Conclusion

There should be an absolute necessary of contract farming practices to attain a new corner in agricultural sector. In order to sustain in rising demand for agricultural produce dissemination and accessibility, farmers must come out of the old box and enter into new era of contact farming in order to have better price for the produce, assured marketability, abolishing unpredictability of market, use of technologies, easy access to information, power of price decision of produce and finally a better standard of life!

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Role of Information and Communication Technology in Agricultural Marketing

Article ID: 11406

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Introduction

Agriculture is primary occupation in Indian sub-continent and it counts around 56% populations depend on agriculture for their livelihood. Small farm holdings and lower productivity are keeping the farmers at poverty level.

Despite bringing advanced technologies to the farming community, there is no proper dissemination of information. Farmers are facing difficulties in accessing the technology available, government policies, resources, markets for their products, and other institutional services.

The professional scientific guidance on crop production is not available to them in a timely manner. Information and communication technology (ICT) is one of the better solutions to dissemination the requisite information in a cost-effective manner.

ICT in Agriculture

ICT refers to the Technologies that provide access to information and assist or support in storage, processing of Information, helps in dissemination of Information through telecommunication medium such as radio, television, cell phone, computers, satellite technology; Internet including email, instant messaging, video conferencing and social networking websites which made possible for users across the world to communicate with each other to quick access of information.

ICT technologies are applied for processing, exchanging and managing data, information, and knowledge. GPS, GIS, Smart mobile phone, tablets and application software's are some of the ICT uses in the agricultural sector. ICT reduce the middle man participation in agriculture by providing better and accurate information to the farmers. Make the farmers aware of on-going market information and prices of the commodities. Enhance the well-being of the farmers and encourage the more marketable surplus.

Through ICT, the farmer can find new buyers at global level and they may get fair price for their produce. ICT reduces transport and logistics costs of obtaining market information. Commercial buyers can get good quality produce through accessing the markets at large level in hand by using smart phones. Traceability ensures the quality of the produce. Rural farmers are being able to know the minimum and ceiling price of each commodity on daily basis by using internet.

ICT's Initiative and Websites in Agriculture

1. Agrimarknet: It is Comprehensive database which links together all the important agriculture markets in country. Here, Farmers can get to know where the nearest Mandi for his commodity and what the price are. Govt. departments can keep eye on flow of commodities and monitor the prices. Researchers, analysts can information used towards the improvement in Indian agriculture.

2. Agrisnet: It is the vision of creating interconnected technology enabled which can deliver informational services effectively to farming community. Some distinct feature include: farm based advisory, digital marketing linkages etc., all these provide through use of mobile, voice, text, online platforms.

3. Agri Business Centres: It provides a web-based solution to the small and medium farmers as well as owners of large landholdings. It brings on a single platform all the stakeholders in agribusiness like farmers and farmer groups, institutions and autonomous bodies, agro machinery and farm equipment makers, cold chain tech., commodity brokers, cooperatives, food processors, pre- and post-harvest management experts, packaging technology providers, insurance companies, warehousing and logistics agencies, surveyors and certification agencies.

4. e-KRISHI VIPANAN: It professionalizes and reorganizes the agriculture trading business of Mandi Board by installing cost effective digital infrastructure using latest advancement in ICT by collecting and delivering real time information, online. It makes the operations more effective, totally transparent, benefiting all stake holders (farmers, traders & the government), empowering them through accurate and timely information for effective decision making.

5. e-choupal: It is ITC's initiative. In this initiative, the Village internet Kiosks (Sanchalaks) are appointed at each information Kiosks to provide market information. It facilitates easy flow of information to farmers. Readily available agricultural information in their local language on Market prices and other information. It acts direct marketing channel, virtually linked to 'Mandi' system for price discovery.

6. e-nam: It is an Online Trading Platform. Mobile Bidding are followed here. It facilitates the Farmers, Traders and Buyer in an Online platform

7. Kisan Call Centres: Kisan call centres have been established across the country with a view to leverage the extensive telecom infrastructure in the country to deliver extension services to the farming community. The sole objective is to make agriculture knowledge available at free of cost to the farmers as and when desired.

Queries related to agri. And allied sectors are being addressed through the kisan call centres, instantly, in the local language by the experts of State departments, SAUs, ICAR institutions etc. There are call centres for every state which are expected to handle traffic from any part of the country. SMS using telephone and computer interact with farmers to understand the problem and answer the queries at a call centre.

The infrastructure is placed at three locations namely-a professionally managed call centre (level-I), a response centre in each organization, where services of SMS are made available (level-II) and the Nodal Cell (level-III).

8. Reuters market light: It is a mobile- based provider of technical and financial advice to farmers in India. Its main aim is to act as a platform for the enginemen and interaction of farmers and agricultural communities. Through this, they ensure access to relevant information and the ability to transact with one another directly, thereby providing maximum efficiency and value for farmers buying and selling farm produce and related products.

Constraints Faced by the Farmer while Using ICT

Reason studies list out the constraints that majority of the farmers are lacking in awareness, poor literacy and knowledge, lack of confidence, lack of skill in handling ICT. Farmers are not making use of toll free number because of non-response or very heavy occupancy in phone line and they feel difficulty in understanding the voice or text messages by the farmers. There is a poor coordination and implementation of ICT projects in large scale by government sector.

Conclusion

It is concluded from the present study is that the ICT projects are implemented in the agricultural sector but not much faster. Though they are promising to create the difference and also easing the information access, most of the projects are at the preliminary levels and need to be given further existence. Lowering the cost of the tools to be used are also welcomed.

Hence it is a right time to appropriate the data provision through various channels for the development of ICT use in the agricultural sector. Also it is concluded that the exact and correct time implementation of ICT projects could bring the revolutionary change in the farming sector in India. Nevertheless to say that the sector if tied up with the ICT projects will transform the lifestyle of the farmers in the years to come speedily, so that it paves the way to economic development.

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Marketing of Spices in India

Article ID: 11407

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Introduction

The story of Indian Spices is more than 7000 years old Centuries before Greece and Rome had been discovered. The largest produced spice in India is Chilies, followed by Turmeric and Garlic. India is the largest producer of Red Dry chilly in the world in which the high contribution was given by Rajasthan. India is second largest producer of Garlic in the world after China. India grows over 50 different varieties of spices. Total production is around 2.7 million tonnes. Of this, about 0.25 million tonnes (8-10 per cent) is exported to more than 150 countries. The Indian share of the world trade in spices is 45-50 per cent by volume. The world demand for organically produced foods is growing rapidly in developed countries. Since organic foods are free from chemical contaminants, the demand for these products should steadily increase in the new millennium. India has always been practising the traditional ways of using indigenous technologies and inputs mostly in line with modern organic farming principles which result in better demand.

India's Position in Spice Production and Exports

1. India is the largest producer, consumer and exporter of spices, with a 46 per cent share by volume and 23 per cent share by value, in the world market.
2. The Indian spice export basket consists of around 50 spices in whole form and more than 80 products in value added form.
3. India accounts for 25-30 per cent of world's pepper production, 35 per cent of ginger and about 90 per cent of turmeric production.
4. Among the Indian Federal states, Kerala tops in pepper (96 per cent), Cardamom (53 per cent), Ginger (25 per cent) production in the country.
5. Andhra Pradesh leads in Chilly and Turmeric production in the country with 49 per cent and 57 per cent.

Export Promotion Schemes of Board

Financial support for:
1. Adoption of hi-tech in spice processing.
2. Setting up/upgradation of QC laboratory.
3. Iso/haccp certification.
4. Product/brand promotion, packaging development.
5. Participation in trade fairs.
6. Printing of promotional literatures.

Product & Service

There are mainly five products Namely pepper, cardamom (small and large), chilli, vanilla, ginger export outside India. Indian Spices market meet the demand of domestic as well as foreign countries.Indian spice products are different as compare to quality, packing, technology, value and range of product.

Export Status

1. The country at present exports around 50 tonnes of different varieties of organic spices.
2. Exports will get a significant boost in the coming years as more farmers switch to organic methods.
3. Spices Board India has prepared a document on production of organic spices.
4. The document has been published after approval by the National Standards Committee constituted by the members of IFOAM in India.

5. In FY20, spices worth US$ 3.62 billion were exported.
6. During FY19, a total of 1.10 million tonnes of spices and spice products valued US$ 2.80 billion was exported from the country as against 1.02 million tonnes valued US$ 2.78 billion in FY18, registering an increase of 7% in volume.
7. Top 10 importers of Indian spices in FY19 were US, China, Vietnam, Hong Kong, Bangladesh, Thailand, UK, UAE, Malaysia, and Sri Lanka.
8. The total spices export during April 2020 to February 2021 was US$ 3.55 billion and for the month of February 2021 it was US$ 348.32 million.
9. In FY20 (till December 2019), ginger export showed the highest growth of 47% with 19,410 tonnes, followed by cardamom with 31% at 1,060 tonnes and cumin with 14% at 7,350 tonnes.

General Guidelines / Procedure for Exporting Spices

1. The applicant should submit application along with all the requisite documents to the nearest designated regional office of the Spices Board, with an intimation by e-mail to Spices Board, Head office (dm.sb-ker@gov.in), so as to avail assistance. The exporters located in Kerala shall address the applications to the Deputy Director (Marketing), Spices Board, Head Office, Kochi.

2. On receipt of the application and enclosures the Board/Regional Office (RO) will acknowledge the receipt of the application and then process the application as per concerned scheme procedures. The applicant is wholly responsible for providing all the information and documents sought as per guidelines of the schemes.

3. All the applications received shall be scrutinized in the office (regional/ head office as applicable). Once the application is scrutinized and found to be complete in all respects, the Regional Officer shall forward the application to Head Office with his/her recommendation.

Spices Export from India

In terms of product wise exports, Chilli, Oils & Oleoresins, Cumin, Turmeric and mint products are the top spice products in terms of value exported in 2016. India exports majority of its spices to USA, China, Vietnam, UAE, Indonesia, Malaysia, UK, Sri Lanka and Germany. Exports of spices has increased at 4.45% CAGR in value terms and 6.87% CAGR in volume terms between 2012 to 2016. However, India is facing stiff challenge in trade of some important spice from South East Asian countries. In 2016, pepper exports fell sharply due price competition from Vietnam and Indonesia. However, trade of chilli, cumin and value-added products like Oleoresins and oils have shown decent growth.

Spices Import in India

Apart from USA and EU, India is also one the major importers of spices. India majorly imports pepper, ginger, coriander, clove and cassia. The demand for pepper in India is reported to be about 60,000 MT whereas the domestic production is estimated at 55,000 MT in 2016-17. It is mostly imported from Vietnam and Sri Lanka which offer competitive prices. Efforts need to be taken to improve the production of pepper in India which has a promising domestic and exports market. Production of clove in India is affected by vagaries of weather which has forced higher imports. Cloves are imported from Sri Lanka, Madagascar, Zanzibar and Indonesia. Ginger is imported for industrial purpose, for ingredient in masala tea. Due to bumper harvest in east Europe and price considerations, coriander import into India has increased. Cassia is mostly imported from Sri Lanka for quality standards.

Supply Chain and Market Linkage

In case of small enterprises, adequate 'kitchen style' processing is required at farm level. Lack of finances, adequate information of the required technology to improve production efficiency are constraints in developing efficient supply chain. An efficient supply chain ensures minimizing wastages and improving the quality of spices.

Post-Harvest Challenges

Due to increase in other economic activities, producer countries are facing major challenges in finding the agriculture labor for carrying out the good agriculture practices. Post-harvest operations are important to ensure healthy, clean spices for the supply chain forward. Ginger peeling, solar drying of spices, boiling , drying and polishing of turmeric, on-farm processing seed spices are some areas that require immediate attention.

Lack of Price Discovery Mechanism

Apart from production, marketing and trade, stocking of spices is also a factor which influences the farm level prices. Farmers generally overlook the stock position of previous years and have to face the volatility in domestic prices.

Conclusion

Spices are called pearls of developing countries. Spice's trade contributes the major share in the foreign exchange earnings. The larger small holdings involved the valuable spices. Government should enhance the market for spices besides enriching the quality standards and helps the farming community to get better price. For the proper value chain development in spices required organizational development, technical upgrading, management skills and access to financing.

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An Ingenious Approach to Agriculture – Digitalization

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Overview of Digital Agriculture

The conversion of information into a digital (i.e., computer-readable) format, in which the information is organized into bits is termed as digitization or digitalization. The result, we get, is the representation of an object, image, sound, document or signal (usually an analog signal) by generating a series of numbers that describe a discrete set of its points or samples. To enable farmers and other stakeholders within the agriculture value chain and to improve food production, the use of new and advanced technologies is integrated into one system, which is called digital agriculture. The system gathers data more frequently and accurately, often combined with external sources (viz. weather information). To make more informed and appropriate decisions, the resulting combined data is analyzed and interpreted for the farmer. These decisions can then be quickly implemented through robotics and advanced machinery, with greater accuracy and farmers can get real-time feedback on the impact of their respective actions. Hence, it can be said really that digitalization is an ingenious approach to agriculture. Let's explore the same in a better way!

Introduction to ICT

ICT (Information & Communication Technology) is any device, tool, or application which permits the exchange or collection of data through interaction or by transmission. Thus, an umbrella term that includes any such thing ranging from radio to satellite imagery to mobile phones or electronic money transfers is nothing but ICT.

Technologies Adopted for Agriculture

Encompassing a wide range of technologies, digital agriculture has multiple applications along the agricultural value chain. These technologies include:

Cloud computing/big data analysis tools, Artificial intelligence (AI), Machine learning, Distributed ledger technologies, including block chain and smart contracts, Digital platforms, such as e-commerce platforms, agro-advisory apps or e-extension websites, Precision agriculture technologies, The Internet of Things, a principle developed by Kevin Ashton that explains how simple mechanical objects can be combined into a network to broaden understanding of that object, Digital communications technologies, like mobile phones, including:-

1. Sensors, including food sensors and soil sensors.
2. Guidance and tracking systems
3. Variable-rate input technologies.
4. Automatic section control.
5. Advanced imaging technologies, including satellite and drone imagery, to look at temperature gradients, fertility gradients, moisture gradients, and anomalies in a field.

Some Example Applications of Technology

1. Aquaculture: Factors having varying impacts on yield are contamination from pollutants (washed from the land into the water by rain) and diseases. One such example of this is the farming of oysters. To help Tasmanian oyster farmers manage these challenges using sensors, predictive analytics and a clear user interface, the technology company, The Yield, has partnered with Bosch. This enabled more accurate predictions about when water contaminants are much high or an outbreak of disease is likely so that farmers are able to take proactive decisions to reduce oyster loss.

2. Potatoes and reducing water use: A company named PepsiCo has successfully reduced water input to their potato crop by 26% over the past ten years. The way they have done this is through locating sources of waste water for re-use in irrigation. The company also monitor soil moisture, link this to weather forecasts and set more efficient irrigation levels. This will definitely improve sustainability and water availability in countries at risk from drought.

3. Lettuces that help kidney disease sufferers: People with kidney disease and much potassium in the diet such as from high-potassium vegetables is quite unhealthy. This is a serious issue in countries like Japan where 10% of the population suffer from chronic kidney disease. Fujitsu joined with Microsoft and others to grow lettuces with less than 80% of the potassium content of traditionally grown lettuce through minutely controlling growing conditions. This notable work has both enriched diets and demonstrated how sensors, analytics and data visualisation can create a system to improve agricultural practices.

Field Monitoring

1. Crop Health Monitoring (mostly based on NDVI): Normalized Difference Vegetation Index (NDVI) is that method which is used to determine the health of crops through the analysis of drone and satellite imagery. It looks at various wavelengths of light, both visible and non-visible, to make the calculations perfect. This technology allows us to assess the general health of your crops and detect crop variability.

2. Yield Monitoring and Forecasting: The yield information is collected either from satellite imagery and drones or from the sensors installed on the farmer's machinery. These yield sensors are attached to harvesters or tractors and collect information on things like grain yield, moisture levels, and many more, which allows farmers to make better decisions on when to harvest, plan for the next season and fertilization, analyze field variability and many other things.

3. Detection of Diseases, Pests or Weeds: As we have seen, drones have many uses in precision agriculture, the detection of diseases, pests, and weeds are yet another value that comes from drones and hyper spectral imaging. Gamaya's hyperspectral camera is the smallest and most lightweight commercial hyper spectral camera and is currently available. However, this makes it perfect to attach to drones and nano satellites. Gamaya's camera is tightly held with proprietary software to translate raw data into actionable information for farmers.

Automation in Agro-Machinery

1. Farm Robots: Robots are being used in many industries to automate different operations. In farming, robots are used for many such reasons, but one big use is the automation of weed management. Blue River Technology and Ecorobotix, two big companies have developed robots that use cameras to identify weeds in real time and makes decisions on how they should deal with them.

2. Guidance Systems Based on GPS: GPS technology is used to guide automated machinery and vehicles in facts like auto steering, high navigation and positioning, and more.

3. Telematics: It is a process which involves machine-to-machine communication between the hardware and sensors that are involved in automation, viz. when a camera identifies a weed, it needs to communicate this information to another piece of machinery which can pluck the weed out of the ground or spray it with little herbicide. Telematics is very important in automation.

4. Precision Planting: Precision planting is a technical approach to optimizing the planting of seeds. It helps for better seed spacing, better depth control, and better root systems. There are many information which are used to make the proper analysis in identifying the optimal conditions for planting which is easily collectable with the various forms of precision agriculture technology on the market.

Major Success Stories

Akashganga, e-Choupal, TKS(Tata Kisan sansars), Drishtee, Janmitra, e-Uttaranchal.

Android Applications

Emergence of Agri-Web Portals

1. http://www.fao.org/.
2. http://www.agroindia.org.
3. Farmer's Portal.

Benefits of Portals

1. Permanent in nature
2. One stop information hub
3. Strategic tie ups among companies
4. Easy promotions through advertisements
5. Fast problem solving method.

Critics of Smart Agriculture

1. Inadequate Infrastructure
2. Illiteracy
3. Traditional beliefs of non adopting technologies
4. Digital gender gap.

Conclusion

The future of farming is quite bright. There are much more precision agriculture technologies coming out each month. All of these solutions offer substantial value for farmers in their effort to optimize production, better manage their operations and most importantly save money and make money off bigger yields. These technologies are being adopted by farmers at a very fast pace. Now also, the Indian Council for Agricultural Research (ICAR) signed MoU with Digital India to create tele-advisories for farmers. From field monitoring technologies to variable rate application, the present precision agriculture technologies offer an end-to-end solution for today's farmers.

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Techniques of Vegetable Production

Article ID: 11409

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Introduction

World population is increasing at an alarming rate and is expected to reach about six billion by the end of year 2050. Increased hunger and malnourishment are challenging issues for all nations, especially those who are resource poor. Feeding of hunger-laden people of the world not only requires food in quantity but quality as well. But the complex process of growth and development is significantly affected by different agro-climatic condition. Under changing climatic situations, crop failures, shortage of yields, reduction in quality and increasing pest and disease problems are common, which render the vegetable cultivation unprofitable. Hence, there is a need to develop an understanding of the impacts and implications of climate change on vegetable cultivation for timely intervention to ameliorate its harmful effects and is possible by adopting different techniques of vegetable production.

Different Techniques of Vegetable Production

1. Pro tray seedling production technology.
2. Mulching.
3. Training practices.
4. Fertigation.
5. Protected cultivation.

Pro Tray Seedling Production Technology

The production of good quality seedlings is very much essential for getting higher yield and quality of any crop. Though the seeds of many hybrids are made available to the farmers, they lack the technical knowhow of producing quality seedlings. Hence, the production and timely distribution of quality seedlings of vegetables would be a greater scope to meet the growing demand. With this background the technology " Pro tray production of vegetable seedlings" is developed.

Seedling production using pro trays: Seedling production of F1 hybrids of tomato, chillies, capsicum, cauliflower and brinjal using pro trays with coco peat as media could be used. Presently the seedlings of vegetables are raised and distributed to the beneficiaries. Sterilized commercial coco peat is being used as growing media, as it reduces the incidence of seedling diseases and contains right amount of moisture in it. The coco peat is a by-product of coir industry and it has high water holding capacity as, it contains low nutrients and high lignin content.

Mulching

Mulching: Mulching in general is a beneficial practice for crop production. Mulch is simply a protective layer of a material that is spread on top of the soil. It enriches and protects soil and provides a better growing environment. At the same time, it acts as barriers to movement of moisture out of the soil.

Vegetable cultivation in India is susceptible to several pathogenic agents and among them, losses caused by viral diseases are enormous. Although, insecticidal interventions bring down the pest damage, they have led to problem of pesticide residues in vegetables. Insect vectors of viruses have often evolved resistance to commonly used pesticides, which require some alternative control strategies. Moreover, excessive use of pesticides led to the development of undesirable problem like destruction of natural enemies, pest resurgence, and failure of control strategies leading to outbreak of pests. Under such circumstances, mulching is a good option for virus-vector management to control the yield loss. It also helps in having good quality produce.

General Mulching Recommendations: Firstly, knowledge of proper selection of mulch is essential. Depending upon the use and criteria, selection of mulch is required. Using the right mulch can help to conserve water, save plant roots from extremes temperature, improve the soil, and discourage the growth of weeds. For vectors such as aphids, white flies, thrips and hoppers transmitting viruses, silver colour reflective mulch is beneficial as it acts as a repellent. Similarly, for controlling weed, white colour mulch and for increasing temperature black is useful.

Training Practices

Training is done to force or make the plant grow in a certain architecture or structure or trellis. So that they can bear the heavy load of the fruits and produce quality harvest. Ex.:

1. Bower system: Bitter gourd being a weak climber needs support for its growth. The plants trailed on the support (bower) continues to give yield for 6-7 months as against 3-4 months when trailed on the ground without support. Such vines are less susceptible to pest and diseases as they do not come in direct contact with the soil.

2. The Stake and Weave System: Staking and weaving is a highly specialized production system used by commercial tomato growers. Some advantages of staking are improved fruit quality and yield, ease of harvest, less disease, improved spray coverage, larger fruit, and fewer damaged fruit.

3. Plant support net: Plant support net used to support vegetable plants like Cucumber, Bitter gourd, Bottle gourd, Sponge gourd, Ridge gourd, Tomato etc. It is used in Open field Cultivation as well as in Greenhouse farming.

Benefits of training:

a. Improve growth and expand fruiting area:
   i. Increase yield
b. No or less contact with soil:
   i. Cleaner harvest.
   ii. Reduce the incidence of fruit fly.
   iii. Reduce soil borne diseases.
c. Fruit grow fully to perfect/ desirable shape.
d. Easy intercultural operation.

Fertigation

Fertigation is a method of fertilizer application in which fertilizer is incorporated within the irrigation water by the drip system. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high therefore the efficiency is more. In this method liquid fertilizer as well as water soluble fertilizers are used. By this method, fertilizer use efficiency is increased from 80 to 90 per cent.

Advantages of fertigation:

a. Nutrients and water are supplied near the active root zone through fertigation which results in greater absorption by the crops.
b. As water and fertilizer are supplied evenly to all the crops through fertigation there is possibility for getting 25-50 per cent higher yield.
c. Fertilizer use efficiency through fertigation ranges between 80-90 per cent, which helps to save a minimum of 25 per cent of nutrients.

d. By this way, along with less amount of water and saving of fertilizer, time, labour and energy use is also reduced substantially.

Protected Cultivation

Define: Protected cultivation practices can be defined as cropping techniques wherein the micro climate surrounding the plant body is controlled partially/fully, as per requirement of the plant species grown, during their period of growth.

Protected cultivation is being used to control the effect of environment effect. Proacted cultivation is the sustainable approach toward the vegetable production under adverse climate. Besides, from protection to adverse climate condition, the vegetable under protected production yield high quality vegetable in terms of shape, size and colours. The micro climate can be changed inside the poly house. Certain insect requires UV light their vision purpose, the UV opaque covering material for poly house helps to restrict the insect to enter the house. Consequently, there is minimum use of insecticide. The production of vegetable is higher than the open field condition due to congenial inside microclimate and that provided better price.

Conclusion

1. All the techniques of vegetable production i.e., pro tray seedling production technology, mulching, training practices, fertigation, protected cultivation are helps to increase the yield with high quality and mitigate the climate change problem which comes during vegetable production.
2. Pro tray seedling production technology provides good quality seedling.
3. Mulching practices reduce the economic cost of production by reducing the use pesticides and weedicides, conserve soil moisture etc.
4. Training practices specially in vine vegetable crops (cucurbits) and tomato avoid fruit contact with soil and provide high yield with good quality of produce.
5. Get higher yield by increasing nutrient use efficiency through fertigation technique.
6. Vegetable production under adverse climate with high quality yield is possible in protected condition.

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Emerging Paradigms in Formulating Different Types of Biopesticide Formulations

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Abstract

Biopesticides are the formulated form of active ingredients based on microorganisms namely, bacteria, viruses, fungi, nematodes. Application of biopesticides is still limited to only a few percent of all pesticides used for crop protection. There are many factors contributing to that situation, such as expensive production methods, poor storage stability, susceptibility to environmental conditions, efficacy problems, etc. Some of these problems can be overcome by formulation improvements. With many pressures on product performance formulation is becoming the most important area to enhance and extend the activity of biopesticides. In this paper we reviewed different types of biopesticides existing on the market.

Introduction

The biopesticide formulation consists of microbial component with various carriers and adjuvants for improved environmental sustainability, biological agent survival, biocompatibility and storage stability. Biopesticides are still only employed in a small percentage of all pesticides used for crop protection. Many factors contribute to this situation, including high production costs, poor storage stability, vulnerability to environmental conditions and efficacy issues. Some of these issues can be solved by tweaking the formulation. With so many demands on product performance, formulation is rapidly becoming the most crucial area for improving and extending biopesticide action. Here, we shall focus on the different types of biopesticide formulations available in the market.

Biopesticide Formulations

The most important functions of the developed formulations viz., microbial agent stabilization during distribution and storage, product handling, application ease, bioagent protection from adverse environmental conditions, bioagent activity enhancement by increasing interaction with the target pest. These criteria can be overcome in a variety of ways by combining bioagents. Biopesticide formulations can be classified as liquid or dry based on their physical state.

1. Liquid formulations: Water-based, oil-based, polymer- based, or combinations.
    a. Water-based formulations need adding of inert ingredients, viz., stabilizers, stickers, surfactants, coloring agents, antifreeze compounds and additional nutrients.

2. Dry formulations can be produced using different technologies, such as spray drying, freeze drying, or air drying either with or without the use of fluidized bed.
    b. Produced by adding binder, dispersant, wetting agents and so on (Knowles, 2008).

Biopesticides are typically available in two forms: dry formulations for direct application and liquid formulations for water dilution. Dry formulations viz., dusts (DP), seed dressing formulations – powders for seed dressing (DS), granules (GR), micro granules (MG), dry formulations for dilution in water – water dispersible granules (WG) and wettable powders (WP); liquid formulations viz., emulsions, suspension concentrates (SC), oil dispersions (OD), suspo-emulsions (SE), capsule suspensions (CS); Ultra low volume (ULV) formulations (Bharti and Ibrahim,2020).

Dusts

Dusts are made by saturating an active substance with finely ground solid mineral powder (talc, clay, etc.) with particle sizes ranging from 50 to 100 µm. Anticaking agents, ultra violet protectants, and sticky elements to increase adsorption are all inert constituents in this formulation. In most cases, the active ingredient concentration in dust is 10%.

Powders for Seed Treatment (DS)

To promote product adhesion to seed coats, powder for seed treatment is prepared by blending an active component, powder carrier, and accompanying inert. They also contain a red pigment as a safety sign for dressed seed.

Granules (GR)

GRs are heavier than dust particles. Mineral ingredients viz., kaolin, attapulgite, silica, starch, polymers, dry fertilizers, and ground plant residues are used to make coarse particles of size range 100-1000 µ for granules and 100-600µ for micro granules. Granules slowly release their active substance once they've been administered. To release their active substance, some granules require soil wetness (Lyn, 2010).

Wettable Powders (WP)

WPs are finely crushed dry powders that can be applied after being suspended in water. Wettable powders are made by combining an active ingredient with a surfactant, wetting and dispersing agents, and inert fillers, then grinding the mixture to the desired particle size (about 5µ). Wettable powders are gradually suppressed by suspension concentrates or water dispersible granules, due to their dustiness during application. WPs have received a lot of interest when it comes to solid biopesticide formulations because of their extended storage stability, good water miscibility and ease of application with standard spraying equipment. Water dispersible granules (WG) were created to solve the problem of powder formulation dustiness.

Water Dispersible Granules (WDG)

WDGs are meant to dissolve in water, breaking up into a homogeneous suspension similar to that of a wettable powder. These WDGs are largely dust-free and have good storage stability as compared to powder goods. Similar to wettable powders, the products contain a wetting agent and a dispersion agent, but the dispersing agent is normally at a higher concentration. Its property of safety and ease of administration make them appealing to many users.

Emulsions

Emulsions are made up of liquid droplets scattered in another immiscible liquid (droplet size- 0.1 to 10 m). Emulsions can be either oil in water (EW) or water in oil (EO) (inversion emulsion). Before using, both products must be combined with water. It's critical to choose the right emulsifiers for stabilization to avoid instability. Because oil is the exterior phase of the formulation, losses due to evaporation and spray drift are negligible in inversion emulsions. However, emulsions' overall performance may be harmed by lower shelf stability and occasional phytotoxicity. In order to optimize inversion biopesticide formulations, studies on evaluating variety of oils and emulsifying agents are performed.

Suspension Concentrate (SC)

SC is a liquid phase made up of a finely powdered, solid active component distributed in water. Because solid particles do not dissolve in liquid, the mixture must be stirred before use to keep the particles properly dispersed. Suspension concentrate has a complicated composition that includes wetting/dispersing agents, thickening agents, antifoaming agents, and other ingredients to maintain the requisite stability During the grinding process, inert ingredients adsorbed onto particle surfaces prevent re-aggregation of small particles. Since, it is water based, it makes it ease of measuring, pouring safety to the operator and the environment, and cost-effective.

Oil Dispersions (OD)

OD are non-aqueous liquid dispersions of solid active substances intended for dilution before use. The non-aqueous liquid is usually an oil, with plant oil being the best option. Retention, spread, and penetration can all be improved in this fashion. Oil dispersion has a number of advantages, including the capacity to transport water-sensitive active chemicals and the possibility to utilize an adjuvant fluid instead of water to boost and expand pest control. To avoid instability issues, inert components for this type of formulation should be carefully chosen.

Suspo-Emulsions (SE)

SE is a combination of a suspension concentrate and an emulsion. The product is difficult to formulate since it requires the development of a homogeneous emulsion component as well as a particle suspension component that will remain stable in the final product formulation. To overcome the problem of hetero flocculation between solid particles and oil droplets, careful selection of appropriate dispersing and emulsifying agents is required. Furthermore, this formulation must undergo comprehensive storage stability testing.

Capsule Suspension (CS)

CS is a stable aqueous continuous phase suspension of micro-encapsulated active component intended for dilution with water before use. Microbe is encapsulated in capsules made of gelatin, starch, cellulose as its active ingredient. The bio-agent is thus shielded from harsh external conditions namely, UV radiation, rain, temperature and its residual stability is improved as a result of the controlled release. The principle of interfacial polymerization is used in the most common method of encapsulation. Encapsulation in microcapsules has been widely employed to make fungal biopesticide formulations smaller and more effective.

Ultra- Low Volume Liquids (ULVL)

ULVLs have a high concentration of active component that is highly soluble in a crop-compatible liquid. Surface active agents and drift control additives are frequently found in UL products, which are not intended to be diluted with water before use (Bharti and Ibrahim, 2020).

Conclusion

Safety concerns and a shift from single component to multi-component formulations are among the current trends in biopesticide formulations. Furthermore, new forms of formulations viz., nano emulsion, nanosuspension, nano capsule suspension are likely to emerge (Glare, 2012). Plant pathologists, formulation chemists and agricultural engineers would likely continue to enhance procedures and conduct transdisciplinary research to develop good, safe, effective, and affordable plant protection solutions.

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National Institutions for Promoting Agricultural Marketing

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Introduction

The term marketing institutions can be considered to embrace a wide range of organizations, including associations of farmers, traders, and others in the value chain, as well as cooperatives and government marketing agencies. They involve one or more of the marketing functions. Institution involved in agricultural marketing are individuals, cooperative, corporate and government institutions.

Food Corporation of India (FCI)

The Food corporation of India is a statutory body created and run by the government of India. It is under the jurisdiction of Ministry of Consumer Affairs, Food and Public Distribution ,Government of India formed by the enactment of Food Corporation Act, 1964 by the Parliament of India.

Functions: To procure a sizable portion of marketable surplus of foodgrains and other agricultural commodities. To make timely releases of the stocks through the Pubilc Distribution System. To minimize seasonal price fluctuations and inter-regional price variations in agricultural commodities. To build up a sizable buffer stock of foodgrains.

Jute Corporation of India (JCI)

The Jute Corporation of India Ltd.(JCI) was Set up in 1971 as an official agency by the Government of India with the aim to provide Minimum support prices(MSP) to the jute cultivators and also work as a helping hand in raw jute sector. Headquarters is located at Kolkata, West Bengal.

Operations: The company purchases jute at the defined minimum price when market prices drop to this level, and later sells the jute-to-jute mills. In times when demand is strong there may be no need to make purchases since the price remains above the MSP. However, the JCI continues commercial operations in these years. In the 1980s the JCI experienced difficulty in disposing of its stocks of raw jute purchased under the MSP. The Ministry of Textiles used the power vested in the Jute Commissioner under the Essential Commodities Act, 1955 to fix the price of B.T will bag and to require private jute mills to lift raw jute from the JCI. This practice has remained in force since then. In recent years JCI is engaged in promoting alternate jute retting technologies viz. jute decorticator, enzyme-based retting.

Agricultural and Processed Food Product Export Development Authority (APEDA)

The Agricultural and Processed Food Product Export Development Authority(APEDA) is an Export promotion organization under Ministry of Commerce and industries, Government of India, in the year 1986 under the Agricultural and Processeed Food Products Export Authority Act,1985.It is mandated with the responsibility of promotion and development of the export of its scheduled products. Its Head office is located in New Delhi.

Objectives: To Maximize foreign exchange through increased agro exports. To create employment opportunities in rural areas by encouraging value added exports of farm products. To implement the scheme for providing financial assistance to improve post harvest facilities to boost their exports.

Agricultural Produce Market Committee (APMC)

Under the Agricultural Produce Market Committee (APMC) Act,2003, the Agricultural Produce Market Committee (APMC) is a statutory body consitiued by the state government in order to trade in agricultural, Horticultural or livestocks products in Karnataka.

Function: To promote public private partnership in the ambit of agricultural markets..To provide market led extension services to farmer.To promote agricultural activities. To ensure payment to farmers for the sale of agricultural produce on the same day. To announce data on arrivals and rates of agricultural produce from time to time into the market.

Primary Agricultural Cooperative Marketing Societies (PACS)

The PACS/LMPS/FSCS are the bottom-tire of the short term cooperative credit structure functioning at the grassroots (gram panchayat) level. These are primary societies owned by farmers, rural artisans etc.

Objectives: To cater to the credit need, mostly, farm credit and income generation activities of farmers, artistisans and other members. To extend selected banking services to members. To implement kissan credit card scheme for providing timely and adequate farm credit to members. To take up marketing of agricultureal produce of member farmers. To cater to the consumer needs, mostly, essential commodities of members. To create awareness among farmers to adopt improved farming practices. To reach upto the unprivileged section of the commuity through SHGs, JLGs and TFGs.

National Institute of Agricultural Marketing

The National Institute of Agricultural Marketing (NIAM) is a National Level Institute set up by the Ministry of Agriculture, on 8 August 1988 at Jaipur, Rajasthan, to cater to the needs of agricultural marketing personnel and to offer specialized Training, Research, Consultancy and Education in Agricultural Marketing in India and South East Asian countries. The institute is dedicated to Chaudhary Charan Singh, the fifth prime minister of India from where it derives its full name, "Chaudhary Charan Singh National Institute of Agricultural Marketing".

Student Activities

Swachata Pakhwada: Cleanliness is one of the most important aspects among all the students, faculty and staff at CCS-NIAM. In this connection, the number of events are being celebrated by students viz. clean campus day, clean hostel day, green campus day, clean mess day, debate competition, nukkad natak (Street Play), etc in the campus and outside of the campus. Students are also spreading the message on importance of cleanliness to the people as care for surrounding and frequently pay a visit to nearby villages and slum areas for the same. NIAMies are continuously engaged in various cleanliness campaign organized by different ministries, department and other local bodies for the cleanliness initiative.

Blood Drive: Donating blood, daunting as it may seem, is a simple and highly commendable act. Every year a blood donation camp is being organized at CCS-NIAM campus to increase knowledge, awareness, and enthusiasm towards this gracious and hospitable act. On the occasion of foundation day/8th August, Institute organizes blood donation camp in association with Duralabhji Hospital which was sponsored by Lion’s club, Jaipur. NIAMies participated with great zeal in “Blood Drive” to donate blood and save life.

National Youth Day: Jan 12th is observed as National Youth Day on Swami Vivekanand's birthday and the ideal way to commemorate this day was by conducting a Blood Donation camp and creating awareness of the importance of blood donation. The creative and innovative students of the institute brought out colourful posters highlighting the importance of blood donation with catchy slogans which motivate the students to come forward and donate blood.

Function

To conduct research on long term project.To impart training to various levels of organizations.Bankable project for creation of market infrastructure.To offer consultancy services.

Conclusion

Marketing Institution provide market support to the affiliated member Co-operative Marketing Societies in procuring, storing and marketing of agricultural commodities.It also provide storage facilities for perishable agricultural commodities and agro-based products by maintaining cold storage plants.

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Participation of Corporates in Agriculture Sector

Article ID: 11412

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Introduction

In India, the majority of the holdings are too small. About 76.4 percent of the total holdings in India are below the size of 2 hectares and on these again 28.8 percent of the total operated area is engaged into these marginal and smallholdings. The average area operated in the case of the marginal farm is only 0.4 hectares and in the case of a small farm, it is about 1.4 hectares only. Cultivation in such a smallholding is uneconomic and unprofitable. Under such conditions if these marginal and smallholdings are consolidated and if the small and marginal farmers pool their land, resources, and other inputs and then start cultivating their land jointly by forming a co-operative, they can get the benefits of large-scale farming. By this corporate farming, the entire farm is managed as a single unit and Every member earns a share of the total produce following their land contribution and labor performed.

Corporate Farming

It is a modern food industry issue and encompasses not only the farm itself, but also the entire chain of agriculture-related business, including seed supply, agrichemicals, food processing, machinery, storage, transport, distribution, marketing, advertising, and retail sales. Corporate farming is often used synonymously with agribusiness (although agribusiness quite often is not used in the corporate farming sense), and it is seen as the destroyer of the family farm.

Importance of Corporates as New Supply Chain in India

The GOI's new agricultural policy envisages that corporate sector participation will be promoted through contract farming and land leasing agreements to allow accelerated technology transfer, capital inflows, and assured market for crop production, especially of oilseeds cotton and horticultural crop, following this innovative agribusiness model have come up. Through vertical coordination Indian corporate and rural India has entered into a collaborative partnership. The common thread among all these initiates has been integrating and tightening the supply chain. Through corporate farming farmers' price risk is often reduced as they specify prices in advance. They also introduce new technologies and also enable farmers to learn new skills. By this, agriculture productivity increases and also consolidation of small farmlands into larger landholdings i.e., from 100 million ha to 160 million ha and the output required from that also increase from 200 million tonnes to 400 million tonnes with involvement of less than 60 crore people.

Agricultural and Processed Food Product Export Development Authority (APEDA)

The Agricultural and Processed Food Product Export Development Authority(APEDA) is an Export promotion organization under Ministry of Commerce and industries, Government of India, in the year 1986 under the Agricultural and Processeed Food Products Export Authority Act,1985.It is mandated with the responsibility of promotion and development of the export of its scheduled products. Its Head office is located in New Delhi.

Objectives: To Maximize foreign exchange through increased agro exports. To create employment opportunities in rural areas by encouraging value added exports of farm products. To implement the scheme for providing financial assistance to improve post harvest facilities to boost their exports.

Corporates Vs Family Farming

Why is the family farming disappearing: Many farmers feel this is in the plans either by the government or by big corporations. If they run most of the farmers off of the farms, big corporations can take control of agriculture completely, thereby eventually being able to set their price for agriculture products. Today's prices are driving farmers out of business.

Contract farming: It is a form of vertical integration where the farmer is contractually bound to supply a given quality of product to a processing or marketing enterprise. The buyer agrees in advance to pay a certain price to the farmer and often provides technical advice and inputs.

Benefits of corporate farming: By lowering the cost of raw food inputs, creating a sophisticated long-distance distribution network producing processed convenience foods, and making food available year-round in the vastly stocked supermarket, corporate forming has presented consumers in the wealthiest regions of the world with an immense variety of food at relatively low cost. Today, in North America, only about 10% of the average income is spent on food. By this measure, provided this method is sustainable, corporate forming would appear to be a tremendous success.

Production and Current Scenario

Current scenario: The average agricultural growth rate over the last 40 years was 4.3 percent which reflects good performance. Population growth rate averaged around three percent over the last 40 years which is slightly below the growth rate of the agriculture sector. With the advancement in technology and awareness, the trend of food consumption is changing towards high nutritional and hygienic foods. This is also a widening gap between demand and supply. In this scenario, a higher growth rate of the agriculture sector is needed so that the domestic needs could be fulfilled. The scope of horizontal expansion in agriculture production has become limited due to a shortage of irrigation water.

Solution for the scenario: There is a need to make quality seeds and fertilizers available at a competitive cost; improved pest/weed management; transfer agriculture-related technology and providing technical knowledge to farmers together with the requisite funds needed by them and introducing a well-planned marketing mechanism.

Conclusion

India, given the diverse Agro-climatic zones, can be a competitive producer of different types of crops. There is a need to convert our factor price advantage into a sustainable competitive advantage. Corporate farming is good and it will help to increase the productivity of the farm as observed in various regions because it is backed and financed by big Corporations. In today's situation, corporate farming will be more useful for small and marginal farmers, they get more profited when they cultivating their land jointly by forming a co-operative, which can get benefits of larger scale. The farmers also get benefited.

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Assam Fights Against COVID-19 with its Traditional Knowledge

Article ID: 11413

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Summary of Article
This research article is based on traditional knowledge and different ethnomedicinal practices of the North-eastern Himalayan region which are helping the people to boost their immunity and fight against Covid-19.

Introduction
The year 2019 really will be a notable year for the human history. The coronavirus disease or covid 19, destroyed the normal lifestyle of all the people around the globe. Millions of people lost their lives as well as it created a huge loss in the world economy. The whole world declared this critical situation as a pandemic. Initially there were no medicines or vaccines available to fight against the deadliest disease. Precautions like face masks and sanitizers were recommended by the government and other health related organizations. Till now 2.98 Cr. Cases have been registered, of which 2.87 Cr. Recovered and 3.85L people lost their lives because of the pandemic in India.

India is a country known for its traditions and diversity, also it is the country from where Ayurveda was originated. Our ethnomedicinal practices are well known to the world, where we use different types of plants and herbs for the treatment of different diseases and disorders. All the communities of India irrespective of any cast and religion have their own beliefs and techniques to tackle against diseases. The traditional healers of every community are one of greatest source of traditional etnomedicinal practices. The North Eastern part of India; which comes under eastern Himalayan zone is really rich in biodiversity. The available Forest land of the region is 17.11 (million ha) of which Agricultural land s 3.91 (million ha). The Indigenous crop germ-plasm available in the area is more than 3000 Nos, Orchids 600 (175 rare spp.), Medicinal plants 119 Species belonging to 09 genera (Roy et. al).

Description
According to government statistics, it is confirmed that the rate of affected people due to covid-19 is too less in the North eastern Himalayan region in the comparison with other Indian states. All of the states of North eastern region of India are really doing well to stop spreading covid-19 in their respective places and achieving good results. There might be multiple reasons for that, it might be because of less population, properly following of the Covid protocols or their healthy lifestyle. But we also have to admit that the food practices of the region are really helping them to fight against Covid-19. The North eastern people use very less oil and spices in their food. Mostly they include different herbs, shrubs and leafy vegetables in their culinary preparations. Maximum of these items are rich in vitamins, minerals and antioxidant properties which helps them to stay healthy and fit all the time. Also, the people from these areas follows the traditional ethnomedicine preparations for the minor disease and injuries. In this study I am including some of the known and some underexploited or underutilized plants from Assam, belongs to state of North eastern Himalayan region which people are widely using to fight against covid-19.

Serial no	Local Name	Scientific Name	Uses/ Culinary practices
1.	Mosondori	*Hottuiniya chordata*	1. Tender leaves were crushed and mixed with other spices to make chutney. 2. Curries made with small fish with other ingredients.

2.	Hoguni lota/ Giloi	*Citus limon*	1. The lemon is cut into pieces and squeezed. The extracted juice is mixed with salt and sugar and drinks as a refreshing drink. 2. It is also used in other culinary activities as the normal Leon.
3.	Kaji nemu/ Assam lemon	*Citus limon*	1. The lemon is cut into pieces and squeezed. The extracted juice is mixed with salt and sugar and drinks as a refreshing drink. 2. It is also used in other culinary activities as the normal Leon.
4.	Amlokhi	*Phyllanthus embolic*	1. Consumed as a table fruit. 2. Salt preserved and stored for a long time.
5.	kosu/ colocasia	*Colocasia esculent*	1. Colocassia curry is made with black pepper and other spices which is an ethnic dish of Assam. 2. Leaves were steam cooked.
6.	Kolkhar	*Musa sp.*	It is actually an alkali prepared from the dried banana pseudo stem, suckers and peel. It is also a major element of Assamese delicacies. 1. Used as a substitute for cooking soda. 2. Used in multiple dishes to enhance its taste.
7.	Tulokhi/ tulsi	*Osimum tenuifloram*	1. Consumption of tender leaves in empty stomach. 2. By making "kadha", with cinnamon, ginger, black pepper and honey.
8.	Black pepper	*Piper nigrum*	1. The king of spice is normally added to maximum dishes as a regular spice, but due to covid people are consuming it with kadha, pickles and other curries. 2. Consumption of roasted and crushed powder of black pepper with different food items.
9.	Drumstick	*Moringa oleifera*	1. Curry and other dishes where it is added as the main ingredient. 2. Drumstick leaves powder to boost the immunity.
10.	Turmeric	*Curcuma long*	1. Added as normal spice. 2. Fresh juice is mixed with warm milk as an immunity booster.

Fig A: Assam lemon

Fig B: Kolkhar (banana alkali)

Conclusion

It's not possible to say that these medicinal plants, vegetables for food items are directly helping people to fight against Covid-19. But surely these items are contributing as an immunity booster. From ancient times people were dependent on the traditional healthcare system as there was no facility for modern medicines and practices. So, we must appreciate and conserve this kind of traditional knowledge. More research and scientific analysis is needed in this field. Apart from thatfor the Covid-19, people are consuming warm water, eating sprouts, doing gargle with different herbs and also taking steam therapy. Hope we will be free from this virus soon.

Acknowledgment

I want to thank all the people who helped me to get this information's on different traditional practices. Special thanks to Kunal Kaushik, Siddhant Chetia, Student, M.Sc Horticulture, Sikkim University for their help in this study and Suprov Phukan, student, Dr. Bhupen Hazarika regional Govt. film and television institute for this photographic helps.

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Sustainable Sugarcane Initiative (SSI) An Approach for Improving Sugarcane Production in India

Article ID: 11414

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Sugarcane is a significant crop in terms of its contribution to the national economy and livelihood support to millions of farmers. In India, sugar is a 550 billion rupees worth industry and more than fifty million sugarcane farmers and their dependents and a large mass of agricultural laborers are involved in sugarcane cultivation, harvesting and ancillary activity (Sugar Economy 2011). There is a growing demand for sugar in India, the largest sugar consuming country in the world.

According to the Agriculture Outlook prepared jointly by Paris-based Organization for Economic Cooperation and Development (OECD) and Food and Agriculture Organization (FAO), the sugar demand in India has been growing steadily at about four per cent per year over the past 10 years (PTI 2011). Hence, there will be more and more stress on the sugarcane ecosystem to meet this growing demand in future.

While the area and production of cane follow an 'up and down' cycle in every 3–4 years, the mean productivity of 11 major sugarcane producing states in India is at 66.9 t ha-1 only (Sugarcane statistics 2011). Cane cultivation is facing a rough path ahead due to increasing input and labor costs and lack of any alternate innovative technologies to boost the productivity.

So, it is essential not only to increase the cane productivity but also to maintain it sustainably by conserving scarce resources over a period of time. To achieve this, there is a strong need for some alternate methods of cane production that should improve the cane yield on the principles of "more with LESS". Sustainable Sugarcane Initiative (SSI) is one of such methods of sugarcane cultivation.

Sustainable Sugarcane Initiative (SSI) is an approach to the cultivation of sugarcane, that can reduce inputs - water, chemical fertilizers, seed material and farm space - while improving sugarcane production significantly. It also reduces crop duration and provides a longer period of the cane crushing season to the sugar industry.

This farm-based approach (as opposed to crop-based) also gives farmers options to grow intercrops, such as pulses to improve their income. Most importantly, SSI reduces the overall pressure on water resources and contributes to recovery of ecosystems. It conserves soil moisture, thereby allowing for growing of dryland crops in the same region. SSI is inspired from the successful approach of System of Rice Intensification (SRI) paddy cultivation, which like SSI, originated from farmers and civil society to improve agricultural productivity while reducing pressure on natural resources.

The Major Principles that Govern SSI are

1. Raising nursery using single budded chips.
2. Transplanting young seedlings (25-35 days old).
3. Maintaining wide spacing (5X2 feet) in the main field.
4. Providing sufficient moisture and avoiding inundation of water.
5. Encouraging organic method of nutrient and plant protection measures.
6. Practicing intercropping for effective utilization of land.

Raising Nursery Using Single Budded Chips

Single-budded chips, carefully removed from healthy canes, are used for raising the nursery. Only 50-75 kg of bud chips are used for a hectare of crop and the remaining canes could be sent for crushing. To raise the seedlings, the selected buds are placed individually in the cones of plastic or biodegradable germination trays along with the coco-pith (coconut coir waste). Through this method, a high percentage of germination can be achieved within a week, based on the agro-climatic conditions. This method for seedling growing is found to be the best among all the methods in terms of seed saving and proper cane growth.

Transplanting Young Seedlings

The young seedlings raised in the nursery are transplanted to the main fi eld at the age of 25 – 35 days. It is important to note here that this one month growth of seedlings achieved under SSI method cannot be achieved even after two months in conventional method.

Transplanting at Wider Spacing

In conventional methods, the distance between two rows is maintained at 45 to 75 cm (1.5-2.5 ft), and 16,000 three budded setts (48,000 buds) are directly planted in the soil to achieve normal population of 44,000 canes per acre. But unfortunately, only 25,000 millable canes are achieved at the end. On the other hand, in the SSI method of sugarcane cultivation, wide spacing of 5X2 feet maintained in the main fi eld leads to 45,000 to 55,000 millable canes because of more tillering. So, wider spacing in SSI cultivation not only reduces the seed usage from 16,000 three budded setts to 4,000 to 5,000 single buds, but most importantly it also supports easy air and sunlight penetration in the crop canopy for better and healthy cane growth.

Water Management

In SSI water management is another crucial issue. It is always emphasized that sufficient moisture is provided rather than inundating the field with water as flooded condition will actually hinder the growth of the plant. Measures like raising of nursery, following furrow/alternate furrow irrigation, optimum application of water through drip irrigation should be followed. So, by giving only required quantity of water about 40% of water is saved.

Organic Method of Cultivation

The SSI method discourages high application of chemical fertilizers and use of pesticides and weedicides. Farmers should incorporate more organic manures, bio-fertilizers and follow biocontrol measures. The sudden switch over to organic cultivation is not advisable. Instead, a gradual reduction of inorganic and adoption of organic methods can be tried by framers for long term benefits.

Intercropping

SSI supports intercropping in sugarcane with crops like wheat, potato, cowpea, french bean, chickpea, water melon, brinjal etc. In addition to effective utilization of land, this practice will reduce the weed growth up to 60% and give extra income to farmers.

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Important Diseases of Cole Crops and their Management

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Cole crops can be affected by many diseases. However, just a few are likely to occur on a single crop in each growing region and season. Before planting, identify which diseases are likely to occur locally and, if feasible, check disease incidence statistics in the field to be planted. Select cultural techniques and crop varieties that mitigate the effect of major diseases. It is necessary to understand where a pathogen originates, how it disperses and infects agricultural plants, and what environmental circumstances promote disease development.

Damping-Off

Rhizoctonia solani or *Pythium spp*. are the most prevalent causes of seedling disease. Damping-off and root or stem rots can also be caused by *Phoma lingam* and *Phytophthora spp*. *Pythium* is also capable of causing seed rot. *Pythium* seed rot and damping-off are more common in cool, rainy conditions, whereas *Rhizoctonia* thrives in warm soils. Damping-off can occur after seedlings germinate but before they emerge from the soil. The most apparent example is when it happens after emergence. Lesions are most commonly seen at or near the soil's surface. Plants tumble over and die when the stem tissue collapses and becomes black and shrivelled. Often, cole crop seedlings will live for some time and develop slowly, but the affected region will not spread, giving birth to a spindly condition known as wirestem. Such seedlings should not be transplanted. Damping-off may occur anywhere in a field or seedbed, but it is usually in fields with a high green organic matter content with poor drainage or compacted soil. Over-watering or over-crowding of seedlings accentuates the problem. Plants beyond the third- or fourth-leaf stage are not susceptible.

Control:

a. Use seed treated with a suitable fungicide.
b. Avoid planting when the soil is cold.
c. Prepare a good seedbed, which encourages quick germination and vigorous growth.
d. Ensure residues are thoroughly decomposed before planting.
e. Sow thinly on raised beds to improve aeration and soil drainage.
f. Practise good water management, preferably with sprinkler irrigation, to ensure that soils are not over wet.
g. Drench the seedbeds with an appropriate fungicide at first signs of damping-off, or even as a preventative measure.

Clubroot *(Plasmodiophora brassicae)*

This is a devastating disease that affects many cruciferous plants. It may survive in the soil for many years and thrives in acidic soils with enough rainfall. It spreads from field to field due to the movement of diseased plants, particularly transplants, as well as the movement of contaminated soil on machinery and surface water run-off. It can also be spread by the dung of animals fed contaminated plant material. Plants may be infected for some time before displaying signs of stress. The initial above-ground signs are generally a minor drooping of leaves during the day, followed by recovery at night, and then persistent wilting afterwards. Infected plants are often smaller than others. Roots are enlarged into various shapes. Multiple infections of the same root cause the extreme swelling and grotesque distortion that characterise the disease. Such roots crack and are invaded by other organisms causing decay.

Control: Once in the soil there is no economical way to eliminate the disease. It persists for many years. Disease prevention is thus the only answer.

a. To prevent contamination of clean fields, wash machinery with high-pressure equipment to remove contaminated soil and other debris before moving from infected to non-infected fields.
b. Prevent water movement from infected to clean fields. Ensure that infected plant material does not move over. Grow transplants in fumigated beds; young plants can be infected for some time before showing symptoms and cannot always be identified at transplanting.
c. Seedlings (even from commercial seedling growers) irrigated with contaminated water can become infected, so ensure that the water source is not affected.
d. Clubroot spores do not germinate well in alkaline soil, so liming may help reduce disease incidence. However, liming may not be effective in well-buffered soil. Apply lime annually if the soil pH is below 7.
e. There is some evidence to suggest that a two- or more year rotation away from cruciferous crops, and into a cereal, can markedly reduce clubroot incidence.

Fusarium Wilt or Cabbage Yellows (*Fusarium oxysporum* f. *conglutinans*)

This fungus is capable of destroying sensitive cabbage varieties, as well as kohlrabi and kale. Broccoli, Brussels sprouts, and cauliflower are unaffected. The disease is most severe in the summer, when sensitive cabbage types show only minor symptoms. It grows the fastest in temperatures ranging from 24°C to 29°C, with little growth occurring below 15°C. The fungus may survive in the soil permanently, even during prolonged periods of high temperature and drought. The fungus spreads by infected plants and dirt on agricultural machinery, drainage water, footwear, and tools. Once in a field it is dispersed through cultivation and other practices that move soil or plant debris about.

Control:

a. Plant resistant cultivars.
b. Grow cabbages in winter, when disease development is slow; even then use resistant cultivars if possible.
c. Grow transplants in disease-free soil or fumigate the soil.
d. Rotate to nonhost crops, such as tomatoes or lettuce, to reduce buildup of the fungus in the soil.
e. Prevent infected soil or plant residues from contaminating clean fields.

Black Leg *(Phoma lingam)*

On cole crops, this fungus produces a variety of symptoms including seed rot, damping-off, root and stem rots, and leaf lesions. Typically, stem rots begin at or below ground level. Because black leg affects the roots and lower stem, afflicted plants are frequently wilted and tiny. The most noticeable black leg symptoms appear on the basal section of the stem, just shallow soil surface. The rot is semi-dry and tan in colour, with blackened patches and tiny black pycnidia (fruiting bodies) on the surface. The blackening of the xylem is seen when sliced through. Cool, wet environments are also beneficial to this creature. It can spread by seed or survive in plant debris in the soil.

Control:

a. Rotate infected fields out of cruciferous crops for at least two years.
b. Use disease-free seed or treat the seed with hot water.
c. Fumigate seedbeds.
d. Plough infected debris under.

White Blister or White Rust *(Albugo candida)*

White blister tends to be a more sporadic disease, but can infect many cruciferous plants. Raised white pustules form on the lower surfaces of leaves, with a yellowing on the opposite side of the leaf. Pustules sometimes have a greenish tint, but are generally pure white and look almost as though white enamel paint has been splashed onto affected parts. These pustules have also been observed on broccoli heads; affected buds are white and are stimulated to grow very large, with some malformation. Affected heads are not marketable. Under favourable cool, moist conditions the spread and development of the disease is rapid.

Control:

a. Fungicidal treatment of seedlings is advisable where infections occur; repeat when necessary.
b. Good water management can reduce the incidence of the disease.

c. Fumigation of seedbed soil.
d. Good seedbed preparation and practices, to allow aeration and drying.
e. Prevent over-lapping of plantings and plough in old crops as soon as harvesting has been completed.

Black Rot (*Xanthomonas campestris* pv. *campestris*)

This bacterial disease can be very destructive under rainy, humid conditions, particularly in warm weather. Summer crops are more severely affected. Increasing use of sprinkler irrigation in dry areas, and repeated cropping with crucifers, have caused it to become more prevalent. The most serious losses seem to occur in Brussels sprouts and cabbages, with cauliflower also fairly seriously affected. Broccoli yields seems to be less affected. Initially, yellow to light brown patches appear at the margins of leaves, and later a network of black veins develops within these areas. Affected areas turn brown and dry out, often leaving a characteristic triangular shaped lesion on the leaf margin, with one point of the triangle directed towards the midrib. Sometimes the entire leaf's margin is affected. The pathogen spreads from the margin to areas within the leaf blade that soon become necrotic. Leaf drop of older, infected leaves is common. The bacteria continue to move into the main veins and vascular system of the plant, turning the tissue brown or black. Plants affected in the seedling stage may die or remain stunted. The bacteria enter the plant through natural openings at the margins of the leaves or through insect wounds.

Control:

a. Use tolerant cultivars where these are available, e.g., cabbages.
b. Ensure the seed is disease-free or apply a hot-water treatment to seed.
c. Practise a minimum of a three-year crop rotation.
d. Control cruciferous weeds.
e. Deep plough to bury all infected plant material.
f. Increase the interval between irrigation. A drier regime is required.
g. Avoid sprinkler irrigation where possible.
h. Avoid growing crops over periods when conditions favour disease development.

Erwinia Soft Rot *(Erwinia carotovora)*

This bacterial soft rot is typically an issue on harvested products rather than in the field, but it can harm developing crops. It causes a soft, watery decay of afflicted plant parts as well as an unpleasant odour. It is thought to be only mildly parasitic, requiring a wound or damage to penetrate the plant. Points of entrance include sunburn, insect bites, and mechanical damage. No control measures are generally practised.

Export Capacity of Bihar's Shahi Litchi

Article ID: 11416

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In a major boost to export of GI certified products, season's first consignment of *Shahi Litchi* from Bihar was exported to United Kingdom by air route.The phyto-sanitary certification for exports of *Shahi Litchi*was issued from newly established certification facility at Patna. The fruit is being exported by Cira Enterprises and sourced from farmers in Muzaffarpur, Bihar. The Litchi is being imported by H & J Veg, London.

APEDA collaborated with Department of Agriculture, Bihar along with other stakeholders such as farmers, exporters and importers for facilitating exports of *Shahi Litchi.* Senior officials including Dr. M Angamuthu, Chairman, APEDA, N. Saravana Kumar, Principal Secretary Agriculture, Bihar and others participated in the event for exports of *Shai Litchi.*

Because of short-shelf life of litchi, there is need to explore exports opportunities for the processed and value-added products. Shahi litchi was the fourth agricultural products to get GI certification from Bihar in 2018, after*Jardalu mango, Katarni rice* and *Magahi paan.* GI registration for *Shahi Litchi* is held with the Muzaffarpur-based Litchi Growers Association of Bihar.

Muzzafarpur, Vaishali, Samastipur, Champaran, Begusarai districts and adjoining areas of Bihar have favorable climate for growing *Shahi Litchi.*

India is the second largest producer of litchi (Litchi chin) in the world, after China. The translucent, flavoured aril or edible flesh of the litchi is popular as a table fruit in India, while in China and Japan it is preferred in dried or canned form. Bihar tops in terms of production of litchi.

Photo source: The economic Time

APEDA has been facilitating Bihar government in formulating State agri-export plan which would provide road-map for boosting agricultural and processed food products exports from the State. After the finalisation of State agri-export plan, the export potential of Makhana, mango, litchi and other fruits and vegetables can be harnessed.

Bihar government is making efforts in association with APEDA and other agencies for creating required infrastructures such as customs clearance facility, laboratory testing facility, pack-houses, pre-cooling facilities, which would harness and boost agricultural exports potential of the State.

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Silicon: Role in Biotic and Abiotic Stresses of Plants

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Silicon is a tetravalent metalloid and semiconductor with atomic number 14. It is hard and brittle crystalline solid with blue grey metallic lusture. Jons Jakob Berzelius was the first person to discover and characterize it in pure form. Rarely it occurs as pure element in the earth's crust because of its large affinity towards oxygen. Elemental silicon (Si), is the second most abundant element in the earth's crust after oxygen, which is mainly composed of silicates. Silicon is not considered as essential for plant growth and development, however, increasing evidence in the literature shows that this metalloid is beneficial to plants, especially under stress conditions. Indeed, Si alleviates the toxic effects caused by abiotic stresses, e.g., salt stress, drought, heavy metals. Biogenic silica is also a deterrent against herbivores. Additionally, Si ameliorates the vigor of plants and improves their resistance to exogenous stresses. The protective role of Si was initially attributed to a physical barrier fortifying the cell wall (e.g., against fungal hyphae penetration), however, several studies have shown that the action of this element on plants is far more complex, as it involves a cross-talk with the cell interior and an effect on plant metabolism (Luyckx et al., 2017). Datnoff and Rodrigues (2005) demonstrated that application of silicon to rice cultivar BG 367-4 increased the resistance to blast as well increased silicon content in rice. They reported that number of blast lesions on leaves of cultivar decreased linearly, shoots in which more silicon is accumulated showed less incidence of leaf, neck blast and panicle blast. Alhousari and Greger (2018) studied the silicon-mediated resistance to herbivorous insects and the mechanisms involved and determined that Si can upregulate and prime plant defence pathways against insects. Goto et al. (2013) carried a work of ultraviolet microspectrometry and X-ray microanalysis in the cells of leaf blades of rice plants grown in a paddy field with (+/Si) or without (-Si) application of a silicate fertilizer. The +/Si rice plants had the lower UV absorbance around 280 and 320 nm in the leaf blades compared with those of the -Si rice plants. Percival et al. (2016) made comparative evaluation of the fungicide penconazole with silicon products. Trees were sprayed with silicon product and fungicide at the recommended rate and he found that silicon when applied to apple tree provided a significant degree of protection against apple scab. This shows that silicon-based products are useful under field conditions and offer a potential management strategy of apple scab. The presence of silicon in the cell wall increases their strength, rigidity to cell wall, resistance to salinity, drought tolerance, photosynthetic activity improved growth, health and productivity of the crop. Exogenous application (foliar and soil application) of silicon was effective in mitigating several responses of biotic and abiotic stress damages by improving the plant water uptake and transport. The other important role of silicon is reducing the adverse effects of stress may be by improving soil conditions. Therefore, silicon could be used as a regulator to improve plant growth and resistance under stress conditions. There is need for applied research to evaluate water use efficiency, drought tolerance and resistance to disease and insects on more crops.

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Crop Residue Management: A Potential Means to Increase Soil Health and Productivity

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Introduction

Agriculture is the backbone of Indian economy. A huge mass of community is serving the country's population through farming.

A wide variability of crops is cultivated in different agro-ecological regions. According to Ministry of Agriculture, 2012; 93.9 million tons (MT) of wheat, 104.6 MT of rice, 21.6 MT of maize, 20.7 MT of millets, 357.7 MT of sugarcane, 8.1 MT of fibre crops (jute, mesta, cotton), 17.2 MT of pulses and 30.0 MT of oilseeds crops are produced annually. As a matter of fact, a huge volume of crop residues is produced both on-farm and off-farm due to use of input intensive advanced agricultural technologies in today's world which causes depletion of soil.

It is estimated that approximately 500-550 MT of crop residues are produced per year in the country. As a result, a huge amount of crop residues is burnt otherwise which make it labour intensive to clear out from the fields. Farmers often burn this crop residues in-situ, which brings adverse environmental impacts (Blanco-Canqui et. al., 2009; Chen et. al., 2019; Maneepitak et. al., 2019). Burning of crop residues has a tremendous negative impact on human health.

It was reported that Asian countries contribute for more than one-third of the total biomass burning in-situ (Chen et. al., 2019). Pertaining to Assam, a total of 11.43 MT crop residues per year are produced, out of which 2.34 MT remains as surplus (Ministry of New and Renewable energy, 2009); and 1.42 MT are burnt every year (Inter-Governmental Panel on Climate Change).

Thus, Crop Residue Management (CRM) can be defined as a conservation practice that usually involves utilization of left overs in the field rather than wasting/burning with the help of tillage implements. This practice is designed to leave sufficient residue on the soil surface to reduce wind and/or water erosion.

Adverse Effect of Crop Residues Burning

Loss of nutrients: Department of Soils, Punjab Agricultural University, Ludhiana, reported the following nutrient loses with the burning of a ton straw during 2010:

a. Nitrogen 6-7 kg (80%).
b. Phosphorus 1-1.7 kg (25%).
c. Potassium 14-25 kg (21%).
d. Sulphur 1.2-1.5 kg (4-60%).

Impact on soil properties: Heat generated from burning of residues results in increase of soil temperature which causes death of beneficial soil microorganisms. Repetitive burning results in complete loss of microbial population and disturbs the status of C:N ratio in the top 0-15 cm soil profile, which is significant for root development.

Emission of greenhouse and other gases: Burning of crop residues result in producing harmful Green House Gases (GHGs) and aerosols like CH_4, CO, N_2O etc. Studies revealed that CO_2 (70% of Carbon present), CO (7%) and CH_4 (0.66%) while 2.09% of Nitrogen (N) in straw is emitted as N_2O when this crop residues are burnt. Moreover, it produces harmful smoke which could be potential carcinogen leading to various air borne/lung diseases. On burning of a tonne of straw releases the following in the air as reported by Hyderabad, Centre of Sustainable Agriculture:

a. Particulate matters-3kg: Carbon dioxide-1460 kg (13 tha^{-1}).
b. Ash-199 kg: Sulphur oxide-2kg.

Other Losses of Soil/ha

1. Organic carbon-95 lakh ton.
2. Urea-80 kg.
3. Diammonium phosphate-13.75kg.
4. Potash-128 kg.

Technological Interventions for Managing Crop Residues

1. Incorporation of crop residue into soils prevents soil erosion from wind & water and increase the soil moisture status.
2. Promotion of use of crop residues as inputs in preparation of bio enriched compost/Vermicompost/farm yard manure.
3. Use of crop residues for Mushroom production.
4. In-situ management of crop residue as surface mulching of straw or left over after harvesting.
5. Crop residues can be used for animal feed, thatching for rural homes, biofuel for domestic and even bedding materials for poultry birds. Thus, crop residues possess tremendous scope for the farmers.
6. At the time of harvesting, farmers should be availed with the subsidies for hiring of machineries from Agriculture Service Center, Custom Hiring Cetre for effective generation as well as management of crop residues.

Some of the Benefits from CRM

1. Improves soil nutrient status, maintains soil moisture and check soil erosion.
2. Conserve's soil moisture, and improves infiltration and aeration within the soil profile.
3. Improves soil physical properties, such as water-holding capacity, soil permeability, etc. (Carlesso et. al., 2019).
4. Helps in adding soil organic matter and provides food for soil micro-organisms (Shan et. al., 2013) leading to increase crop productivity.
5. Act as a primary contributor to elemental carbon in soil (Fang et. al., 2018).
6. Helps in decreasing soil salinity level (Fan et. al., 1993).

Conversion Technologies for Sustainable Crop Residue Management and their Possible Outputs

Sl. No.	Techniques	Outputs
1	Gasification	Syngas
2	Liquefaction	Bio-oil,
3	Pyrolysis	Bio-oil, Biochar, Syngas
4	Combustion	Electricity
5	Anaerobic digestion	Biogas
6	Alcoholic fermentation	Bio-ethanol
7	Photobiological hydrogen production	Bio-hydrogen
8	Transesterification	Biodiesel
9	Photosynthetic microbial fuel cell	Electricity

Source: Sarkar et. al., 2020

Conclusion

Finally, it can be concluded that the crop residues after the harvesting are not at all be designated as waste. Rather, these are the potential bio products which play a significant role in bringing out higher farm income overall along with maintaining soil health and nutrient status for sustainable productivity.

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Role of Farm Women in Agriculture

Article ID: 11419

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Introduction

Agriculture is the backbone of Indian Economy. Farm women play a vital role in encouraging the agricultural growth and production. Women are regarded as "the creators of all the green things in the world". M.S. Swaminathan states that "it was women who first domesticated plants and they're by initiated art of farming". It is believed, that men produce the world food, and women prepare it for the table purpose. Rural women account for more than half of the food produced in the world. Farm women since centuries are involved in agriculture. According to census 2011, the total number of female workers in India is 149.8 million comprising of 121.8 million in rural areas and 28.00 million in urban areas respectively. Out of 149.8 million female workers 35.90 million female workers are working as cultivators and 61.50 million are agricultural labors while 52.40 million are engaged in agriculture and allied activities.

Categories of Farm Women in Agriculture

1. The landless agricultural labors.
2. Women cultivating their own piece of land and also working as wage laborers.
3. Women working in their own lands due to shortage of labors.
4. Women supervising the agricultural operation performed by labors on their own land.

Multi- Dimensional Role and Tasks of Farm Women

1. Agriculture: Sowing, transplanting, weeding, irrigation, fertilizer application, plant protection, harvesting, winnowing, storing, grading etc.

2. Domestic: Cooking, water collection, fuel wood collection, household maintenance.

3. Allied Activities: Cattle management, fodder collection, fuel wood gathering.

Participation of Farm Women in Agriculture and Allied Activities

Nearly 78% of all active women are engaged in agriculture as compared to 63% of men.

1. Crop Production.
2. Live-stock Production
3. Horticulture
4. Post-harvesting operations etc.

About 70% of farm work is performed by women. Traditionally, women always play an important role in agriculture- as farmers, co-farmers, wage labors and managers of farms:

a. Women in India are major producers of food in terms of value, volume and number of hours worked. In rural India, the percentage of women who depend on agriculture is as high as 70%.

b. In 2009 women survey, 94% of the female labor worked in cereal production, while 2.28% worked in vegetable production and 3.72% were engaged in fruits and spice crops.

c. According to Food and Agriculture Organization, Indian women represented a share of 21% and 24% of all fishers and fish farmers respectively.

Challenges Faced by Farm Women

1. Women have unequal land rights. Limited rights or access to arable land further limits livelihood options and exacerbates financial strain on women, especially in women- headed households.
2. Women have limited access to use of productive resources.
3. Women perform all un-mechanized agricultural tasks and perform multiple tasks.

4. Women have little control over decision making process, either inside home or outside home.
5. Without access to capital or household decision making abilities women lack the resources that are for their labor stability and stability of their household.
6. Few women holding of agricultural productive resources such as land, animals and machinery.
7. Women farmers in agricultural sector suffer from high illiteracy rate.

Conclusion

Farm women plays the significant and crucial role in agricultural development and allied fields. The nature and extent of women's involvement in agriculture varies from region to region. But regardless of this variation there is high contribution of women towards agriculture.

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Group Dynamics in Agriculture Extension

Article ID: 11420

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Introduction

Group dynamics refers to a sort of political ideology concerning the ways in which groups should be organized and managed. This ideology emphasizes on the importance of democratic leadership, the participation of members in decisions and the gains both to society and to individuals. Group dynamics refers to set of techniques such as role playing, buzz sessions, observations and feedback of group processes and group decision. Group dynamics is the study of group and in general term used for group processes. It is relevant in the fields of psychology, sociology and developmental communication studies.

The Beginnings of Group Dynamics

1. Experimental creation of social norms.
2. The social anchorage of attitudes.
3. Groups in street corner society.
4. Experimental manipulation of group atmosphere.

Five Stages of Group Dynamics

Bruce Tuckman created a model in 1965 in which the steps of group dynamics are defined:

1. Forming: The first stage is creating a team; it is the selection process e one of the most important steps when looking for members. Individuals ask questions of one another to figure out whether the selected number of people would be beneficial for the group.

2. Storming: In this stage group members confront each other with ideas and the ways tasks need to be completed, leadership is tested amongst the individual in order to gain recognition of which individual has the aptitude to lead. Members try to look for a position that suites better to their identity.

3. Norming: is generally a result of understanding each other's needs to complete the project and members come to agreements to move forward towards a common goal. The leader at this point usually motivates each member to keep them on track.

4. Performing: at this stage members realize their individual roles and group goals. The leader has directed well enough to allow members to become self-reliant to complete the tasks necessary for the project to come together in its entirety. Meetings become productive and individual work afterwards is consistent with the goals and tasks assigned.

5. Adjourning: It is the final stage and is when the group comes together to celebrate the efforts of everyone for completing the project. Adhesive groups will always come together at the completion of a project and commend each other for their efforts, because each understands that parts of the project could not be completed without the other.

Importance of Group Dynamics

1. In any community an individual is subjected to many influences. In the community development an extension worker aims to change the attitude, knowledge and skill of people. It is therefore necessary to identify the existing group structure to bring change in rural life.

2. Groups and group dynamics are largely a matter of socially transmit tradition. The theory of group dynamics helps in the investigation of things such as change, resistance to social pressure, attraction, rejection and interdependence.

Conclusion

Group dynamics helps in the formation of group and imparting information among the members of group so that information is conveyed to many people at same time, a skill acquisition group focuses on the practical application of information. With the help of group dynamics the objectives are achieved and goals are accomplished.

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Recycling of Organic Residues

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Introduction

Recycling of organic wastes as manure for sustainable soil health is important in the present scenario. Burning of rural and urban refuse with energy recuperation or its use for land filling are wasteful processes, which should be avoided (Gaur, 1987). Recycling of these wastes can be done by making manure. These are biodegradable and can be broken down into simpler organic molecules.

Organic residues are materials originating from living sources like plants, animals and microorganisms. Organic residues exist in nature either in solid state or liquid state. Generally found organic wastes are –

a. Municipal solid waste.
b. Cattle waste.
c. Food and agricultural remains.

Methods of Organic Residues Recycling

Composting is a microbial non - polluting and safer method for disposal and recycling of organic residues by bio - conversion. Compost is an organic matter which includes plants and animal residues decomposed by the activity of bacteria and other microbes at a given time.

Similarly organic refuses such as human wastes, decomposable garbage, sewage and sludge which are produced abundantly can be recycled for:

a. Crop manuring.
b. Application on forest land.
c. For land reclamation.
d. Biogas production.
e. Aquaculture production.

Animal feed is one of the most common and efficient method of recycling organic residues. Feeding organic waste t animals is a simplest and easiest method of recycling.

Anaerobic digestion during this process anaerobic microorganisms convert different type of biomass and other organic wastes into biogas and nutrient rich residues that can be used for various applications such as fuel for household works and for farming.

Rendering is the process of converting waste animal tissues into stable and usable forms like feed protein. The solid products of rendering can be used for preparing pet feeds and fat products are added to make soaps.

Rapid thermophilic digestion is the process of rapid fermentation of organic residues by activating fermenting microorganisms at high temperature. The process of thermophilic digestion is an exothermic process and maintains at temperature 55-65° C. The product of thermophilic digestion is bio-fertilizer that can be used on soil for increasing fertility. Thermophilic digestion is generally used in wastewater industry for treating sewage sludge.

Mechanisms of Organic Residues Recycling

Collection is the first step in the organic residues recycling is the collection of waste materials which can either be on a small scale in a kitchen or on a large scale in industries.

Decontamination is an important step in organic residues recycling. This step is particularly important while dealing with organic residues from industries. Besides, any non-biodegradable substance like glass, plastic, and bricks, if present, should be removed during this step.

Preparation before the organic residues is added to a recycling system, it should be prepared. The method of preparation employed depends on the type of recycling method chose. For, e.g., composting requires shredding and stacking of organic waste.

Recycling process depends on the nature of the organic residues and desired end products, an appropriate method of recycling should be adopted. Human wastes like sewage and fecal wastes can be recycled via anaerobic digestion whereas sewages can be treated through thermophilic digesters.

Screening and grading the obtained residues or compost are then screened into different sizes to be used accordingly for different purposes.

Challenges in Recycling of Organic Residues

1. The long-term application of compost-recycled waste on soil may lead to accumulation of heavy metals, from where they might transfer to different trophic levels of the food chain.

2. Some selected groups of persistent organic pollutants like chlorinated dioxins, polycyclic aromatic hydrocarbons, and organo-chlorine pesticides are accumulated in solids during the treatment process. These compounds might have detrimental effects on lower organisms or in some cases, even on humans and wildlife.

3. The use of bio-fertilizers produced via processes like composting and vermicomposting results in significant input of heavy toxic metals like cadmium and lead, which might have a direct effect on human and animal health.

4. Recycling process like composting generates odors which might cause air pollution or discomfort.

5. Microbial degradation of organic waste might result in the formation of airborne microorganisms or bio-aerosols, which may cause potential risks like respiratory disorders on the plant workers and nearby residents.

Conclusion

Organic residue recycling helps to stabilize the generated waste and contribute for greener planet. Recycling of organic waste material helps to increase the physical and chemical properties of soil. Recycling of residues generates energy for future and present generation and thus maintains sustainability. Recycling helps to reduce the cost of agriculture by using local on farm products.

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Minimum Support Price (MSP) and it's Issues – Way Forward

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Summary

In the recent times, Minimum Support Price has helped the Indian farmers to fight against the impacts of financial variance. In recent news we all might have heard about MSP but many of us don't know what exactly MSP is and why the farmers are fighting for it. The MSP acts as a safety net for the Indian farmers and is the important core of the agrarian transformation that saw in India changing from a food insufficient to a food surplus country. Throughout the past decades, Minimum Support Price has helped the Indian farmers to fight off the impacts of financial variances. The MSP has become a significant argument after the farmer's protests arrived at the public capital. After the Independence, India was gazing at a significant shortage regarding cereal creation. After the striving first decade, India chose to go for broad farming changes. The Minimum Support Price was started in the year 1966-67. First time the MSP was fixed for wheat at Rs. 54 for each quintal.MSP played an important role in protecting the farmers from price fluctuations and from middleman in the markets.

Introduction: What is MSP?

The Minimum Support Price or the MSP is popularly known as support price also because it is the method of safeguarding or protecting net for the farmers in India from the vulnerabilities of the business markets as well as against those of the natural kind.

Historical Perspective of MSP

The Commission for Agricultural Costs & Prices (CACP) is come into existence in January 1965.Currently, the Commission comprises a Chairman, Member Secretary, one Member (Official) and two Members (Non-Official). The non-official members are representatives of the farming community and usually have an active association with the farming community.

Objectives of MSP

1. Ensure remunerative prices to the farmers for crops by encouraging high returns on investment and production
2. It also aims to bring a balanced realization of sufficient food production and consumption needs at the same ensuring adequate and affordable food grains to all the people.

Determination of MSP

The CACP will decide the MSP for crops by considering lot of comprehensive factors like supply and demand factors of each crop, the following factors:

1. Cost of production
2. Changes in input prices
3. Input-output price parity
4. Trends in market prices
5. Demand and supply
6. Inter-crop price parity
7. Effect on industrial cost structure
8. Effect on cost of living
9. Effect on general price level
10. International price situation

11. Parity between prices paid and prices received by the farmers.
12. Effect on issue prices and implications for subsidy

Source: Farmer Portal

The Commission makes use of both micro-level data and aggregates at the level of district, state and the country. The information/data used by the Commission; inter-alia include the following:

a. Cost of cultivation per hectare and structure of costs in various regions of the country and changes their in.
b. Cost of production per quintal in various regions of the country and changes therein.
c. Prices of various inputs and changes therein.
d. Market prices of products and changes therein.
e. Prices of commodities sold by the farmers and of those purchased by them and changes therein.
f. Supply related information - area, yield and production, imports, exports and domestic availability and stocks with the Government/public agencies or industry; Demand related information - total and per capita consumption, trends and capacity of the processing industry.
g. Prices in the international market and changes therein, demand and supply situation in the world market.
h. Prices of the derivatives of the farm products such as sugar, jaggery, jute goods, edible/non-edible oils and cotton yarn and changes therein.

Crops Covered Under MSP

Sowing season in India for crops varies from state to state and the harvesting of the crop also depends on variety. Thus, a harvested crop sown in kharif may reach in the market even before October. MSP of Kharif Crops for every year is applicable from September. As of now, CACP recommends MSPs of 23 commodities, which comprise 7 cereals (Paddy, Wheat, Maize, Sorghum, Pearl millet, Barley and Ragi), 5 pulses (Gram, Tur, Moong, Urad, Lentil), 7 oilseeds (Groundnut, Rapeseed-Mustard, Soybean, Sesamum, Sunflower, Safflower, Niger seed), and 4 commercial crops (Copra, Sugarcane, Cotton and raw Jute).The increase in MSP for Kharif Crops for marketing season 2021-22 is in line with the Union Budget 2018-19 announcement of fixing the MSPs at a level of at least 1.5 times of the All-India weighted average Cost of Production (CoP), aiming at reasonably fair remuneration for the farmers. The expected returns to farmers over their cost of production are estimated to be highest in case of Bajra (85%) followed by urad (65%) and tur (62%). For rest of the crops, return to farmers over their cost of production is estimated to be at least 50%.

Table.1 MSP of Kharif, Rabi and other crops from 2020-21 to 2021-22:

Commodity	Variety	2020-21	2021-22
A) Kharif crops			
Paddy	Common	1868	1940
	Grade-A	1888	1960
Jowar	Hybrid	2620	2738
	Maldandi	2640	2758
Bajara		2150	2250
Ragi		3295	3377
Maize		1850	1870
Tur (Arhar)		6000	6300
Moong		7196	7275
Urad		6000	6300
Cotton	Medium Staple	5515	5726
	Long Staple	5825	5025
Groundnut		5275	5550
Sunflower seed		5885	6015
Soybean	Black	-	-
	Yellow	3880	3950

Sesamum		6855	7307
Niger seed		6695	6930
Wheat		1925	1975
Barley		1525	1600
Gram		4875	5100
Lentil		4800	5100
Rapeseed		4425	4650
Safflower		5215	5327
Toria		-	-
Copra	Milling	9960	10335
	Ball	10300	10600
De-Husked Coconut		2700	2800
Jute		4225	4500

Source: Farmers portal

The Table 1 shows that, the MSP of Kharif, Rabi and other crops increases every year. For Kharif crops, 3.8 % hike for paddy, and highest for sesamum 6.59% hike and lowest for maize. From Rabi crops, highest increase in MSP is for Lentil gram and rapeseed and mustard followed by safflower. For wheat and barley increase of 75 per quintal and Rs.50 per quintal respectively has been announced.

Who Sets MSP?

Price policy reports → Government by CACP → For different crops → comprehensive questionnaire→ state governments and concerned National organizations like FCI, NAFED and CCI, JCI, Trader's organizations, processing organizations, and key central Ministries. The Commission visits to states for on-the-spot assessment of the various constraints thatfarmers face in marketing their produce, or even raising the productivity levels of their crops. Based on all these inputs, the Commission then finalizes its recommendations/reports, which are then submitted to the government.The government, in turn, circulates the CACP reports to state governments and concerned central Ministries for their comments. After receiving the feed-back from them, the Cabinet Committee on Economic Affairs (CCEA) of the Union government takes a final decision on the level of MSPs and other recommendations made by CACP.Once this decision is taken, CACP puts all its reports on the web site for various stakeholders to see the rationale behind CACP's price and non-price recommendations.

Way Forward

The Minimum Support Price is an important tool for deciding India's Agricultural price policy as it's declares before the sowing time and assures farmers income. Help to incentivize the farmers and sufficient remuneration to the farmers.MSP also provides food grains supply to buffer stocks and secures the food security programme through Public Distribution Scheme. Farmers are protected from the middlemen and fluctuating market conditions as it provides them an assured market in addition to a minimum assured return. On the whole, it was found that the MSP has succeeded in providing floor rate for major food grains like paddy and wheat.

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Crop Nutrient Management through Remote Sensing

Article ID: 11423

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Agricultural production strategies have changed with in the past few decades. Efficient management of nutrients is one of the main challenges facing production agriculture. Here, remote sensing is providing field-scale diagnostic methods that will enable detection of nutrient deficiencies early enough to avoid yield or quality losses. When interfaced with variable rate sprayer equipment, real-time canopy sensors could supply site specific application requirements that lessen contamination of surface- or groundwater supplies and improve overall nutrient use efficiency (Schepers and Francis, 1998). When combined with remarkable advances in Global Positioning System (GPS) receivers, microcomputers, geographic information systems (GIS), yield monitors, and enhanced crop simulation models, remote sensing technology has the potential to transform the ways that growers manage their lands and implement precision farming techniques. Field operations over smaller fields can especially benefit from use of Unmanned aerial vehicles (UAV's).

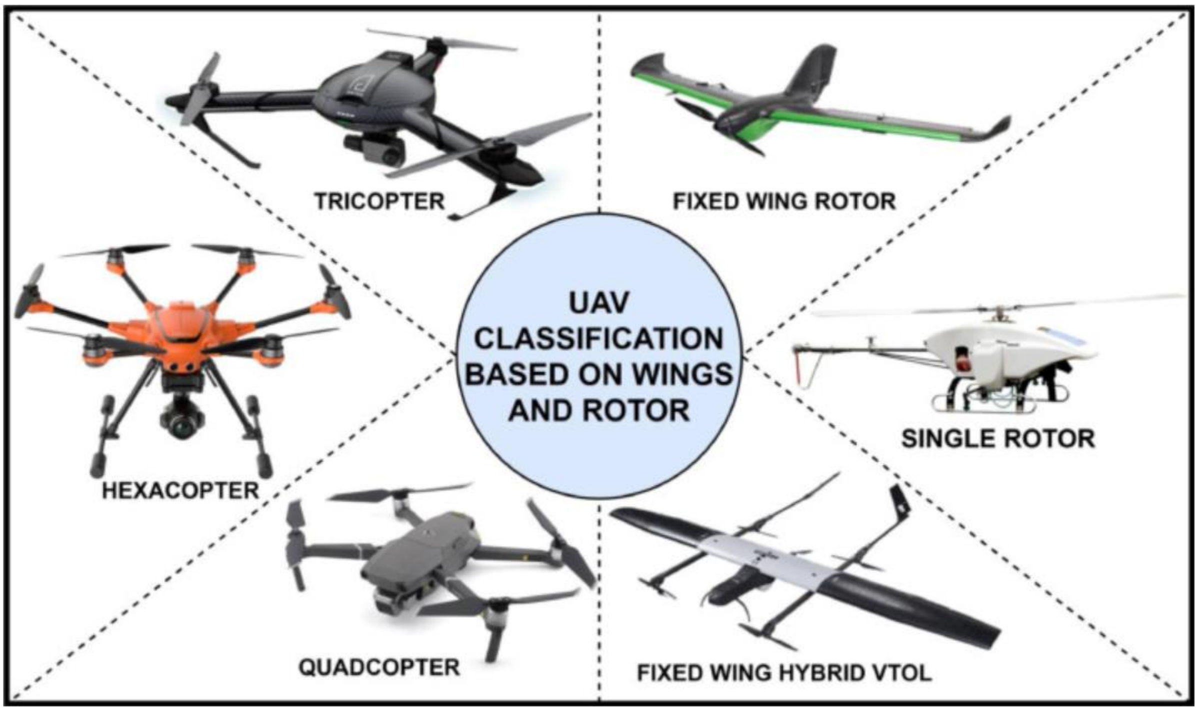

Figure 1: Classification of Unmanned aerial vehicles (UAV's)

UAVs have been developed to support the practice of precision agriculture (Huang et al., 2015). The UAVs are operated remotely either by telemetry, where the operator maintains visual contact with the aircraft or autonomously along pre-programmed paths using GPS and inertial guidance. Huang et al. (2015) developed a low volume sprayer for an unmanned helicopter. The helicopter has a main rotor diameter of 3 m and a maximum payload of 22.7 kg. The developed sprayer was able to deliver liquid covering the 30-meter swath, 42-meter downhill. Results revealed that spray coverage was sensitive to the power voltage but not release height.

Nitrogen (N)

The relative techniques were developed for using a SPAD chlorophyll meter, colour photography, or canopy reflectance factors to assess spatial variation in N concentrations across growers' corn fields (Schepers et al., 1996).

Figure 2: SPAD chlorophyll meter

Because these techniques were based on comparisons with readings obtained from an adequately fertilized strip in the same field, they obviated strict requirements for beforehand knowledge of the relationship between nutrient concentration and crop reflectance, or precise sensor calibration, or the need to convert data to surface reflectance factors. Bausch and Duke (1996) developed an N reflectance index (NRI) from green and NIR reflectance of an irrigated corn crop. The NRI was highly correlated with an N sufficiency index calculated from SPAD chlorophyll meter data and provided a rapid assessment of corn plant N status for mapping purposes. Because this index was based on the plant canopy as opposed to the individual leaf measurements obtained with SPAD readings, it has potential for larger scale applications and direct input into variable rate fertilizer application technology. Taking an indirect approach, Raun et al. (2001) reasoned that a mid-season, remote estimate of potential yield would help growers adjust top dress N applications based on preplant soil N tests, within season rates of mineralization, and projected N removal. They estimated potential grain yields of winter wheat (*Triticum aestivum* L.) from several post-dormancy NDVI measurements which were normalized by the number of growing degree days that had accumulated between the observation dates. This normalization adjusted for differences in local weather and also compensated for spatial variations in N requirements caused by differences in soil properties and management options that affected stand establishment and early season growth.

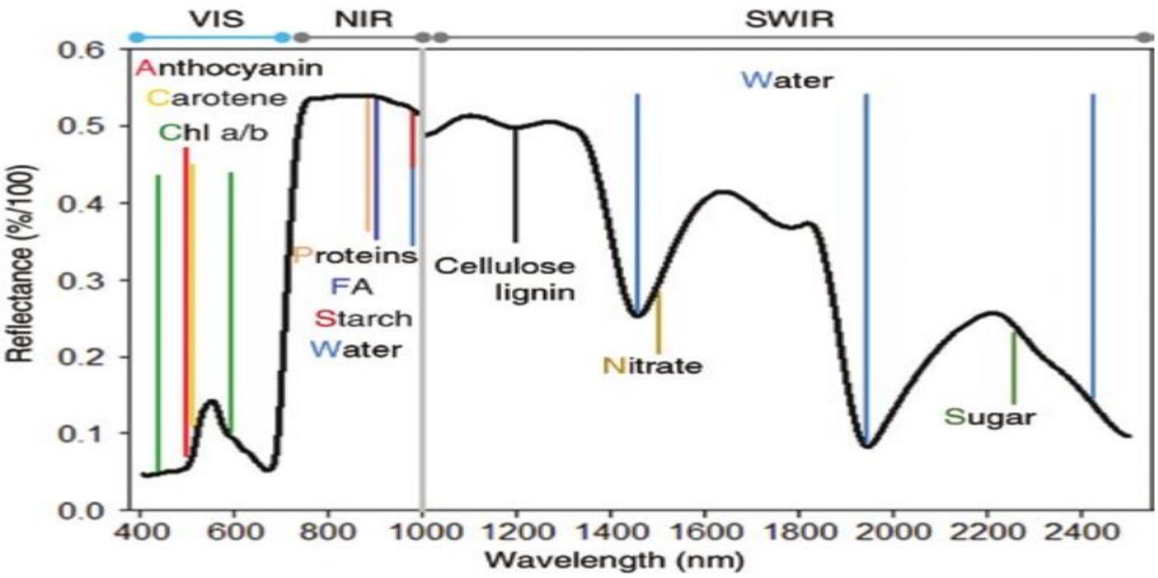

Figure 3: Plant reflectance spectrum with absorption features of example compounds in plant in the VIS and NIR recorded with the hyperspectral camera ImSpector PFD V10E and SWIR recorded with the Im-Spector N25E.

Note: VIS- Visual, NIR-Near infrared, SWIR-Shortwave infrared.

Other Nutrients

Monitoring symptoms caused by other nutrient deficiencies can be problematic because they rarely occur uniformly across a field and often need to be distinguished against background variation in canopy density. Osborne et al., 2002a have conducted research which shows usefulness of hyperspectral data in distinguishing differences in N and P at the leaf and canopy level, but the relationships were not constant over all plant growth stages. Adams et al., 1993 have detected Fe, Mn, Zn, and Cu deficiencies in soybean leaves using both leaf fluorescence and hyperspectral reflectance techniques that evaluate leaf chlorosis based on the shape of the reflectance spectrum between 570 and 670 nm (Yellowness Index; Adams et al., 1999). The increased availability of hyperspectral imaging sensors and advanced analysis tools like partial least-squares regression and spectral mixing techniques mentioned earlier will facilitate studies to extend this concept to the canopy level. It should be mentioned that ARS scientists have worked for a number of years with the Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), and NASA in developing and refining new remote sensing technologies for detecting changes in plant biochemistry, physiology, and metabolism [e.g., early research using plant fluorescence to detect water stress in citrus (McFarlane et al., 1980)]. These newer approaches using laser induced fluorescence (LIF) have considerable potential for previsualise identification of nutrient and water stress and for detecting optimal levels of plant growth and yield under different fertilization rates in the field (Daughtry et al., 2000).

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Soybean Food Products: Cheaper and Rich Source of Proteins

Article ID: 11424

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Abstract

Soybeans are one of the most popularly grown legumes, native to the East-Asia and now grown almost everywhere. They are used as oilseeds as they are made up of around 18% oil. Soybean is grown almost all the states of India. The Madhya Pradesh state is known as "Soybean State" as it produces highest quantity of soybean. During the last two years, Soybean has been grown in Madhya Pradesh in an area of about 4.4 million ha and production around 3.9 million tonnes with an average productivity of 796-885 kg/ha. Soybeans are used in preparation of oil, bio-fuel, crayons and some other uses too. The use of soybean products in the feed and food industry has increased steadily. The world soybean production is currently 219.8 million metric tons out of which India produced 9.3 million metric tons constituting about 4% of the total world production. Out of this production, less than 10% is directly used for human consumption (Gandhi, 2009). The dominant position of soybeans and their products is primarily associated with their high nutritional quality especially with respect to protein and amino acids. Present paper reviews the simplest methods of preparation of few soybean products.

Introduction

India has already entered soybean development race, although the experience of India as an active participant in this race is not even of two decades. Soybean is not a new crop to India. It was grown in India long before it was introduced in USA in the early 1800s. Madhya Pradesh is the main soybean producing state in India. Soybean is cultivated in monsoon season and fresh arrivals are seen from October onwards.

Soyabean

'Soyabean is a valuable gift of mother nature to human beings'

Soybeans are looked upon not merely as a means to supply food for humans and animals, but also at the same time to serve as a means for improving the soil through their ability to fix atmospheric nitrogen. As a legume, it is an ideal component of a sound agricultural system. It is in the perspective of all these advantages of soybeans and its adaptability and productivity across tropical, subtropical and temperate environments that significant strides have been made in its innovation. In fact, the expansion of soybean across the world has been characterized as one of the striking developments of recent decades. While the importance of soybean as a commercial crop with immense potential for food and feed has been well recognized now by developed countries, developing countries (including India). In India, which is predominantly a vegetarian society, fats and proteins of vegetable origin acquire special significance in diet and soybean preparations are the answer.

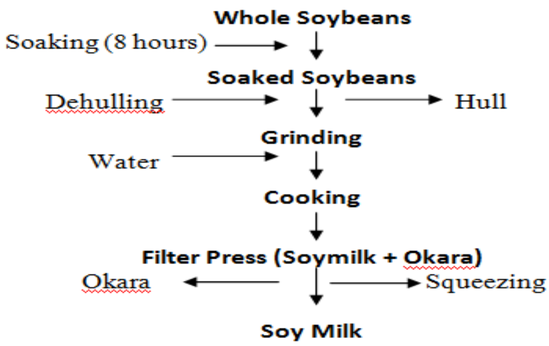
Soybean can play a vital role in balancing the protein deficiency of our diet. Protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain, 4 times of egg; 12 times of milk. Soybean has 3% lecithin, which is helpful for brain development. It is also rich in Ca, Protein and Vitamins A, B, C and D. In countries or regions where animal protein are not available or where the price of meat are beyond the purchasing power of average population, soybean and soybean products may be used as their substitutes.

It has been recognized as one of the premier agricultural crops today for various reasons in the world. Now-a-days different types of human foods are prepared from soybean such as soymilk, tofu, Ice cream, beverage etc. Oil and protein rich soybean have now recognized all over the world as a potential supplementary source of edible oil and nutrition. Millions of people consider soybeans to be the ideal crop because they serve as a food supplement for both humans and animals. Protein, fat, vitamins, and minerals are all present, as are all other dietary components. For many people, soybean has evolved into a nutritious food. Soybeans could help individuals avoid numerous ailments if they were more aware of them. It was shown that those who eat soybeans or soybean products have a lower risk of heart disease, osteoporosis, and cancer and also helps to minimize diabetes. Obesity people who eat soybeans lose weight. Soybean aids in the management of hypertension, cholesterol, and vascular function.

Soybean Products

A number of products can be prepared from soybean which helps improving nutrition. Present article describes methods of preparation of only few such products which can be prepared by a common man for domestic use. These products are 'Soya Milk', 'Tofu', 'Soya Flour' and 'Soya Nuggets', etc.

1. Soya Milk: The soymilk may consist of pure water, soybean extract, sugar and salt. It has 3-4% protein, 1.5-2.0% fat and 8-10% carbohydrates. Flavored soymilk may consist of pure water, soybean extract, sugar, salt, flavors and permitted food colors. Soybean milk is prepared from soybean and it has very high nutritional value. It does not have lactose, gluten and caffeine. It has low fat content and very high omega 3 and protein contents. Its taste shows similarity with hazelnut taste and it has creamy structure. The mineral substances of soybean milk such as calcium, phosphorus and ferrous are higher than mineral substance content of cow milk. It may be used instead of cow milk in many processes. However, its bean taste and flavor affect some consumers negatively. For these consumers, there are some flavored Soy milk types available in the markets. It can be used in making of milky desserts because of its low saturated fatty acid and cholesterol contents.



The clean (Sorted and Graded Soybeans) and fresh 500 gm soybean seeds are taken. Whole soybeans are soaked in lukewarm water for 8 hours, the beans are then washed with normal water 3-4 times then soaked soybean's husk are removed by means of pressure of two hands and cleaned with continuous flow of fresh water. Then clean dehulled soybeans are ground with water separately by blending machine for extraction of Soymilk. The homogenized mass is then boiled at 100°C for 10-15 minutes of time with constant stirring and then it was strained through a fine cloth to separate milk from Okara.

2. Tofu (Soya Paneer): It is also known as soybean curd and is a good source of protein and isoflavones. It is made by adding calcium or magnesium salts to soy milk, which enables the soy protein to coagulate to form curd. A simple and low-cost technology for making tofu was developed at domestic level. When the tofu is made with calcium, calcium becomes an essential component. The texture of tofu can vary from extra firm, firm, soft and silken, can be used in almost any culinary capacity. Extra firm tofu is best used for marinating and cutting in to cubes for a stir-fry. The softer one is used for desserts or other foods those require wetter consistency

The process for preparing Soy milk has already been described earlier. Once the Soybean milk is prepared then it is cooled to 80°C and coagulated using half tea spoon of citric acid. The coagulum is then transferred to a muslin cloth to separate Whey and Tofu, and then it is pressed with a weight. The quality of Tofu is influenced by nine factors e.g., the water to soybean ratio, the soaking time and temperature of the soybeans, the grinding processing, heat processing and the heating rate, the stirring speed at various points in the process, the coagulation temperature, the type and concentration of the coagulants, method of adding the coagulant to the soymilk, and the weight and time of press of the curds.

Soy Milk
↓
Heating up to 80 °C
↓
Adding of Coagulant
↓
Coagulum
↓
Tofu Press
↓
Tofu

Processing of soybean into soy products (Soy milk and Soya paneer) in laboratory.

Whole SoyMilk & Dehulled SoyMilk

Tofu from Dehulled Soy milk & Tofu from Whole Soy Milk

Okara: By- product obtain during soybean slurry. It is used as a animal feed and also for human consumption

3. Soya Flour: Medium Fat Soy flour is used for fortification with other cereals/millets/pulses at 10-15% level in the preparation of traditional recipes. In chickpea flour and papad, it can be added up to 20 and 40%, respectively. Soybean flour or Soy flour is a nutritious, high protein ingredient used in numerous food formulations. Soy flour is generally the flour produced by milling the whole, dehulled soybean. Flour or meal is made from fat extracted soybeans by numerous well-known means. Defatted flour or soybean concentrate is commonly used to make texturized soy product by extrusion processes. Soy protein isolates are produced by fractionating soy flour or concentrate to obtain functionality and other desirable attributes. Soy flour is an excellent source of soy protein, bio active components such as is flavones and dietary fiber. This ingredient is a great source of iron, potassium and B vitamins. It has a bio-active component which provides relief from menopausal symptoms such as hot flashes, prevent breast cancer, prostate cancer, and colorectal cancer and maintain healthy bones. The profile and content of bio-active components differ from product to product that depends on how the soy protein is processed and how much soy protein is found in the food. It is the healthy source of protein due to high quality of protein containing all amino acids essential for growth.

Soybeans Grains
↓
Sorting
↓
Cleaning
↓
Soaking(30 min)
↓
Dehulling
↓
Oven drying (at 70 °C for 10 hours)
↓
Winnowing
↓
Milling (into fine particles i.e. Soy flour)
↓
Sieving
↓
Packaging
↓
Storage

4. Soya Nuggets: Soybean nuggets are normally known as vegetarian meat. The reason behind the same is because it possesses similar properties like original meat. Soybean is a rich source of protein and among all vegetarian food products; it has highest level of protein (about 50%). It is prepared from defatted (DOC) Soya flour by the process of extrusion cooking. Though soya bean is mostly produced in Madhya Pradesh but now days, states like Chhattisgarh, Gujarat, and West Bengal are also producing in good quantities of soybean.

Soya Nuggets are as good as original meat. They possess similar properties in terms protein content. They are also similar chewy characteristics on soaking in water. Also, they are free from cholesterol, and thus heavily used as meat substitutes. These nuggets can be used in preparing various food products in households as well as in restaurants and can be important because of its high nutritional value.

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Farm Mechanisation: Status, Strategies and its Challenges in Indian Agriculture

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Farm Mechanisation

Farm mechanisation refers to the development and use of machines that can take place of human and animal power in agricultural operations with end objective to enhance overall productivity and production with the lowest cost of production. The level of farm mechanisation is low in India as compare to China and western countries.

A direct correlation has been suggested between level of farm mechanisation and productivity. At present time, Indian farmers are adopting it at a faster rate in comparison to recent past. Farm power availability from tractors has grown from 0.007 to 1.03 kW/ha for last 53-54 years and it is further estimated to reach 3.74 kW/ha by 2032-33.

The overall level of farm mechanisation in India is about 40-45% and 90% of the farm power is contributed by mechanical and electrical power sources. To assure timely perform of various agricultural operations, average farm power availability needs to be increased from the present level.

Table-1 Agriculture grass domestic product and level of farm mechanization in the world agriculture.

Countries	Agricultural GDP (%)	Workforce (%)	Level of farm mechanization (%)
USA	1.0	2.5	95.0
Europe	1.4	3.9	95.0
Russia	3.1	14.4	85.0
Brazil	4.3	14.8	75.0
China	7.5	35.0	50.0
India	15.9	49.0	40.0

Source: FAO Year Book, 2013, World Bank open data, 2013, FICCI and PWC, 2019

Table-2 Cropping intensity and power availability on Indian farms:

Year	Cropping intensity (%)	Food grain productivity (t/ha)	Power available (kW/ha)	Power per unit food grain production (Kw/tonne)	Net sown area (ha/tractor)
1965-66	114.00	0.64	0.32	0.50	2162
1975-76	120.30	0.94	0.48	0.51	487
1985-86	126.80	1.18	0.73	0.62	174
1995-96	130.80	1.45	1.05	0.70	82
2005-06	135.90	1.72	1.49	0.87	45
2010-11	140.50	1.93	1.78	0.92	34
2011-12	141.50	2.08	1.87	0.90	31
2012-13	140.90	2.13	1.94	0.91	29
2013-14	142.00	2.11	2.02	0.96	27

Source: Singh (2015b)

Table-3 Level of farm mechanisation in agricultural crops at different operations/activities in India.

Crops	Seedbed preparation (%)	Sowing/planting/transplanting (%)	Weed and pest control (%)	Harvesting and threshing (%)
Rice	85-90	5-10	80-90	70-80
Wheat	90-95	80-90	70-80	80-90
Maize	90-95	80-90	70-80	50-60
Sorghum	80-90	30-50	60-70	20-30
Millets	80-90	30-40	60-70	20-30
Oilseeds	80-90	30-40	60-80	20-30
Potato	90-95	80-90	80-90	70-80
Cotton	90-95	50-60	50-60	0
Chickpea	90-95	50-60	60-70	30-40
Sunflower	80-90	40-50	80-90	60-70
Fodder crops	80-90	20-40	80-90	10-20
Vegetable crops	70-80	5-10	80-90	<1

Source: Tiwari et al., 2019

Benefits of Farm Mechanisation

1. Helps in conversion of uncultivable land to agricultural land through advance tilling machines and shifting land use for feed and fodder production.
2. Dealing with increasing cost of the labour by reducing cost of farming by 20%.
3. Increase efficiency of farm labour by reducing workloads. And it can reduce time required for farm operations and activities by 15-20%.
4. Inputs saving (seeds and fertilizers 15-20%).
5. Improvement in the cropping intensity and making agricultural land commercially more viable through boosting farm output and thus farm income.

Need of Farm Mechanisation

1. In India, 63% of the total landholdings are below one hectare and more than 86% landholding are less than two-hectare accounting for 19% and 40% of the cultivated area (142 million hectare), respectively. Fragmentation of farm land holding is a major concern and average size holding has reduced from 2.82 to 1.1 hectare from 1970-71 to 2010-11 (Tiwari et al, 2019).
2. Increased the cost of farm labours due to increased migration of rural workers to the urban areas.
3. Overdependence of Indian agriculture on the monsoons.
4. Decreased or stagnant productivity of the rice-wheat cropping system.
5. Demand for sustainable agricultural productivity to feed our present and future human and animal populations.
6. Due to intensive involvement of labourers in various agricultural farm operations, there is need for the high-cost machinery for better turnout in shorter period of time.
7. Use of tractors enhanced agricultural productivity due to better seed-bed preparations, timeless operations, precision in distribution and placement of seed and chemical fertilizers.
8. Central government is focusing to achieve the target of doubling farmer’s income by 2022.

Strategies to Increase Level of Farm Mechanisation

1. Ashok Dalwai Committee (doubling of farmer’s income) has recommended the establishment of at least one custom hiring centre (CHC) at every village or gram panchayat in case of small villages. CHC should house the low order machines needed and suits to production systems in that village.

2. Establishment of Agricultural Machinery Bank (AMB) at district level. AMB is expected to house cost incentive machines like combine-harvester's and its maintenance and repair facilities.

3. As a third tier in the hierarchy of farm mechanisation, regional or state level service centres may be promoted in the private sector to specialise and a package of services.

4. The states must undertake crop/agricultural planning at district and block levels. So, that most appropriate type of development is carried out. This will ensure better capital use efficiency in farm mechanisation.

Initiatives Taken by the Governments

1. Sub-mission on Agricultural Mechanisation (SMAM): This mission was launched by central government in 2014-15 with the following objectives:

a. Increasing the reach of farm mechanisation to small and marginal farmers and to the region where availability of farm power is low.

b. Promoting custom hiring centres to offset the adverse economies of scale arising due to small landholding and high cost of individual; ownership.

c. Creating hubs for hi-tech and high value farm equipment's.

d. Creating awareness among stakeholders through demonstration and capacity building activities.

Under this scheme assistance is provided to the state governments to impart training and demonstration of agricultural machinery and financial assistance. Mission has eight components namely, first-promotion and strengthening of agricultural mechanisation through training, testing and demonstrations, second-demonstration, training and distribution of post-harvest technology and management, third- financial assistance for procurement of agriculture machinery and equipment and fourth- establish farm machinery banks for custom hiring, fifth- establish hi-tech, high productive equipment hub for custom hiring, sixth-promotion of farm mechanisation in selected villages, seventh- financial assistance for promotion of mechanised operations per hectare carried out through custom hiring and eighth- promotion of farm machinery and equipment in North-Eastern region). The scheme will be implemented in all the states, to promote the usage of farm mechanization and increase the ratio of farm power to cultivable unit area up to 2.5 kW/ha.

2. Crop residue management scheme (CRMS): This is a central government scheme which was launched in 2018 by the Ministry of Agriculture and Famers Welfare. Under this scheme, farmers are provided farm machineries for insitu-management of crop residues through establishment of custom hiring centres.

3. Multilingual mobile app/FARMS-app: Farmers are connected with CHC (s) which are situated in their locality to take farm machineries on the rental basis for various agricultural operations. This mobile app was developed by the Ministry of Agriculture and Famers Welfare, Government of India.

4. Yantra Laxmi Scheme: This is an initiative of the government of the Telangana state. Under this scheme, state government will provide a subsidy of 50% and 100% for SC and or ST small and marginal farmers (having 2.5 hectares of land) for purchasing of mini-tractors, rotavators, power welders and trans-planters.

5. Other schemes/missions: Farm mechanisation are also being implemented through schemes/missions such as Rashtriya Krishi Vikas Yojana (RKVY) 2007, Mission for Integrated Horticulture Development of Horticulture (MIDH) 2014-15 and National Mission on Oilseed and Oil palm (NMOOP) 2014-15.

Challenges with Farm Mechanisation in India

1. Economies of scale and operations (Small average land holding size about 2.7 acres as compare to Canada- 235 acres and USA- 145 acres as per agricultural census, 2015-16).

2. Low-income level of farmers (About 86% Indian farmers are small and marginal and earns on an average of rupees 77112 per annum as per NSSO report, 2016. This hinders huge investment for mechanisation of agriculture).

3. Credit procedure (To avail farm loan for various activities helping farm mechanisation is cumbersome and rate of interest is higher in comparison to the crop loans).

4. Variability in farm powers (Poor availability of farm power varies highly from one state to another state according to agro-climatic zones of India. Lack of access to power results in slow uptake of farm mechanisation and hence non-intensification of farm productivity among small and marginal farmers).

5. Subsidy limitations (The central/state government have been providing subsidy for individuals/group of farmers are available based on the budget allocation and not on farmer's requirement basis).

6. Low awareness (Farm mechanisation is viewed as only usage of tractors, power tillers, combine-harvester's and threshers. There are many other machines suitable for small land holdings. Farmers are not aware about this kind of machines and methods of using them).

What can be Done?

1. Consolidation of small land holdings to reap the benefits of agricultural mechanisation.
2. Reduce/eliminate subsidies and use these funds to decrease the interest rates on agricultural loans and taxes for purchase on agricultural equipment's and implements.
3. Need to be promoted small farm machines/impalements operated individually, keeping in the view the versality of various crops, cropping systems and agricultural operations.
4. Quality of farm machines must be assured as it brings confidence among the formers for adaption of farm mechanisation.
5. Need to innovate custom hiring/ a rental model by paddy transplanter, combine-harvester's and laser land leveller etc. to reduce cost of production of crops.
6. Advance machines and implements make in India initiative can be used to support the manufacture of inputs and farm implements currently being imported from foreign countries like USA, Canada, Japan, Brazil etc.
7. Number of custom hiring centres should be increased.
8. Skill development in the area of operation, repair and maintenance of farm implements.
9. Development of gender friendly equipment should be taken up as the percentage of women workforce in agriculture is increasing day by day.
10. In order to provide economical solutions of farm mechanisation to the formers, cooperative farming should be promoted in areas of small sizes of landholdings.

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Role of Minerals in Immunity

Article ID: 11426

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Every living organism has the ability to resist or fight against infection, this in-built capacity to protect itself is called immunity. The efficacy of immune system functioning depends on large number of factors like genetic, ecological, environmental, social, economic and also dietary patterns being one of the important driving forces.

Dietary habits/ nutrition and immunity have a strong association since ages. Adequate nutrition right from fetal stage is vital for the healthy development of immune and also other organ systems. Nutrient deficiencies like protein energy malnutrition or any other vitamin and mineral deficiencies negatively effects immune systems by reducing number of lymphocytes or by reducing their ability to kill pathogens or by lowering their antibody recognition capacity so on and so forth. Thus, it is clear that optimum nutrition is vital for a healthy immune system. Both macro and micro nutrients are important for optimum functioning of immune system, as they are required for growth, proliferation, repair and maintenance of immune cells. However, there are certain nutrients that specially improve defense mechanisms if present in adequate quantity. Vitamins A, C, E and minerals like copper, iron, selenium, Iodine and zinc are some such minerals that improve disease fighting capacity of immune cells.

Minerals play important role in immunity either by acting as cofactor for antioxidant enzymes or by directly getting involved in genesis, maturation of immune system and immune cells

Iron

It is essential mineral needed by both humans and pathogens for growth and development. Iron has vital role in both innate (natural) immunity and adaptive (acquired) immunity. As a part of innate immune responses iron is sequestered with in cells and in extracellular fluid it is bound to transferrin making it unavailable to pathogens. Iron is also crucial for adaptive immunity which is mediated via B and T lymphocytes. Iron is essential for various adaptive immune responses like lymphocyte proliferation, maintenance of T cell number, macrophage cytotoxic activity, cytokine production, antibody production and also maintenance of lymphoid tissue. Hence, it is evident that addressing public health problem of iron deficiency anaemia would also help in reducing infections and associated morbidity and mortality.

Rich Sources: Amaranth leaves, Bengal gram, Rajmah, Soyabean, Gogu leaves, Black raisins, Cashew nuts, Garden cress, Gingelly seeds, Sunflower seeds, Egg, Chicken, Mutton, Liver (goat and poultry).

Copper

Vital role of copper in immunity is established by the facts that copper deficiency in infants leads to neutropenia, thymic hypoplasia and splenomegaly. Administration of cooper to deficient individual's helps in reversal of the situation. Copper is essential for proliferation B lymphocytes, maturation of T cells and thus deficiency leads to reduced levels of T and B lymphocytes in blood circulation that lowers overall pathogen detection and killing capacity of the immune system. Copper acts as cofactor for super oxide dismutase enzyme that is involved in production of hypochlorous acid during phagocytosis. Thus, copper deficiency leads to reduced bactericidal activity. On the other hand, excess copper or excess ceruloplasmin causes immune suppression for which the reasons are unclear. Hence, balanced intake of copper is essential for optimum functioning of immune system.

Rich Sources: Ragi, Bengal gram, Amaranth seeds, Black gram, Cow pea, Rajmah, Peas, Almonds, Arecanut, Cashew nut, dry Coconut, Gingelly, Ground nut, Walnut, Goat liver, Crab, Oyster.

Zinc

It is essential mineral that is required as a co factor for more 300 enzymes and also important for formation of zinc fingers during DNA synthesis. Thus, zinc plays a vital role in many physiological processes of human system, one such being immune system. Zinc has multi-faceted role in human immunity being an important part of both innate and adaptive immune responses. Zinc is essential for normal growth and maintenance of thymus gland, where maturation of T lymphocytes takes place. Hence, zinc deficiency or zinc mal-absorption leads to atrophy of thymus gland and reduced production of thymulin (essential for maturation of T cells). Therefore, Zinc deficiency leads to reduction in T-cell numbers and their efficacy to mitogenic challenge, reduced T-cell participation in antibody production, delayed-type hypersensitivity reactions. Zinc plays crucial role in regeneration of mucosal epithelium thus creating a strong first line of defense. Apart from this zinc is required for reducing oxidative stress generated by various pathways. Zinc is an inhibitor of NADPH oxidase, zinc is required for superoxide dismutase (SOD), and it induces MT (metallothionein, which is very effective in decreasing hydroxyl radicals). Henceforth focus can be shifted to correcting zinc deficiencies to improve immunity and quality of life of immune suppressant subjects.

Rich Sources: Soyabean, Poppy seeds, Almomds, Cashew, Gardencress, Gingelly, Linseeds, Sunflower seeds, Mushroom, Egg, Goat meat, Oyster.

Selenium

As seleno-protein, selenium acts as co factor for variety of enzymes, one among those is glutathione peroxidases which reduces hydrogen peroxide and hydroxide radicles generated during phagocytosis, thus helps in maintaing redox potential of the cells. Selenium is also involved in cyclooxygenases reactions that oxidize arachadonic acid to prostaglandins and thromboxanes, which tend to be anti-inflammatory. Hence forth selenium is essential for modulating immune responses in humans.

Rich sources: little millet, Peas, Wheat, Linseeds, Gingelly seeds, Egg, Chicken.

Iodine

It is clearly established that iodine is important component of thyroid hormones and its role is largely confined to human physiology but in the recent past Iodine is also known for its immune promoting properties. Iodine is the important component of myeloperoxidase enzyme that helps neutrophils in killing pathogens by producing hypochlorus acid (antimicrobial). Iodine also aids in stimulating IgG secretion by plasma cells. Thus, Iodine is also gaining importance for its immune properties.

Rich sources: Cod, Shrimp, Sea weeds, Iodised salt.

Conclusion

Human beings need a healthy immune system to fight and recover against infectious diseases and disorders. A large number components play vital role in maintaining healthy immune system, adequate nutrition being one such important component. Hence, nutrients play important role in both in innate and adaptive immune responses. Among the nutrients some minerals like iron, copper, zinc, selenium etc., have role all immune activities. Thus, ensuring food and nutritional security helps to improve quality of life of mankind by way of improving their disease fighting capacity.

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Physiological Processes Involving Circadian Dynamics in Plants

Article ID: 11427

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Introduction

Plants being sessile are subjected to light and temperature cycle due to rotation and revolution of earth on its tilted axis. Plants anticipate variations in environment by their internal timekeeper known as circadian clock. Circadian clock is the endogenous time keeping molecular mechanism that requires approximately 24h to complete a single cycle. This circadian clock controls physiology, metabolism and behaviour of plants that vary greatly between day and night. Light and temperature are two important environmental cues which influence the clock pace and synchronize it by affecting the molecular responses at core oscillator and further coordinates output rhythmicity. Efficient integration of these outputs into metabolic and physiological network is necessary for proper growth and development (Nohales and Kay 2016). Knowledge of rhythmic response of plant dates back to 4th century BC when Androsthenes during the marches of the Alexander the great on the island of Tylos (Bahrein) observed the rhythmic movement of leaves of *Tamarindus indicus*. Later in 1729, de Mairan, the French astronomer reported the endogenous origin of the rhythmic leaf movement in *Mimosa pudica*. After about 200 years of de Mairan report "circadian" word was coined by Franz Halberg with French origin; cica (about) and dies (day).

Circadian Clock Consists of 4 Main Components

Component	Biological Function
Circadian oscillator	Generate a rhythm with a ~24h period within the cell
Entrainment pathways	Synchronize the oscillator with the external time of day so that the clock stays accurate
Output pathways	Communicate temporal information from the oscillator to other parts of the cell
Circadian gating	Adjust the sensitivity of entrainment and output pathways depending on the time of day

Molecular Mechanism of Circadian Clock

Present understanding of the plants circadian oscillator is from late 1990s which was based on the genetic and biochemical studies which described about 1st transcriptional loop (Alabadi et al. 2001). This interlocked transcriptional feedback loop is composed of morning elements; CIRCADIAN CLOCK ASSOCIATED 1 (CCA1), LONG ELONGATED HYPOCOTYL (LHY), PSEUDO-RESPONSE REGULATORs (PRRs) and evening elements; EARLY FLOWERING 4 (ELF4), TIMING OF CAB EXPRESSION 1 (TOC1), LUX ARRHYTHMO (LUX), NOX (also known as BROTHER OF LUX ARRHYTHMO or BOA).

Prominent Functions Regulated by Circadian Clock

Circadian clock controls many output responses such as photosynthesis, respiration, hypocotyl elongation, seed germination, stomatal conductance, flowering, leaf movement, senescence, biotic and abiotic stress responses. Some of the prominent functions are described as follows:

Hypocotyl elongation: The clock regulates the daily and rhythmic elongation of hypocotyl in response to photoperiod, which is best explained by light mediated degradation of PHYTOCHROME-INTERACTING FACTOR 4 (PIF4) and PIF5 and its accumulation in night time. It is further well explained by coincidence model, under long days PHYTOCHROME B (PHYB) and DELLA suppress the accumulation of PIF4/5 protein even though accumulation of mRNA was high. On the other hand, long nights lead to removal of clock mediated suppression of protein accumulation and there by lead to higher PIF4/5 protein accumulation in dark condition (Niwa et al. 2009).

Flowering: The photoperiodic control of flowering involves sensing of photoperiod by clock regulated GIGANTEA (GI) and FLAVIN-BINDING KELCH REPEAT F-BOX 1 (FKF1) in the phloem companion cells of leaf. Under short day condition accumulation of GI-FKF1 protein complex is very less to overcome the inhibition of CONSTANS (CO) gene transcription by clock-regulated CYCLING DOF FACTOR (CDF). Whereas under long day condition peak accumulation of GI-FKF1 protein complex degrades the CDF protein and permit the CO transcription and further accumulation of protein. This CO protein is stabilized by light mediated PHYTOCHROME A (PHYA) and CRYPTOCHROME 2 (CRY2). This stabilized CO protein further activates FLOWERING LOCUS T (FT) transcription and translation. This FT further moves to shoot apical meristem (SAM) via phloem and complex with FLOWERING LOCUS D (FD) to activate many floral meristem identity genes FRUITFULL (FUL; also known as AGL8), SUPPRESSOR OF OVEREXPRESSION OF CONSTANS 1 (SOC1), LEAFY (LFY) and APETALA1 (AP1) (Song et al. 2015).

Stress response: Accumulation of C-REPEAT BINDING FACTOR (CBFs) and ABA in response to cold and drought is also gated by circadian clock respectively. Plants use the circadian clock to temporally restrict both the basal expression and the induction of defence pathways to the time of day when the threat posed by pathogens and herbivores is maximum, thereby minimizing fitness costs (Greenham et al. 2015).

Sugar metabolism: Several experimental studies have shown the rhythmic control of the plant metabolism involving conversion of starch to sugars and vice versa in response to photoperiod, but the molecular mechanism was unidentified till recently. The molecular mechanism of regulation of circadian phase in response to sugars was recently identified by Frank et al. (2018). It was observed that BASIC LEUCINE ZIPPER63 (bZIP63) transcription factor regulates the PSEUDO RESPONSE REGULATOR 7 (PRR7) the circadian oscillator gene in response to sugars and regulate the circadian phase. This bZIP63 transcription factor is regulated by KIN10 α subunit of the sugar sensing kinase SnRK1 which is required for sucrose induced changes in circadian phase. Further TREHALOSE-6-PHOSPHATE SYNTHASE1 (TPS1) which is responsible for synthesis of a signaling molecule trehalose-6-phosphate is also required for sucrose induced circadian phase adjustment. Daily rhythmic adjustment of circadian phase involves the bZIP63, TPS1 and KIN10 α subunit of SnRK1 in response to sucrose.

Future perspective: Complexity of circadian behavior requires more carefully defined experiments involving forward and reverse genetics assisted by mathematical modelling. Identification of regulatory components of circadian clock and mechanisms involved will help in optimization of plant performance and fitness. As entrainment studies become more detailed, crop performance can be improved by matching circadian rhythms to local growing conditions.

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Classification of Livestock Feed Stuffs

Article ID: 11428

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Introduction

Feed stuff refers to any of the constituent nutrients of an animal ration. Feed, also called animal feed, food grown or developed for livestock. Modern feeds are produced by carefully selecting and blending ingredients to provide highly nutritional diets that both maintain the health of the animals and increase the quality of such end products as meat and milk. Animals in general require the same nutrients as humans. Some feeds, such as pasture grasses, hay and silage crops, and certain cereal grains, are grown specially for animals. Other feeds, such as sugar beet pulp, brewers' grains and pineapple bran, are by-products that remain after a food crop has been processed for human use. Surplus food crops, such as wheat, other cereals, fruits, vegetables and roots may also be fed to animals. Livestock feeds are broadly classified into two groups. These are roughages and concentrates. Besides, there are feed supplements (vitamins and minerals) and feed additives.

Roughages

The feedstuffs that contain more than 18% crude fibre (CF) and less than 60% total digestible nutrients (TDN) are called roughages. Roughages are bulky in nature, and poor source of readily available carbohydrates. It may be of two types on the basis of moisture content, viz., dry roughages and succulent roughages.

1. Dry roughages: They contain about 10-15% moisture, e.g., straw, hay etc. Straw may be of paddy, wheat, maize, jowar, bajra, etc., out of which paddy straw is popular as livestock feed. However, nutritive value of paddy straw is poor. It contains about 45% TDN and only 3% protein. It also contains high quantity of lignin. Hay is sun dried green grasses preserved for future use, and contains more than 75% dry matter.

2. Succulent roughages: It contains about 60-90% moisture, e.g., pasture grass, fodder, tree leaves, silage, root crops, brewery by-products and food processing plant wastes, etc. Pasture grasses are Doob, Anjan, Chengali, etc. Fodders may be leguminous type having more protein content (Berseem, Lucerne, Cowpea, etc) and non-leguminous type having less protein but more energy content (maize, jowar, bajra, oats, barley, napier grass, etc). Common tree leaves used as livestock feed are subabul, babul, bamboo, nulbery, etc. Root crops are beet, turnips, carrot, etc. Silage is preserved fodder crops under anaerobic condition, having about 70% moisture.

a. Berseem and Lucerne are winter legumes.
b. Cow pea, rice bean and guar are summer legumes
c. Maize and jowar are major kharif non-leguminous fodder crops.
d. Oats and barley are important rabi non-leguminous fodder crops.
e. Guar is drought-resistant legume.
f. Silage is anaerobically fermented product of green forages, also known as "pickle green fodder". Optimum pH of very good silage is 3.7-4.2.
g. Thick-stemmed crops like maize are suitable for silage making and thin-stemmed crops like Lucerne, oats are suitable for hay making.

Concentrates

The feed stuffs that contain less than 18% crude fibre (CF) and more than 60% total digestible protein (TDN) are called concentrates. Concentratres are rich in nutrients. They have less moisture, and these are usually more digestible than roughages. Concentrates are divided into two groups as energy-rich concentrates and protein-rich concentrates.

1. Energy-rich concentrates: They have less than 18% CP, e.g., cereal grains (maize, sorghum, barley, etc), mill by-products (flour, rice bran, wheat bran, etc), molasses (obtained from sugar industry).

2. Protein-rich concentrates: They have more than 18% CP. It may be of two types, viz., plant origin and animal origin. Protein-rich concentrates of plant origin are different types of oil cakes like ground nut cake (GNC), soyabean cake, mustard cake, linseed cake, etc. Protein-rich concentrates of animal origin are fish meal, meat meal, etc.

The Difference between concentrates and roughages is given in Table 1.

Table 1 Difference between concentrates and roughages:

Sl. No.	Parameters	Concentrates	Roughages
1	Moisture and dry matter content	Moisture 10% and dry matter 90%	Dry fodder: moisture 10% and dry matter 90% Green fodder: moisture 85-90% and dry matter 10-15%
2	Crude fibre content	< 18%	>18%
3	Digestibility	High	Comparatively less
4	Nutritive value per unit mass	High	Low
5	Nature	Compact	Bulky
6	Keeping quality	High	Variable (Dry fodder; high Green fodder; less)

Feed Supplements

Feed supplements are categorized into two groups viz. mineral supplements and vitamin supplements. Animals usually get these vitamins and minerals from various feed sources. However, in most of the cases, livestock feeds based on concentrate and roughage are generally deficient in minerals, especially calcium, phosphorus, sodium, zinc, iron, copper, manganese and iodine etc. Therefore, these mineral supplements are to be provided to the animals from outside sources. Ruminant animals (cattle, buffalo, sheep, goat), having functional rumen, do not require dietary supplementation of vitamins (water soluble vitamins and fat-soluble vitamin K). Animals exposed to sunlight can synthesize Vitamin D. Similarly, animals receiving sufficient green forages need no supplementation of Vitamins A and E. Vitamin and mineral supplements are available in the markets in various trade names. These feed supplements may be fed to animals as such through drinking water or as electuary, or mixed with feed, as and when needed. When it is used, it should be fed continuously at least for 10 days. Feed supplements are used to prevent deficiency diseases, and to promote growth and production.

Feed Additives

A feed additive is an additive of extra nutrient or drug for livestock. Such additives include vitamins, amino acids, fatty acids, minerals, pharmaceutical, fungal products and steroidal compounds. The additives might impact feed presentation, hygiene, digestibility, or effect on intestinal health. Feed additives represent various classes of molecules, compounds or organisms that promote ingestion, absorption, assimilation of nutrients, growth and health. They affect physiological processes such as immune function, stress resistance and reproduction. These are not essentially nutrients, but their presence in feed in minute quantity promotes intake, digestion and utilization of feed. Finally, they increase the nutritive value of feed leading to increased feed efficiency, growth and production of animals. An additive is an ingredient or combination of ingredients added to the basic feed mixture, which are to be handled and mixed carefully. The most common feed additives are antibiotic growth promoters, probiotics, antioxidants, enzymes, anticoccidials, antifungals and toxin binders, antistress medicines, anthelmintics, immuno-stimulants, electrolytes etc.

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Role of Biochar in Soil Health

Article ID: 11429

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Introduction

Biochar is the carbon rich product obtained when biomass, such as wood, manure or leaves, is heated in a closed container with little or no available air. Discovered in sub-soils of fired forest in amazonian region (Brazil) and known as terra preta. Earlier known as agrichar.

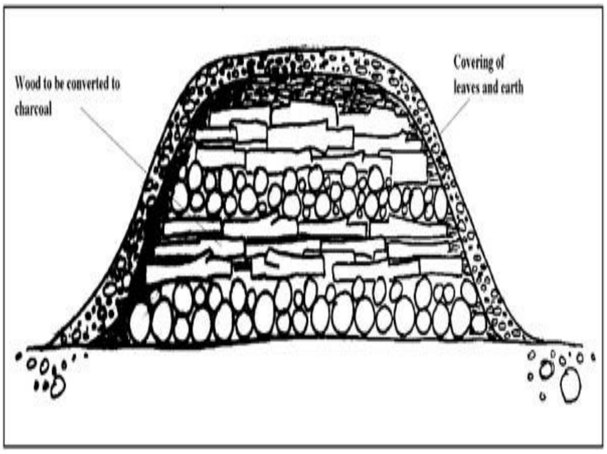
Materials Used to Make Biochar

Dairy, poultry, agricultural and other organic waste materials. Eg. Poultry Liner, Paper Sludge, Dairy Manure, Green Waste, Wood Waste, Rice Hulls, Algae Waste, Straw, Pig Manure, Cotton Trash, Nut Shells, Woody Weeds, Switch Grass etc.

Methods of Biochar Production

1. Traditional Method (Heap Method).
2. Slow pyrolysis.
3. Fast pyrolysis.
4. Intermediate pyrolysis.
5. Carbonization.
6. Gasification.

Heap Method



Slow Pyrolysis

1. Relatively low reactor temperatures (450- 650 ºC).
2. Operating at atmospheric pressure.
3. Very low heating rates, ranging from 0.01-2.0 ºC/s.

Fast Pyrolysis

1. High reactor temperature (>700 ºC).
2. Operating at elevated pressure.
3. High heating rates, ranging from 10-50 ºC/s.

Intermediate Pyrolysis

A hybrid of slow and fast pyrolysis:

Carbonization:

a. Hydrothermal carbonization: Biochar is obtained by applying high pyrolytic temperature (200–250°C) to a biomass in a suspension with liquid under high atmospheric pressure for several hours.

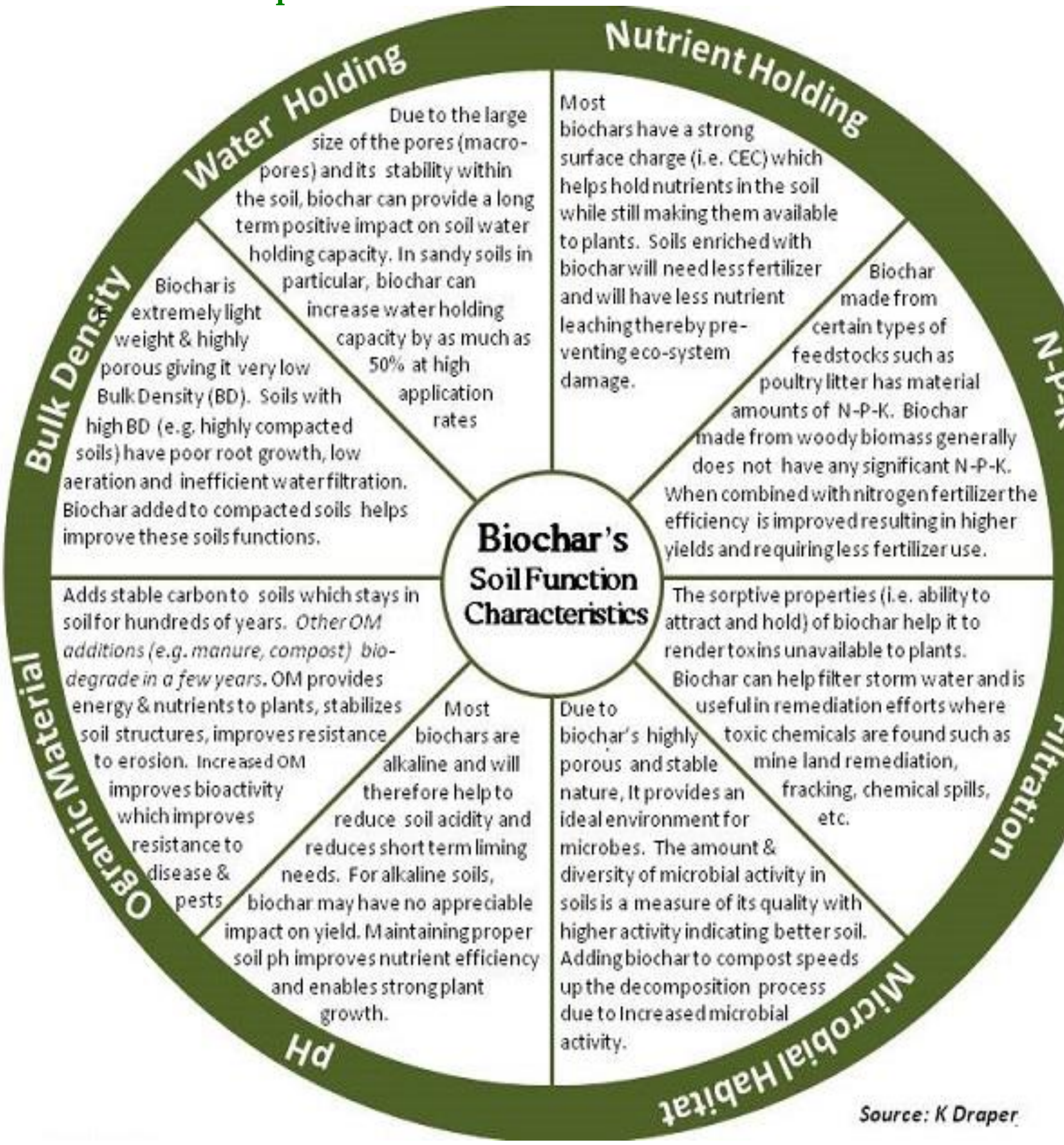
b. Flash carbonization: A flash fire is lights up at an elevated pressure at the underneath of a packed bed biomass. The fire travels in an upward direction through the carbonization bed against the downward flow of air supplied to the process.

Gasification: The biomass feedstock to some extent is oxidized in the gasification chamber at a temperature of about 800°C at atmospheric or elevated pressure.

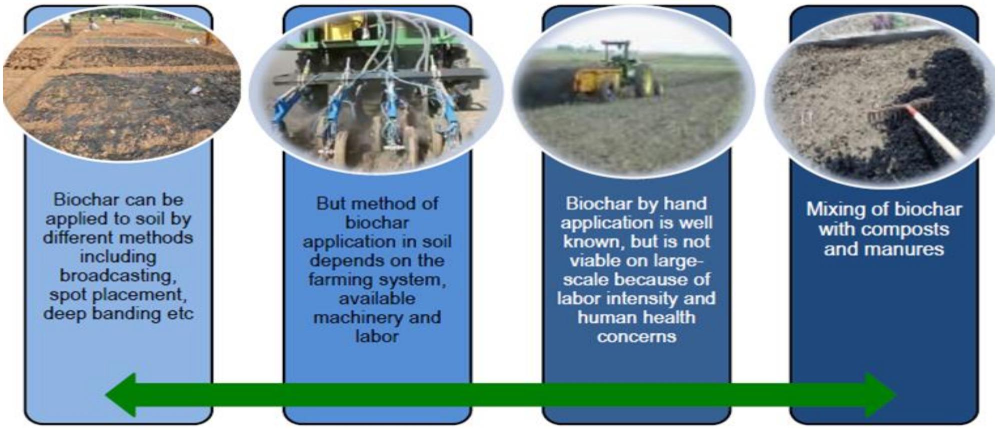
Properties of fresh biochar:

a. High mineral content, especially Ca (for low pH soils), K. Mg and P with relatively higher solubility.
b. Reactive surfaces that can complex soil organic and mineral matter and toxic substances.
c. A high concentrations of oxygenated functional groups especially carboxylic and phenolic.
d. A high redox potential.
e. High micro/meso pore volume for adsorption of gases and liquids.
f. Soluble or easily oxidized surface organic molecules (especially aliphatic) that are produced in low temperature pyrolysis.

Biochar as Soil Heath Improver



Methods of Biochar Application



Conclusions

1. It sequester carbon for longer period.
2. It improves physical, chemical and biological properties of soil.
3. Mitigate climate change by reducing emission of GHG.
4. Act as sink of heavy metals.
5. Improves yield of crop, when applied in combination with other organic/inorganic fertilizers.

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Pathogenic Reaction of Sugarcane Varieties for their Resistance to Red Rot Disease

Article ID: 11430

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Abstract

Thirty sugarcane varieties were evaluated to know the reaction against red rot pathogen by adopting plug as well as nodal cotton swab methods of inoculation with CF07 and CF08 isolates at SRI, Pusa. Out of thirty evaluated varieties only single variety (CoSe 01421 and CoP 06436) respectively was found resistant against both isolates whereas, 26 varieties against CF07 and 24 varieties against CF 08 were showed moderately resistant and rest varieties was found moderately susceptible to susceptible reaction in both the isolates. In case of nodal cotton swab method of inoculation, 3 varieties showed susceptible and rest 26 varieties showed resistant against CF07 isolate while, 4 varieties showed susceptible reaction and 25 varieties showed resistant reaction against CF08 isolate.

Keywords: Sugarcane, varieties, reaction, red rot.

Introduction

Sugarcane is a major cash crop cultivated in many parts of the world. In India, sugarcane an important agro-industrial crop and the principal source of sugar which covering the second largest acreage among all the cane growing countries of the world. In Bihar, its production (182.85) lakh tonnes and its average productivity of (60.15) tonnes/ha (GOB, 2019). However, its production and productivity is low due to several abiotic and biotic stresses in Bihar. Among several stresses' sugarcane diseases are one of them which cause considerable damage to crop as well as juice quality. Bihar is considered to the hot spot for diseases like red rot, wilt and smut. Among these, red rot disease caused by *Colletorichum falcatum* Went is the most important and dreaded disease in all the sugarcane growing regions of Bihar. The incidence of the disease depends on the congenial conditions prevailing during the crop season. Due to red rot disease a loss of 10-25% was observed (Mohanraj et al., 2003). Gill et al. (2012) due to red rot infection considerable losses were found both in yield and juice quality of cane in subtropical India. Minnatullah and Kamat (2018) also noticed deterioration in cane juice quality due to red rot infection. Due to this disease several important varieties of sugarcane have has whipped out from commercial cultivation (Viswanathan, 2012). Losses due to red rot range from 10-50 per cent depending up on the cultivar, environment and pathogen strain (Ghazanfar and Kamran, 2016). It occurs in many cane growing countries but a threat for subtropical regions, in India. For the disease like red rot of sugarcane, cultivation of resistant varieties seems to be the most satisfactory, economical and long-lasting solution of the problem. Due to the appearance of new pathotypes of red rot pathogen the currently commercially released resistant varieties breaks down and becomes susceptible after some periods of their cultivation. To know the pathogenic reaction of the varieties, the evaluation of varieties for the prevalent pathotypes in a particular location is an important before its commercial release and their cultivation. Therefore, to maintain the flow of resistant varieties against red rot, breeding of resistant varieties an essential routine process for effective management of the disease.

Materials and Methods

A field experiment was conducted of Sugarcane Research Institute, RPCAU, Pusa, to assess the sugarcane varieties for their reaction against red rot disease. Altogether, 30 varieties were evaluated in the three replication and the plot size was of 6-meter row in each replication with recommended agronomical practices. Varieties were inoculated artificially by plug and nodal cotton swab methods of inoculation (Srinivasan and Bhat, 1961 and padmanabhan, 2012). In plug method inoculation was carried out in the middle of 3rd internode from the ground level. A hole was made with the help of inoculter in seven-month age crop. Seven-day old cultures of CF07 and CF08 was injected separately into the hole and sealed with wax coated papers immediately. After 60 days of inoculation, canes were splits opened longitudinally and scored as per the (0-9) scale.

Rating Based on the 0-9 Scale

1. Condition of top: Green (0), Yellow/dry -1

2. Lesion width:

a. One third of cane width affected – 1.
b. Two third of cane width affected -2.
c. Whole width of cane affected – 3.

3. White spots:

a. White spot restricted – 1.
b. White spot progressive – 2.

4. Nodal transgression:

a. One node crossed – 1.
b. Two nodes crossed – 2.
c. Three or more nodes crossed – 3.

In case of nodal cotton swab method of inoculation canes were inoculated by removing top most leaf sheath around the nodes and placed cotton swab dipped in red rot pathogen suspension around the nodes and immediately wrapped with wax coated paper to maintained humidity at nodes. After 60 days of inoculation, the nodes are scrapped with sharp knife. Varieties having spots, reddish lessons appearing or spreading are rated as susceptible and varieties with no any types of spots and lesion development are rated as resistant reaction against red rot disease.

Result

Thirty sugarcane varieties of different maturity groups were evaluated artificially along with check by using CF07 and CF08 isolates of red rot pathogen by adopting plug as well as nodal cotton swab methods of inoculation. The data (Table -1) revealed that, by plug method of inoculation single variety CoSe 01421 and CoP 06436 respectively showed resistant reaction against both the isolates i.e., CF07 and CF08. Whereas, 26 varieties showed moderately resistant reaction against CF07 isolate and 24 varieties showed moderately resistant reaction against CF08 isolate. While, 2 varieties (CoSe 15452 and CoSe 15453) showed moderately susceptible reaction against CF07 isolate and 4 varieties (CoBln 15501, CoSe 15452, CoP 15441 and CoSe 15453) showed moderately susceptible reaction CF08 isolate.

In case of nodal cotton swab method of inoculation, 3 varieties showed susceptible and rest 26 varieties showed resistant against CF07 isolate while, 4 varieties showed susceptible reaction and 25 varieties showed resistant reaction against CF08 isolate.

Conclusion

Due to red rot disease considerable losses were observed both in yield and juice quality of cane. This disease in also responsible for quick decline and removal of commercial varieties from cultivation. The use of resistant varieties is the reliable method of disease control to avoid any epidemics. Development of new varieties is the need of the time to sustain a sugar factory as well as cane growers in Bihar as well as nation. Plug method of inoculation is more authentic than nodal cotton swab method of inoculation and this inoculation method should be adopted during evaluation of sugarcane varieties against red rot disease for durable resistant. The varieties showing resistant to moderately resistant reaction with good agronomical performance may be released for commercial cultivation.

Table 1: Evaluation of sugarcane varieties against red rot disease:

Sl. No.	Entries	Disease reaction					
		Red rot					
		Plug				Cotton swab	
		CF07		CF08		CF07	CF08
		Rating	Reaction	Rating	Reaction	Rating	Reaction
1	CoBln 15501	3.2	MR	4.4	MS	R	R

2	CoLk 15466	2.8	MR	3.4	MR	S	S
3	CoLk 15467	3.0	MR	1.6	MR	R	R
4	CoP 15436	3.2	MR	3.2	MR	R	R
5	CoP 15437	2.6	MR	2.2	MR	R	R
6	CoSe 15451	3.4	MR	3.0	MR	R	R
7	CoSe 15452	5.2	MS	4.4	MS	R	R
8	CoSe 15455	2.4	MR	2.2	MR	R	S
9	CoSe 15456	3.6	MR	2.6	MR	R	R
10	CoLk 94184	3.6	MR	3.2	MR	R	R
11	CoSe 01421	1.2	R	3.6	MR	R	R
12	CoBln 15502	3.6	MR	2.6	MR	R	R
13	CoLk 15468	3.6	MR	2.8	MR	S	S
14	CoLk 15469	2.8	MR	3.2	MR	R	R
15	CoP 15438	3.1	MR	3.2	MR	R	R
16	CoP 15439	3.4	MR	2.8	MR	R	R
17	CoP15440	2.2	MR	3.4	MR	R	R
18	CoP 15441	3.6	MR	5.0	MS	R	R
19	CoSe15453	4.6	MS	4.2	MS	S	R
20	CoSe 15454	3.4	MR	3.4	MR	R	R
21	CoSe 15457	2.6	MR	2.4	MR	R	R
22	BO 91	3.6	MR	3.2	MR	R	R
23	CoP 06436	3.2	MR	1.0	R	R	R
24	CoP 9301	3.4	MR	3.2	MR	R	R
25	CoBln 16501	3.8	MR	2.6	MR	R	R
26	CoBln 16502	2.6	MR	2.2	MR	R	R
27	CoLk 16470	2.2	MR	2.6	MR	R	R
28	CoSe 16451	2.4	MR	2.4	MR	R	S
29	CoSe 16452	2.2	MR	2.4	MR	R	R
30	CoSe 95422 (Check)	5.6	MS	5.4	MS	S	S

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Destructive Phase of Covid Second Wave in Rural India: Villagers are Most Sufferers

Article ID: 11431

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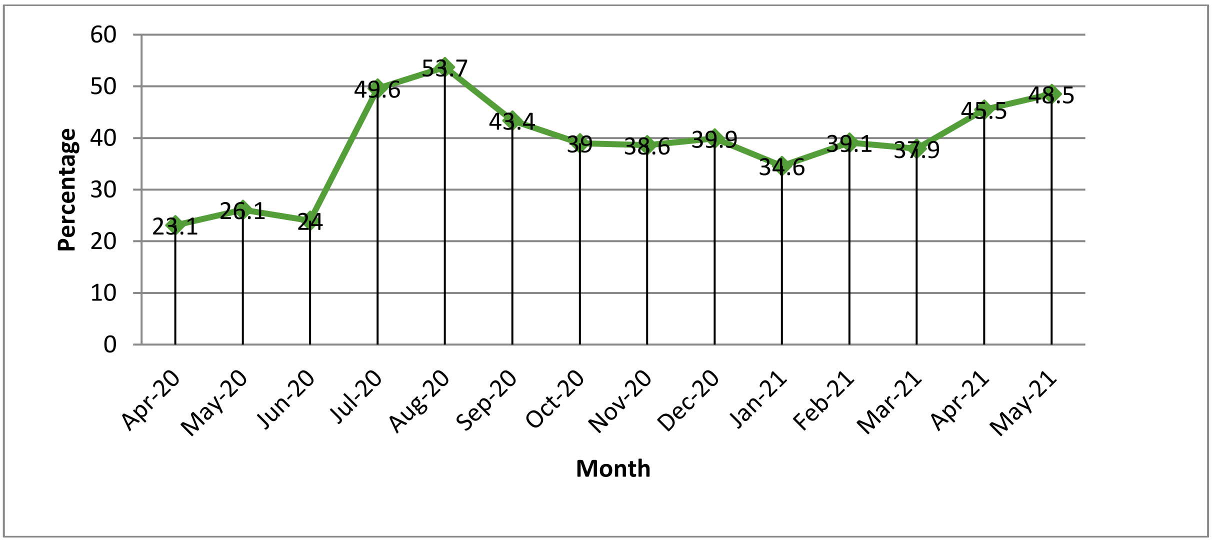
Introduction

Covid first wave which had slowly emerged in 2019 and spread vigorously in the initial year of March 2020. By witnessing the increased cases of viral infection among the people, Government of India announced full lock down in nation at last week of March 2020. Due to this, sudden lock down there is a negative effect on manufacturing sector, industries, IT services, exports, transport services which has drastically brought down the revenue sources for the country and shrink by GDP 4.5 percent on August 2020. The agriculture sector, rural villagers was remained unaffected during first wave of Covid 19. As the Covid cases starts falling from November 2020, there is a slight liberty of people to open restaurants, entertainment halls, educational institutions to continue their work force which again boost up the economy. The country has again seen the sharp rise in Covid cases after three months of first wave which raised in end of March 2021 drastically which affected mainly rural districts thereby badly hurted the rural livelihood income.

Rising Cases of Second Covid Wave in Rural Districts of India

Government has again announced partial lockdown in third week of April due to dangerous viral infection Covid attack. The two months of April, March of 2021 has shaken the whole world with record of highest mortality cases. The people in urban areas have moved towards their villages in order to save their lives from deadly virus. In this process, they have slightly spread the viral infection as they continued their business activities, trading and commercial transaction from village. The graph 1, shows the percentage share of spread of Covid in rural districts. In 2020, the spread of Covid in rural areas ranged from initially recorded 29.1 percent which eventually raised to 48.5 percentage in May 2021. It was estimated that, 15 worst rural districts belong to 5 states which is topped by Maharashtra, Andhra Pradesh, Kerala, Karnataka and Rajasthan. There is a percentage rise of 22.4 percent when compared to estimates April 2020 to April 2021.

Graph 1: Share of Rural Districts in New Covid Cases



Source: SBI Research's estimates 2021

Villagers are Most Sufferers in Lost their Livelihood Income and Lives

The people who reside in urban areas has got vaccinated because of its timely availability and continued to take precautions. Even though Government has arranged vaccination programmed in villages but due to some negative myth or fear, most of the villagers didn't showed willingness to take vaccine immediately which became one of the reasons to get effected to Covid. The number of beds in hospitals, oxygen cylinders has been becoming shortage as the infectious cases has been doubled during the period of second wave compared to first wave. Lack of a greater number of health care centres, hospitals, medical care are one of the top most reason which resulted in high infectious cases in rural areas. Most of the villagers are not timely vaccinated due which urged rise of spread among the villages.

In some states, there is a partial lockdown where all commercial activities have been restricted either up to 10 am or 12 pm for few days and full permission for few emergency services like medical stores, water services. Because of this curfew timings farmers and traders couldn't able to travel to other places where there is a scope of more selling of produce. Generally, most of village farmers or traders likely to sell their agricultural commodities to APMC mandis and urban markets. But due to local restrictions and partial lockdown, the villagers couldn't able to market their produce which ultimately lowered their income earnings and leading them sometimes to sell at forced sales of surplus at lower prices

Ways to Reduce the Spread of Covid in Rural India

1. Implementing of regular mobile van services to test the Covid cases in villages.
2. Vigilance committee should be placed mandatory to monitor the vaccination centres and motivate the villagers to take timely vaccine and create awareness about benefits of being vaccinated.
3. Public or Private sector has to set up of more beds in hospitals with more medical staff to have primary treatment.
4. Create a way for promoting online trading usage by farmers in order to sell their produce which gives price assurance of their produce.
5. Clear guidance for the people to manage them self during initial stages of infection Covid at home isolation.
6. Proper sanitization, wearing of masks should be made compulsory while working in constructions, MGNEREGA work sites and mass gathering.
7. Following rules of limiting the numbers of persons in attending functions or ceremonies to control the virus spread.

Conclusion

Due to less business activity in rural areas, most of the village farmers, petty merchants became sufferers to repay their loans which created rural indebtness. A step towards Infrastructure development, modern trading services by government will eventually reduce the risk in income earning of rural farmers and comfort their lives. Once in a century, a pandemic interferes with human lives. We have to move forward by taking precatory step with developed science and technology. To stop the spread of any pandemic, it is must to follow the precautions at initial stages which will saves many lives.

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Yoga and Gardening

Article ID: 11432

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Introduction

Gardening is not always a gentle hobby; sometimes it's a true athletic event. There is a lot of lifting, crouching, pulling, bending, and other manoeuvres that can get your heart rate up and build muscle, but also leaving you sore and aching. Regular yoga practice can help develop strength and flexibility to make gardening easier. To enjoy the fruits of your labour more, why not practice yoga in the garden?

Yoga and Gardening – How it can Help?

1. There are many documented benefits of yoga, some of which you'll feel right away, while others come with regular practice. Yoga can help strengthen muscles, improve flexibility, lower blood pressure, improve circulation, increase mobility, and relieve stress or depression.

2. For gardeners, one of the most important benefits of yoga is pain relief. Yoga is known to relieve lower back pain, arthritis pain, and all kinds of chronic pain. You can get natural relief from your sore back, stiff neck, and aching knees triggered by those hours spent in the garden. The best way to get benefits of yoga is with regular practice.

3. A couple of sessions per week will give you lasting results. Also, try shorter sessions or a few poses to warm up for gardening, as a break during a long time in the garden, and to unwind and stretch after gardening.

Gardening with Yoga Practice- Poses to Try

Garden yoga should be done in whatever way best benefits you. Try a few different poses, try doing the poses at different times, and come up with a routine and schedule that helps you the most.

Wide-legged forward bend: This is a simple pose that will strengthen your back for bending down in the garden. Practice bending at the hips, feet out wide with knees soft, and back straight, not rounded.

Squat pose: Squat deeply with feet set apart a little more than shoulder width. Keep your back straight and heels firmly on the ground. This will bring relief to your lower back but avoid it if you have bad knees.

Extended side-angle: This pose stretches just about everything. With the right leg bent at the knee, reach the left foot back and keep it straight with the foot firmly on the ground. Stretch the right arm up as you bend your torso over your right leg and reach the left arm down to the right foot.

Revolved abdomen pose: This will stretch out your lower back, abs, and hip flexors. Lie on your back and pull your knees into your chest. Spread your arms out wide to either side, palms up. Twist both legs, knees bent, to one side while keeping your torso as flat against the ground as possible.

Bridge pose: This pose stretches your neck and upper back. Lying on your back with knees and feet flat on the ground, lift your hips up as high as possible. Your arms should be flat on the ground, palms down.

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Herbicide Residue, Reasons for Herbicide Accumulation and Management of Herbicide Residue

Article ID: 11433

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Introduction

Herbicides have become obligatory for increasing the Agricultural production and to maintain the non-cropped area free from weeds. In general, herbicides are formulated in such a way that they degrade from the environment after completion of their intended work, but a few of them persist in the environment and pose a serious hazard to the succeeding crop and also surroundings. Herbicide is said to be persistent if it is present in the soil in its original or closely related but phytotoxic forms even after its mission is accomplished and the quantity that exists is referred to as residue. The herbicide demand in India is rising sharply and could double in the next three years as an acute labour shortage makes them a cheaper option. Usage of herbicides occupy 44% of the total agrochemicals globally and 30% in India. Herbicides vary in their potential to persist in soil. Herbicide families that have persistent members includes the triazines, uracils, phenylureas, sulfonylureas, dinitroanilines, isoxazolidinones, imidazolinonesetc. These herbicide compounds possess far reaching environmental consequences when persistent in the soil.

Reasons for Herbicide Residue Formation in Soil

1. When herbicides are applied in more dose than recommendation.
2. Continuous usage of single herbicide.
3. And the crop failure necessitates replanting results in double dose of herbicide application
4. Decomposition of applied herbicide proceeds very slowly.
5. A susceptible crop follows a short - term crop which received a persistent herbicide.
6. Higher organic matter content leads to adsorption of major quantity of pre- emergence herbicides resulted in reduced volatalization and leaching losses so, more residue in soil.

Longer persistence of herbicides poses a hazard to subsequent land use. Decomposition of herbicides is chief importance in bioactivation of all herbicides added to soil. It can be managed by following methods.

Cultural and Mechanical Management Practices

1. Integrated weed management (IWM) involves the application of a variety of management practices to control weeds.
2. Herbicides are used only when weed populations exceed an economic threshold level that justifies their application.
3. Field scouting is required to monitor weed populations.
4. Nonchemical weed control methods, such as crop rotation, cultivation, competitive hybrids, rotary hoeing and altered planting dates, are emphasized as management practices that can reduce the need for herbicides.
5. Tillage operations help in bringing deep present herbicide residues to soil surface which would aid in decontamination by volatilization.
6. Mechanical incorporation of an herbicide by placing it below the mixing zone (eg., Atrazine) helps to reduce runoff loss, which takes place through the solution or water phase and not much with soil particles.
7. Site specific application using variable rate applicator.

Enhancing the Herbicide Degradation (Bio Stimulation and Bio Augmentation)

The term “biostimulation” is often used to describe the addition of electron acceptors, electron donors, or nutrients to stimulate naturally occurring microbial populations.

The process of bioaugmentation is the introduction of specific microorganisms (indigenous or non-indigenous) aiming to enhance the biodegradation of target compound or serving as donors of the catabolic genes.

Biochar Addition

Application of biochar is also a very good option to temporarily immobilize the herbicide residues in soil and allow the crop to escape from toxicity.

Use of Herbicides in Combination and Split Doses

The usage of herbicides in combinations can reduce the rates of application of highly persistence molecules in soil and in turn reduced their concentration. Similarly, applying herbicide in splits will reduce the amount of herbicide residue.

Use of Optimum and Reduced Dose of Herbicide

The indiscriminate use of herbicides leaves behind residues in food and produce. Hence, the hazards of herbicide residues can be minimized by the application of chemicals at the least possible dosage by which the desired weed control is achieved. Applying herbicides in bands rather as broadcast will reduce the total amount of herbicide to be applied.

Alternative Use of Herbicides

Avoid repeated use of herbicides with similar modes of action to reduce the potential development of herbicide resistance.

Use of Non-Phytotoxic Oil, Adjuvants and Surfactants

Non-phytotoxic oil, adjuvants and surfactants reduce the residual hazard besides enhancing the weed killing potency. Adjuvants modify certain physical characteristics of the spray solution like surface tension and wetting ability, which may modify the spray solution's response to move in the soil.

While using herbicides all prevention and management aspects should kept in mind for huge harvest as well as quality food production without deteriorating environment. Hence, integrating the mechanical and cultural management practices with herbicides for managing weeds is a viable option. The combination of bioaugmentation and bio-stimulation along with nutrient addition might be a promising technology to accelerate the biodegradation. Crop rotation and increasing the organic matter content is definitely a promising technique for managing the herbicide persistence and residue in the soil.

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Use of Drone is Boon for Sugarcane Cultivation

Article ID: 11434

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Abstract

Drones have revolutionized agriculture by offering farmers major cost savings, enhanced efficiency, and more profitability. By quickly surveying vast stretches of farmland, drones can map the property, report on crop health, improve spraying accuracy, and monitor sugarcane cultivation with respect to weedicide, pesticide and irrigation systems.

Introduction

The adoption of modern technologies in agriculture, such as the use of drones or Unmanned Aerial Vehicles (UAVs) can significantly enhance risk and damage assessments and revolutionize the way for management of sugarcane cultivation for waterlogged condition. DRONE (Dynamic Remotely Operated Navigation Equipment) is a device which can fly either with the help of autopilot and GPS coordinates on the pre-set course or can be operated manually with radio signals using the remote control or smartphone app. With the availability of so many sensors, drones can detect the things which are beyond the visible range of human sight. Therefore, real-time, more accurate, reliable, and objective information can be derived from drones in greater detail and fewer errors.

Presently, farmers are facing many problems like unavailability or high cost of labours, health problems by coming in contact with chemicals (fertilizers, pesticides, etc.) while applying them in the field, bite by insects or animals, etc. In this context, drones can also help farmers in avoiding these troubles. Drones are nowadays emerging as a component of precision agriculture along with contributing to sustainable agriculture. Various sensors are used in the drones based upon the purpose. Mostly the sensors sensitive to the following bands of electromagnetic waves are used in agriculture:

1. **Red, Green, and Blue (RGB) bands:** These bands are used for counting the number of plants, for modeling elevation, and visual inspection of the crop field.
2. **Near Infra-Red (NIR) band:** This band is used for water management, erosion analysis, plant counting, soil moisture analysis, and assessment of crop health.
3. **Red Edge band (RE):** It is used for plant counting, water management, and crop health assessment.
4. **Thermal Infra-Red band:** This band has applicability in irrigation scheduling, analyzing plant physiology, and yield forecasting.

Applications

Soil and plant study: Drones can be used to mount sensors which are able to analyze the soil conditions, terrain conditions, moisture content, nutrients content and fertility levels of the soil which can be further used for planning the pattern of sowing of different crops, irrigation scheduling as well as for managing fertilizers application considering spatial variability of the crop growth and field conditions.

Monitoring of sugarcane crop: Drones can be used for monitoring of sugarcane throughout the crop season so that the need-based and timely action can be taken. The quick and appropriate action can prevent yield loss. This technology will eliminate the need to visually inspecting the crops by the farmers. The data acquired by drones during cane monitoring could be used to compute vegetation indices, which can be integrated with weather forecast data and soil fertility data.

Weed management: Drones can be used to identify the weeds present in the field. These weeds could be timely rooted out from the field so that they do not compete for resources with the main crop.

Foliar spraying: Drones can be used to spray chemicals like fertilizers, pesticides, etc. based on the spatial variability of the crops and field. The amount of chemicals to be sprayed can be adjusted depending upon the crop conditions, or the degree of severity of the insect-pest attack. Fertilizer and insecticide can also be applied during waterlogging condition to save the crop cane in adverse condition. In this way, drones pave the pathway to precision agriculture. This ultimately increases the efficiency of the chemicals applied, thereby reducing their adverse impacts on the environment by decreasing the soil and water pollution. Thus, it can lead towards sustainable sugarcane cultivation.

Irrigation scheduling of crops: Drones having sensors for optical, multispectral, and thermal imaging which can pinpoint the heat and water stress in the crops at a specific location. It may be used to apply irrigation to the crops based on their requirement. This will prevent the wastage of water and will ensure the efficient utilization of irrigation water.

Crop health assessment: Using different kinds of sensors pertaining to visible, NIR and thermal infrared rays, different multispectral indices can be computed based on the reflection pattern at different wavelengths. These indices can be used to assess the conditions of crops like water stress, insect-pest attack, diseases, etc. The sensors present over the drones can see the incidence of diseases or deficiency even before the appearance of visible symptoms like yellow leaf disease in sugarcane or smut of sugarcane, drones can be used for detection of percentage of disease incidence. The incidence of newly emerging insects and disease in Bihar like yellow leaf disease in sugarcane or Pokkah Boeng, fall army worms can be regularly monitored. Thus, it serves as a tool for early detection of the diseases and infestations of pests.

Protecting the field from animal damage: The thermal cameras mounted over drones can detect animals or human beings during the night. So, it can be used to protect fields from the damage caused by animals, which are otherwise difficult to detect in the large fields during night time. So, it will work more efficiently than human guards.

Conclusion

Drones are aircraft devices that are capable of flying and carrying materials above the ground. Drones are very popular because mass media networks patronize its functionality and efficiency when capturing videos and images. Thus, drone may be used to suggest appropriate application of fertilizers/ pesticides at right time before large scale incidence of insect pest and diseases and correction of nutrients deficiency symptoms.

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Biology and IPM Practices for Gram Pod Borer, *Helicoverpa armigera* (Hubner) in Pigeonpea

Article ID: 11435

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Abstract

Pigeonpea, *Cajanus cajan* L. is major pulse crop, which is broadly cultivated all over India. It is also recognized by various names like tur, arhar, red gram, grown in Kharif season of tropics and sub-tropics. The gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is widely distributed on many host plants throughout the tropics and sub tropics. Eggs are laid singly or in clusters on all parts of plant i.e., on leaves, flower buds, flowers and developing fruits and sometimes on stems and growing points but have preference for young shoots and florets. The larvae of gram pod borer feed on buds, flowers and pods. On pods, holes are made by the entry of larvae. Generally, developing and partly matured seeds are eaten by larvae. The half part of larvae remains within pod while feeding on the developing seeds.

Introduction

Pigeonpea is an important pulse crop after gram, which is widely cultivated throughout India. Pigeonpea is a multipurpose crop. It is a major source of protein and complements the protein deficient cereals diets in rural areas of India. It produces a significant amount of bio-mass. The dry shoots are invariably used as a fuel, fencing and thatching.

Being a leguminous crop, symbiotic bacteria in root nodules fix atmospheric nitrogen as a result soil fertility is improved. The gram pod borer, *Helicoverpa armigera* (Hubner) is the most damaging pest of pigeonpea and sometimes cause more than 80 % of crop yield loss. Young larvae feed on the developing buds, flowers whereas matured larvae bore into the pods and feed the grains (Khajuria et al., 2014; Khajuria et al., 2015; Khajuria et al., 2017; Khajuria and Kumar 2017).

Biology of Gram Pod Borer

The gram pod borer lifecycle stages are egg, larva, pupa and adult.

Adult: The adult moths have yellowish to orange fore-wings in females and greenish grey in males, with a lightly darker transverse band in the distal third. The kidney shaped mark is little distinct and smoky. Hind wings are pale grey with a darker broad marginal band having small brown marking at base. Adult moths feed on nectar. Moths have a wingspan of 35-40 mm. They live for about 10 days during which time females lay 1000 eggs. Eggs are laid singly or in clusters on all parts of plant i.e. on leaves, flower buds, flowers and developing fruits, and sometimes on stems and growing points but have preference for young shoots and florets.

Eggs: Fertile eggs hatch in 3-5 days in normal conditions. As they develop, eggs change from white to brown to a black head stage before producing a hatchling. Not all eggs are fertile. On hatching, the larvae feed for a short time on the tender leaflets by scrapping green tissue and then shift to flower buds and tender shoots.

Larvae: Larval periods last for 17-23 days in normal conditions. The colour of the larvae varies from yellow to green, pink, orange, brown or black but all have characteristic light and dark stripes along each side. Slowly larvae enters and feeds on the seeds inside the pods. The half part of larvae remains within pod while feeding on the seeds. Larvae can cut hole on one to another locule and feed 30-40 pods in its life time.

Pupae: Mature larvae crawl to the base of the plant, tunnel up to 10 cm into the soil and form a chamber in which they pupate. Pupae will usually develop to produce a adult moth in 10-16 days. The adult moth emerges, feeds, mates and is then ready to begin the cycle of egg laying and larval development. Pupal periods last for 9-11 days.

Total Life Span

The total life span of gram pod borer varies from 37.0 to 49.0 days.

Nature of Damage

The pest is active throughout the year but damage to pigeonpea is cause from November to March. The damage is caused by the larvae which feed on the leaves and destroy the seedlings in the early stages. It has been estimated that a single larvae/caterpillar destroys 30-40 pods of gram in its life time. Fungi and bacteria may develop due to the damaging of the plant. Frass may arise along the feeding hole from larval feeding within. Flower buds and flowers bored by small larvae may drop, mature larvae bore into locules of pods and consume developing seed. Short duration varieties are subject to greater damage.

IPM Practices

1. Seed treatment with carbosulfan + *Trichoderma* spp. and vitavax @ 3 ml + 10 g and 2 g/kg of seed, respectively.
2. Installation of pheromone traps @ 10 per hectare.
3. Installation of bird perches @ 50 per hectare.
4. Mechanical collection of grown-up larvae.
5. Spraying of HaNPV @ 500 LE/ha or *Bacillus thuringiensis* (Bt) @ 1000-1500 g/ha.
6. Spraying of NSKE @ 5 per cent.
7. Need based spraying of following relative eco-friendly insecticide, I, II, III spray should invariably coincide with 25 per cent flowering, early podding, milk dough stage.
8. Indoxacarb 14.5 SC @ 75 g a.i./ha
9. Spinosad 45 SC @ 73 g a.i./ha
10. Acetamiprid 20 SP @ 20 g a.i./ha
11. Emamectin benzoate 5 SG @ 11 g a.i./ha

Conclusion

Helicoverpa armigera is a key pest of both field and horticultural crops. Pigeonpea sustainability can be achieved by integrated management of gram pod borer that comprises a proper integration of practices such as resistant cultivars, seed treatment, adopting good agronomic practices, installation of pheromone traps & bird perches and biological control. Any single method of approach to pest management may not be feasible. Hence, the best alternative is the Integrated Pest Management (IPM) approach, which is based on the principles of managing the pest rather than aiming at its complete eradication. Integrated management of *Helicoverpa armigera* should be practiced by combining above mentioned practices as per the availability of resources and economics of farmers.

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Strategies for Improving the Productivity of Rabi Pulses

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Introduction

Pulses are an integral part of Indian agricultural economy next to cereals and oilseeds in terms of acreage, production and economic value. Pulses are rich source of protein and energy, but in India, these are largely cultivated under energy starved conditions resulting in poor pulse productivity. This is mainly because of unavailability of quality seed at desired time, cultivation on marginal and sub-marginal lands, imbalanced use of fertilizers and non-adoption of improved crop management practices. India is the largest producer and consumer of pulses in the world, accounting for about 25 per cent of global production, 27 per cent of consumption and 34 per cent of food use (Pooniya et al., 2015). To reduce the demand supply gap, government of India launched various programmes in pulses. Still, prime attention is required to meet the food security challenges, especially in case of pulse sector. In order to enhance and sustain the pulse productivity at high levels, the development and promotion of low–cost pulse production technology need greater attention so that technology is widely adopted by the farmers for improving input resource use efficiency in agriculture.

Among overall pulses rabi pulses occupy around 51.20 per cent of area and 58.53 per cent of production, thus a special attention towards rabi pulses is imperative in fulfilling the desired targets of overall pulses production scenario of the country.

Ways to Improve Productivity

1. Selecting the best fit crop in the existing cropping system.
2. For rabi pulses right time of sowing is the most important factor that decides overall yield. Generally sowing window for rabi crops is very narrow and should be taken at most care.
3. Choosing suitable variety that adopts to local conditions.
4. Providing lifesaving irrigation at places where water is a scarce resource.
5. Using water conserving techniques to increase the duration of water availability.
6. Balanced fertilization, i.e., applying nutrition as per soil test values and correcting any deficiencies observed on plant during growth and development.
7. Managing pests and diseases in right time.

Research Findings Showing Yield Improvement of Rabi Pulses

Roy et al., 2009, observed that among the different varieties of lentil, Moitree (WBL 77) yielded the highest (1332.71 kg ha-1), exhibiting yield advantages to the tune of about 49-70 per cent over the others. Irrespective of the varieties, sowing on November 01 and 10 were found to be advantageous and any advancement or delay in sowing caused yield reduction.

Abdullah et al., 2016, studied the effect of supplemental irrigation on growth and yield of lentil and observed in both study years that, highest biomass, harvest index and grain yield values were obtained from fully irrigated treatments (I100), while non-supplementary irrigated treatments have provided lowest values. It should be clearly noticed that growth parameters including yield were lower under over-irrigation treatment (I125). Hence, it is recommended that farmers need to optimize the supplemental irrigation technique to obtain desired yields.

Pradeep et al., 2017, studied the effect of irrigation levels and hydrogel application on different varieties of chickpea and concluded that, irrigation scheduled at 0.6 IW/CPE + 2.5 kg ha 1 hydrogel recorded significantly higher grain yield (1920 kg ha–1) as compared to irrigation scheduled at 0.4 IW/CPE (1648 kg ha–1). Among the varieties A-1 recorded significantly higher grain (1894 kg ha–1) which was on par with ICCV-2 (1938 kg ha–1), JG-11 (1865) and JAKI-9218 (1766 kg ha–1). Interaction effect of irrigation levels and varieties was significant. A-1 variety with 0.6 IW/CPE + 2.5 kg ha–1 hydrogel recorded significantly higher grain yield (2152 kg ha–1) as compared to other treatment combinations.

Tripath et al., 2019, studied the effect of different levels of phosphorus, sulphur and micro nutrients and came to conclusion that application of higher level of fertilizer (60 kg P_2O_5 + 20 kg S ha-1) improved yield attributes, yield performance of chickpea along with soil properties irrespective of the micronutrients applied. Maximum seed yield (22.22 q ha-1) was recorded with the application of fertilizer M3 (3 kg Zn ha-1 + spraying of boron) (0.3%). At every level of fertilizers, micronutrients augmented the yield attributes and yield of the crop along with soil properties. Combined application of micronutrients proved superior to their sole applications with respect to yield and nutrient uptake in chickpea.

Conclusion

1. Among different varieties of lentil WBL 77 out yielded all other varieties with 49-70 per cent yield advantage over others.
2. Nov' 01- Nov'10 (first fortnight) was found to be optimum time for sowing of lentil to produce higher vegetative and grain yield.
3. Application of irrigation at 0.6 IW/CPE along with 2.5 kg ha 1 hydrogel provided highest yields of chickpea compared to others.
4. Optimum irrigation provided optimum yield of lentil, any deviation on either side reduced yields significantly.
5. Application of micronutrients like 3 kg Zn ha-1 + spraying of boron (0.3%) improved overall yield of chickpea along with normal primary nutrients.

Points to Focus for Further Improvement

1. Varieties with wider window of sowing need to developed.
2. Location specific studies to validate different agronomic operations need attention.
3. More studies need to be done with regarding mechanization in pulses.

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Hydrogel and its Significance in Agriculture

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A starch-based hydrogel is biodegradable and inexpensive, and can be adjust to its ability to hold water. Cross-linked acrylic acid polymer hydrogels are most commercially available; they are generally insoluble but slowly break down releasing acrylamide.

Potassium polyacrylate or sodium polyacrylate are common ingredients in hydrogel for agriculture purpose. It can absorb a lot of water and transform it into a gel to store it because it's a superabsorbent material. This technique improves the water-holding qualities of certain soils, such as clays and sandy loams, by using insoluble gel-forming polymers. This can increase the amount of water held and used (up to 85 percent in some cases) improve soil permeability, reduce the need for irrigation, reduce compaction, soil erosion, and leaching, and improve plant growth.

Hydrogels are commonly called are cross-linked three-dimensional polymers that absorb water. Three main types of Hydrogels found appropriate for agricultural use are as follows:
1. Cross-linked polyacrylates.
2. Starch-graft copolymers.
3. Cross-linked Polyacrylamides & Acrylamide-acrylate copolymers.

Agriculture of Hydrogel in Agriculture

1. Conservation in Agricultural Lands.
2. Drought Stress Reduction.
3. Enhanced Fertilizer Efficiency.
4. Enhanced growth of plants.
5. Coating protecting agents (herbicides and pesticides) for slow release.
6. Polymers for soil remediation.
7. Seed additives to support seed germination or seed coatings.

Application Rates of Hydrogel

Purpose	Rate of hydrogel
Arid & Semi-arid Regions	4-6g/kg soil
For all level of water stress treatment and improved irrigation period	2.25-3g/kg soil
To delay permanent wilting point in sandy soils	0.2-0.4g/kg OR 0.8% of soil whichever is more
To reduce irrigation water by 50% in loamy soil	2-4g/ plant pit
To improve relative water content and leaf water use efficiency	0.5-2.0g/pot
To reduce drought stress	0.2-0.4% of soil
To prohibit drought stress totally	225-300kg/ha of cultivated area
To decrease water stress	3% by weight

Conclusion

The application of hydrogel especially in arid and semi–arid regions improve soil physical properties, increases the water holding capacity of the soil, improving irrigation efficiency, increasing the growth of some crops, and enhancement water productivity of the crops. According to physical and chemical structures of hydrogels, it can be used for an absorbent in environment preservation in the agricultural sector as soil conditioners, water retention and nutrient carriers for plant roots.

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Sugarcane Farming – A Brief

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Agriculture is most pioneer sector of any economy. An optimum fraction (nearly 60%) of population still rely on agriculture directly or indirectly all over the world. "Statistical yearbook"; Food and Agricultural Organization, 2013. Sugarcane cultivation and development of sugar industry runs parallel to the growth of human civilization and is as old as agriculture.

The importance and use of sugarcane and sugar in the country's socio-economic milieu is deep rooted and immense. In the current day rural economy set up on sugarcane cultivation and sugar industry has been focal point for socioeconomic development in rural areas by mobilizing rural resources, generating employment and higher income, transport and communication facilities.

Sugarcane is a perennial grass that thrives well in tropical and frost free warm temperate areas. It requires high temperature, plenty of sunlight, large quantities of water (at least 1500 mm of rain per year unless grown with irrigation), fertile soil, and good drainage.

The crop cycle varies between 10 and 24 months, but can be extended four times or more by additional ratoon cropping. Cane is harvested after 12 to 18 months for most plant crops, after 12 months for ratoon crops.

In modern, fully mechanized cultivation areas, as is the case in the US and Australia, the growing period may be shorter, with plant cane harvested 9 months after spring emergence, and 7-8 months for ratoon crops. Harvesting is generally done in the dry period and when stalks contain the maximum amount of sucrose.

Sugarcane provides the cheapest form of energy food with the lowest unit of land area per unit of energy produced. The crop was originally used for chewing, but now almost exclusively grown for the production of sugar as a food sweetener or for the production of ethanol for motor fuel. Most of the manufacturing process for extracting the sucrose from the cane is done at or nearby the plantation.

Only the final refining of the sugar takes place in the importing countries. Sugarcane is an important cash crop grown in India. About 7 million sugarcane farmers and large number of agricultural laborer's are involved in sugar cane cultivation and ancillary activities. Apart from this, the sugar industry provides employment to 5 lakh skilled and semi-skilled workers in rural areas.

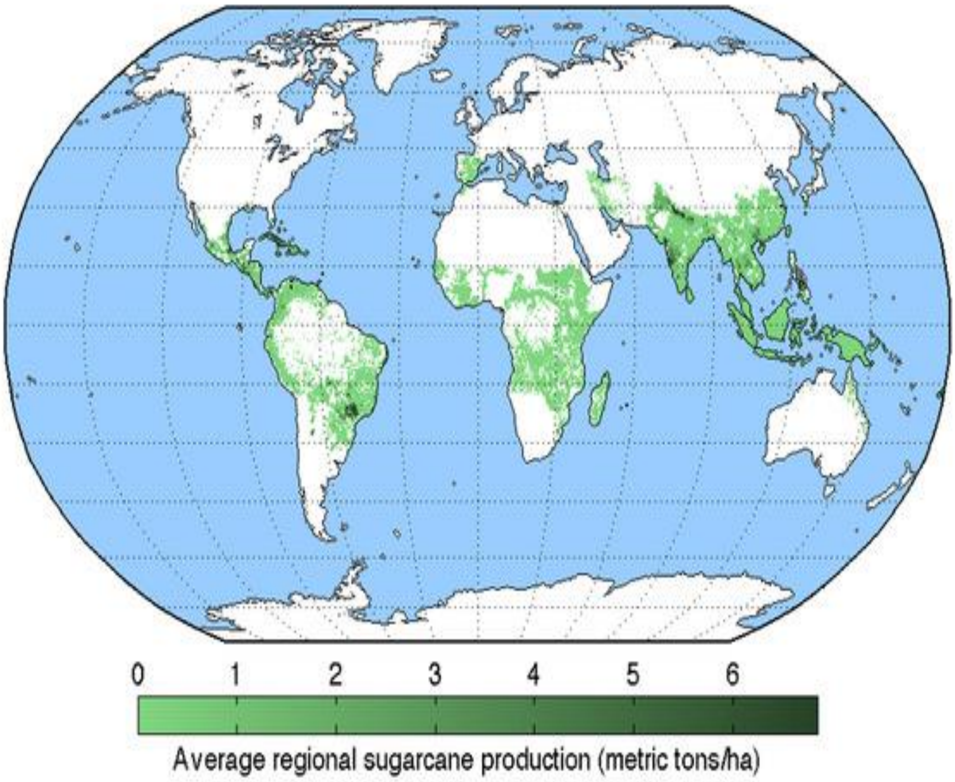
In India; agricultural geographical area has a fraction of nearly 2:5 or we can say nearly 40-50 percent. In Indian economy agriculture shares nearly 17.9 percent in GDP. India is second largest producer of agricultural products.

India accounts for 7.68 percent of total global agricultural output. According to CIA Factbook (2014); total production of agriculture sector is $366.92 billion, (Statistical times). Sugarcane is rich source of sucrose. Sucrose is major product extracted and used as raw material in the food industry. Also, it is fermented to produce ethanol.

Sugarcane accounts for 80 percent of sugar produced; most of the rest is made from sugar beets. Other than sugar, products derived from sugarcane include falernum, molasses, rum, cachaca, and bagasse. Sugarcane mature stalk is typically composed of 11-16 percent fiber, 12-16 percent soluble sugars, 2-3 percent non-sugars, and 63-73 percent water. Also, it contains considerable amount of minerals in it. The average yield of cane stalk is 60-70 tonnes per hectare per year.

Distribution of Sugarcane Production in World

Brazil is the biggest grower of sugarcane, and produces sugar and ethanol for gasoline-ethanol blends (gasohol) as transportation fuel. In India, sugarcane is sold as jaggery, and also refined into sugar, primarily for consumption in tea and sweets, and for the production of alcoholic beverages.



Top Ten Sugarcane Producer Countries

S.No.	Country	Production (Tonnes)	Remarks
1	Brazil	514,079,729	
2	India	355,520,000	
3	China	106,316,000	
4	Thailand	64,365,682	
5	Pakistan	54,752,000	P
6	Mexico	50,680,000	
7	Colombia	40,000,000	F
8	Australia	36,000,000	
9	United States	27,750,600	
10	Philippines	25,300,000	F
11	**World**	**1,557,664,978**	**A**

P=Official figure, F=FAO estimate,
*=Unofficial/Semi-official/mirror data,
C = Calculated figure, A = Aggregate (may include official, semi-official or estimates).

(Source: Food and Agricultural Organization of United Nations: Economic and Social Department: The Statistical Division - 2008).

Sugarcane is the world's largest crop by production quantity, with 1.7 billion tons produced annually across 24 million ha worldwide, (The Food and Agriculture Organization, 2012). Sugarcane was cultivated on about 26 lakh ha (64 million acres), in more than 90 countries. Brazil is the world's largest sugarcane producer which alone accounts for 41 percent of the world total with a yield of 79.1 t/ha.

India is the second largest sugarcane producers in the world, producing around 340-350 million tons of sugarcane per annum on 4.2 million ha area with a approx. yield of 66.1 t/ha. (Directorate of economics and statistics, DAC&FW, 2015-16). Production of sugar is the second largest agro-processing industry in the country after cotton and textiles. India is the only country that produce plantation while sugar unlike other countries that produce raw or refined sugar or both. In India, sugarcane is the key raw material for production of Sugar and Gur. India is one of largest sugarcane producers in the world, producing around

350 million tons of cane per annum. Production of the sugar is the second largest agro-processing industry in the country after cotton and textiles. In India, sugarcane the key raw material for production of Sugar and Gur, planted once a year during January to March. It is the major cost driver for the production of sugar. It being an agricultural crop is subject to the unpredictable vagaries of nature, yielding either a bumper crop or a massive shortfall in its cultivation from year to year.

The sugarcane growing may be broadly classified into two agro-climatic regions – subtropical and tropical. The subtropical zone includes four States: 1) Uttar Pradesh (UP) 2) Bihar 3) Punjab 4) Haryana. The tropical zones include five States.

These are: 1) Maharashtra 2) Andhra Pradesh 3) Tamil Nadu 4) Gujarat 5) Karnataka.

Uttar Pradesh is the largest producer state of sugarcane. (Economic and statistical data; distt.) From several regions of U.P., Basti is one of the major producers of sugarcane which alone produced 660.72 lac ton in 2017-18 from an area of 45496 ha with an average yield of 627.20 Q/ha (Cane development & sugar industry department, 2017)

In spite of sufficient resources, technologies etc., a continuous and severe fall in production and land acquiring sugarcane cultivation can be seen in past years. Also, malfunctioning and destruction of sugar mills put a negative psychological change in farmers perception which can be observed over sugarcane farming. Transfer and passage of land acreage of sugarcane over other crops can be visualized as the constraints.

Thus, taking up a study on knowledge level and the constraints associated with its production in one of the leading sugarcanes growing belt. It seems a genuine demand of time to study the economic aspects of sugarcane cultivation.

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Impact of Urban Landscape Gardening on Health and Well-being

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Introduction

Landscaping basically involves an activity of designing or improving an area or landscape to create a more desirable space in an aesthetic way. When this is achieved by planting of ornamental trees and shrubs, annual and perennial flowers, establishing lawns, and placement of certain garden adornments to create a natural scene and develop a picturesque effect, it is termed as Landscape gardening. According to Bailey, Landscape gardening is the application of garden forms, methods and materials to the improvements of the landscape and the landscape in this connection is any area large or small on which it is desirable to develop a view or design. Landscape gardening is considered an aesthetic branch of Horticulture, which aims at imitation of nature to improve the total living environment of the people.

Fig: Community Area © Design Concepts, Colorado Landscape Architecture Firm

Urban landscaping is not exactly a new concept, it was first proposed in 19th century by Frederick Law Olmsted, the Father of Landscape Architecture, in relation to the US cities. However, with the rise of urbanization witnessed around the world, the United Nations Population Division reported that in the year 2019, more than half of the world's population (55.71%) lives in the urban area which is approximately 4.29 billion people (World Urbanization Prospects, 2018). Hence, the subject of urban landscaping gained a new interest and significance with the new emerging attitudes, particularly with respect to limited space and the impact on human health and environment.

Approaches to Urban Landscape Gardening

There have been few approaches to landscape gardening based on the function it serves and the purpose of the individual or group of individuals in establishing a proper landscape garden. These approaches have been applied over the years and several researchers and theorists have observed certain findings to support the concept and ideas of maintaining a landscape garden.

1. Aesthetics: The aesthetic approach of landscape gardening is the basis of gardening that dates back to centuries ago. Ancient royals in different parts of the world had taken the pleasure of gardening to serve the visual purpose and since then have never left the scene of landscaping. This approach focuses on creating a new landscape based on artistic principles and methods. It was promoted by several theorists. Since then, the relativity of urban landscape aesthetic and the daily life of people, their perception and preferences have been under study by certain researchers and scholars.

2. Identity: Historical gardens and spaces have proven as an important cultural and historical identity in modern landscapes. Gardens developed ages ago as a result of vast experimentation with contributions of styles and ideas of the time, can be considered a valuable asset of the present day. The urban landscape indicates the lifestyle of the residents, their interactions and activities, their values and beliefs, as well as the affiliations of the city to the geographical location, time, climate, economy, society and politics (Aminzadeh et al., 2016). They often bring out the distinctiveness of a specific place or a country. The identity approach of landscape gardening thus could even serve as a vital source of information.

3. Function: The purpose of landscape gardens in carrying out certain functions of human activities was mentioned by Gehl (1987), citing compulsory and optional activities carried out in created spaces of urban areas. The main idea is that urban spaces in addition to being meaningful can satisfy the needs of comfort, relaxation, engagement with the environment. The responds of human needs whether mental or behavioral is the main duty of the urban landscape in the concept of function. These, in the present urban cities, have proven success in terms of recreational parks and gardens.

4. Ecology: The importance of landscape gardens' approach to ecology cannot be emphasized enough as human existence basically depends on their interaction with the environment. The gardens established from ecological point of view are planned with local climate, soil, topography and environmental conditions in mind. They form complex ecosystems of living organisms that improves the quality of environment. In the urban perspective, ecological approach has emerged as a multidisciplinary field with many of the tools needed for advancing cities' sustainability and resilience (Mc Phearson et al., 2016).

Impact of Urban Landscape Gardening

Fig: Fort Tryon Park in Manhattan, New York. © Diane Cook and Len Jenshel

1. Physical health and bodily functioning: The impact of landscaping on human health was reported as early as 1980s when Roger Ulrich (1984) conducted a comparative study on the recovery of 46 patients of gall bladder surgery at a hospital in Pennsylvania whose rooms faced a blank brick wall with patients who could see trees. Patients with tree views had shorter hospital stay, took fewer strong and moderate pain killers, and received fewer negative evaluative comments in nurse's notes. The results hinted at a significant influence of viewing nature upon human health. Several studied on health impacts had thus been conducted since then, among which few are described below:

a. Green cover and urban forests helps reduce the risk of heat-related illnesses for city dwellers.
b. Lack of park access has been linked to mortality.
c. More urban landscape is associated with lower adult mortality and fewer premature babies.
d. There exists a correlation between the occurrence of respiratory diseases and vegetation and species diversity.
e. Vegetation diversity lowers the risk of being asthmatic in children.

2. Mental functions and perception: Vegetation rich landscapes not only have impact on physical health but on the mental and psychological functioning as well. Ulrich (1979) tested participants' feelings before and after viewing images of urban scenes. The results indicated that individuals who viewed scenes of cities with trees and other vegetation showed significantly reduced feelings of fear and increased positive feelings and delight, compared with individuals shown scenes of treeless city scenes. Several findings as below were also reported by other researchers to support this theory.

a. Wild nature and cultivated nature is associated with a relaxed mood state while water is associated with relaxed and happy moods.
b. Park visits can rejuvenate residents, enhance contemplation, and provide a sense of peace and tranquility.
c. Quantity of green space in the neighbourhood and access to garden or allotment, are significantly predicting of stress in deprived communities.
d. Urban gardening is associated with greater EWB (Emotional Well-Being) outcomes due to the participants' association with accomplishment, identity, and social connectivity.

3. Social and daily functioning: Personal engagement in landscaping in the urban areas has proved to be an initiator of social participation and also become an instigator for active daily life. Garden areas in cites allows establishment of social ties and build a greater feeling of community. These had in turn resulted in reduced crimes and allow residents to feel safe in their neighborhoods. Few more findings have also concluded the same.

a. Providing green space is a method to increase informal contact and presence of trees and grass in identical public housing is associated with the formation of strong social ties among neighbors.
b. Classrooms with views of trees and shrubs improve student performance and behavior in terms of test scores, graduation rates, continuing on to college and less criminal behavior.
c. Buildings with high levels of vegetation had fewer property and violent crimes than buildings with low levels of vegetation.
d. More natural the view from the girl's home was, her self-discipline was observed to be improved.
e. Urban gardening as a result of personal motivations includes experience of nature being part of a community, and spending (free) time meaningfully.

Conclusion

Apart from certain environmental benefits, literature over the years has proved that maintaining a landscape garden in the urban areas have a direct impact on the physical and mental health of a person. In the modern world of industrialization and urbanization, amidst the busy life of people, keeping aside few hours for landscaping and gardening will not only serve its aesthetic purpose but also improve the overall well-being of a person.

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Biofortified Vegetables: A Novel Option for Mitigating Hidden Hunger

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Introduction

Indian agriculture is bestowed upon with various cropping seasons, agro-climatic zones and a mega-biodiversity where all crops can survive. The biggest challenges are inadequate food, hunger and malnourishment due to the ever-increasing world population. Hidden hunger is a lack of vitamins and minerals. Hidden hunger occurs when the quality of food people eat does not meet their nutrient requirements, so the food is deficient in micronutrients such as the vitamins and minerals that they need for their growth and development. Deficiency of vitamins and minerals results in poor growth and compromised psychomotor development of children, reduced immunity, fatigue, irritability, weakness, hair loss, wasting of muscles, sterility and death. Major micronutrient deficiencies include zinc, iron, iodine, folic acid, vitamin D, and Vitamin E. Nutritional supplements are one solution, but these are expensive. By enrichment of staple food with required micronutrients is one way to fight this hidden hunger. Several agricultural strategies like fertilization with micronutrients, breeding for higher micronutrient status of crop variety, making transgenic and biofortification can noticeably contribute to the elevation of hidden hunger.

Biofortification is derived from the Greek words where ‘bios’ means "life" and ‘fortificare’ means "to make strong". Biofortification is the process of adding nutritional value to the crop. In other words, biofortification refers to increasing genetically the bio-available mineral content of food crops. It consists of breeding new varieties of staple foods that have higher mineral and vitamin content. It can be described as a complementary, rural-targeted micronutrient program strategy for better reaching remote regions, which often comprise the majority of the malnourished vulnerable populations. Developing bio-fortified crops also improves their efficiency of growth in soils with depleted or unavailable mineral composition.

Importance and Goal of Biofortification

It is especially important for a poor rural community with limited access to diversified diet, commercially marketed fortified foods, or supplements and also important for woman and children since they face a greater risk of micronutrient malnutrition and the goal of biofortification is to help reduce the high prevalence of iron, zinc and vitamin A deficiencies by improving the micronutrient density of the staple food crops that are produced and consumed by low-income populations. Unlike traditional food fortification, biofortification does not require food to be processed centrally, as the micronutrients are already present in growing crops, making it more accessible to those who consume food that is grown locally, perhaps by themselves. Biofortification is a long-term strategy aimed at increasing the micronutrient intake of large numbers of people throughout their lives, contributing to an overall reduction in micronutrient deficiencies in a population. However, it is not expected to treat severe micronutrient deficiencies or eliminate them in all population groups. Even so, the introduction of biofortified crops will provide a sustainable and low-cost way of reaching people with poor access to formal markets or healthcare systems.

Necessity and Socio-Economical Aspect

Human beings require an adequate amount of nutrients to live productive and healthy life. These nutrients play a critical role in the development of physical and mental health. Agricultural and horticultural products are a primary source of micronutrients but are mostly deficient in essential elements, leading to disabilities, sickness, increased morbidity, impaired development, diminished livelihood, and reduced national and socio-economic development. A large number of people around the world are chronically undernourished, and deprived of commercially marketed fortified foods, mainly women and children, despite the advancements. This is an elite technique to overcome hidden hunger by the addition of desired minerals to improve the quality of crops. Nutritional targets for biofortification includes elevated mineral content, improved vitamin content, increased essential amino acid levels, better fatty acid compositions, and heightened antioxidant level in crops.

Biofortified crops provide a low-cost way of reaching people having poor access to formal and health-care systems. Bouis et al., (2011) summarised that the biofortified staple food might be unable to furnish as high a level of minerals and vitamins per day as the supplemental or industrially fortified food products, but assist in enhancing the daily adequacy of micronutrients intake among the individuals throughout their life cycles.

Objectives of Biofortification

1. To develop vegetable crops containing highly available micronutrients such as iron, zinc and vitamin A for preventing global deficiency of these nutrients.
2. To screen for biofortification of vegetable crops from existing germplasm.
3. To study the efficacy of mineral nutrients.

Table 1. Source of nutrients from vegetables:

Nutrients	Vegetables
Carbohydrate	Sweet potato, potato, cassava
Protein	Pea, lima bean, french bean, cowpea
Vitamin A	Carrot, spinach, pumpkin
Vitamin B1	Tomato, chilli, garlic, leek, pea
Vitamin C	Chilli, sweet pepper, cabbage, drumstick
Calcium	Hyacinth bean, amaranthus, palak
Iron	Amaranthus, palak, spinach, lettuce, bitter gourd
Phosphorous	Pea, lima bean, taro, drumstick leaves
Vitamin B5	Palak, amaranthus, bitter gourd, pointed gourd
Iodine	Tomato, sweet pepper, carrot, garlic, okra
sodium	Celery, green onion, Chinese cabbage, radish

Table 2. Targeted vegetable crops for biofortification:

Crop	Target nutrients
Cassava	β-Carotene
Sweet potato	β-Carotene
Beans	Iron
Potato	Iron

Strategies of Biofortification of Vegetables

In general, three complementary strategies can be employed to increase mineral concentrations in edible crops:

1. Agronomical biofortification.
2. Conventional breeding.
3. Genetic engineering.

Agronomical Biofortification

One of the most important strategy is agronomical biofortification, employs the use of fertilizers containing the mineral elements lacking in human diets. Agronomic biofortification is the application of micronutrient-containing mineral fertilizer to the soil and/or plant leaves (foliar), to increase micronutrient contents of the edible part of food crops. A common limitation for agronomical biofortification is the generally low Phyto availability of mineral micronutrients in the soil. Appropriate crop rotations, intercropping, or the introduction of beneficial soil microorganisms to increase the phyto availability of mineral elements could also be important tools of agronomical biofortification. The agronomical biofortification by soil fertilizers is relatively simple with fast results but the success of it depends on several factors such as physical and chemical characterization of soil, mineral mobility and soil microbial activities.

Conventional Plant Breeding

Traditional breeding mainly focused on yield attributes breeding from last four decades and lack of priority on nutritional aspects leads to decreased amount of nutrient status in the existed varieties. Recent progress in conventional plant breeding has emphasized the fortification of important vitamins, antioxidants and micronutrients. The potential to increase the micronutrient density of staple foods by conventional breeding requires adequate genetic variation in concentrations of β-carotene, other functional carotenoids, iron, zinc, and other minerals exists among cultivars, making a selection of nutritionally appropriate breeding materials possible. Different breeding methods were used in biofortification. Selection is the most primitive method which exploits the natural variability present in the population. Other methods include hybridization, pedigree, bulk method and Single seed descent method. When there is no much variability in the population, variability is created by using special methods like polyploidy and mutation breeding to develop biofortified crops.

Genetic Engineering

Lack of sufficient variation among the genotypes for the desired character/trait within the species or when the crop itself is not suitable for conventional plant breeding then genetic engineering offers a valid alternative for increasing the concentration and bioavailability of micronutrients in the edible crop tissues. Transgenic is the process of introducing one/more genes into an organism from another organism. It enables to incorporate the desired transgene into an elite cultivar.

Table 3. Biofortified vegetable varieties:

Crop	Variety	Character	Institute	Year
Carrot	Pusa Rudhira 	• Higher level of Carotenoid (7.14 mg) & Phenol (45.15mg)/ 100g • Possess antioxidant property • Self core red colored variety with delayed bolting.	IARI, New Delhi	2008
	Pusa Asita 	• Self core black-colored roots • Late bolter. • Rich source of anthocyanin.	IARI, New Delhi	2008
Raddish	Pusa Jamuni 	• First purple-fleshed nutritionally rich variety • High in anthocyanin & ascorbic acid content.	IARI, New Delhi	2012
	Pusa Gulabi 	• First Pink fleshed variety • High in total carotenoids, anthocyanin and ascorbic acid content. • Grows exceptionally well in heat of summer.	IARI, New Delhi	2013
Cauliflower	Pusa Beta Kesari 1 	• Countries first biofortified cauliflower. • Contains high β-carotene (8.0-10.0 ppm)	ICAR, New Delhi	2015
Sweet potato	Bhu Sona	• High β-carotene(14.0mg/100g) • Tuber yield: 19.8 t/ha • Dry matter: 27.0-29.0%	ICAR-CTCRI, Thiruvananthapuram, Kerala	2017

		• Starch: 20.0% • Total sugar: 2.0-2.4%		
	Bhu Krishna 	• High anthocyanin(90mg/100g) • Tuber yield: 18.0 t/ha • Dry matter: 24.0-25.5% • Starch: 19.5% • Total sugar: 1.9-2.2% • Salinity stress tolerant	ICAR-CTCRI, Thiruvananthapuram, Kerala	2017
Cassava	Sree Kanaka 	• Early maturing (75-85 days) • Cylindrical tubers with dark orange flesh colour • High carotene (9-10 mg/100g)	CTCRI, Thiruvanantpuram, Kerala	

Conclusion

The major area of research for developing countries after food security is nutritional security. Because the major population of the developing world is suffering from "hidden hunger" and combating this problem, the agricultural scientist is capable of changing the physiology of crops by biofortification of vegetables and cereals. There is much scope for plant breeders, molecular scientists, and genetic engineers to improve the micronutrient density and vitamin content of staple food crops and vegetables for developing countries. Moreover, after the development of variety, which is rich in micronutrients and vitamins, it should be adopted by the farmer on a large scale without hindering its production and productivity. There is enough genetic diversity of vegetables available, and it has to be screened for a particular trait. For enhancing micronutrients in the plant, there should be a clear understanding of the mechanism of ion uptake from the soil, redistribution within tissues and homeostasis in the plant. Working on enhancing micronutrients and vitamins with the help of conventional breeding or by genetic engineering requires particular traits that need to be incorporated. The recent advances in genetics made it possible to enhance micronutrients by reducing anti-nutrients such as the reduction of phytic acid or tannins. Genome editing tools like ZFN, TALENS, CRISPR-Cas9, etc. have the potential to edit plant genes or knockdown undesirable traits and can be exploited for the biofortification of vegetables.

Dish Garden

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Introduction

A dish garden is a garden grown indoors in a container. Although the name might suggest they are grown in dishes, in practice, almost any kind of container can be used, as long as it's large enough. The idea is to create a landscape in miniature by selecting several different compatible plants – "compatible" is an important point and we'll come back to it – and growing them together while also incorporating other decorative elements as you see fit. Dish gardens are thought to have first appeared in Japan several centuries ago when landscape artists created them as a way of demonstrating their abilities to potential clients. Nowadays, they are increasingly in vogue as many people choose to grow them in their urban spaces.

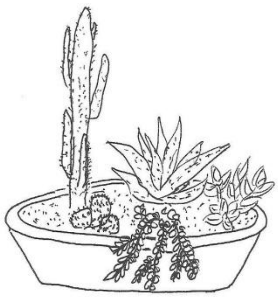
Why Grow a Dish Garden?

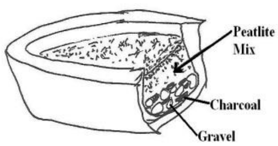
1. They are a perfect solution for otherwise sterile city apartments and bring the well-documented health benefits of being around plants to those who otherwise have little opportunity to be in contact with nature.
2. Dish gardens are the ideal project to entrust to children to help them learn about gardening and plants, all while giving them an outlet for their natural creativity. Planting a dish garden will allow you to spend quality time with your child as you work on your creation together.
3. Finally, dish gardens can make beautiful gifts. By planting, tending and growing a garden, the time invested can say so much more than something you simply picked up in a store at the last moment.

Need for a Dish Garden

1. To start your own dish garden, there is very little you actually need. The most obvious item is the dish itself, and you can use pretty much anything you like.
2. If you choose to, you can spend money on a decorative glass dish that costs a lot of money; or you can just as easily use an old salad bowl or an empty ice cream tub – it's up to you. As a guideline, a dish that is around 3" deep is about perfect.
3. One point to remember is that dish gardens don't usually have a hole in the bottom for drainage, although this is not a rule. If you make one with a drainage hole, just remember to also use some kind of tray to catch the water. Having chosen your dish, and bearing in mind that dish gardens don't usually have holes, the next part of the garden is making sure the bottom doesn't become waterlogged. This means you need to line the container with a drainage layer.

Materials



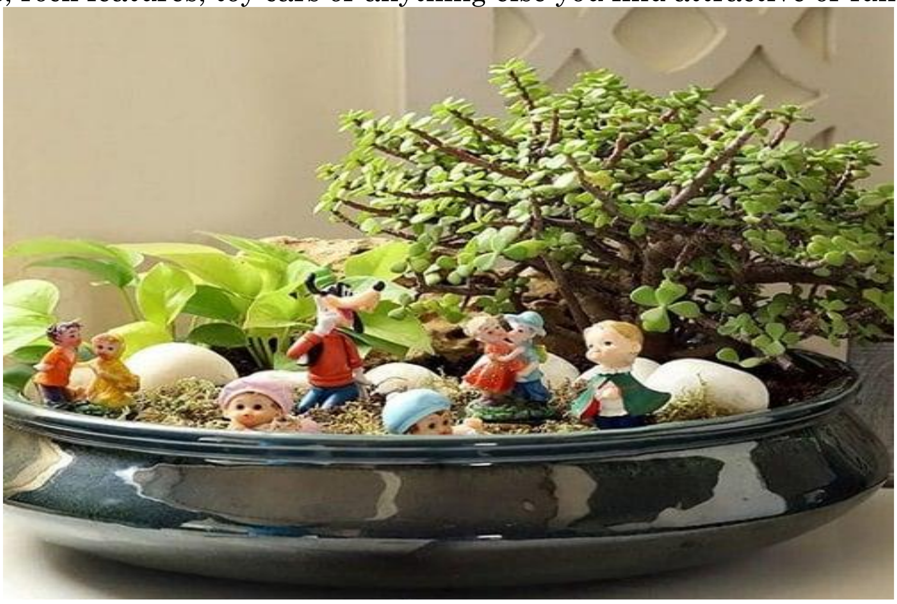


1. Dish.
2. Gravel.

3. Charcoal.
4. Peatlite mix.
5. Water.
6. Miniature xerophyte plants.

Procedure

1. Take your dish and fill the bottom with around an inch or so or gravel or other drainage material. Cover over with a layer of charcoal and top off with the soil. Potting soil is recommended rather than regular garden soil.
2. Depending on the size of your dish, you should choose around three to five plants. Try to choose plants that are not only compatible but that also complement each other. For example, try to incorporate a mix of height, color, shape and so on for a pleasing visual effect.
3. Arrange them in the dish and observe them from different angles. If the garden will be seen from all side, the tallest plant is probably best in the middle; if it will be seen from only one side, the tallest plants can go at the back.
4. Once you are satisfied, fix them into place. Once the plants are in, you can then add any decorative elements you have chosen. Again, this is down to your own creativity and imagination – feel free to create miniature pathways, rock features, toy cars or anything else you find attractive or fun.



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Use of Soil Solarization for Plant Disease Management

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Introduction

1. Soil solarization is an environmentally friendly method of using solar power for controlling pest such as soil born plant pathogen including fungi, bacteria, nematode and insect along with weed seeds and seedling in soil by mulching the soil and covering it with trap usually with transparent polythene cover, to trap soil energy.

2. Soil solarization is a simple, safe and effective alternative to the toxic, costly soil pesticide and the lengthy crop rotations now needed to control many damaging soil pests.

3. It involves covering the soil with transparent plastic sheeting during an appropriate summer fallow period.

4. It captures solar energy and raises the temperature in the soil to levels lethal to many soils borne pests.

5. It's a pre-plant method for disinfecting soil for control of soil borne insect, pathogen and weeds.

6. The major commercial use of solarization has been in regions with high solar radiation and high temperatures.

Twelve Steps for Successful Soil Solarization

1. Plan to solarize a portion of your garden when solar radiation is optimal. (April to June).
2. Avoid areas with shadows or north-facing slopes.
3. Roto till the soil to incorporate current weeds, crop residues, compost, fertilizers etc.
4. Remove any sharp stricks, stalks etc. that could puncture the plastic.
5. Thoroughly moisten the soil (or wait for a good soaking rain)
6. Cover the moist soil with clear, polyethylene plastic sheeting.
7. Bury the edges of the sheeting with soil, landscape timbers etc. to prevent wind from getting underneath the plastic or hot air from escaping.
8. To achieve the highest solarization temperatures, cover the first sheet with another sheet of clear, polyethylene sheeting. (The first sheet may be black if the second sheet is clear)
9. If you use two layers, create an air gap between the layers of sheeting with strips of insulation, small blocks of wood, bricks etc.
10. Avoid materials with sharp edges. Bury the edges of the second sheet.
11. Keep the top surface free of dust and water during the solarization period.
12. Remove the plastic after 4 to 6 weeks (perhaps sooner if hot, sunny clear days have been common). When planting your garden, avoid the outer edge (1-2 ft) of the solarized area.

Principles of Soil Solarization

1. Soil solarization involves trapping of solar heat/energy through polyethylene covering to raise the soil temperature to the level where it becomes lethal.
2. It was first introduced on a commercial scale in 1993, the characteristics that leads to its wide spread use are its relatively low cost, easy provability, excellent chemical resistance, toughness and flexibility, freedom from odour and toxicity, low water vapour permeability and in thin films transparency.
3. It is highly transparent to light in the spectrum of 0.3 – 3.6 cm except for two absorbance bands around 7 and 14 µm in the infra-red spectrum.
4. It reduces hest convection and water evaporation from soil to the atmosphere.

Component of Soil Solarization

1. Quality of polyethylene film:

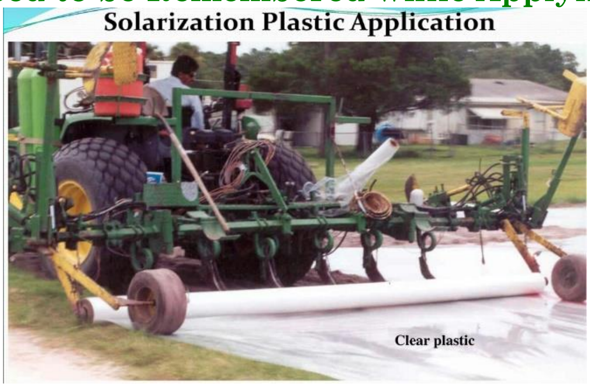
a. Colour: Clear or transparent polyethylene films should be used but not black films.
b. Thickness: Polyethylene film having 19-25 µm thickness are more efficient.

2. Soil preparation: Soil should be disked or turned over and raked smooth to provide even surface and to improve water penetration and to moisture the soil profile.

3. Soil moisture: Soil can be moistened by 40-50 mm per irrigation or by drip or furrow irrigation following laying of the polyethylene film, but care must be taken to apply the film as soon as possible to avoid water loss.

4. Time and duration of soil coverage: Killing of weed seeds and seedlings is related to time and temperature exposure. April-June in northern part is the best time for solarization of soil.

These are Factors that Need to be Remembered while Applying Soil Solarization



1. Transparent, not black, polyethylene plastic should be used, as this transmits most of the solar radiation.
2. Solarization should be carried out during periods of high temperature and intense solar radiation.
3. The thinnest plastic possible should be used, as it is both cheaper and somewhat more effective in heating.
4. The plastic sheeting should be kept in place for as long as possible.
5. Use a clear UV- stabilized plastic trap or sheeting 0.5 to 4 mils thick.
6. The edges of the sheets must be buried to a depth of 5 to 6 inches in the soil to prevent blowing or tearing of the trap by the wind.
7. White or black plastic usually does not transmit enough solar radiation to raise soil temperature to lethal levels for many soil pests.
8. Temperature inside the plastic covering rise to 13ºC higher than outside temperature which is very lethal to insect pest and diseases.

Pest and Disease Control Using Soil Solarization

1. Soil solarization is one of the effective ways of suppressing the larvae of white grub, cutworm, hairy caterpillar as they gets killed inside the soil due to high temperature.
2. Soil solarization helps in reducing root knot disease by suppressing the nematode population by 66% in nursery within 15 days.

3. Plants grown in solarized potting mix soon after treatment have often benefited from improved seed germination, better stand establishment, improved plant height, early crop maturity and increased yield.

The effect of field treatment the prior growing season on stand establishment, root yield(q/ha) of sugarbeets grown at East lansing, Michigan, Non-treated seeds were used in all experiments.

Experiment	Treatment			
	Barren Fallow	Black Plastic	Clear Plastic	LSD (0.05)
1989 A	44.0	49.6	57.5	8.9
1989 B	37.4	47.3	44.2	10.9
1990 A	50.5	55.7	59.6	9.1
1990 B	52.2	56.3	60.1	6.9
1991	53.4	53.7	58.3	8.6
Mean	47.5	52.5	56.0	3.5

Effect of Soil Physic-Chemical Properties

1. Soil Moisture and temperature.
2. Chemical changes: When soil is heated much of the resident micro-biota is killed and degraded, thus liberating the mineral nutrient (increase NH4-N/NO_3-N, P_2O_5 and K_2O)
3. Biological changes: Effect of solarization on soil microbiota or more selective Thermophilic and Thermotolerant fungi, bacteria survive and even flourish under solarization.

Beneficial Side Effects

1. Control of weeds and other pests.
2. Increase plant growth response – beyond disease control.
3. Combined with other method.
4. Production is increased 20 to 30%. Solarized seedbeds require 20-30% less seed compare to normal seedbed.

Applicability of Soil Solarization

1. Unlike other method of weed management soil solarization brings about control of wide variety of weeds and pests including soil borne fungi, bacteria, nematodes and enhance availability of mineral nutrient to crop plants.
2. In addition, many parts of tropical India experience extreme summer, thus this area have a great potential to utilize soil solarization for weed management.

Limitation and Constraint

1. The major constraint in soil solarization is the high cost of polyethylene films.
2. In many parts of India land is also left fallow during summer show their scope for utilizing soil solarization as weed management method without any adverse effect on succeeding crops.

Conclusion

It is user-friendly nonhazardous, environmentally safe and after effective for more than one growing season or a year. Soil solarization is a safe and effective alternative for weed management other than chemical.

Solarization repeated for two consecutive years can considerably enhance the effect on crop yield and weeds control.

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Mushroom, It's Benefits and Scope in India

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Introduction

Mushrooms are widely known for their great taste and amazing health benefits. Packed with a ton of essential vitamins and minerals, they make for an excellent addition to once diet. They are rich source of vitamin and even contain vitamin D which is rarely found in any edible substance.

The anti-inflammatory effect of mushrooms has been shown to greatly improve the efficiency of the immune system. Research has found that mushrooms help stimulate microphages in the immune system, enhancing its ability to defeat foreign bodies and making you less susceptible to serious illnesses. Some mushrooms also contain anti cancerous property and lower the risk of cancer up to 70-80%.

Types of mushrooms found in India:
1. White button mushroom.
2. Straw mushroom.
3. Oyster mushroom.
4. Milky mushroom.
5. Cremini mushroom.
6. Shiitake mushroom.
7. Portobello mushroom.

Scope of Mushroom Production in India

As in production of mushroom we mostly utilize residue of agriculture product so it is quite budget friendly. Apart from being budget friendly mushroom cultivation is eco-friendly, but due to less awareness about the health benefits of mushroom and its cultivation technique many people don't grow mushroom.

Mushroom production provide employment to youth also and provide them a great opportunity to earn. Mushroom is good source of protein and nutrition especially for those who are vegetarian. There are several varieties of edible mushroom that one can grow but most edible one in India is button mushroom and oyster mushroom which is also known as dhingri mushroom in India.

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Bajra – Its Benefit, Diseases and their Management

Article ID: 11444

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Bajra is also known as Pearlmillet *(Pennisetum glaucum).* It is originated from Africa from where it has spread to India. In India it is predominantly grown in Rajasthan.

Followings are the importance of bajra:
1. Mineral rich cereal.
2. Protein rich (10.5 to 14.5) with higher level of essential amino acids.
3. They possess biological value similar to wheat & rice.
4. It is staple food for 100 million.
5. It is also a good forage crop.
6. It is also grown as pasture crop.

Major Diseases of Bajra

1. Downy mildew - *Sclerospora graminicola*

Symptoms: Infection is mainly systemic and symptoms appear on leaves and inflorescence. The initial symptoms appear in seedlings at three to four leaf stages. The affected leaves show patches of light green to light yellow colour on the upper surface and the corresponding lower surface bears white downy growth of the fungus consisting of sporangiophores and sporangia. The yellow discolouration often turns to streaks along veins. As a result of infection young plants dry and die ultimately. Symptoms may appear first on the upper leaves of the main shoot or the main shoot may be symptom free and symptoms appear on tillers or on the lateral shoots.


Management:

i. Deep ploughing to bury the oospores.
ii. Roguing out infected plants.
iii. Adopt crop rotation.

iv. Grow resistant varieties WCC-75, Co7 and Co (Cu)9.

v. Treat the seeds with Metalaxyl at 6g/kg.

vi. Spray Mancozeb 2 kg or Metalaxyl + Mancozeb at 1 kg/ha on 20th day after sowing in the field.

2. Ergot or Sugary disease - *Claviceps fusiformis*

Symptoms: The symptom is seen by exudation of small droplets of light pinkish or brownish honey dew from the infected spikelets. Under severe infection many such spikelets exude plenty of honey dew which trickles along the ear head. This attracts several insects. In the later stages, the infected ovary turns into small dark brown sclerotium which projects out of the spikelet.

Management:

i. Adjust the sowing date so that the crop does not flower during September when high rainfall and high relative humidity favour the disease spread.

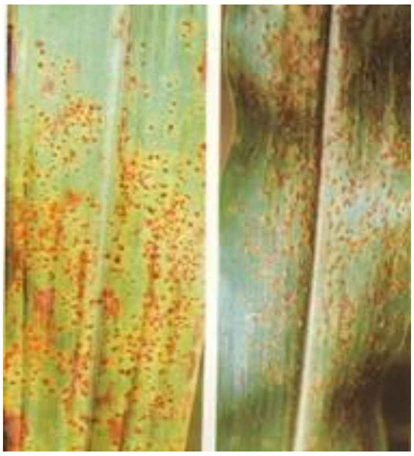
ii. Immerse the seeds in 10 per cent common salt solution and remove the floating sclerotia.

iii. Remove collateral hosts.

iv. Spray with Carbendazim 500g or Mancozeb 2 kg or Ziram 1kg/ha when 5-10 per cent flowers have opened and again at 50 per cent flowering stage.

3. Rust - *Puccinia pennisetti*

Symptoms: Symptoms first appear mostly on the distal half of the lamina. The leaf soon becomes covered by urediosori which appears more on upper surface. The pustules may be formed on leaf sheath, stem and on peduncles. Later, telial formation takes place on leaf blade, leaf sheath and stem. While brownish uredia are exposed at maturity, the black telia remain covered by the epidermis for a longer duration.



Management: Spray with Wettable Sulphur 3 kg or Mancozeb 2 kg/ha.

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Assessment of IPM Module for the Management of Sucking Pests of *Bt* Cotton

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Abstract

The study on assessment of IPM module for the management of sucking pests of cotton in Panchmahal district was carried out in farmer's fields of cotton growing tracts of Panchmahal district. The experiment was carried out in 5.0 ha with active participation of farmers with an aim to assess the IPM module for the management of sucking pests in cotton.

In IPM module, consisting of one spray application of Beauveria bassiana (2 x 108cfu) @ 4 g /l water, two sprays of thiamethoxam 25 WG @ 0.01 per cent (0.4 g /l water) and one spray of acephate 75 SP @ 0.075 per cent (1 g /l water) following threshold level (5 sucking pests /leaf) was found effective and economical for the management of sucking insect pests in Bt cotton. The application of this practice also resulted higher yield as compared to farmers' practice.

Keywords: Bt cotton, IPM module, sucking insect pests.

Introduction

Cotton (*Gossypium spp.*) is popularly called as friendly fiber because of its usefulness, appearance, performance and above all its natural comfort. Cotton pest control has always been an immensely challenging task for entomologists all over the world. In India around 162 insect pests have been reported to cause damage to the cotton crop. Among them, only a dozen is major and half of them are key production constraints which cause losses to the extent of 30-80 per cent.

Cotton is an excellent reproductive host for many sucking insects such as leafhoppers, *Amrasca devastans* (Distant); aphids, *Aphis gossypii* (Glover), whiteflies, *Bemisia tabaci* (Gennadius) and thrips *Thrips tabaci* (Lindemann). The avoidable loss due to sucking pests is up to 33.02 % (Nikam *et al.* 2017).

To control sucking pests, cotton farmers rely heavily on synthetic pesticides. At least 2-3 sprays are used against sucking pests. Due to continuous and indiscriminate use of synthetic insecticides, there is resistance and hence increase in production cost, toxicity to natural enemies.

So, possible solution is adoption of IPM module plays a key role. Keeping these things in view an on-farm trial was carried out in farmer's fields to assess IPM module for the management of sucking pests of *Bt* cotton.

Materials and Methods

The field experiments were carried out during Kharif season of 2014-15 to 2018-19 at five villages of Panchmahal district to assess the IPM modules against sucking pests of Bt cotton under OFT activity of ICAR- Krishi Vigyan Kendra-Panchmahal (Gujarat). In this study, 12 farmers were selected for trial. The IPM module was adopted from AAU, Anand (Gujarat) while farmers' practice comprised of chemical insecticide sprays (Table1).

The insecticides were sprayed when the pest attained Economic Threshold Level (ETL). The observations on population of sucking insect pests' viz., aphid, leaf hopper, whitefly and thrips were made on three plants selected randomly in each sector.

From each selected plant, three leaves were selected randomly from top, middle and bottom canopy to record the pest population. The observations were recorded at fortnightly interval right from the germination to last picking of the crop. Cotton yield was recorded and the data were presented as seed cotton yield in q/ha and benefit cost ratio was also worked out.

Table 1. Details of management practice against sucking pests of cotton:

Management practice	Details
Integrated Pest Management Module (IPM module)	IPM practices consisting of: • One need based (5 aphids or leafhoppers or whiteflies/leaf) application of *Beauveria bassiana* (2 x 108 cfu/g) @ 4 g/l water followed by two need-based applications of thiamethoxam 25 WG 0.01% (0.4 g/l water) (50 g a.i./ha). • Need based (5 thrips/ leaf) application of acephate 75 SP 0.075% (1 g/l water) (375 g a.i./ha). • The waiting period of thiamethoxam 25 WG 0.01% (50 g a.i./ha) and acephate 75 SP 0.075% (375 g a.i./ha) maintained 21 and 15 days after application, respectively. • Installation of yellow sticky traps @ 10/ha.
Farmer's Practice	Farmers used unsystematic spraying of different insecticides like imidacloprid 17.8 SL @ 200 ml/ha, fipronil 5% SC @ 1500 ml/ha, monocrotophos 36% SL @ 800 ml /ha etc. at different crop stages. The farmers usually tend to give higher than the recommended dose.

Results and Discussion

A comparison of on farm trials based on IPM module and farmer's practices were analyzed. Of the two practices, IPM module for the management of sucking pests in Bt cotton was found to be more effective over farmer's practice. The data pooled over periods and years showed significantly lower aphid population in IPM (1.22 aphids /3 leaves) than in farmer's practice (16.41 aphids /3 leaves), significantly lower leaf hopper population in IPM (0.69 leaf hoppers /3 leaves) than in farmer's practice (5.87 leaf hoppers /3 leaves), significantly lower whitefly population in IPM (0.31 whiteflies /3 leaves) than in farmer's practice (3.32 whiteflies /3 leaves) and significantly lower thrips population in IPM (0.68 thrips /3 leaves) than in farmer's practice (19.78 thrips /3 leaves). Highest yield of 27.25 q/ha was recorded in IPM practice whereas 18.50 q/ha were recorded in farmers' practice. The Cost: Benefit ratio was also high in the IPM module 1:2.63 as compared to farmer's practice (1:1.90). The data indicated that IPM module was better than the farmer's practice under local conditions. Thus, IPM strategy kept the population of sucking insect pests viz., aphid, leaf hopper whitefly and thrips below their threshold level (5/leaf). Khajuria et al., (2017) reported that *Beauveria bassiana* reduced the infestation of aphids on potato crop. Khajuria et al., (2020) have reported higher effectiveness of thiamethoxam for the control of sucking pests in Bt cotton. During present study also, *Beauveria bassiana* and thiamethoxam are also found effective in management of sucking pests in cotton. Khajuria et al., (2016) have reported that the seed cotton yield from demonstrated plots was high which resulted in a higher cost benefit ratio in comparison with farmer's practice. These results are in accordance with our study as in the present study highest yield was obtained in IPM during the years of investigation. Over all, the benefit cost ratio was high in IPM module as compared to farmers' practice.

Conclusion

IPM module found effective in comparison to farmer practice of indiscriminate use of pesticides. The results clearly indicated that integrated pest management strategies need to be adopted even in Bt cotton to have higher yield and better benefit cost ratios. So, the above said management practices must be followed by the cotton growing farmers. It is concluded that IPM strategy can be recommended to the farmers for management of sucking pests effectively and economically in Bt cotton.

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Installation of yellow sticky traps in cotton crop	**A field view of trial on IPM module**

Role of Women in Agriculture in India

Article ID: 11446

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Summary

Women are making considerable contribution to agriculture by playing role such as labourers, cultivators, entrepreneurs etc. Women does work from sowing to harvesting of crop. In rural regions, women also maintain livestock along with their daily household activities. However, women work is not properly recognized in agriculture and they are called as invisible workers. Most of the activities of women are not considered in economic development but these are important on daily basis. Their work should get attention at both at household and professional level.

Introduction

Agriculture plays an important role in economic development of country. India is a population of 1.38 billion people and 70 per cent of population directly or indirectly involved in agriculture. Agriculture provides employment opportunities to 50% of the country's population. Agriculture contributes 13.4% to GDP. Agriculture is dominated by men but women role in agriculture cannot be avoided. About 84% of rural women depend on agriculture, it can be understood from the figures that women's contribution rate to tea plantations is about 47%, 26.84% to cotton cultivation, 45.43% to oil seeds and 39.13% to vegetable production. According to M.S. Swaminathan, domestication of plants was started by women who initiate collecting seeds from their surroundings and started planting them while, men were busy in searching food for their family. Women role in agriculture vary from country to country and region to region. Women constitute nearly half of the country's population. If women will be secured financially then it will contribute to the overall development of the country. Agriculture has opened many opportunities for women entrepreneurs. According to the economic survey 2017-18, shift of men from rural to urban sectors resulted in feminisation of Indian agriculture. About 45.3% of labor in agriculture constitutes of women only. Women have major role in livestock and poultry management. With the passage of time, agriculture has revolutionized but women remained a labor.

Women as Entrepreneurs

Previously, agriculture was not seen as entrepreneurship sector as compared to other sectors. It was only considered as farming done by poor people for their living. But things have changed now, government and

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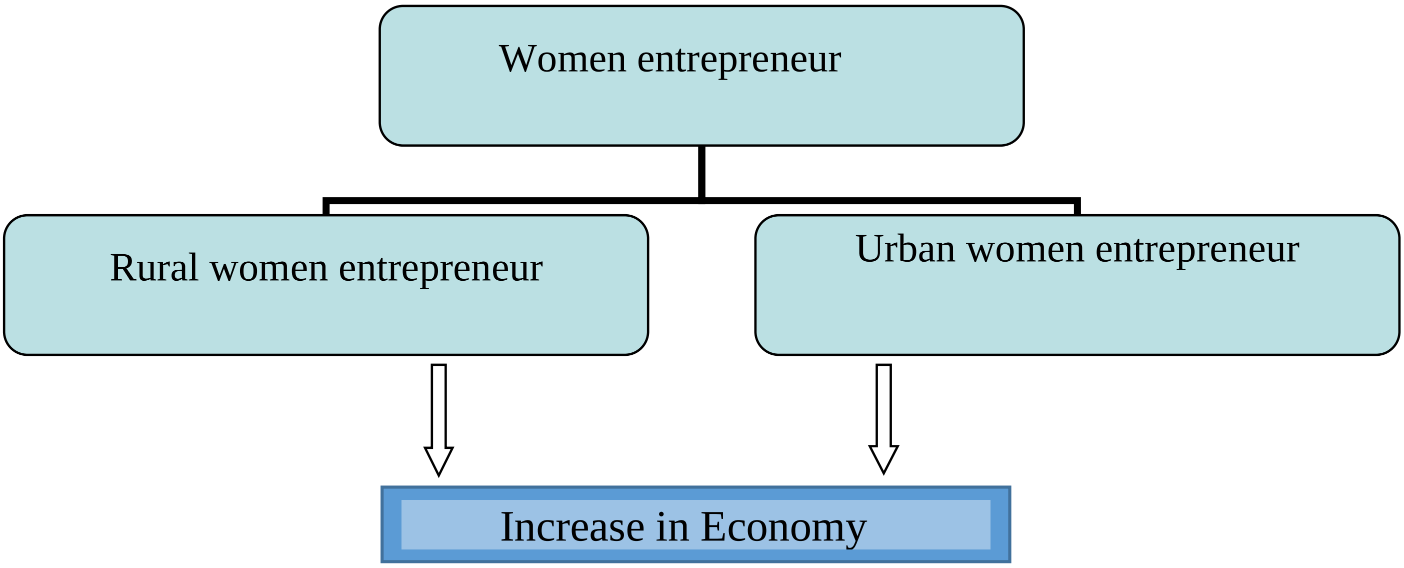
people are taking initiatives for agriculture. Women are important part of the agricultural economy. Women become an entrepreneur when she initiates her own startup and business considering all risk factors. Women all around the India are setting examples for other women as successful entrepreneurs. Women entrepreneurship is the perfect way of empowering women. It is helpful in two aspects one is gender equality and sufficiency in food production. There are different types of women entrepreneurs in rural and urban areas. According to Government of India, women entrepreneurship can be defined "as an enterprise owned and controlled by women having a minimum financial interest of 51 percent of the capital and giving at least 51 per cent of the employment generated in the enterprise to women" (Goyal and Prakash, 2011; Jena et al., 2018). Increase in women agripreneurship will have positive impact on economy definitely. Women can play an important role in rural development. If proper knowledge, guidance, finances and resources are provided to rural women, they can be motivated to become an entrepreneur and in this way they can give employment to another women also.



Women in rural areas can turn their hobbies into an enterprise, e.g food processing, mushroom cultivation, vegetable nursery production, bee keeping etc. This resulted in lesser migration towards cities and economic potential will shift towards villages but increase the economy of country as a whole.

Challenges Ahead of Rural Women

Agriculture is dominated by men for the kind of work they do. Rural women are less aware about the opportunities. They also have lack of knowledge, limited resources, more responsibilities and work load. For the revolution of women in agriculture, women should take initiative for themselves instead of relying on someone else. There are different challenges faced by women as given below:

Education: Rural women literacy rate is very low and it is the main reason women remain unaware of opportunities or information. Women should get education. Time to time training camps should be organized at the village level for developing additional skills.

Independence: Women are not independent in their decisions either in agriculture or elsewhere. They have to depend on others for their decisions. So, women should be included in decision making processes.

Limited resources: Although women are highly involved in agriculture but most of them don't have ownership right on the land which they cultivate. This causes less recognition to the women cultivators. It affects the credit accessibility from the different financial system as it also requires collateral (assets, land) to avail financial support for different startups.

Less earning: Women wage workers are low paid as compared to men. Women work is mainly concentrated to labor force. They are not given the opportunity of technology work. Women have less earning in urban sector also.

Dual work: Women have to perform the household work along with their job or profession. This leads to lack of organization and increases dependence.

Conclusion

Food security can only be achieved by involvement of all genders together. Women play a very crucial role in agriculture and their role cannot be neglected. But women have unequal availability of resources and it also affects their potential. Women work has not been recognized yet, that's why their pay is less and they are regarded as inferior. It can be concluded that agriculture is the best sector where women can exploit their potential by adopting profession like entrepreneurship.

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Post-Harvest Management of Underutilized Carambola

Article ID: 11447

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Introduction

Carambola, popularly known as star fruit is the fruit of Averrhoa carambola, a species of tree native to tropical Southeast Asia. It is widely grown in tropical countries. Star fruit is an attractive tropical fruit of the Oxidaceae family and genus averrhoa. It is known as Golden star.

The word ‘carambola’ is derived from the Sanskrit word Karmaranga meaning “food appetizer. It is a juicy fruit with predominantly yellow greenish in appearance with a succulent pulp having high nutritional and medicinal value. It grows wildly in the hillocks of Chandel district, Manipur. Carambola is one of the underutilized fruit available in plenty in Chandel district, Manipur. It is highly perishable it gets spoil and rotten before they are consumed.

So, the shelf life of the carambola fruit can be extended by the process of preservation. It is the process of prevention of decay or spoilage of food thus allowing it to be stored in fit condition for future use. Drying and value addition in the form of squash, RTS, jam, pickle, candy and salted dry preserve it could extend the shelf life up to 3 months to 1year.

Due to lack of storage facility and knowledge on processing, preservation and value addition, a huge quantity of fruits go wasted every year. To tackle such problem, KVK, Chandel took initiative for the promotion of processing and value addition of such underutilized fruits. The postharvest losses can be reduced from 25% to 75%. Development of such food product are also low-cost venture and could be in reach to below poverty lined population as well providing them avenue for starting small enterprise on processing of carambola which can empower rural tribal women by enhancing income generation and could improve livelihood.

Health Benefit of Carambola Fruit

1. Carambola fruit has antioxidants and flavanoid contents which help to fight against cancer and inflammation effectively.
2. The Vitamin C present in carambola helps to boost immune system, which helps to fight against cold, flues and other common infections.
3. It contains low fibre, high water content, high mineral and high fibre which helps in weight reduction.
4. It helps to maintain normal blood pressure and heart.
5. It helps to improve iron absorption, aids in digestion and boost milk production in women.
6. It helps in preventing cardio-vascular diseases, atherosclerosis and help to reduce cholestrol level.
7. It helps to make skin more radiant and help to rid of fungal infection.
8. It helps in boosting immune system, stimulating lactation, detoxifying the body, relieving respiratory distress and aiding in weight loss.

Table. 1: nutritional value of carambola fruit per 100 gm. of edible portion:

Energy - 28.0 kcal	Vitamin C - 34.4 mg
Total fat - 0.1 gm	Carotene - 0.03 mg
Moisture - 91.9 gm	Potassium - 133 mg
Sodium - 2 mg	phosphorus - 11.0 mg
carbohydrate – 6.1 g	Calcium - 4.0 mg
Dietry fibre - 0.8 g	Iron - 0.32 mg
Niacin - 0.294 mg	Thiamin - 0.03 mg
Protein - 0.7 gm	Riboflavin - 0.019 mg

Processing of Squash

For the preparation of carambola squash select fresh, sound fruits and then weigh and wash them properly with cold water. Then, cut the fruit into five or six parts and trim to remove seed, fibre and upper ribs. Then crush the piece for juice extractor and strain the juice by muslin clothe. Sugar, citric acid, juice and KMS are weighed as required. Water is also measured according to calculation. Then make sugar syrup by boiling sugar, citric acid and water and filter the syrup by using muslin clothe and then cool the syrup. The syrup is mixed with the juice and then KMS is dissolved in small quantity of water and add to the squash and mix it properly. Finally, the squash is to be poured into sterialised bottle and seal it properly.

Table. 2: Formulation of Carombola Fruit Squash:

Ingredients	Amount
Carambola juice	1litre
Sugar	1kg
Citric acid	5gm
KMS	2gm
Water	500ml

Processing of RTS

For RTS preparation select healthy mature fruit. Wash the fruit and trim to remove seed, fibre and rib. Juice is extracted by using juice extractor and filter the juice in strainer or muslin clothe. Sugar, citric acid, juice and KMS are weighed separately and water is also measured according to required amount. Then sugar, citric acid and water are heated to boil and then strain through a filter. The syrup is cooled and mixed with the juice and remaining water and mixed it properly. Then KMS is dissolved in small quantity of water and add to RTS. After mixing properly it is finally poured into sterialised bottle.

Table. 3: Formulation of Carombola Fruit RTS:

Ingredients	Amount
Carambola juice	1litre
Sugar	1.5kg
Water	6litre
Citric acid	5gm

KMS	2gm

Processing of Chutney

Selection of fresh and mature fruit is the first step for preparation of chutney. Then the fruit is weighed and washed in water thoroughly. Then, cut the washed fruit with stainless steel knife into small pieces. The pulp is extracted from the fruit by using pulp extractor. The extracted pulp is cooked by adding 500 gm sugar and spices till it becomes slightly thick in consistency. Then 10 gm of citric acid is added and cooked it till it reaches chutney consistency or TSS of 68 degrees Brisk. Add few drops of red colour to the cooked chutney and fill it hot into sterialised glass bottle and seal properly when it is cooled. Then store it in cool dry place.

Table. 4: Formulation of Carombola Fruit chutney:

Ingredient	Amount
Carambola pulp	1kg
Sugar	500gm
Citric acid	5gm
Red color	Few drops
Spices	10gm

Processing of Candy

Select fresh healthy mature fruit and wash it properly with cold water for the preparation of candy. Prick the fruit by using stainless steel fork to facilitate penetration of sugar inside the fruit. Then prepare the sugar syrup of 50 percent TSS and keep the fruit inside the syrup overnight. Next day drain the syrup and increase its strength to 60 percent TSS and keep the fruit overnight again. Repeat the process same till the strength of the syrup becomes 72 degrees brisk. Drain the syrup; then dry it under shade at ambient condition. Then coat the candy with sugar powder and dries it properly. Store the product in sterialised dry bottle.

Table.5: Formulation of Carombola Fruit Candy:

Ingredient	Amount
Carambola fruit	1kg
Sugar	1.25kg

Sugar powder	100gm	 

Table 6: mean score for performance of color, flavor, texture, taste and overall acceptability of various products of carambola:

Name of the products	Sensory attributes				
	Colour	Flavour	Texture	Taste	Overall acceptability
Carambola squash	7.0	7.5	-	7.2	7.2
Carambola RTS	7.2	7.1	-	7.4	7.0
Carambola chutney	8.2	8.0	7.8	8.2	8.3
Carambola candy	7.6	7.4	7.5	8.5	8.2

Conclusion

Carambola is a highly perishable fruit and it is gone wasted every year. Preservation in the form of value-added product like squash, RTS, chutney, candy and salted dry preserve could extend the shelf life and also made the product available throughout the year, it also adds variety to the diet and also helped to improve the nutritional status of the people. The preserved value-added product could reduce the post-harvest losses to 25% from 75% and can extend the shelf life of RTS up to 3 months, squash up to 6 months and for jam, candy and salted dry preserve, it can be extended up to up to one year. An enterprise on processing of carambola on large scale could improve the livelihood and can also empower rural tribal women by enhancing income generation and also help employment generation of many farm women.

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Nehru Yuva Kendra – Together Towards Tomorrow

Article ID: 11448

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Introduction

India is the world's most youthful nation. A nation with such youth power cannot dream small. We cannot commit this crime. We should dream big; we should enable the youth to dream big and we should give them an opportunity to realize their dreams - Narendra Modi

Youth are a significant human resource for development and, as a result, vital agents of social change, economic progress, and technical advancement innovation. This is a thriving, lively, and active community human resources with implications for the future not only for India, but for the entire world. As a result, youth participation is required in a country's development initiatives, in activities based on the youth's specific needs, desires and aspirations. The Nehru Yuva Kendra Sangathan (NYKS) helps mobilise rural youth between the ages of 15 and 29 to achieve this goal. NYKS was founded to harness and channel the power of youth via the concepts of volunteerism, self-help, and involvement. It is the world's largest grass-roots voluntary organisation of its kind. The Nehru Yuva Kendra Sangathan has 623 district offices to handle youth programmes and activities at the district level, as well as 29 state offices to monitor and coordinate activities at the state level. NYKS is also associated with village-based youth clubs. It is to continue to develop and empower them so that they can become productive and responsible citizens, assume local leadership, and participate actively in the community development process. The goal of these grassroots clubs is to build village-level action groups of teenagers who may work together for their own development and work with a concern for the poor and needy people. National Youth Volunteers and various youth clubs and Mahila Mandals are the core strength of NYKS that works at the local or grass root level in villages. These village-based organisations have transformed into local pressure groups as well as catalytic agents for social, cultural, political, and environmental change as a result of NYKS. Many of these organisations have evolved into Functional Activist groups with a focus on rural development and self-sufficiency.

Objectives of Nehru Yuva Kendra Sangathan

1. The objective is to motivate, encourage, and help organise the country's rural youth; to strengthen their capacities to create democratic institutional arrangements in the form of village-based Youth Clubs with appropriate representation from all sections of society; and to enable the target audience to live a substantive, sustainable, and happy life.
2. To make it easier for people to believe local leadership and take part in sustainable development and rural uplifting activities .
3. To help rural youth develop their attitudes and abilities and they'll become productive, responsible citizens of modern India.
4. Involve them in activities that contribute to the development of the country to work to create an environment in which everyone, regardless of caste, colour, sex, or religion, has an equal opportunity to serve the country.
5. To aspire toward resource self-sufficiency. To make use of NYKS's networks for the development and promotion of programmes in the priority areas of job creation, literacy, and family welfare.

Initiatives Taken by Nehru Yuva Kendra Sangathan

The Government of India, through its rural youth-focused flagship organisation, the Nehru Yuva Kendra Sangathan, achieves the set objectives through Core Programs that are uniformly distributed across the country's district kendras, implement Ministry of Youth Affairs and Sports Schemes, and undertake Special Programs for youth development and empowerment.

1. Youth Club Development Programme: This programme intends to establish new clubs and strengthen an existing network of youth clubs that include people from all walks of life. The forum will also be utilised to introduce and highlight topics of concern to young people that must be addressed in a sense of participation.

2. Training on Youth Leadership and Community Development: Through 3-day training programmes, the programme aims to develop leadership qualities, personality development, and skills for taking up community development initiatives among the youth so that they can act as agents of social change and disseminate information about various schemes and programmes among the people in general and youths in particular.

3. Promotion of Sports: The goal of the initiative is to promote sports culture among rural kids. Youth Clubs are given financial assistance to purchase basic sports equipment for regular sports activity. For supplying sports equipment to Youth Clubs worth around Rs.3,000 per club (including Rs.1,000 for a football) in order to promote sports and games in the villages. Also, the initiative is to establish and encourage rural sports and games among NYKS Youth Clubs and to make sports a natural process and way of life in rural India, as well as to give opportunities for young people to showcase their abilities.

4. Skill Up-gradation Training Programmes (SUTP): All 623 districts with the help of Trainers and reputable/recognized Skill Development Agencies, the aim is to strengthen the youths for employment by giving a variety of relevant skill-based training courses.

5. Promotion of Folk, Art and Culture: The program's purpose is to help rural youths respect and understand their folk, art, and local culture, as well as having the chance to display their folk-art cultural talent and participate in its preservation and promotion. These programmes were created with a focus on folk songs, folk dances, and folklore, among other things.

6. District Youth Convention: All District NYKs organise this programme every year to provide a chance and platform for Rural Youth Leaders to display their products, express themselves, share their experiences, and suggest best practise programmes for youth empowerment. This programme raises awareness about the role of youth clubs in nation development and raises knowledge about concerns connected to accessible employment prospects for them.

7. Education in Basic Vocations: Education in Basic Vocations aims to teach rural young women and men in basic vocations, boost their self-esteem in society, and direct them to other agencies for skill development training. The program's sequence of activities includes mobilising youngsters into groups, improving their abilities, arranging for support resources, for the purpose of improving rural youth's occupational skills and enabling them to improve their self-esteem in society, as well as empowering youth to address issues and concerns that they face on a daily basis , encourage young people to start their own jobs or income-generating programmes, and informing them about new talents that are in high demand in the market.

8. Awards to Outstanding Youth Clubs (AOYC) at District, State and National Level: The "fundamental goal" is to "promote the expansion of Youth Clubs, which are acknowledged as social change facilitators." Youth Clubs are thought to be important in nation-building and other activities such as literacy, skill development, health awareness, environmental preservation, national integration, social harmony, sports, and the development of long-term welfare benefits in villages. It includes encouraging more Youth Clubs to participate in community welfare and nation-building activities through fostering the expansion of Youth Clubs and their developmental activities.

Conclusion

Besides all these programmes that are written over the youth of our country specially who are from the rural communities have a very high aspiration and aim to achieve good for themselves as well as the rural community of which they are part of. The success of the Nehru Yuva Kendra Sangathan and the continuously emerging youth clubs are not less than any examples that the youth of the country if he/she gets an opportunity to serve their people and the community has no less desire to work. Youths are the only future a country have and a country must have to develop their youth into something productive so as to experience its own development with the time. Given that about three-quarters of India's population lives in rural areas, the country's overall development is dependent on their advancement. The NYKS was founded in this setting to harness the strength of rural youth and empower them to pursue self-development and societal contribution. As a group, the young have stepped forward to address a variety of local issues, with the goal of achieving rural sustainability, self-sufficiency, and, as a result, national development.

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Omega-3 Fatty Acids in Developing Mental Health

Article ID: 11449

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Summary of Article

Nutrition is the major driving factor for mental health as well as brain development. It is well documented that fish oil containing omega-3 fatty acids (EPA and DHA) can have the ability to decrease potential health hazards like inflammation, mental disorders, etc. epidemiological studies also have shown that high consumption of fish has greatly reduced cardiovascular diseases as well as other inflammatory conditions. So, this article mainly discussed the beneficial effects of n-3 fatty acids on mental health and also the mechanism of actions.

Introduction

The rapid globalization and changes in lifestyles from the traditional environment have accelerated the tensions as well as a mental illness to the next level. Nutrition is also a reason behind that. But providing adequate safe food to the huge global population is a challenging task. However, in recent times, the potential growth of the aquaculture sector is accelerating to fulfill consumers' demand by providing good quality healthy food. Health, nutrition, and convenience are the major factors driving global food safety as well as the global economy. Seafood has always got importance to play a dynamic role in addressing nutritional issues all over the world. In that context, fish oil is very popular for fulfilling the physical as well as mental development in human health. Therefore, fish consumption (around 20.5 kg per capita worldwide in 2018, SOFIA,2020) and also omega-3 supplementation have increased tremendously in the past few decades in developing countries.

Essential Fatty Acids

PUFAs (Poly Unsaturated Fatty Acids) are classified into two major groups as omega-3 (ω-3 or n-3) and omega-6 (ω-6 or n-6) respectively based on the position of double bonds. PUFA comprises essential unsaturated fats which help to regulate the body functions (Das, 2006). Some essential fatty acids such as linoleic acids (LA, 18:2 ω-6) and α-linolenic acids (ALA, 18:3 ω-3) must be provided with food because they cannot be synthesized or produced in the human body. The omega 6 and omega 3 unsaturated fats are very essential portions of the human diet and the proportion of 4:1 is ideal. But the huge consumption of linoleic acids as oils and less consumption of α-linolenic acids results in several harmful diseases mainly cardiovascular and inflammatory diseases (Simopoulos, 2003). This imbalanced situation can be fixed by providing the fishes which are wealthy in EPA and DHA (Simopoulos et al., 2000). Omega 3 unsaturated fats such as EPA and DHA are also applied for the treatment of mental disorders, anxiety, and therapeutic purposes (Shahidi, 2004).

Sources of Omega-3 Fatty Acids Including Dietary Source

Marine fishes are an acceptable wellspring of EPA and DHA which are omega 3 unsaturated fats and utilized for the medicines of mental issues. Fatty fishes like, salmon, trout, and herring are the rich wellspring of EPA and DHA than other different fishes. Fish oil is another significant source and is devoured as dietary upgrades. Fish oil is wealthy in omega-3 unsaturated fats, which are vital for wellbeing and to minimize physical as well as mental illness. If consumes fish daily, then it serves to balance the omega 3 unsaturated fats in our body. LA and ALA are found in plant oils and green vegetables and seeds individually.

Marine Bacteria as a Source of Omega 3 Fatty Acids

It has been thought that PUFA is missing in the bacterial membrane but various marine bacteria have been displayed to create long-chain n-3 PUFAs like EPA and DHA. These PUFA rich microorganisms are principally found in marine origins including, low-temperature, remote ocean conditions, and the digestion tracts of marine fishes. The amount of omega 3 fatty acids differs according to species to species, amount of lipid content of the fish, temperature of the waterbody, and habitat. Highly fatty fishes contain more EPA and DHA than other lean fishes. The fish oil acquires from fatty fishes also a wellspring of omega 3 fatty acids. The capsule is made from fish oil contains around 30% of omega 3 fatty acids (Calder and Yaqoob, 2009). Consumption of the marine fishes or fish oil capsule serves to enhance the amount of omega 3 fatty acids in our body (Wall et al., 2010).

Chemistry & Mechanism of Action

The precursor of omega-6 and omega-3 unsaturated fats are linoleic acid and α-linolenic acid individually. EPA and DHA are the two fundamental parts utilized as dietary upgrades. Although human body cells cannot produce or synthesize these LAs and ALAs, they can only metabolize them into necessary compounds by introducing with their twofold securities. Omega 3 unsaturated fats have various contributions towards different systems of our body. There are 4 general mechanisms by which (n-3) PUFA could influence cell and tissue conduct to evoke their physiological activities (Philip, 2012). Thus are:

1. (n-3) PUFA could influence metabolite or hormone concentration which deliver some impact on cell and tissue behavior.
2. (n-3) PUFA could influence different components (e.g., oxidation of LDL; oxidative pressure) that also have some impact on cell and tissue behavior.
3. Direct impacts of (n-3) PUFA on cell conduct through surface or intracellular unsaturated fat "receptors" or "sensors".
4. Impacts of (n-3) PUFA on cell behavior intervened through changes in the structure of cell film phospholipids.

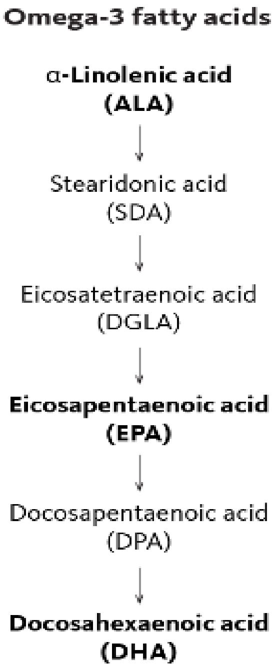

Fig:1 Synthesis pathway of omega-3 fatty acids

Prevention of Mental Disorders

Depressive disorder: Depressive disorder is distinguished by depressed mood especially decreased interest in or the capacity to get delighted from all exercises. This issue is profoundly weakening, seriously restricts psychosocial working, and reduces personal satisfaction. Depression is hard to treat, but the organization of omega-3 unsaturated fats is arising as an approach toward its avoidance and treatment and it also influences various neurobiological factors which are associated with this problem (Ross, 2016). So, consumption of omega-3 unsaturated fats through foods is immensely important to overcome these disorders.

Schizophrenia: Schizophrenia is a perplexing and heterogeneous social and intellectual condition that is portrayed by different side effects such as delusions, hallucinations, impaired motivation, and social withdrawal. An interruption in psychiatric health that outcomes from hereditary or potentially ecological variables has been set as the reason for schizophrenia. Due to the scarcity of micronutrients together with essential fatty acids, vitamins, and minerals, schizophrenia occurred. Scientists have been observed that if the phospholipid concentrations are reduced in neuronal membranes, then it affects the nervous system which can lead to schizophrenia in vulnerable individuals. Omega-3 fatty acid levels should be replenished and used for the treatment of psychotic-like symptoms (Schlögelhofer et al., 2014).

Bipolar disorder: Bipolar disorder is a lifelong condition that is described by substituting conditions of depression and raised state of mind (lunacy or hypomania) and the intermittent phases of euthymia. Low degrees of omega-3 unsaturated fats (DHA) in erythrocyte films result in bipolar turmoil in the body. Higher paces of fish utilization affect the lower occurrence of the bipolar issue among the populations. So, bipolar turmoil can be improved through the adjunctive organization of omega-3 PUFAs (Montgomery and Richardson, 2008).

ADHD (Attention Deficit Hyperactivity Disorder): ADHD represents. ADHD is a typical mental condition that influences kids and teenagers. Oxidative pressure in patients with ADHD may diminish omega-3 levels which accelerate ADHD-related side effects. It is portrayed by age-improper degrees of hyperactivity, carelessness, and impulsivity. Children and youths who have been diagnosed to have ADHD display long-term social, academic, and emotional wellness issues. However, there is little proof to help the efficacy of omega-3 PUFA supplementation in decreasing the detrimental effects of ADHD (Lange et al., 2014).

Others Health Benefits

Eye problems: DHA is highly abundant in the retina of your eye. If you don't get enough DHA then vision issues may emerge. So, getting sufficient DHA diminished eye injury and visual deficiency.

Heart-related problems: Respiratory failures and strokes are the world's driving reasons for death. But fish-consuming communities had very less paces of these illnesses. Omega-3 fatty acids have been obstructed to numerous health benefits including, reduction of triglycerides, reduction of blood pressures, raise the cholesterol level, and obstruct the formation of detrimental clots.

Inflammation: Inflammation is a natural reaction to contaminations and harm in your body. Omega-3 unsaturated fats can decrease the creation of particles and substances connected to inflammation, for example, inflammatory eicosanoids and cytokines.

Conclusion

Omega-3 unsaturated fats have been utilized in various sickness states. They have cardioprotective impacts which are safe and inexpensive. All in all, omega-3 unsaturated fats are well endured by numerous gatherings including pediatric and geriatric. Omega-3 unsaturated fats improve the length and quality of sleep as well as good for skin also. The symptoms of unsaturated fats appear to be gentle and create some temporary problems in the intestinal tract. The bulk of the information supports omega-3 unsaturated fats part in the treatment of mental disorders. However, the advantages of eating fish as a component of the human diet usually exceed the potential dangers of openness to pollutants.

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Bio Science to Bio Economy – A Way Forward to Eco Friendly Resource Development

Article ID: 11450

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Introduction

There are renewable and nonrenewable resources in nature. The use of Nonrenewable resources became more important in our daily lives. The materials like plastic, metals, Iron, synthetic which we are using in different forms creating negative impact on environment.

The degradation of plastic takes hundred years and mean while during this process, lots of plastic waste being dumped in seas, oceans, water bodies making marine life to extinct from nature and also interfering in our food chain.

Human life is facing challenges with regards to their health, water, food security issues. By considering the issues, a concept of Bio economy is getting its own importance which is mainly ecofriendly. It mainly focusses on use of renewable resources rather than nonrenewable resources.

It stressing the importance of shifting from use of fossil to bio fuels which will reduce pollutants that are harmful to human health. The concept works with large interlink of various sectors like agriculture, forestry, fisheries, food industry, textile industry, paper industry, cosmetic industry and pharmaceutical industry. A bio economy is based on the use of research and innovation in the biological sciences to create economic activity and public benefit.

Scope of Bio Economy

Bio economy works on the principle of innovative actions for use of biological resources to provide products, processes and services in all economic sectors within the frame of a sustainable economic system. It is eco-friendly process as it emits low carbon in the climate.

The countries like USA, Canada, European union, Australia, have established initiatives on Bio economy. India, being a biodiversity rich country, there is a scope for implementing the concept soon after having proper strategies and plan of action.

Three Innovations Needed for Bio Economy

1. Technological Innovation to reduce carbon emissions in the environment.
2. Organizational innovation through which there will be change in the institutions and individual behavior.
3. Social innovation to create more opportunities for employment generation.

Bio Economy in Agriculture

Every farmer uses chemical fertilizers, pesticides during cultivation of crops in field. Sometimes, these chemicals have some negative effect on soil fertility, yield quality. Organic farming is a form of bio economy in which it uses micro flora and soil microbes which promote healthy yields and increases soil fertility which also reduces agricultural induced environmental effects. Bio products which are used as inputs are biomass from agricultural waste, microbial like algae, forestry materials like wood.

Through anaerobic process, by heating biomass in the absence of air, it will produce oil like liquid that can be burned like fuel oil or refined into chemicals and fuels. As shown in the figure 1, After using this bio fuels by auto mobiles, it will produce carbon dioxide which can be absorbed by plants through the process of Photosynthesis but in contrast the fossil fuels release high level carbon dioxide which is harmful to environment and stays in nature for long time.

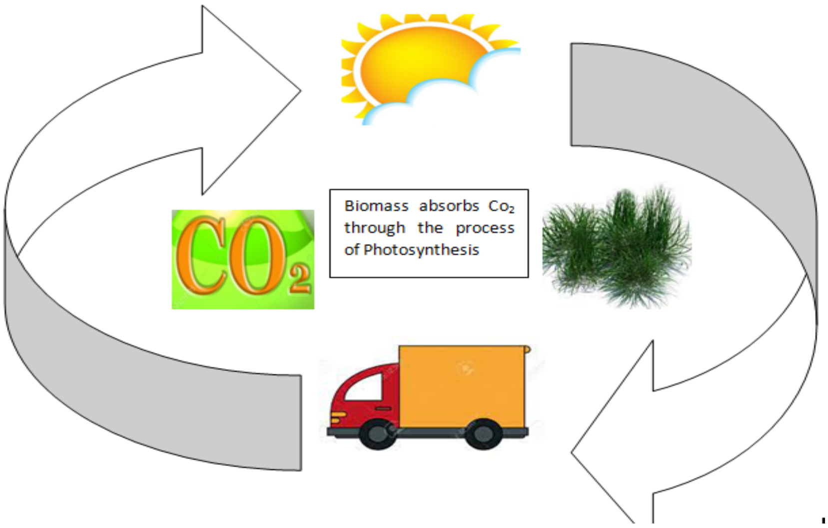

Figure 1: Process of Bio mass to Bio fuel

Policy Strategies Related to Bio Economy Development

1. Blue economy: It is the process of transforming the aquatic biomass into food, feed, nutraceuticals, pharmaceuticals, cosmetics, energy, packaging and clothes. It can also provide livelihood and employment opportunities to the people by engaging them in fisheries, marine transport, tourism, waste management.

2. Green Economy: It involves green production and markets by reducing depletion of natural resources and increasing reliance on low carbon energy supply to which helps to mitigate climate change.

3. Regional bio economy development: As the bio resources like forest, agriculture, water bodies are widely distributed in rural areas. These geographical differences between the fossil and bio economy resources have major implications in providing scope for employment for rural areas.

4. Bio based economy: It mainly involves the use of biotechnology and biomass in the production of goods, services, or energy. It tries to produce renewable biological resources

5. Bio energy and Hi tech: Producing renewable source of energy from plants and animals. Like include burning wood to create heat, using biodiesel and ethanol to fuel vehicles, using methane gas and wood to generate electricity. The industries can use much more of wood rather than metal iron in constructing the high buildings, algae panels, bio batteries for energy sources.

Chemistry & Mechanism of Action

The precursor of omega-6 and omega-3 unsaturated fats are linoleic acid and α-linolenic acid individually. EPA and DHA are the two fundamental parts utilized as dietary upgrades. Although human body cells cannot produce or synthesize these LAs and ALAs, they can only metabolize them into necessary compounds by introducing with their twofold securities. Omega 3 unsaturated fats have various contributions towards different systems of our body. There are 4 general mechanisms by which (n-3) PUFA could influence cell and tissue conduct to evoke their physiological activities (Philip, 2012). Thus are:

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4. Impacts of (n-3) PUFA on cell behavior intervened through changes in the structure of cell film phospholipids.

Conclusion

Bio economy is an innovative approach which collaborates all stake holders and all sectors in producing bio inputs to produce other final products. The ecofriendly products will easily degrade in soil and reduce cascading effects to environment. Even if we cut down trees for creating bio mass, we can immediately replant with other plant and save our nature. As it has included more labour work in managing of waste and natural resources there is a large scope of geographical employment. This concept has its own importance by strengthening ecosystem as well as human livelihoods.

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Role of Training in Capacity Building-Justification Through Case Studies

Article ID: 11451

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Introduction

Quite often, the notion of capacity building is associated to the idea of increasing or developing skills and competencies at an individual level, i.e., training of staff. Capacity building is a much broader concept that should be considered from a systemic perspective, which involves different clusters, as individuals, organizations, institutions and society.

Capacity Building

Capacity building (or capacity development) is the process by which individuals and organizations obtain, improve, and retain the skills, knowledge, tools, equipment and other resources needed to do their jobs competently or to a greater capacity (larger scale, larger audience, larger impact, etc.).

According to the definition of United Nations Development Programme (UNDP): "In the global context, capacity refers to the ability of individuals and institutions to make and implement decisions and perform functions in an effective, efficient and sustainable manner".

At the individual level, capacity building refers to the process of changing attitudes and behaviour imparting knowledge and developing skills while maximizing the benefits of participation, knowledge exchange and ownership. At the institutional level it focuses on the overall organizational performance and functioning capabilities, as well as the ability of an organization to adapt to change. At the systemic level it emphasizes the overall policy framework in which individuals and organizations operate and interact with the external environment."

Training

According to Dale S. Beach, training is 'the organized procedure by which people learn knowledge and/or skill for a definite purpose'. The terms 'training' and 'capacity development' are sometimes confused or used interchangeably. But training is just one element of capacity development. It usually focuses on providing skills for specific problems (e.g., using MS office or Adobe Photoshop). Capacity development encompasses a whole range of activities designed to take into account the local cultural, policy and organizational context (including the analysis of policy contexts, awareness building, and institutional adjustments).

Training is provided through various approaches, including the organization of one-to-one technical support, mentoring, shadowing, workshops, exchange visits, and study tours albeit the requirements of each training should be customized for each situation.

Capacity Building and Training are Entangled

Capacity building and training are entangled to one another or in simple words; they are indivisible from one another. Be it fixing problems associated with institutional arrangements or development of leadership skills or promoting the development of knowledge or accountability, every form of capacity building involves training from micro (individual) to organizational level.

Role of Training in Capacity Building

All interventions in capacity building should provide training for all the direct stake holders. Other stakeholders who are indirectly associated with interventions including the owners of establishments / organizations may also benefit from training. Training may also be needed to support advocacy efforts. Training will eventually lead to formation of new trainers who in turn can eventually become trainers of their peers and of other groups.

Examples:

a. In capacity building of a National disaster relief team, it involves the process of systematic stimulation and developing their capability over time to achieve their skills through training which leads to improvement of knowledge, systems, and institutions – within a wider social and cultural enabling environment.

b. Capacity building of a democratic government involves increasing ability to handle problems associated with environmental, economic and social transformations and building up ability to budget, collect revenue, create and implement laws, promote civic engagement, be transparent and accountable and fight corruption.

Justification through Case Studies

1. Dr.K. Madhu babu, (2008) conducted A study on training interventions of EEI on the capacity building of functionaries of development departments. This study revealed that, the capacity of extension personal is said to have been built when they acquire sufficient knowledge and skills to do a particular task. Training helps to enable the knowledge & skills. The study involves five clientele states of EEI i.e., A.P., Tamil Nadu, Karnataka, Kerala and Orissa. A total of 237 trained extension functionaries who had attended training programme Results of this study, says that training programs were useful to the trainees in both direct and indirect ways through gaining more knowledge and skills and their utilization at back home situation. Gaining of knowledge and skills in training programs are helps in capacity development of trained extension personals effectively.

2. Chauhan, (2008) conducted a study on Capacity building of farmers through training on organic farming practices in Surendranagar district of Gujarat state. They selected 90 trained and 90 untrained from Surendranagar district of Saurashtra region The results in trained farmers' case 76.00 per cent were ready to adopt and also in the procedure of organic farming certification passing through NSC (National Steering Committee), AA (Accreditation Agency) and I & CA (Inspection and Certification Agency) by awareness imparting in the training program while untrained farmers' were found only 41.75 per cent due to lacking of information regarding certification. And the percentage of adoption of organic farming practices like seed treatment with Trichoderma, application of bio pesticides instead of chemical pesticides, application of FYM green manuring etc are higher in trained farmers compared to untrained farmers. This result shows that capacity building of farmers is enhanced through training on organic farming practices.

Conclusion

There is enough evidence to inform that training is and will be major constituent of capacity building and it (capacity building) takes place through training inevitably in every step and form. Training can be selected to optimize the impact of a capacity building Programme. But the institutions and organizations should carefully consider methods for intervention offered in capacity building, based on the targeted group and purpose. Capacity building interventions can enhance knowledge, skill, self-efficacy, changes in practice or policies, behaviour change etc. provided, the interventions follow effective training systems.

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Effect of Volatile Organic Compounds (VOCs) in Plant Health

Article ID: 11452

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Introduction

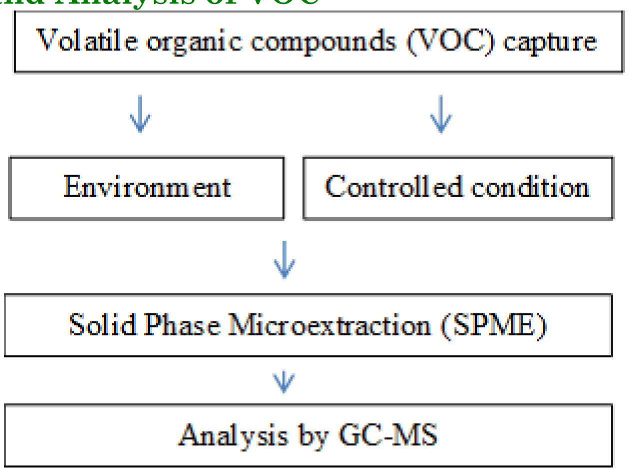
Volatile organic compounds are chemical substances produced and emitted by plants and other organisms in gaseous form. Composed of carbon, they help plants to attract pollinators, defend against herbivore insects and parasites, and serve as signals to neighbor plants.

VOCs are a major currency in plant communication where they mediate above- and below-ground interactions between plants and the surrounding organisms (i.e., other plants, microorganisms, pollinators, seed dispersers, herbivores, and their natural enemies). Considering the multiple interactions mediated by VOCs and their impact on a plant's reproductive success and survival, they can be a crucial weapon in plant-plant competition.

Volatile Mechanisms

Mechanisms by which volatiles can mediate plant competition can be direct or indirect. Direct mechanisms include establishing a neighbour's identity and status to select adequate responses and affecting competitor's seed germination or growth through VOC-mediated allelopathy. Indirect mechanisms can affect the plant's competitive ability by modifying interactions with other trophic levels, for instance, through associational resistance or chemical camouflage. These mechanisms are not mutually exclusive and can be seen as part of a continuum.

Collection, Extraction, and Analysis of VOC



VOCs Protects Plants to Withstand Biotic and Abiotic Stresses

Emission of VOCs can be induced at any time from leaves of all plant species following abiotic or biotic stresses. The emission of isoprenoids, the most abundant group of VOCs, is stimulated by abiotic stresses and improves plant resistance either by direct quenching of reactive oxygen species (ROS), or indirectly by stabilizing cell membranes. However, protection of cell membranes to avoid toxic accumulation of ROS is only one among the many roles of VOCs that may be exploited in agriculture.

VOCs Inhibit Growth and Development of Plant Pathogens

The capacity of various VOCs produced by leaves to inhibit germination and growth of plant pathogens, yet the mechanisms of action remain unknown. Citral, carvacrol, and trans-2-hexenal were reported to be effective in hampering in vitro growth and germination of *Monilinia laxa*, the agent of brown rot of stone fruit.

In particular, trans-2-hexenal provided protection also when tested in vivo on apricot, nectarine, and peach fruits as a postharvest biofumigant. In addition, the growth of *Colletotrichum acutatum*, causing citrus post-bloom fruit drop, was moderately inhibited in vitro when exposed to linalool. Botrytis cinerea, a necrotrophic fungus with a very broad host range, has been reported to be highly sensitive to the in vitro application of monoterpenes, such as (+)-limonene. However, exposure to (+)-limonene stimulated in vitro growth of the fungal pathogen *Penicillium digitatum*, whereas this fungus was highly inhibited by the application of citral.

VOCs Improve Plant Growth and Productivity

Emission of VOCs from leaves can have allelopathic effects and impair the growth of other competitive plant species. Hexenal and isoprenoids (mono- and sesqui-terpenes), for instance, have been demonstrated to inhibit seed germination and root growth. By mediating competition between plant species, VOCs may allow to control weeds and thus enhance crop productivity through a more efficient acquisition of nutrients, water, and light. Moreover, it was recently proposed that VOCs (i.e., isoprenoids) may work in synergy with other secondary metabolites (i.e., carotenoids) and hormones (i.e., cytokinins) which are all synthesized by the methyl erythritol phosphate (MEP) pathway to regulate senescence. Aging of plant tissues is controlled by changes in hormone levels and may lead to uncontrolled accumulation of ROS following damage to cellular organs (i.e., membranes) and other macromolecules (i.e., DNA). Therefore, a sustained production of volatile isoprenoids may synergize with the biosynthesis of cytokinins and increase antioxidant activity at the foliar level. This could prevent cell degradation and death, thus prolonging the life span of leaves and flowers with a positive impact on the whole plant production process.

Conclusion

Potential applications of VOCs are much wider, as they can also protect from pathogens and environmental stresses. VOCs prime plant's defense mechanisms for an enhanced resistance/tolerance to the upcoming stress, quench reactive oxygen species (ROS), have potent antimicrobial as well as allelopathic effects, and might be important in regulating plant growth, development, and senescence through interactions with plant hormones. VOCs are applied in agriculture solely for the "push-pull strategy", where the crop of interest is both intercropped with plant species that emit VOCs able to repel ("push") herbivores, and surrounded with plants emitting VOCs that simultaneously attract ("pull") herbivores away from the field.

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Role of Insects in Sustainable Agro-Ecosystem

Article ID: 11453

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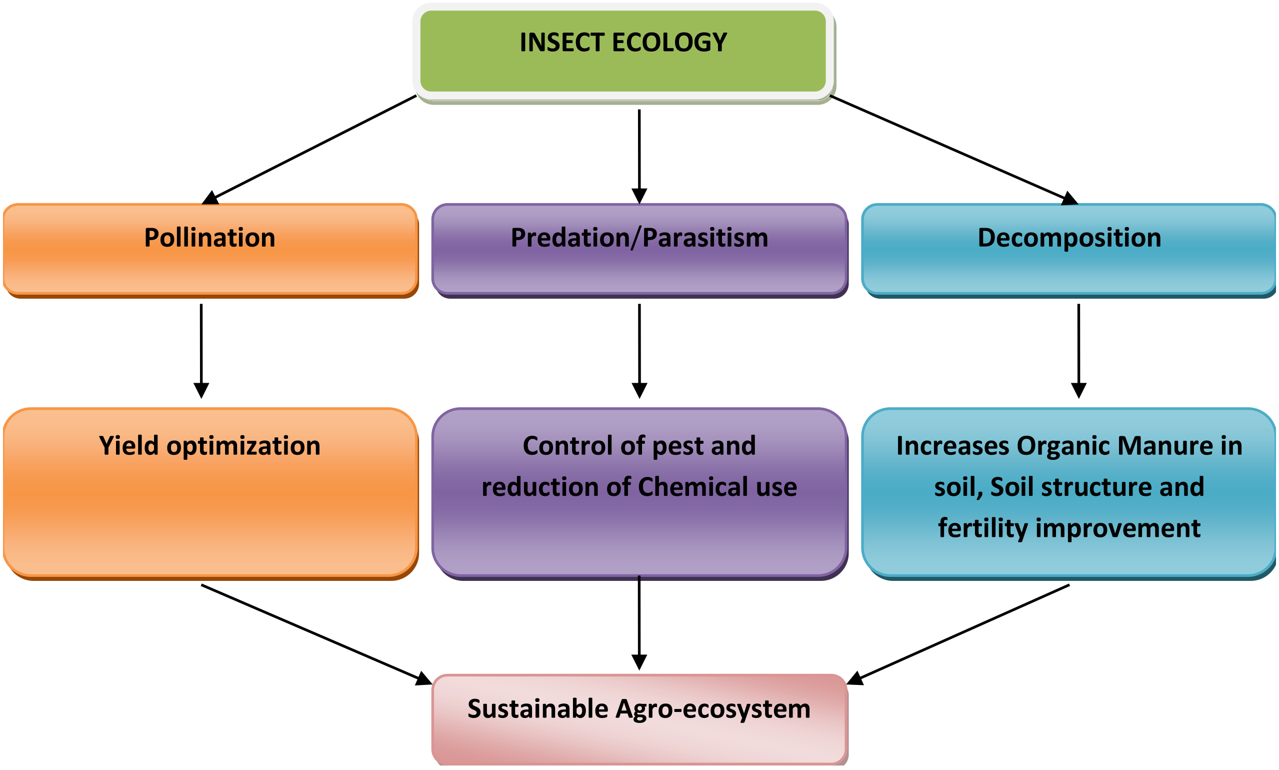
Introduction

Insects play important roles in nutrient cycling, seed dissemination, bioturbation, food chain pollination, and pest control, among other ecological processes. Production strategies in traditional agriculture are focused on a few selected species and their unique requirements. Understanding the role of insects in ecosystems can help us appreciate their value in the long-term viability of our agricultural systems, according to the researchers. The global challenge is to maintain high and consistent yields while also ensuring that agricultural production is environmentally sustainable. Insects' role will be reconsidered in order to ensure food security and environmental conservation.

Role of Insects in Ecosystem

Mechanisms by which volatiles can mediate plant competition can be direct or indirect. Direct mechanisms include establishing a neighbour's identity and status to select adequate responses and affecting competitor's seed germination or growth through VOC-mediated allelopathy. Indirect mechanisms can affect the plant's competitive ability by modifying interactions with other trophic levels, for instance, through associational resistance or chemical camouflage. These mechanisms are not mutually exclusive and can be seen as part of a continuum.



Role of Insects in Agro Ecosystem Sustainability

1. Pollination: Around 80% of all trees and plants on the world are pollinated by insects. Plants expend a lot of energy to produce gorgeous flowers that are loaded of nectar. These characteristics are created largely to attract insects, who are the primary pollinators for the majority of them. Plant-insect interactions are quite complicated. Most important pollinators include beetles, flies, ants, moths, butterflies, bumble bees, honey bees, solitary bees, and wasps. Bees are one of the most common pollinators, and they can live in groups or alone. Common social pollinators such as honey bees and bumble bees are generalists who visit a variety of plant types for nectar and pollen. Honey bees, the most significant crop pollinators, pollinate over 100 different fruits and vegetables, whereas bumble bees, which vibrate while pollinating, are more effective pollinators for plants like tomatoes. Pollination of native crops such as blueberries, squash, pumpkin, cucumbers, and cranberries are aided by native pollinators. If bees were not there, most of the plants we rely on would be unable to produce the majority of the food we consume. The vast majority of the plants would be unable to reproduce as well. Pollinator numbers are decreasing in some areas, governments prompting to adopt pest management and efficient land-use methods to boost pollinator activity. Authorities are now aware of the importance of conserving and rehabilitating pollinator habitats.


Figure: 1 Pollination by HoneyBee

Yield Increase Due to Bee Pollination:

Sl. No.	Crop	Yield Percent increase
1.	Coreander	187
2.	Lucern	112
3.	Cucurbitacious vegetable	30-100
4.	Onion	93
5.	Apple	44
6.	Mustard	43
7.	Sunflower	32-48
8.	Gingelly	25
9.	Cardemum	21-37
10.	Cotton	17-19

2. Predation: Insect predators naturally manage herbivorous insects that have the potential to become pests; three types of predatory insects are frequent. Many predatory insects, such as ground beetles, tiger beetles, lady bird beetle grub and ant lion larvae, use their mandibles to grab and kill their prey. Praying mantis, huge water bugs, and ambush bugs are among the insects that have larger front legs (raptorial legs) to catch and kill prey. A third method of prey capture used by winged predators is to grab prey with all of the legs while in flight. Dragonflies, robber flies, and scorpion flies are among the insects that adopt this technique. All of these insects are generalists, eating any suitable-sized arthropod they come across.

Figure: 2 Predation on aphid by Lady bird beetle grub

Figure: 3 Predation of grasshopper by Praying mantis

Predator insects and their attack insects:

SL. No.	Predator insect	Attack insects
1.	Lady bird beetle	Aphids, whiteflies, scales, mites, mealy bugs and other soft-bodied insects.
2.	Praying mantis	Many, including aphids, flies, beetles. Feeds on pests as well as beneficials.
3.	Green lace wing / Brown lace wing	Aphids, spider mites, whiteflies thrips, leafhoppers, scales, mealy bugs, psyllids, small caterpillars and insect eggs.
4.	Dragon fly / Damsel fly	Mosquito, moths, bees, flies.
5.	Syrphid (Hover) fly	Aphids, scales, thrips and other small soft-bodied insects.
6.	Assassin bugs and ambush bugs	Caterpillars, aphids, beetles, and others.
7.	Ground beetles and tiger beetles	Aphids, caterpillars, other beetle larvae, fly larvae, mites, springtails, slugs, and even small weed seed.
8.	Paper wasps, yellow jackets, potter wasps, and hornets	Caterpillars, aphids, midges and leaf miners.
9.	Big eyed bugs	Lygus bugs, aphids, leafhoppers, spider mites.
10.	Predatory mites	Plant feeding mites.
11.	Anthocorid bugs	Spider mites, thrips, aphids, pear psylla, young scale, various insect eggs.

3. Parasitism: Entomophagous parasites, which are also insects, are parasites that feed on other insects. The parasites usually attack immature insects or larvae. Some parasitic insects lay their eggs in the bodies of other insect species, such as larvae. When the eggs hatch, the parasitic young kill and eat the larva, gaining nutrients from the host. The host is paralysed by the parent parasite, which is then consumed by the young parasite. This is most commonly seen in wasps like *Ampulex compressa*, whose young eat paralysed cockroaches stung by the parent. Some wasps, such as *Ropalidia romandi*, puncture their host's abdomen and live there; the parasites affect their behaviour and appearance, and even render the host infertile, but they do not kill their hosts. Almost every insect species is taken by at least one form of parasite.

Figure:3 Parasitism by Braconid wasp On Hawk Moth Larvae

Figure: 4 Parasitism by jewel wasps (Ampulex compressa) on Cockroach

Parasitoid insects and their attack insects:

SL. No.	Prasitoid insect	Attack insects
1.	Parasitic Wasp *(Meteorus trachynotus)*	Leaf roller
2.	Braconid wasp	cocoons on tomato hornworm
3.	*Encarsia formosa*	whitefly
4.	*Aphelinus mali*	woolly apple aphid
5.	*Trichogramma* sp.	Lepidopteran Insects.
6.	jewel wasps *(Ampulex compressa)* *Evania appendigaster*	Cockroaches
7.	*Platygaster oryzae*	Rice gall midge.
8.	*Telenomus beneficiens*	*Scirpophaga incertulas*

9.	*Telenomus remus*	*Spodoptera litura*
10.	*Oorncyrtus pyrillae*	*Pyrilla perpusilla*

4. Decomposition: Many insects called saprophages feed on the decaying bodies of plants and animals because they are a rich supply of organic materials. Insects that have evolved to this lifestyle are significant to the ecosystem because they contribute in the recycling of dead organic matters.

Entomologists distinguish several distinct categories among saprophagous insects:

a. Those who eat dead or dying plant tissues - Termite, Grubs.
b. Those who eat dead animals (carrion) - Blow fly, ant, wasps, mites.
c. Those that eat other animals' wastes (faeces)- Dung beetles, termites.

A diverse range of soil and wood-dwelling species that shred leaves or tunnel in woody tissues make up the dead plant feeders. They promote degradation by increasing the amount of surface area exposed to weathering and decomposer activity. They are significantly responsible for the formation of a humus layer that frequently covers the soil. Fungi, bacteria, and other microbes that release carbon, nitrogen, and mineral elements for assimilation by live plants use this layer as an incubator.

Among the carnivorous predators are Beetles, Blow fly larvae (maggots), Wasps, Ants, Mites, and other insects. Each species only stays for a short time on the dead body, but as a group, they quickly eat and bury the decaying flesh. Blow flies are the first to arrive on a body, and they are also the first to grow and leave. As the body decomposes, other species follow in a fairly predictable pattern.

The odour of animal waste attracts many kinds of manure flies and dung beetles. Adults lay their eggs in fresh dung, and larvae eat the organic content in the dung. Many dung-feeders have specific preferences for different types of manure: for example, the species associated with horse feces may be considerably different from that found in cattle manure on the same farm.

Tumblebugs, a type of dung beetle, roll the excrement into a little ball (50 times on animals' own weight) and place it in a hole excavated in the dirt earlier. To act as a nursery for their larvae, they place an egg on the ball of faeces and cover it with soil.

Figure: 5 Tumble bug rolling Dung balls.

Figure: 6 Blow fly decomposing Animal body

5. Food chain: The food chain is formed by insects, especially for entomophagenic vertebrates like numerous mammals, birds, amphibians and reptiles. Insects are found in almost every food chain on the planet. First-order consumers are known as caterpillars. Caterpillars devour plants and absorb the nutrients produced by the plants into their bodies.

Second-order consumers are birds. Birds that do not eat plants will eat the caterpillar, allowing them to consume the plant nourishment. The caterpillar plays a crucial role in providing food for a variety of different animals.

Caterpillars are in charge of delivering the sun's energy, which is locked in plant food to many bigger creatures, such as birds, bats, amphibians, and fish; consume insects before predators consume them. The mortality of insects is thought to be a major factor in recent bird population reductions. People in certain societies gather and consume insects themselves.

They are a great source of protein, vitamins and minerals and are valued in many Third World nations as delicious products. Actually, an insect that is not consumed by mankind in any way is uncommon to discover. Wasps, ants, locust, cicadas, mantises, Caterpillar, Cricket, and grubs among the most popular.

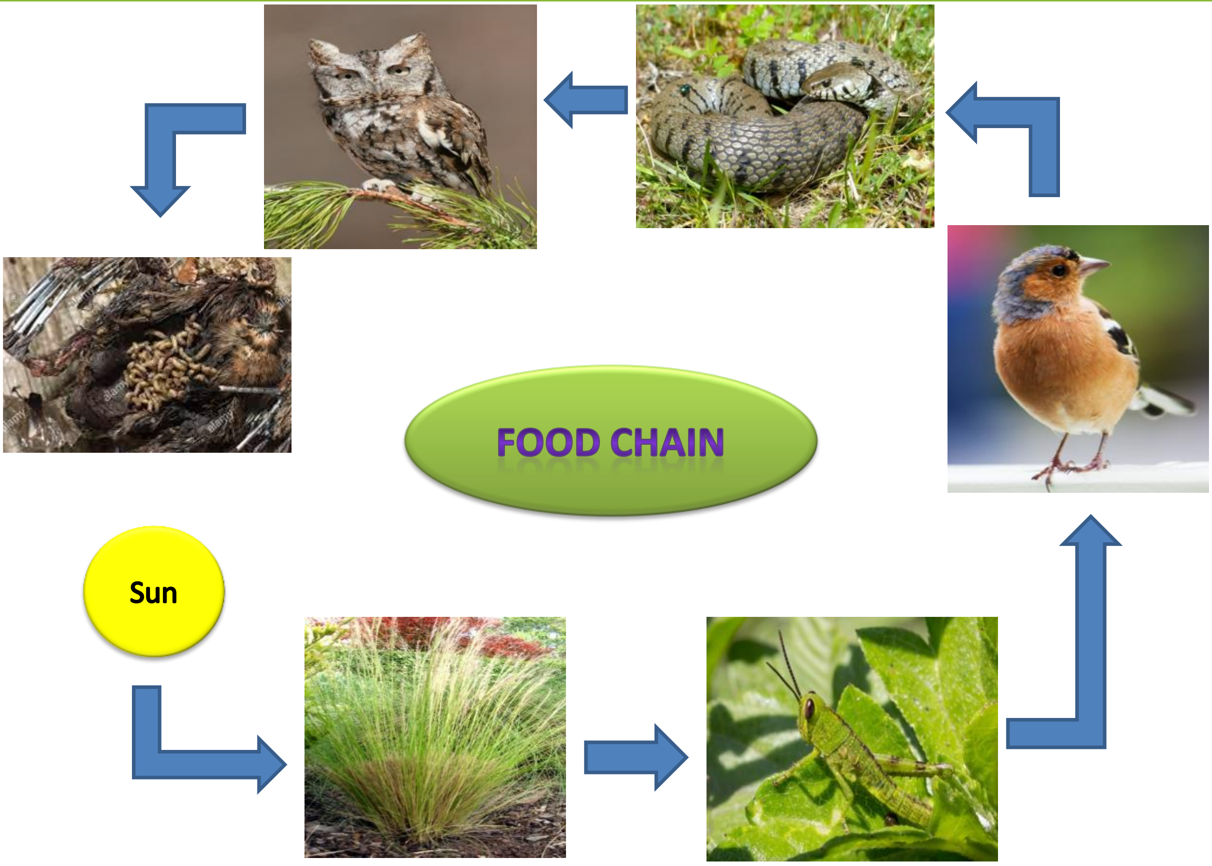


Figure:7 Food Chain (Sun-Grass–Grasshopper–Bird–Snake–Owl–Decompose by insect)

Conclusion

Insects are important contributors to ecosystem function on all levels and play important roles in all ecosystems. We must manage agricultural systems in such a way that insects provide important ecosystem services become an integral component of the system. The importance of insects in ecosystems should be the focus of future sustainable agricultural research. Insect's relationship with humans is beneficial, benign or pestiferous only because we have defined it as such. Therefore, some insects can have more than one relationship with humans. Honey bees pollinate our crops but may be considered a pest because they can sting. Ants are unwanted guests if found in a house but are important decomposer organisms for the maintenance of soil fertility. Food, lumber, clean air and water and all the other goods and services derived from ecosystems would not exist without insects. Living in balance with insects and the other component of ecosystems will aid human survival and prosperity.

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Agrobots for Sustainable Crop Production - An Overview

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Abstract
Mechanization is a critical component of productive farming systems. It facilitates the shift from subsistence to market-oriented agriculture, creates off-farm jobs for women and youth and accelerates rural development. Agricultural tools, equipment and machinery for land preparation, crop management, harvest and post-harvest operations, processing and all actions in the agri-food value chain are among the mechanization choices. Agriculture, particularly in poor nations, can be made more appealing to rural youth through digital advancements in automation technologies. New and more appealing jobs can be developed with the required rural infrastructure, supply chains, services, and training in place, benefiting those rural communities that were left behind when agriculture relied on simple hand tools. This publication provides a timely overview of the next generation of agricultural machinery, focusing on robotics for agricultural production in order to accelerate rural development.

Introduction
Agricultural mechanization offers the power and equipment needed in the field and on the farm to prepare the land to establish and maintain crops, store and process agricultural products. It has progressed from simple hand tools and animal-powered implements to complex engine-powered machinery over time. Conversely, hand tools and animal power are still widely used in underdeveloped nations, hampering agricultural output and harming small-scale farmers' livelihoods. The aim to alleviate drudgery and remove hard work during peak labour periods drives mechanization improvements. Data-driven agriculture, aided by robotic solutions that incorporate artificial intelligence (AI) approaches, will be the foundation of future sustainable agriculture (Saiz- Rubio and Rovira-Mas, 2020). Hence, this report explores the possible applications of agricultural technology, through a novel Agriculture 4.0 approach by employing Agrobots or Agricultural robotics for achieving sustainable agricultural production in developing countries.

Agriculture 4.0
Agriculture evolves in tandem with science and technology, and it's only a matter of time before the Internet of Things (IoT) makes its way to farmland. Technical advancements in new agricultural technology should aim to increase production efficiency, quality, environmental effect, and risk connected with production. Precision farming, blockchain adoption in value chains (e.g., transportation, storage, washing, grading, packaging, labelling, or processing), AI for pest and disease diagnostics and management options, remote sensing (satellite and drone imagery), and deployment of ground sensors (soil, crop, or meteorological stations) or automated equipment for farm operations are all examples of such improvements (Valle and Kienzle, 2020).

Agrobots
Robotics refers to systems or machines that have additional intelligence added to them for autonomous work or that have a new intelligent machine produced for an existing function. Existing systems with some components that have been automated for transporting or working without human intervention are referred to as automated equipment. The term "agrobot" or "agricultural robotics" is an appropriate description for autonomous devices that can do a variety of repetitive agricultural chores on the farm without the need for direct human participation, from land preparation to harvesting. Agrobots are capable of a wide range of tasks. The first agrobots on the market are designed to do three things: remove weeds, monitor pests and diseases, and harvest specialty crops (fruits or vegetables). An agrobot decreases labour needs (weeding and harvesting), restricts the use of inputs (pesticides), and reduces crop losses due to late

detection of pests and illnesses, all of which save money. Agrobots have as many applications as there are agricultural activities. Prototypes that can prepare the soil, sow, control pests, and harvest cereal crops currently exist (e.g. barley or maize). Agrobots are also lighter than traditional machinery (such as tractors with implements or specific spraying or harvesting equipment), allowing them to avoid soil compaction and access fields that are inaccessible to large machinery (land affected by wet conditions).

AI and CV for Weeding

Weeding is one of the tasks that farmers would gladly delegate to agricultural robots. To perform such a task, an agrobot must be equipped with technologies that allow it to detect and remove weeds from the cultivated crop. Computer Vision and Artificial Intelligence are examples of such tools. These technologies rely on machine learning skills to improve their accuracy, allowing the robot to take and refine images of the targeted area, identify the things discovered and lastly, use its end-effector to electrocute the weeds (Sims et al., 2018).

Herbicide Efficiency

Currently, herbicide resistance has been observed in more than 250 weeds as a result of exploitation of these products. Farmers have already suffered financial losses as a result of this phenomena. To address the aforementioned issue, robotic methods are currently being employed to target the weeds using a spraying system that only releases the quantity of herbicide required, considerably minimizing the crops' exposure to chemicals. We obtain a double benefit: first, the food supplied to the people will include less chemicals because farmers will no longer be required to apply pesticides across entire fields.

Planting and Seeding

Agricultural robots with Computer Vison can create three-dimensional models of specific locations. These maps can be used for a variety of tasks, such as planting seeds while maintaining a safe spacing between them. This process, known as 'thinning,' ensures that items expand to their full potential. This gadget has a four-year lifespan before it needs to be replaced.

Improved Irrigation Methods

Water is a limited resource that must be conserved as much as possible. While watering plants in a field may appear simple and basic, it is a critical agricultural activity that can influence whether a crop succeeds or fails. Both plant and soil health can be harmed by too much or too little water (which in turn can hinder the cultivation of future crops). Some IoT solution providers say that their technology, which includes sensors that assess soil moisture, can save water consumption by 30%. It gives farmers the information they need to prevent over-irrigation or drought. To measure water levels, the sensors are put around trees. These sensors are connected to irrigation systems to water only those trees that are actually thirsty.

Optimization of Pest Control

Inefficient pest control can drastically damage agricultural productivity. Manual inspection for pests is immensely time-consuming, especially for large-scale farmers and never a scalable procedure. Farmers may utilize IoT sensors to get reliable, real-time data on the health of their crops, which can help them spot pest infestations. Image sensors with low and high resolution can be used to learn about the general behavioral patterns of specific pests on a farm. For example, if climate sensors detect certain circumstances in which certain pests thrive, the IoT system might help farmers anticipate an infestation and prepare ahead of time. These sensors, as well as other smart-farming technologies, can be used to assess the efficacy of existing pesticide applications. Users can tweak how, where, and when particular tactics are implemented. Many variables, such as human subjective perception and human mistake, are eliminated when using IoT in agriculture.

Demeter

Demeter can drive, steer and control the cutter head while the operator can focus on other tasks. It can harvest crop like wheat and alfalfa. It has cameras on it so that it can detect the difference between the crop that has cut and hasn't.

Fruit Picking Robot

The robot can distinguish between fruits and leaves by using video image capturing. If a match is obtained the fruit is picked. Mobility is priority and the robots must be able to access all the areas of tree being accessed. Artificial Intelligence applied to agriculture also has the power to respond to the decreasing agricultural workforce. Robots, as strawberry picking machines, can harvest eight acres of land in 24 hours.

Conclusion

Agricultural robots are still in their infancy, but there are already signs of their potential. The challenges ahead are not just technological, but also socioeconomic, especially in terms of capacity building and a thorough understanding of the principles and technology at hand. Agrobots, on the other hand, will be able to undertake jobs that are labour intensive by nature, and will thus make a significant contribution to enhancing sustainable agricultural production and the livelihoods of smallholder farmers in poor nations. Agricultural robots also present an opportunity to increase crop production efficiency, improve agricultural sustainability, and bring innovation and advanced technologies to new areas.

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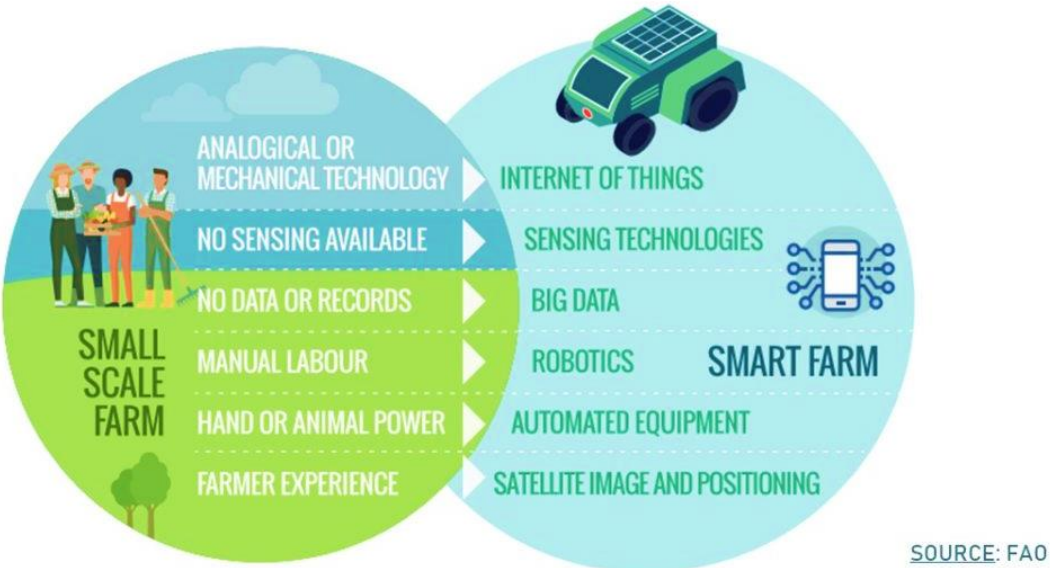

Comparison between a smart farm (Agriculture 4.0) and a small-scale farm (conventional agriculture)

Robotic weeders

Pesticide Spraying robots

Fruit Picking robot

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Success Story on Management of Fall Army Worm in Maize

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Abstract

Maize, *(Zea mays)*, also called as corn, cereal plant of the grass family (Poaceae or Gramineae) and its edible grain used as livestock feed, human food, bio-fuel, and raw material in industry. Maize crop is cultivated in all districts of Gujarat and also in Panchmahal district throughout all the seasons. Due to the recent incursion of fall armyworm, (*Spodoptera frugiperda*, J. E. Smith) on maize, the farmers were feared and neglected the crop. With the adoption of recommended technology, farmer has reported lowest leaf, whorl, tassel and cob damage caused due to fall armyworm also had direct relation in minimizing the larval population. Due to technology intervention, intercrop resulted in the increased activity of natural enemies' viz., spiders and coccinellids. The highest grain yield was recorded in the recommended technology (32.50 q/ha) with 34.85 per cent increase over farmers practice (24.10 q/ha).

Keywords: *Spodoptera frugiperda*, maize, recommended technology.

Introduction

In the past 3-4 years, there occur few challenges towards maize crop growing due to alarming problem of an invasive pest, fall armyworm (FAW), *Spodoptera frugiperda* not only in Gujarat all over India. The maize is major crop and cultivated during all the three seasons' viz., Kharif, Rabi and summer in Panchmahal district. In order to increase the area extension and production of maize, which is uncertain due to the non-adoption of proper management practices to combat this pest. Hence, to overcome the problem on technology adoption, under ICAR-KVK Panchmahal intervention on demonstration of FAW technology was carried out during Kharif season 2019-20 in the farmer field of Mr. Amarsinh Narvatsinh Chouhan, Bediya village, Kalol taluka, Panchmahal district of Gujarat with an objective to reduce FAW incidence with the adoption of recommended technology of NAU, Navsari Gujarat.

Results

The recommended technology was demonstrated in the farmers field with farmers practice as mentioned below (Table 1) towards the management of FAW. The technology adopted by the farmer registered in the reduction of FAW as compared to the farmers practice (without technology). With the adoption of technology i.e, spray of neem oil @ 40 ml (1500 PPM) per 10 litres of water and intercrop with pigeonpea, the farmer has recorded the lowest leaf, whorl, tassel and cob damage caused by FAW which had positive relationship in reducing the larval population. The neem oil spraying caused lethal effect on larvae on different crops caused mortality and inhibit the larval development (Khajuria et al., 2016a; Khajuria et al., 2016b; Khajuria et al., 2015; Khajuria et al., 2014). Due to technology intervention, intercrop with pigeonpea recorded in the increased activity of natural enemies' viz., spiders and coccinellids. The pheromone trap catches were taken at weekly interval and recorded 5 adult male moths/week till 40 DAS. The adult male catches of fall armyworm at initial stages of crop growth had a positive impact on the grain yield. The highest grain yield was recorded in the recommended technology (32.50 q/ha) with 34.85 per cent increase over farmers practice 24.10 q/ha (Table 2).

Conclusion

Recommended technology adoption in maize has brought a significant impact in terms of reduction of fall armyworm and increase in yield. Raising of intercrop has tremendously increased the activity of natural enemy population in the field thereby indirectly reducing the larval population. In general and to be specific, recommended technology adoption in maize is the need of the hour to combat FAW in the upcoming years.

Table 1: Recommended technology Vs Farmers practice:

S. No.	Recommended technology	Farmer's practice
1	Deep ploughing	Normal ploughing
2	Application of neem cake (100 kg)	Not applied
3	Seed treatment with thiamethoxam 30 FS (10 g/kg of seed)	Not treated
4	Inter crop: Pigeonpea	-
5	Pheromone traps (5 Nos)	-
6	Spray of neem oil @ 40 ml (1500 PPM) per 10 litres of water at15-20 days after sowing (DAS)	-
7	Spray of neem oil @ 40 ml (1500 PPM) per 10 litres of water at 45 DAS	Spray of chlorpyriphos 30 ml / 10 litres of water

Table 2: Impact of recommended technology and farmers practice towards fall armyworm:

Parameters	Recommended technology	Farmer's practice
Leaf damage (%)	10.6	26.20
Whorl damage (%)	6.10	35.70
Tassel damage (%)	5.60	22.10
Cob damage (%)	6.10	25.20
Larval population (number per plant)	0.62	1.71
Trap catches (numbers) (mean /week)	5.00	-
Natural enemies (number per plant)	1.40	1.10
Grain Yield (q/ha)	32.50	24.10
Benefit cost Ratio	2.33	1.93

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Nematode-Fungus Interaction in Crop Plants

Article ID: 11456

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Summary
Fungi and nematodes are the most considerable organisms in soil habitats. They play vital roles for retaining the stableness of food webs and for facilitating nutrient cycling. Nematode fungus interaction in the soil is numerous and fungus can cause considerable damage once they enter into the plant roots in the presence of nematodes. This text offers a vast framework of interactions between fungi and nematodes with an emphasis on those that effect vegetation and agriculture ecosystems.

Introduction
Environment comprises of numerous sorts of life forms, including various kinds of infinitesimal organic entities like archaea, protozoa and nematodes etc., which collaborate with one another to perform biological system capacities. Their collaborations occur through various mechanisms like predation, parasitism, mutualism or contest. These connections are basic for keeping up biological system balance (Topalovic and Heuer, 2019).

The phylum Nematoda, is considered to be the second biggest phylum in the set of all animals, enveloping an expected 5,00,000 species (Bongers and Bongers, 1998). Fungi are primary decomposers of dead natural matter; they perform major jobs in supplement cycling in the biological system. In spite of the fact that growths may look like plants, they are truth be told developmentally more firmly identified with creatures than to plants. Both fungi and nematodes are heterotrophs and commonly found co-existing in a diversity of natural and man-made ecosystems, especially in the rhizosphere of plants, including crops, with significant impacts on agriculture and forestry.

Nematode- fungus interaction was first observed by Atkinson (1892) in cotton. *Fusarium* wilt of cotton (*Fusarium oxysporum*f.sp. *vasinfectum*) was recorded more severe in the presence of root-knot nematodes (*Meloidogyne* spp.). Interactions between *Meloidogyne* spp. and *Fusarium* wilt has been documented in several host crops such as alfalfa (Griffin, 1986); beans (France and Abawi, 1994); tomatoes (Abawi and Barker, 1984; Suleman*et al.*, 1997); cotton (De Vay*et al.*, 1997; Abd-El-Alim*et al.*, 1999); coffee Bertrand *et al.,*(2000); peas (Siddiqui &Mahmood, 1999); bananas (Jonathan and Rajendran, 1998); and lentils (De *et al.*, 2001).

Besides, *M. incognita* has been determined in affiliation with the pathogen, *Thielaviopsis basicola,* which causes black root-rot of cotton (Walker *et al.,* 1998). In aggregate, they caused seedling mortality, root necrosis, suppressed early seedling boom and eventually lessen the proportion of bolls (Walker *et al.*, 2000; Wheeler *et al.,* 2000). In potatoes, *Globodera–Verticillium dahliae* and *Pratylenchus–Verticillium dahliae* disease complexes have become particularly notorious. Early senescence or 'early dying' caused by *V. dahliae* and *V. albo-atrum* is accentuated by presence of *Pratylenchus* spp. (Evans, 1987).

Pratylenchus–V. dahliae, besides reducing the crop yields, produced other destructive outcomes including the disruption of photosynthesis, stomatal conduction and transpiration (Saeed *et al.*, 1997).

Another disease complex involves the soyabean cyst nematode, *Heterodera glycines* and the fungus *Fusarium solani*. Sudden death syndrome (SDS) caused by *F. solani* is a major disease of soyabean which, among other symptoms, induces root rot, crown necrosis, interveinal chlorosis, defoliation and abortion of pods (Rupe, 1989; Nakajima et al., 1996).

Meanwhile, entomopathogenic nematodes and pathogenic fungi have been shown capable of generating additive interactions to increase insect pest mortality (Ansari, and Shah, 2015). In these cases, an initial fungal infection plays a key role in weakening the larvae and increasing the pest insect's susceptibility to nematodes by generating a stressful condition and altering the insects' behavior (Ansari, 2006).

Table 1. Nematode-fungus disease complexes in insects:

Sl. No	Nematode	Pathogen	Crop/Insect
1.	*Steinernemadiaprepesi*	*Fusariumsolani*	Wax moth, Weevil
2.	Heterorhabditisbacteriophora, Steinernemafeltiae, *S. kraussei*	*Metarhiziumanisopliae*	Black vine weevil
3.	*H. sonorensis*	*F. oxysporum*	Corn earworm
4.	*S. feltiae, S. carpocapsae, H. bacteriophora*	*Aspergillus* spp., *Penicillium* spp.	Carob moth
5.	*S. diaprepesi*	*F. solani*	Weevil

Table 2. Nematode–fungus disease complexes in crops:

Crop	Name of the disease	Nematode	Fungus	Role of nematode
Cotton	Damping off	*Meloidogyne incognita acrita*	*Rhizoctonia solani*	Assists
		M. incognita acrita	*Phythiumsp.*	Assists
	Vascular wilt	*M. incognita acrita*	*Fusariumoxysporum F. vasinfectum*	Assists
	Black shank	*M. incognita acrita*	*Phytopthoraparasitica var. nicotianae*	Assists
Tobacco	Damping off	*M. incognita acrita*	*P. debaryanum*	Assists
	Vascular wilt	*M. incognita*	*Fusariumoxysporumf.sp.nicotianae*	Assists
Banana	Vascular wilt	*Radopholussimilis*	*Fusariumoxysporumf.sp. cubense*	Essential
Tomato	Vascular wilt	*Meloidogynespp*	*Fusariumoxysporumf.sp. lycopersici*	Assists
	Cortical rot	*Globoderarostochiensis*	*R. solani*	Assists
Potato	Damping off	*Ditylenchus destructor*	*P. infestens*	Assists
	Cortical rot	*G. rostochiensis*	*R. solani*	Assists
Onion	Damping off	*Ditylenchusdipsaci*	*Botrytis alli*	Assists
Brinjal	Vascular wilt	*P.penetrans*	*Verticiliumalbo-atrum*	Assists
Wheat	Stem rot	*Anquinatritici*	*Dilophosporaalopecuri*	Essential

Increased chlorosis and in some cases vascular discolouaration in wilt resistant cultivars of chickpea were observed due to the concomitant infection with *Fusarium* wilt and root knot nematodes (Maheswari *et al*., 1995).

In concomitant inoculation of root knot nematode and FOL, severity of the wilt was significantly increased and plant growth and yield reductions were also considerably higher compared to the sum of individual effects of pathogens (Khan and Akram, 2000). There was a possibility of systemic induced susceptibility to the fungus by local nematode infection (Hadevi and Sahebani, 2008).

Exudates released by the plant roots are believed to attract both soil pathogens and the root knot nematode to the rhizosphere of the plant (Badri and Vivanco, 2009). Injuries caused by the root knot nematode as they penetrate the plant roots could then provide entry points for the fungal pathogens (Bhagawati*et al*., 2000).

Deepa *et al*. (2014) reported significant reduction in the plant growth parameters in *Tylenchulus semipenetrans- F. solani* interaction in lemon. It was observed that nematodes were more pathogenic than fungus and in combined inoculation, the pathogenic effect of fungus was found to be enhanced more when it was coupled with nematode as a pre disposing factor for fungal infection. The inoculation of fungus prior to nematodes caused reduction in nematode multiplication.

Reduction of Host Resistance

In the development of crop species that express resistance to economically important pests and diseases, the significance of nematode–fungus complexes are seldom, if ever reported, yet there are a number of studies that report breakdown of resistance during concomitant infections (Hillocks, 1994). Bowman &

Bloom (1966) found that the tomato cvs Rutgers and Homestead, resistant to *F. oxysporum*f.sp. l*ycopersici*, developed symptoms of wilt during split-root experiments with M. incognita. Further studies (Sidhu & Webster, 1977) using root layering and grafting techniques confirmed that a nematode-induced factor could be passed through a resistant scion (a graft from a resistant tomato cultivar) and render it susceptible to *F. oxysporumf.sp.lycopersici*. In contrast, resistant scions in tomato plants free from *M. incognita* infestation could block infection by *F. oxysporum*f.sp. *lycopersici*.

Vargas et al. (1996) observed a similar effect on chilli (Capsicum annuum), where the nematode *Nacobbus aberrans* caused a loss of resistance to *Phytophthora capsici* even if the nematode and oomycete were physically separated on split roots. While few reports have addressed how this might occur, Marley and Hillocks (1994) demonstrated that nematode-induced loss of resistance to *Fusarium udum* in pigeonpea (*Cajanus cajun*) was associated with reduced levels of the isoflavanoid phytoalexin cajanol. However, cajanol content was 62% lower and resistance was lost during combined infections of *F. udum*, *M. incognita* and *M. javanica* where wilt disease incidence and severity were significantly higher than in plants inoculated with *F. udum* alone. Although this study clearly shows that nematode infestation reduced a chemical defence mechanism to fusarium wilt in pigeonpea, it is still not known how nematode activity modified the plant. Marley and Hillocks (1994) suggested that either the overall metabolic rate of the plants was reduced, or specific changes were made to the synthesis of isoflavonoids during nematode attack.

Future Perspectives

For the management of illness complexes, a variety of alternate techniques have been examined. Several research in plant breeding (Meksem *et al*., 1999; Prabhu *et al*., 1999) have focused on identifying the loci responsible for dual resistance in soyabean against *F. solani* and *H. glycines*, both of which are involved in sudden death syndrome. Multiyear cropping regimes (Chen et al., 1995) and soil solarization (Lazarovits*et al*., 1991) have had varying degrees of success in lowering V. dahliae and P. penetrans population densities. Finally, the detrimental effects of a disease complex on pigeonpea involving the sedentary endoparasite, Heterodera cajani and the fungus *F. udum* were reduced following application of the fungi *Paecilomyces lilacinus* and *Verticillium chlamydosporium* together with the vesicular arbuscular fungus *Gigaspora margarita* (Siddiqui and Mahmood, 1995). The most promising method of combating disease complexes involving nematodes and fungi appears to be an integrated approach that targets both interacting organisms.

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Disruption of Food System During Covid Pandemic

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Abstract
The economic activity of the country at large was in danger, when the whole nation was ordered to quarantine themselves due to corona virus pandemic. The non-availability of labour during lockdown interrupted in harvesting activities and disrupted the supply chains because of transportation problems. Prices declined, closure of hotels, restaurants and tea shops depressed milk sales. COVID caused economic losses in every sector. The pandemic has specially affected the food market due to lockdown which affected the supply of agricultural and other food products, and also to reduce loss of employment and income. Government has been working with national and international organizations to find ways to remove difficulties in such tough times and finding ways to secure the future of food systems.

Introduction
The COVID-19 pandemic caused severe threat to mankind and all related aspects. The regulations for prevention like social distancing and sanitization are followed by all the nations worldwide which have resulted in closed markets, businesses, educational institutes, entertainment parks, religious gatherings etc. Very few workers from some selected industries are not working from home like the healthy industry and the food related personnels because however the situation may be, food production and supply is critical for every living being, even during a pandemic situation. There are many measures taken by the government to help in limiting the health crisis but the complete shutdown of economic activities except essential services for the first 21 days in the first phase of lockdown created an economic crisis and misery for the needy, with massive job losses and rising food insecurity within the under-privileged, daily wage earners and rural workers of villages by causing unemployment, financial and hence nutritional distress and finally malnutrition in many under nourished areas and vulnerable age groups.

Scenario During Lockdown
When 1.3 billion Indians were ordered to quarantine themselves, the economic activity of the country at large was in danger, starting from farming and animal rearing to consumption. Punjab was particularly hampered much because most of the country's rice and wheat granary are practised here. This sudden crisis hit hardest to millions of people in cities, where they had come to work for a few months before returning home to sow or harvest their land. Many workers had to stay for days without money and food, and even tried to move to their homes on foot as no vehicles was working. Their families faced difficulty in assessing rations even through PDS. The only thing they were dependent upon was NGOs and any kind of donations provided by noble people. This pandemic situation has highlighted the issue of unemployment and under employment in a modernised world.

Agriculture and Supply Chains
The non-availability of labour during lockdown hass interrupted harvesting activities and disrupted the supply chains because of transportation problems. Prices have declined for wheat, vegetables, and other crops, yet consumers were paying more. Many media reports showed that the closure of hotels, restaurants and tea shops depressed milk sales in India. Also, poultry farmers have been badly hit due to misinformation that meat and poulty may be carriers of COVID-19. S. Mahendra Dev, Director and Vice Chancellor of IGIDR, Mumbai has said some expert statements in this regard.

1. The government has correctly issued lockdown guidelines that exempt farm operations and supply chains. But implementation problems leading to labour shortages and falling prices should have been rectified.

2. Keeping supply chains functioning well is crucial to food security. It should be noted that 2 to 3 million deaths in the Bengal famine of 1943 were due to food supply disruptions—not a lack of food availability.
3. Farm populations must be protected from the corona virus to the extent possible by testing and practicing social distancing.
4. Farmers must have continued access to markets. This can be a mix of private markets and government procurement.
5. Small poultry and dairy farmers need more targeted help, as their pandemic-related input supply and market-access problems are urgent.
6. Farmers and agricultural workers should be included in the government's assistance packaging and any social protection programs addressing the crisis.
7. As lockdown measures have increased, demand has risen for home delivery of groceries and E-commerce. This trend to be encouraged and promoted.
8. The government should promote trade by avoiding export bans and import restrictions. If there is any export restrictions in food chain supply there will be potential global food insecurity in all the developing countries. Revenue losses, food and other edible commodities price surge and ban on export and import are causing havoc in food security.

Food security "hot spots" include:

a. Fragile, conflict-affected, where logistics and distribution are difficult
b. Countries of multiple crises where pest and weather extremes cause damages
c. Poor, needy, vulnerable and the food insecure.
d. Currency depreciation, which ultimately drive up the cost of food imports.

Devastating Effect on Food Security

When traders, labourers, exporters and importers have to abide by the lockdown rules of export bans, there will be traumatic effects on the food security. COVID caused economic losses especially to countries that rely only on imports. Even small countries that merely depend on tourism are facing revenue losses due to stop on tourist visits. The pandemic has also affected food market by logistical constraints and labour shortages due to lockdown which may increase the prices of food items worldwide. To monitor the supply of agricultural and other food products, and also to reduce loss of employment and income, the World Bank Group has been working with partners of the government and international offices and finding ways to impact people's ability to buy food. Organisations may find ways to transport food commodities in interstate borders by maintaining norms that prevent spreading of COVID, and also to urban areas from remote producing places so that there are no food shortages in specific regions that may lead to panic buying many times. It should be The WTO recognises that during such cases of short-term difficulties, food importing countries are eligible to obtain financial help in order to address such situations to ensure free flow of food products.

Policies Adopted by the World Bank:

1. Treating food as 'essential service' to keep food moving and opening special procedures for food, trade and agricultural inputs to ensure supply chains are kept open and functional.
2. Incorporating necessary health and safety measures along segments of food supply chain.
3. Supporting the most vulnerable populations via safety net programs, complemented by food distributions in areas where supply chains are severely disrupted.

In India, women's self-help groups, supported under the National Rural Livelihoods Mission co-financed by the World Bank, mobilized to meet shortages in masks and sanitizers, ran community kitchens and restored fresh food supplies, provided food and support to vulnerable and high-risk families, provided financial services in rural areas. In Angola, the World Bank financed Commercial Agriculture Development Project. This project helped farmers, cooperatives and small and mid-sized agricultural enterprises expand and improve their operations to meet the needs of local communities during the pandemic. Liberia worked with the government to ensure that food supply chains are sustained for longer period of time. Disruptions in the food supply chain were minimal, but logistical challenges were emerging. The Bank responded by fast tracking certain activities and activating a Contingency Emergency Response Component through Smallholder Agriculture Transformation and Agribusiness Revitalization Project (STAR-P) so the government can meet immediate food needs of vulnerable people, keep domestic supply chains moving and support smallholder farmers to increase food production. In Pakistan, more than 18,000 households mainly female-headed, received direct livelihood support through World Bank-financed projects to develop kitchen gardens, small scale livestock and agricultural activities.

Conclusion

Even before the novel corona virus outbreak, researchers noted the vulnerability of the nation's food systems in countries. COVID-19 brought light to the ways we should adopt to adequately mitigate climate change and find adaptation solutions in agriculture. The food value chain affected in different ways and therefore, the governments, private sector, NGOs, and farmers are grappling with the implications for current and future of food systems. Food security is threatened in some fragile places and countries where they are already suffering from food insecurity and climate change impacts, COVID-19 can potentially slip into conflict around access to increasingly scarce resources. We will need new research to understand how risks cascade across sectors and borders and their potential impacts on food system actors, and new approaches that account for interconnected risks.

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Super Seeder: An Alternative to Stubble Burning

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Introduction

Super seeder: The super seeding machine is a tractor-mounted machine that cuts and raises the rice straw, sows the wheat on the ground and deposits the straw in the seed area as a cover. It also grows rice straw in the fields. This technology is environmentally friendly for soil health and saves water as well. While sowing wheat, farmers usually burn rice residues which reduce soil fertility and produce gases harmful to humans, animals and the environment. Therefore, to maintain the nutritional value of the soil, SUPER SEEDER is the most effective tool for sowing wheat in rice residue without burning straw.

Fig.1. Super seeder machine

Main Parts of SUPER SEEDER

1. A box for seeds and fertilizer.
2. Seed and Fertilizer Pipes.
3. Three-point link.
4. Frame.
5. Gear box.
6. Drive wheel.
7. Seed and fertilizer adjusting lever.
8. LJF smart type blade.
9. Seed and fertilizer box cover.
10. Foot rest.
11. Roller.
12. Tyne.
13. Side disc.
14. Soil guard.

Instructions for the Operator

The superior seed drill is connected to the tractor by means of a three-point linkage system. After coupling with the tractor, the PTO shaft of the tractor is connected to the coupling of the PTO shaft of the machine, which drives the rotor of the super seeding machine. When the steering wheel moves the fertilizer and seed meter, the seeds and fertilizer start to fall into the furrow/slits opened by the furrow opener.

During the Operation

1. To operate the machine, use a 55-75 HP double-clutch tractor.
2. Always use the PTO shaft at 540 rpm.
3. Do not engage the PTO at full speed.
4. Set engine to 180-240 rpm and tractor starter in 1st and 2nd gear depending on straw load.
5. Raise the super seeder by rotating it to avoid obstacles and bending issues.

After the Operation

1. The equipment, seed and fertilizer hopper, metering system, etc. must be properly cleaned after use.
2. Wash the box of seeds, fertilizer and moving parts at the end of the season.
3. Store the device on a hard surface in a cool, dry place.

How to Use?

1. The user manual describes how to use the super Seeder correctly and safely and the precautions to be taken when using it. Read this manual carefully before using the super seeder. Keep this guide near your tractor after reading it.
2. Do not wear loose clothing or silencers to avoid falling into a controlled part of the rotation.
3. Children or people who are not familiarity with the Super Planter Operation Manual and Safety Cards may not use the Super seeder.

Fig.2. Super seeder machine in the fields

4. The super seeder is not allowed to be used by persons under 16 years of age.
5. Do not touch the rotating parts of the machine while it is running.
6. Check the oil level of the main gear before using the super seeder.
7. Check all bolts and nuts regularly.
8. Before using the machine, replace missing or damaged parts.
9. After hitching the SUPER SEEDER to the tractor, check the connection of the upper link, the lower link and the vertical link before lifting the SUPER SEEDER by the position control level. Always use the lower gear of the tractor to tilt the ground and a good cut for straw residue.
10. The depth of the fertilizer, the SUPER SEEDER seed hopper can be adjusted by raising or lowering the slide position in the depths.
11. For very fine seedbed, drive the tractor very slowly. The working speed of the tractor should not exceed 4-5 kilometers per hour.
12. Do not allow anyone to come between the tractor and the unit while it is paired or disconnected.

Important Instructions

1. Check the moisture content of the soil before using the machine in the field.

2. For rice harvesting, using the combine with the Super SMS system, cut the rice straw emerging from the combine into small pieces before dropping it on the ground and distributing it evenly throughout the field. This in turn facilitates the operation of the rice straw. SUPER SEEDER has high moisture content in the residue, thanks to this, it can prevent super-seeding.

Main Features

1. The possibility of sowing wheat immediately after harvesting the rice i.e., the option of perennial varieties of wheat and rice.
2. The possibility of sowing wheat in the residual moisture i.e., it saves irrigation.
3. Sowing wheat on the specified dates even after a long period of cultivation of basmati rice varieties.
4. Less weed growth
5. Improving soil health
6. Environmentally friendly
7. A one-step solution to today's farming needs.
8. There is no need to burn rice residues, while respecting the environment and soil health.
9. Higher yield because germination is much better in loose soil compared to other seedling solutions.
10. It has a unique design that can be used for tillage and fully functional as rotary cultivator according to the seasonal needs of the farmer.
11. Significant cost savings for the farmer in the initial investment compared to other solutions.
12. Farmer does not need to purchase the plowing machine separately.
13. Can be used as a multi-crop seeder.
14. Safety cover on all moving parts.
15. Transparent PVC tube embedded in wires.

Super Seeder Advantages

1. This technology is environmentally friendly.
2. Save money as it requires less time for field operations which reduces fuel and labor costs.
3. Direct seeding also reduces soil disturbance.
4. We can stop straw burning.

Precautions to be Followed

After daily work or after 10 hours:

a. Tighten all bolts and nuts.
b. Check the gear oil level.
c. Lubricate the rotor bearing and PTO drive shaft.

Weekly or for every 50 working hours:

a. Apply oil / grease for all side belt drives.
b. Check the gearbox oil level.
c. Lubricate the side rotor axle, side discs and PTO shaft.

For every 400 working hours: Change gear oil periodically and use recommended only.

Projection:

a. Rocks and other debris released by the rotor can travel long distances. Always keep a safe distance from the machine.
b. Stay away from parts and machine while engine is running, external PTO is engaged, and rotors are turning/running.

Lights and indications: Before moving the machine on public roads, make sure all legally required lights and indicators are on. Make sure lights and gauges are clean and in good working order. Replace any lost or broken equipment.

PTO shaft:

a. Use only the shafts supplied with the equipment recommended by the manufacturer.
b. Make sure the PTO shaft guards are secured with the safety chains provided.
c. Do not wear loose clothing that can catch on the rotating shaft.

d. Before removing or securing the outer PTO shaft, or before performing any work on the equipment, disconnect the PTO drive, turn off the engine, remove the ignition switch and wait till all moving parts to come to a complete stop.
e. Make sure the PTO shaft is still properly installed/fitted and secured in place.
f. Before plugging in PTO, make sure that the speed and direction of rotation of the power outlet comply with the manufacturer's recommendations.

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An Insight into Data Requirements for Registration of Nanopesticides and Nanofertilizers in India

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Introduction

The injudicious and indiscriminate application of agri-inputs particularly fertilizers and pesticides result in several environmental hazards through volatilization, leaching, and run-off from the application site resulting in serious harmful impacts on the human health and environment such as increment of residues in water, soil, and foodstuffs; eutrophication, groundwater contamination etc. (Sarkar et al., 2021a).

Therefore, the application of agri-inputs in lesser and appropriate amounts with a reduced number of applications is one of the prime objectives of sustainable agriculture as it reduces both the harmful impact on the non-target organisms and the risk of environmental contamination (Kundu et al., 2021).

Nanotechnology-based agri-inputs are important in this regard to ensure environmentally benign crop production as well as protection as compared to the bulk application of the conventional formulations. Nano-based products have several advantages over conventional ones due to their high surface area to volume ratio.

Improved bioefficacy, sustained delivery of agri-inputs, relatively less application rate, generation of fewer waste products etc. are key advantages of nano-based agri-inputs. However, the application of nanomaterials in agriculture is still an under-explored area (Sarkar et al., 2021b). To date, there is no uniform international guideline for nanotechnology-derived agro-products across the globe, which is considered as a major drawback of wider acceptance and adaptability of these products.

Similarly, there were no specific guidelines for the assessment of nano-based products for agriculture in India. Therefore, Minister for Science & Technology, Health & Family Welfare and Earth Sciences and Minister of Agriculture & Farmers Welfare and Rural Development & Panchayati Raj released the 'Guidelines for Evaluation of Nano-Based Agri-Input and Food Products in India' in July 2020 to improve the safety and quality aspects of nano-enabled agro-products for wide acceptance to end beneficiaries (Guidelines for Evaluation of Nano-Based Agri-Input and Food Products in India, 2020).

The guidelines have been framed jointly by the Department of Biotechnology (DBT), Ministry of Agriculture and Farmers' Welfare, Ministry of Science and Technology, and Food Safety and Standards Authority of India, Ministry of Health and Family Welfare through concerted Inter-Ministerial efforts coordinated by DBT (The Hindu Business Line, 2020; TERI Web Desk, 2020).

These guidelines are also applicable to sensors and composites developed using nanomaterials. In this article, the assessment guidelines for nano agri-inputs are broadly emphasized (but not limited to) on the domain of nanopesticides and nanofertilizers used in the agriculture sector have been summarized with a specific focus on the different data requirements for their registration.

Definitions of Nanomaterial and Nano-Agri-Input Product

Nanomaterial (NM) should be defined as a material having at least one dimension in the range of 1 to 100 nm. Moreover, any material having improved properties or phenomena due to the effect of dimension(s) may also fall under the nanomaterial category, even if its dimension (s) deviates the nanoscale range, up to 1000 nm.

Nano-agri-input product (NAIP) is defined as "an agricultural input preparation containing NMs (as defined in section 4.1.1) intended for applications (through soil, seed, foliar and drip in crops as well as by other means) on crop for the purpose of farming. NAIPs consist of materials with any of the three dimensions i.e., zero, one or two, on the nanoscale or with an internal or surface structure in the nanoscale" (Guidelines for Evaluation of Nano-Based Agri-Input and Food Products in India, 2020). Nanopesticides and nanofertilizers come under the category of NAIPs.

Registration Requirements for Nano Agri-Inputs (NAIPs)

Nanopesticides and nanofertilizers are required to be registered under section 9 of the Insecticides Act, 1968 and Fertilizer Control Order, 1985 respectively through the concerned nodal agencies at the central and state level. Various parameters to describe the NAIPs are common with the standard data requirements for pesticide and/or fertilizer registrations in India. However, some additional data requirements are included in current guidelines for nano-based products. In general, information on formulation type, their intended use, application methods, justifications for the development of the product, label claims, interaction among different formulants etc. need to be submitted to the competent authority for registration of nanopesticides and nanofertilizers. The detailed information required for their registration purpose can be broadly classified into the following categories-

1. Physico-chemical characteristics: For registration of any nano-enabled products as an agricultural input, nanomaterials used in the product as a.i or carrier, information of the ingredients, product stability in different conditions such as accelerated storage stability, photostability etc., detailed description of the impurities, excipients used for improving the stability are prerequisite. Various information on the characterization of the product such as FT-IR spectroscopy data, particle size analysis, crystallinity, pH, EC, static viscosity, BET surface area etc. should be provided for specifications of the nano-enabled product.

2. Data of toxicity studies: For any product registration, detailed information on in-vitro and in-vivo toxicity to various non-target organisms is mandatory. Nano agri-inputs are not an exception to it. To date, nanomaterials used for crop production as well as protection have been reported to possess several toxicity issues such as phytotoxicity, genotoxicity, mammalian toxicity, toxicity to non-target organisms (Paul et al., 2020). Therefore, to register any nano-agri-input, need-based Cytotoxicity studies i.e toxicity to cells such as ATP Cell Titer-Glo, cell impedance, trypan blue, live/dead cell counting, colony-forming efficiency etc. have to be performed. Genotoxicity study is another important criterion in this aspect. It is the ability to cause damage to the genetic material, which may lead to mutations and ultimately various types of cancers. Genotoxicity studies of NAIPs should be conducted using existing OECD guidelines.

3. Data of bio-efficacy studies: Comparative efficacy studies of the conventional vis-à-vis nano-based agri-inputs should be performed as per the guidelines of the concerned regulatory agencies. Bio-efficacy data such as bio-effectiveness, phytotoxicity, pesticide residues in the plant, soil, and water, persistence in the plant, soil, and water for nanopesticides are required to be produced. Moreover, the effect on natural enemies, succeeding crops (in case of herbicide), soil microorganisms, honey bees, and earthworms are also needed to be assessed. The method of determination of residues of all the formulants, degradation product if any, number of residues, anticipated risks of the generated residue, and bioaccumulation behaviour should also be addressed in the registration dossier.

4. Other required information: Different quality control evaluation parameters and protocols, sampling procedures, and assessment methods should also be specified. Most importantly, occupational hazards, environmental fates, and packaging details must be mentioned.

Conclusion

The release of assessment guidelines of nano agri-inputs is an appreciable effort by the Government of India for bringing nano-revolution in near future under the Indian agricultural context. These assessment guidelines will help the policymakers to frame regulations for nano-based agri-inputs and food products. However, people's perspectives towards nano-based agri-inputs and mass awareness are required to be improved for the adaptability of these nano-enabled products. Global uniformity in regulatory guidelines is also necessary for this perspective for the removal of trade barrier and to make nano-agriculture popular.

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Nanotechnology in Plant Pathology

Article ID: 11460

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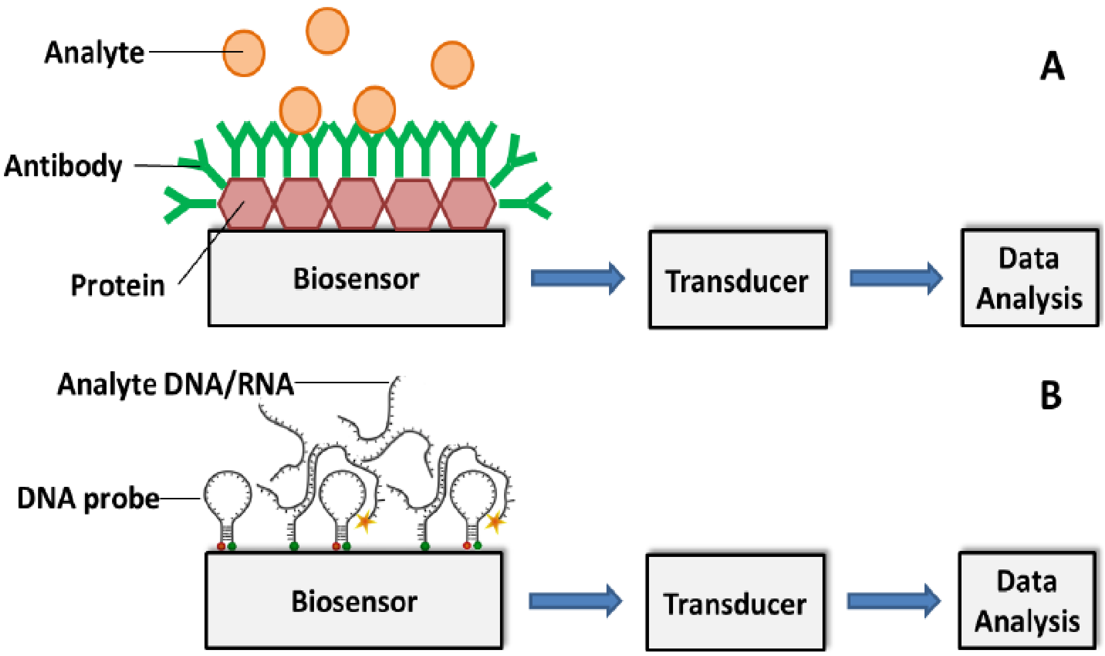
Nanotechnology is one of the most fascinating and rapidly advancing sciences and possess a potential to revolutionize many disciplines of sciences, technology, medicine and agriculture. Conversion of macromaterials into nano size particles (1-100 nm) gives birth to new characteristic and material behaves differently. The word "Nano" is developed from the Greek word meaning "dwarf". In more technical terms, the word "Nano" means 10^{-9}, or one billionth of something. Nanomaterials can be potentially used in the crop protection, especially in the plant disease management. Nanoparticles may act upon pathogens in the same way similar to chemical pesticides or the nanomaterials can be used as carrier of active ingredients of pesticides, host defence inducing chemicals, etc. to the target pathogens (Elmer and Jason., 2018). Ardakani (2013) studied the toxicity of three different nanoparticles *viz.*, silver (AgNP), silicon oxide (SiO_2NP) and titanium oxide (Tio_2NP) against *Meloidogyne incognita* in laboratory and pot experiments. The 100 per cent J_2 immobility and mortality in treatments of 200, 400 and 800 mg ml^{-1} of AgNP. J_2 mortality was 7.3, 16 and 48 per cent in 25, 50 and 100 mg $ml^{-1}$of AgNP, respectively. J_2 mortality was 2 and 4.3 per cent in 400 and 800 mg ml^{-1} of TiO_2NP, respectively. In a pot experiment, all treatments of AgNP and 0.02 per cent TiO2NP effectively controlled *M. incognita*. Naragund *et al.* (2016) synthesized silver and copper nanoparticles through green nano synthesis approach from seed extracts of *Glycine max* (soybean), *Thevetia peruviana* (yellow oleander) and flower bud extract of *Syzygium aromaticum* (cloves). Efficacy of the newly synthesized AgNPs were tested against *Curvularia lunata* (Leaf spot of maize) which showed 95.00 per cent spore inhibition and *Xanthomonas axonopodis* pv. *punicae* (bacterial blight of pomegranate) was less inhibition (9.25 mm) compared to the $AgNO_3$ bulk (12.50 mm) and streptocycline (11.50 mm).



Schematic illustration of a) antibody based and b) DNA/RNA- based biosensor for analyte (pathogen) detection

Chen *et al.* (2013) was first investigated the antibacterial activity of graphene against *Xanthomonas oryzae pv. Oryzae*. The graphene oxide (GO) shown superior bactericidal effect at extremely low dose in water (250 µg/mL), with killing 94.48 per cent mortality, in comparison to common bactericide bismerthiazol with 13.3 per cent mortality. Chikkannaswamy *et al*. (2017) synthesized copper nanoparticles from *Eucalyptus globules* leaves and evaluated against *Ustilago nuda tritici* and *Exserohilum turcicum* by spore germination method which showed 100 per cent spore inhibition over the control at 50 and 100 ppm respectively. Deepika and Pratima, (2016) evaluated the antifungal efficacy of silver nanoparticles (AgNPs) against *Alternaria brassicola*. Results revealed that treatment with 100 and 110ppm of AgNPs both has shown maximum inhibition of pathogen i.e., 92.2 per cent, therefore 100ppm AgNPs was treated as optimize concentration.

Excessive use of fungicides has caused many problems such as adverse effects on human health, pollinating insects, domestic animals, water and soil ecosystems. Proper application of chemicals in the form of nanoparticle can be a suitable solution for this problem. Understanding nanophytopathological studies on physiology of host and pathogen interaction, infection process and disease diagnosis will help in developing new disease management strategy including nanopesticides that are less harmful to the environment than conventional formulations.

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Important Pest and Disease Management in Mango

Article ID: 11461

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Mango (*Mangifera indica* Linn) is the most important fruit of India and is known as "King of fruits". The fruit is very popular with the masses due to its wide range of adaptability, high nutritive value, richness in variety, delicious taste and excellent flavour.

The fruit is consumed in both forms raw and ripe. Raw fruits of local varieties of Mango trees are used for preparing various traditional products like raw slices in brine, amchur, pickle, murabba, chutney, panhea (sharabat) etc. Raw fruit of local varieties of Mango are used for preparing pickle and raw slices in brine on commercial scale while fruits of Alphonso variety are used for squash. The wood is used as timber, and dried twigs are used for religious purposes. The fruit is cultivated in the largest area i.e., 2312 thousand ha and the production are around 15.03 million tons, contributing 40.48% of the total world production of mango. The main mango producing states in India are Uttar Pradesh, Andhra Pradesh, Karnataka, Bihar, Gujarat and Tamil Nadu. Total export of mangoes from India is 59.22 thousand tons.

Pest

Mango leaf hopper: This is the most serious and wide spread pest in India. The nymphs and adult insect make puncture and suck the sap of tender leaves, inflorescence and fruits. The female hopper lay 100-200 eggs on the mid-rib of tender leaves, buds and inflorescence. The total life cycle lasts for 2-3 weeks.

The management of this pest include the following operation:

a. Pruning of overcrowded branches in December.
b. Immediately after harvest orchard keep clean.
c. Spraying of Carbaryl (0.2%) or Chlorpyriphos (0.04%) or Dimethoate (0.06%) thrice at an early stage of panicle formation, full panicle length before flowering and fruit set.
d. Spraying of Nimbicidine (0.2%) at initial stage of hopper population.

Mealy bug: Spraying of Chlorpyriphos 20 EC 2.5ml/lit or Monocrotophos 36 WSC 1.5ml/lit will give control over the pest. Band the trees with 20 cm wide 400-gauge polythene sheets will prevent the spread of the pest. Similarly, release of Australian ladybird beetle, *Cryptolaemus montrouzieri* @ 10/tree will be a very effective bio-control measure.

Mango leaf hopper & Mealy bug infestation

Diseases

Powdery mildew: It is one of the most serious diseases prevalent throughout the country and all the commercial varieties are susceptible to this disease. The diseases is characterized as grayish mealy growth on inflorescence and leaves leading to flower drop and defoliation. The pea size fruits also get sometimes infected with this disease, which become mummified and black. The disease survives in the form of dormant mycelia on the older leaves and in the malformed panicles.

Management:

a. The disease can effectively be controlled with the sprays of wettable sulphur (0.2%), Thridemorph or calixin (0.1%) and Karathane (0.1%). Carbendazim (0.1%) is also effective against this disease. Application of Sulphur dust (350 mesh) in the early morning will protect

b. New flush or spray Wettable sulphur 0.2% or Tridemorph 0.05% will control powdery mildew.

Red rust: The presence of the rusty red fructification of the alga on the surfaces of leaves, veins petiole and young twigs is the symptom of this disease. In the initial stage, the spots are greenish grey and velvety, which trun reddish brown later. Spots are circular to irregular in shape, erumpent, measuring 2 mm in diameter.

The control measures of this disease include the following treatments:

a. Proper and balanced nutrition to the tree, as this disease is directly related to the poor growth and vigour of the tree.

b. Avoid crowding of trees by planting at proper distance and resorting to pruning of crowded branches.

c. Application of Bordeaux mixture (5:5:50) and copper oxychloride (0.3%).

Mango Powdery mildew & Red rust infestation

Management of Physiological Disorders

Mango suffers from the following major physiological disorders, which need corrective measures for saving the crop from loss. Some of these disorders and their possible causes and suggested corrective measures are given below.

Mango malformation:

a. Malformed tissue have lower levels of reducing, non-reducing and total sugars, starch and carbohydrate than the healthy ones.

b. The higher levels of sugars and lower level of starch in malformed parts than in healthy ones suggest the occurrence of hydrolysis of starch into simple sugars and release of sufficient energy required for excessive growth of malformed panicles.

c. The malformed seeding has higher protein, total amino acid, basic, neutral aromatic and sulphur containing amino acids than healthy seedlings.

d. Bombay green variety of mango is highly susceptible to malformation.

e. Bhadauran, Illaichi and Alib are resistant to malformation.

f. Malformed tissue have more free and less bound amino acid.

g. The accumulation of mangiferin in differentiating buds induces their transformation into malformed inflorescence.

h. Ascorbic acid, Glutathione, K2S2O3 are the recommended anti- malformation to reduce the incidence of malformation.

i. Spray of NAA @200 ppm in October-November followed by deblossoming (Feb. – March) control the malformation considerably.


Mango malformation and Black tip

Black tip:

a. Black tip in mango is caused due to deleterious effect of brick kiln fumes which contain SO_2, acetylene and CO_2.

b. Borax (0.8%), caustic soda (0.6%) and washing soda are applied to control this malady, caustic soda is most effective.

Lilium Production Under Protected Condition

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Lilium one of the most important bulbous flowers, belongs to Liliaceae family and is commercially grown in India for cut flowers. Recently, this crop has become popular in many states of India. Lilies have a good demand in the flower market as cut flower and pot plants.

Out of the different types of lilies, Oriental and Asiatic hybrid lilies and Asiatic hybrid lilies and to some extent, the Easter and tiger lilies are the most popular ones as they are excellent cut flowers. The popularity of these lilies is gradually increasing in India. they also offer gardeners a wide variety of heights, flower forms, and colours. In fact, their presence in the garden is so striking that they are often called the “Queen” or “Grande Dame” of the summer garden.

Lilium is the genus of herbaceous flowering plants growing from bulbs, all with large prominent flowers. Most species are native to the temperate northern hemisphere, though their range extends to the northern subtropics. Seeds ripen in late summer. They explicit varying and sometimes complex germination patterns, many adapted to cool temperate climate.

How to Grow Lilium in Greenhouse

The standard type of greenhouse is required for the growth of Lilium which needs conditions like temperature, air circulation, ventilation and light. These factors have to be controlled accurately. A standard height of 4 to 4.5 metre is customary this will provide sufficient room for installing the irrigation and lighting system. Plenty of light is required for the proper cultivation.

Heating System

In many regions, the greenhouse needs to be equipped with a heating system. Asiatic and LA hybrids require minimum greenhouse temperature of 8-14 degree Celsius to other groups require 15–16-degree Celsius to achieve this temperature a norm of the heating system is approximately 220 Watt/metre square of greenhouse volume/hr to provide better heat distribution and climate control heating system.

CO_2 System

CO_2 injection benefits the growth and flowering of longiflorum hybrids and is thus recommended since it produces a sturdier and a greener crop. With the help of hanging burners the gas is supplied from the central boiler or pure CO_2 injection is started upon sunrise and can be continued for a few hours to throughout the day on condition that the greenhouse is closed or little ventilation is carried out and there is sufficient light for photosynthesis. When using assimilation lighting, CO_2 injection can be carried 24 hours a day. Keeping track of CO_2 require monitoring using a simple monitoring device.

Light Equipment

The location of the meter is important for the growth of plants with respect to lighting.

Humidity

The optimum humidity inside the green house should be 80 to 85 %.

Forcing

The bulbs require cold treatment from 2-4° C for 6 weeks in case of Asiatic hybrids and 8 weeks for the oriental ones.

Bedding Media

It is advisable to maintain the Ph of 6-7 for Asiatic and longiflorum hybrid groups and a Ph of 5.5 to 6.5 for oriental hybrids. The chlorine in the soil should not exceed 1.5 mmol/lit.

Coco Peat

Cocopeat requirement is 19 kg/m^2.

Planting Depth

Lilium bulb should initially be planted at the planting depth of 6 inches. Planting depth varies according to the size of bulb.

Irrigation

The amount of water depends on the type of soil, moisture content and variety. Water requirement in summer 6-8 lit/m^2 per day.

Fertigation

It is advisable to apply 12:61:00 @ 2kg/100m^2 at-least one week before plantation. If plants are not strong enough during growing period due to nitrogen deficiency, then a top dressing of Ammonium Nitrate @ 1 kg/ 100 m^2 can be applied up-to three weeks before harvesting.

Varieties

Asiatic hybrids: Dreamland (yellow), Brunello (orange), Novona (white), Pollyanna (yellow), Yellow Giant (yellow), Vivaldi (pink), Black Out (Deep red).

Oriental hybrids: Star Gazer (Pink & white), Nerostar, Siberia, Acapulco (cyclamen pink) and Casablanca. Eastern lily *(L. longiglorum)*: Elegant Lady, Ace Snow Queen, White, American, Croft and Harbo.

Soil and Climate: Soil with good texture and proper drainage is preferred. Maintaining the correct pH of the soil plays a major role in the root development and uptake of nutrients. It is advisable to maintain a pH of 6 to 7 for the Asiatic and longiflorum hybrid groups and a pH of 5.5 to 6.5 for the oriental hybrids. For good plant growth and quality flower production, the night temperature should be around 10-15^0 C and the day temperature should be 20-25^0 C. Higher temperature will produce a dwarf crop with a smaller number of flower buds per stem. The plant should not be grown under direct sunlight. In summer months, due to high light intensity, the plants become stunted in growth. A shading screen with 50-75% shade will be beneficial.

Sowing/Planting: As a thumb rule, the bigger the bulbs, more is the stem length and the number of flowers per stem. Bulbs less than 10-12 cm in circumference should not be used for flower production in Oriental hybrid lilies, whereas bigger bulbs (as big as 22-24 cm) should be planted for production of Asiatic lilies

Planting Depth: The depth of planting should be 10 – 12 cm winter.

Propagation: Liliums are commercially propagated through bulbs. A six-week cold storage period at 2 to 50C is needed to break dormancy. Bulbs can be stored at -20C upto one year.
Spacing: 20x15 cm, 15x15cm or 15x10 cm.

Irrigation: Irrigation is one of the most important factors that promote growth in the cultivation of lilies. Soil should be kept continuously moist. However, there should not be any water stagnation. During the dry spell, the water consumption may be as high as 10 liters/m2 /day.

Crop support: Staking is an important operation in lilly cultivation to keep the plants erect. The most practical way to support the crop is by using netting which should be gradually raised as the plants grow in height so as to get long stems during harvest.

Harvesting: Flowers are ready for harvesting between 90 - 120 days after planting. As soon as first bud shows distinct colouration, the lilies should be harvested. If this is done at a premature stage, the buds will not develop properly. Cutting too late i.e., when the bulbs have opened fully will cause damage to the flowers during transit. Cut stems should be placed in cold water immediately after harvesting. If necessity arises, the flowers can be stored at 2-5^0 C for a week or. Sucrose @ 5% + HQS @ 200 ppm significantly increase the vase life of the flowers.

Yield: 30-40 flower stem /m^2.

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Styles and Types of Gardens

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A garden is a planned space, usually outdoors, set aside for the display, cultivation, or enjoyment of plants and other forms of nature, as an ideal setting for social or solitary human life. The single feature identifying even the wildest wild garden is control. There are basically four styles of gardening that are followed to establish any garden. Discus of them is given below.

Formal Gardens

1. A formal garden is laid out in a symmetrical or geometrical pattern. In this garden, the design is stiff as everything is done in a straight and narrow way. In such gardens, everything is planned in straight lines.
2. Square and rectangular geometric forms are repeated in the various hardscaping features of formal gardens.
3. In the plan of formal garden design, the symmetrical balance is achieved when the same objects (mirror images) are placed on either side of an axis.
4. For example: If there is plant on the left-hand side of a straight road, a similar plant must be planted opposite place on the right-hand side.
5. Arrange flower beds, borders and shrubbery in geometrically designed beds.
6. Trimmed formal hedges, edges, cypress, Ashoka trees and topiary are typical features of a formal garden.
7. Usually, formal gardens are designed for public parks, university/ library gardens, or essential government buildings.

Informal Gardens

1. Informal gardens are characterized by following curves, non-symmetrical arrangements of features and spaces and plants that are allowed to grow into their natural shapes.
2. In the informal garden, the underlying framework is almost entirely disguised by planting, and the garden should look as though it has grown up naturally.
3. Informal gardens are harder to design than formal ones, as they are ruled by irregularity and natural looking planting.
4. A site that is not geometric shape can be a sound basis for an informal garden.
5. Some hardscaping structure needs to exist, or everything will relapse into an untrammelled wilderness.
6. Diagonal or curved path work well, and boundaries between the various areas of your garden are often formed using native mixed hedging.
7. In general, planting in informal gardens includes tall shrubs and taller trees to add to the vertical dimension, and these will often hide the edges of the plot to create a feeling.
8. The garden should revel in colour and should look as natural as possible. If you would like to introduce water, natural-looking ponds, pools are ideal features.

Free Style Gardens

1. A new approach to gardening that allows developing a garden with what on hand.
2. This style combines the good point of both formal and informal as well as naturalistic features are aesthetically mixed to create a picturesque effect.
3. In free style formality and the flatness of all geometrical styles are included along with the freedom in applying the treatment while choosing the essentials of different styles.

4. This style is suited to almost all the situations.

Wild Gardens

1. A comparatively recent style of gardening, the wild garden was expounded by William Robinson in the last decade of the nineteenth century. The concept of a wild garden is not only against all formalism, but it also breaks rules of landscape styles.
2. The main idea of wild gardens is to naturalize plants in shrubberies.
3. The grass should remain unmoved as in nature, and a few bulbous plants should be grown scattered in the grass to imitate a wild scenery.
4. The garden passages should be opened in the woodland and trees; shrubs and bulbous plants should be planted among the forest flora to fulfil his idea of a wild garden.
5. Allow the creepers to grow on the trees, naturally imitating those of the forest.
6. Some modern versions of the wild garden are butterfly gardening, bird garden, biodiversity parks, bio-aesthetic planning and Nakshatra Udyan (The astral garden).

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Principles of Landscape Gardening

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Landscape gardening is an aesthetic branch of Horticulture which deals with planting of ornamental plants in such a way that it creates a picturesque effect. Landscape gardening can also be defined as the beautification of a tract of land having a house or other object of interest on it. It is done with a view to create a natural scene by the planting of lawn, trees and shrubs. Landscape gardening is both an art and science of the establishment of a ground in such a way that it gives an effect of a natural landscape. It can be also defined as the imitation of nature in the garden. It can also be defined as improving of total living environment for the people. The expression of landscape may be gay, bold, retired, quiet, etc. there are 8 basic principles which are discussed below.

Simplicity

Simplicity is what the name implies - simple. Keeping landscapes simple not cluttered or fussy is always a good practice. This is not the opposite of complexity. Many landscapes have very complex features, including the architectural design, water features and extensive lighting features. Landscapes that make people happy and comfortable avoid using too many colors, shapes, curves and textures, but in no way does this mean simplistic, boring or lack of imagination.

Unity

The principle of unity is easily measured if the other five landscape principles have been properly executed throughout the landscape. Unity in design simply means all the separate parts of the landscape work together to create a great total design. Colors, shapes, sizes, textures and other features work together to create a unified space. Patterns and colors are often repeated. Lighting, special features, bed shapes and hardscapes such as walk ways all need to work together to create a pleasing look and a unified landscape.

Harmony

It is an overall effect of various features, styles, and colour schemes of the total scene. The degree of harmony or unity of various elements of landscape is a measure induced in us and is called as beauty. Therefore, the beauty can be defined as the evident relationship of all parts of a thing observed. When different parts of landscape are correctly placed in right way, produces a harmonious effect. Such landscapes create picturesque effect and appeals to visitors. On the contrary, the absence of harmony or lack of unity is ugliness.

Balance

It is very important to maintain the balance on both sides of the central line. The principle involved in making balance of see-saw game can help in understanding this. Equal weights can be balanced only when they are equidistant from the centre. If weights are unequal, the heavier must move towards centre for making balance. The balance may be formal, informal or symmetrical types. Imbalance will look lopsided and will distract the attention. In making the balance with the plants, their form, colour, texture etc.

Proportion

Proportion refers to the size relationship of all the features in the landscape. This includes vertical, horizontal and special relationships. Short people, tall people and children all perceive space differently.

Proportion in landscape design extends to building size, lot size, plant size, areas of plantings to areas of open space as well as the use of the landscape.

Scale

In a garden, scale may be defined as a relative relationship between masses. Scaling of components, size, shape and form unites the different components of design, create harmony and incorporate balance and proportion in design, which may vary with personal choice and type of utility.

1. Lawn (25-30%).
2. Paths (15-20%).
3. Herbaceous border (8-10%).
4. Shrubbery (12-15%).
5. Trees (15%).
6. Building (25-30%).

Focal Point

Any good design has a focal point – the place where the viewer's eye is first attracted. Focalization is sometimes referred to as focalization of interest or simply focal point. The focal point is the strongest element in the design in any given view. A home's focal point is often the front door. The landscape focal point is often something close to the front door to enhance the entrance of the home.

Rhythm

Repetition of same object at equidistance is called rhythm. It can be created through the shapes, progression of sizes or a continuous line movement, rhythm creates movement to the eye. In gardens, generally trees of single species of equal height and shape are planted to create this effect. In Mogul gardens, fountains and water canals have also been extensively used to create such effect. Now-a-days other objects like lights are also used to create the effect of rhythm.

Raising Techniques of Lawn

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Lawn is a piece of land that is covered with green soft grass and is used for aesthetic and recreational purposes. The lawn is known as the heart of the garden because the primary influence of the garden depends on it. The concept of loan is originally from England. Lawns became popular in northern Europe from the Middle Ages. The lawn serves to enhance the beauty of the garden. Maintaining the right loan plays a crucial role in any landscape design. A beautiful, well-groomed lawn can make the whole landscape look beautiful but when the lawn is not maintained the beauty of the landscape inevitably deteriorates. 60-75% of any garden should be dedicated to loan. The lawn is also useful as a playing surface as it reduces ground erosion and dust generated due to the foot pressure of many players. The lawn also serves as a cushion for players in sports such as football, soccer, cricket, baseball, golf, tennis and hockey.

Methods of Lawn Raising

1. Seeding: The most popular grass suitable for seeding is "Doob" grass *(Cynodon dactylon)*. Seeds of grasses are broadcast at the onset the monsoon at rate of 25-30 kg/ha, 12-15 kg/acre and 2.5 g/m2. After seed sowing and light irrigation soil is rolled with the help of roller. Seeds will germinate within 3-5 weeks.

2. Sodding: Sodding is an expensive method of vegetative propagation. However, it can enable establish an instant lawn. This method is recommended where quick cover is desired for some specific purpose viz., checking soil erosion or aesthetic reasons. Establishment procedures for sod include soil preparation, obtaining sod of high quality, transplanting and post planting care. Soil preparation for sodding is identical to that for seeding. The primary objective in sod transplanting is to achieve as quick rooting into the underlying soil as possible. Factors that influence quick rooting include: proper soil preparation, adequate soil moisture in the underlying soil and transplanting techniques that will minimize sod drying.

3. Dibbling: It is the best method of lawn establishment. Rooted or un rooted grass cuttings are planted in slightly ground 7-10 cm apart. Within 5-7 weeks the grass is ready for the first cutting.

4. Sprigging: Sprigging is another method of vegetative propagation where stolons or rhizomes are planted in furrows or small holes. A sprig is an individual stem or piece of stem of grass without any adhering soil. A suitable sprig should have two to four nodes from which roots can develop. Soil preparation for sprigging should be the same as for the other methods of planting. Sprigs are planted at a depth of 1-2 inches, 4-6 inches apart in the furrows. However, shallow planting can also be practiced provided adequate moisture is available. Another method of sprigging is to place the sprigs on the soil surface at the desired interval end-to-end, about 6 inches apart, and then press one end of the sprig into the soil with a notched stick or blunt piece of metal like a dull shovel. A portion of the sprig should be left above ground exposed to light. Regardless of the planting method, each sprig should be tamped or rolled firmly into the soil Sprigs planted this way require frequent light watering once or twice a week until roots become well established and may be required for sever weeks.

5. Stolonizing: Stolonizing is the broadcasting of stolons on the soil surface and covering by top dressing or pressing into the soil. Stolonizing requires more planting material but produces a quicker cover than sprigs.

6. Plugging: The planting of 2- to 4-inch diameter square, circular or block-shaped pieces of sod at regular intervals is called plugging. Three to ten times as much planting material is necessary for plugging as compare to sprigging. The most common turf grasses that are started by the use of plugs are St. Augustine

grass, zoysia grass and centipede grass. These plugs are planted into prepared soil on 6- to 12-inch centers. The closer the plugs are planted together, the faster the sod will cover. However, the closer the plugs are planted together, the more sod it will take to provide plugs to cover the lawn area.

7. Turfing: It is the quickest method for lawn preparation. Grasses are cut into 4-6 cm long pieces for sowing purpose with stem and roots. Turf is a piece of earth of about 5cm thickness with grass thickly grown over it. The pieces may be of small squares or in rolls of small width (30 cm). Selected small piece of grass should be cut uniformly thick selected from a place free from weeds and grasses along with soil are placed on prepared ground side by side closely. Grasses set within 15 days and ready to harvest by 3 months.

8. Turf plastering: It is a good method of lawn preparation on due to less time consumption. A paste is prepared by mixing garden soil, fresh cow dung and water. Bits of chopped up fresh roots and stem or rhizomes of doob grass are mixed with the paste and the paste is spread evenly on the surface of the prepared ground after moistening the soil. The lawn will be ready within 15-30 days by this method.

9. Artificial Lawn: Wheat or barley is sown by broadcasting in the well-prepared field. When the seedlings are about 10 cm height, do light mowing. Greenery for short duration can be achieved by sprinkling pine needles in any area.

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Biochar: An Alternative Method for Stubble Burning

Article ID: 11466

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Abstract
Today, Delhi NCR air pollution linked to straw burning has become a serious environmental problem, putting Delhi's Air Quality Index in the 'severe' category. While farmers are blamed for this problem, it makes sense to understand the reasons behind straw burning. In the critical position to propose a solution to this problem, the production of biochar from agricultural residues and its use for carbon sequestration and greenhouse gas mitigation as a corrective measure to the effects of burning residue carbon dioxide.

Introduction
Biochar is a granular material obtained by heating crop residues to a temperature of 400°C to 600°C in a klin-like structure in the absence of oxygen. It is used as a fertilizer to improve soil health and the ability of farmland to retain water. India is the second largest agricultural economy in which crops are grown throughout the year, producing a large number of agricultural residues, including crop residues or stubbles. The main means of removing stubbles in North India is burning stubble which has become a major environmental problem, severely affecting the air quality.

Fig.1. Biochar

This leads to serious threats to health and ultimately to global warming. Although the Indian government has tried to reduce this problem through various measures and campaigns to promote sustainable management of crop residues or stubbles, the problem has not yet been controlled and the only consequence is an alarming increase in air pollution from straw burning. The burning of straw causes many adverse effects that negatively affect human health, soil health, soil organisms, the ecosystem and the environment.

Biochar - A Panacea for Stubble Burning
Biochar can be used as a potential ingredient to treat the problem caused by burning stubbles or hay. There are several reports available that present the scope of biochar in improving soil nutrient status, plant productivity and mitigating greenhouse gases and they are discussed in this section. Biochar is a carbonized, organic, solid, porous, fine-grained, carbon-rich product obtained from a thermochemical conversion called pyrolysis under conditions of low or no oxygen. It is a material with relatively higher carbon content than its parent material, high stability and a specific surface area of 0.5-450 $m^2 g^{-1}$. It has been reported to contain nutrients such as calcium, phosphorous, potassium and magnesium; and micronutrients such as manganese, copper, iron and zinc. The carbon-nitrogen ration and carbon, nitrogen content of biochar ranged from 19 to 221, 33.0 to 82.7% and 0.10 to 6.0%, respectively. Biochar can be used as a soil amendment that has been reported to improve soil water, soil surface, earthworms, nutrient retention and beneficial microorganisms.

Benefits of Biochar for the Soil

As a soil amendment, biochar changes soil surface, bulk density, pore distribution, and water holding capacity, absorbs organic and inorganic pollutants and reduces nutrient leaching. It serves as a slow-release nutrient reservoir in the soil.

The combined application of biochar and compost reported an increase in β-glucosidase activities, hydrolysis of FDA, and doubling of the activities of soil alkaline phosphatase, proteases and enzymes involved in the carbon, nitrogen, and phosphorus cycles.

Since extracellular enzymes are the proximate agents of organic matter decomposition and nutrient cycling, increased activities of the above enzymes improve the nutrient status of the soil. Applying a mixture of biochar, compost, and fertilizer has been reported to increase soil N-NH4, N-NO3, P and K to 1.3, 1.8, 1.3, and 1.7 times, respectively.

In general, the use of biochar (exclusively or in combination with manure and fertilizers) in the soil has shown many positive effects on different plant metabolism and thanks to which it has increased the yields in different crops. The effects of biochar on plants are described as a review of vegetable crops.

The use of biochar in vegetable crops is relatively minor and the benefits of biochar can be explored to maximize the growth and productivity of vegetable crops. An increase in plant available water (PAW) was observed in watermelon and cowpea, which was attributed to the improvement in available soil moisture (ASM) obtained by applying biochar at 25 tons/ ha at a depth of 10 cm.

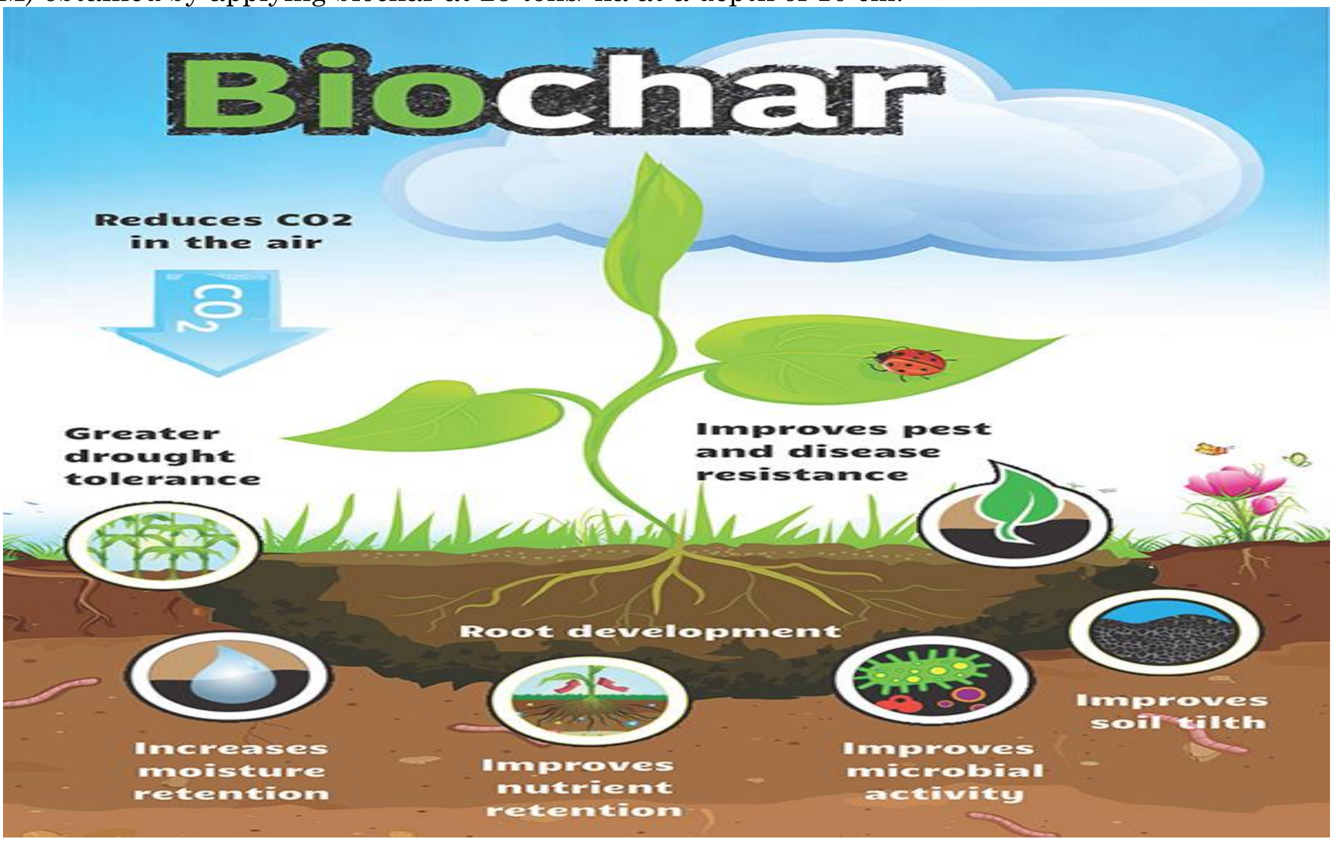

Fig.2. Benefits of Biochar Application

In lettuce, better qualities of the leaves such as a greater number of plant leaves/, length, Leaf area and width were found with the combined use of biochar and compost on unfertilized soils. The total plant biomass of cowpea increased with the application of biochar to 25 tons/ha at a depth of 10 cm which was due to the better growth of the binding roots and the absorption of water through the pores of the fine charcoal.

Likewise, an increase in the dry weight of the plant has been reported in lettuce with exclusive application of biochar. The increase in yield with the application of biochar in several crops seems to be due to the improvement of soil fertility and water retention.

Fig.3. Representation of Biochar of different materials at different temperatures

Schematic Representation of Biochar Solutions

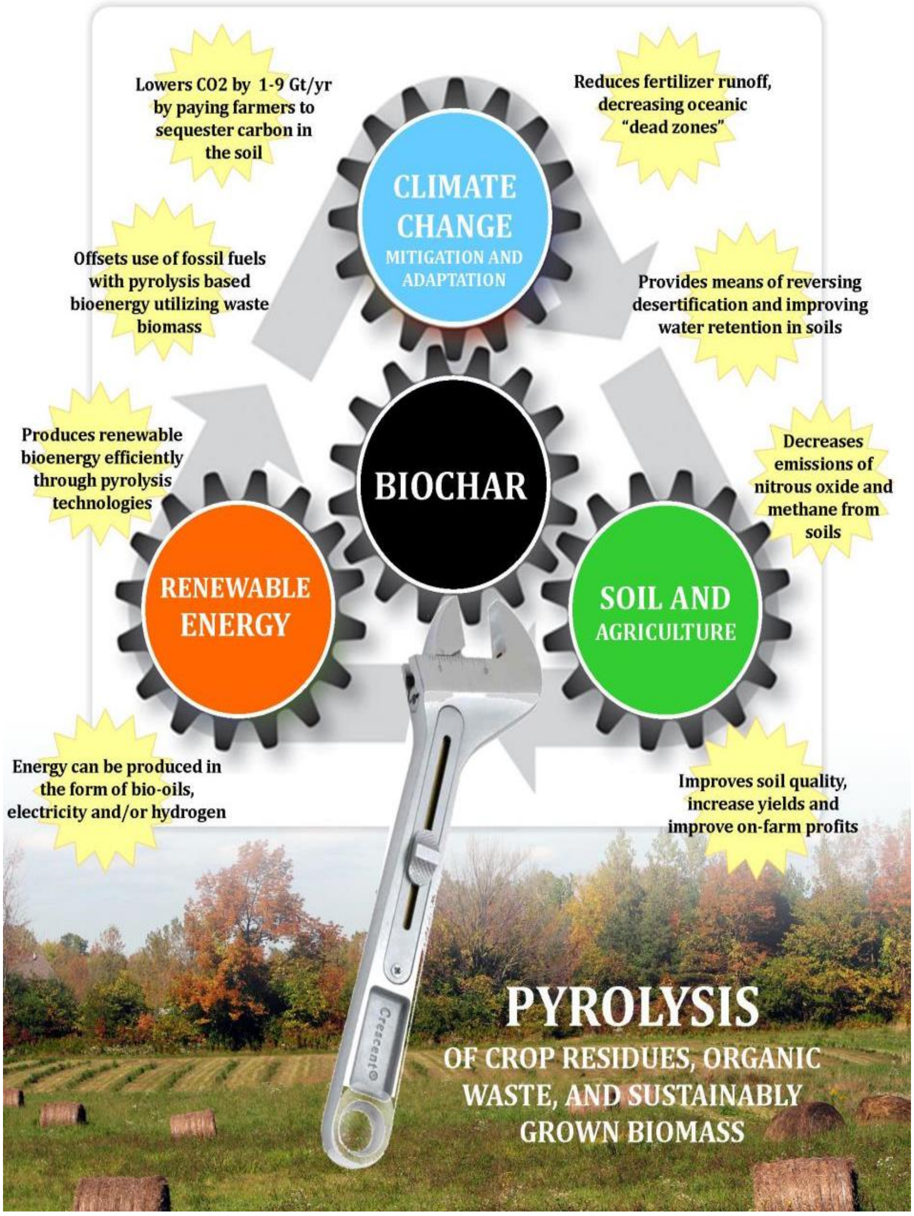

Fig.4. Representing Biochar solutions

Conclusion

The large-scale rice and wheat crop rotation system in India generated a large amount of crop residue often more than the amount of grain harvested. Typically, much of this stubbles/crop residues are burned in the field to clear the farm for the next planting, releasing toxic pollutants into the atmosphere and degrading air quality. Unlike incineration, stubbles/ crop residues can be exploited to produce economically valuable and environmentally friendly materials, such as compost or biochar.

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Relation of Endosymbionts with Insect Immunity System

Article ID: 11467

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Introduction

The insect immunity system has a wide variety of defence mechanism like humoral and cellular immunity. The recognition of microbe-associated molecular patterns(MAMPs) initiates these defence reactions. Endosymbionts effects more on humoral immunity but also have impact on cellular immunity. Insects have evolved mutualistic and obligate interactions with bacteria. Long-term obligate interaction between insects and bacteria has an effect on various physiological functions of the host. Endosymbionts Generate high levels of reactive oxygen species (ROS) , AMP in epithelial cells and nitric oxide (NO) is also involved in the regulation of innate immune responses to bacteria and other parasites. Transcriptional levels of melanization, AMP and Toll related genes also increases. Due to replication of the endosymbionts immune priming occurs in the new host.

Endosymbionts of Insects

1. Primary endosymbionts: These are transmitted vertically from mother to offspring and those endosymbionts provide specific nutritional compounds to their host that are important for their survival and development. For example, *Buchnera aphidicola* endosymbiotic bacteria of the *Acyrthosiphon pisum* synthesize essential amino acids that the aphids can't get from the plant sap. *Wigglesworthia glossinidia* is primary endosymbionts of tsetse fly and synthesize vitamins.

2. Secondary endosymbionts: These can be horizontally, vertically or via the environment transmitted and evolved symbiotic relationships with their hosts more recently. For example, *Sodalis glossinidius* bacteria in the tsetse fly, which are maternally transmitted to the progeny and can also be found inter- and intra-cellularly in various tissues of the fly. The pea aphid contains three secondary endosymbionts namely *Hamiltonella defense, Regiella insecticola* and *Serratia symbiotica*. *Hamiltonella defense* provide protection to aphid from parasitoid wasps.

Effects on Insect Immunity System

Effects of Wolbachia and Spiroplasma (two most commonly found facultative endosymbiotic bacteria and also most common reproductive parasite in the biosphere) on the insect immunity is given below.

1. Wolbachia consisting *D. melanogaster* and *D. simulans* flies (strains wAu, wRi, wNo, wHa, and wMelCS, respectively) infected with three gram-negative bacterial pathogens i.e., *Pseudomonas aeruginosa* PA01, *Serratia marcescens*, and *E. carotovora. Bacteria* didn't affect survival ability of flies compared to Wolbachia-free control flies.

2. Flies having the Spiroplasma strain MSRO as endosymbionts, which naturally infects *D. melanogaster* were more susceptible to septic injury with the Gram-negative bacteria *Erwinia carotovora* and *Enterobacter cloacae* but not susceptible with the Gram-positive bacteria *Enterococcus faecalis* and the fungus *Beauveria bassiana* compared to flies lacking the *Spiroplasma sp*. endosymbiont.

3. Adult *D. melanogaster* (wild type) naturally infected with the Wolbachia strains wMelCS and wMelPop survive longer in case of infection by the various RNA viruses e.g., Flock House Virus (FHV), Cricket Paralysis Virus (CrPV) and Drosophila C Virus (DCV).

4. Adult *D. simulans* with naturally harbouring Wolbachia endosymbionts can also be protected against DCV and FHV infection, but the protection is not same by all the *Wolbachia sp*. Strain.

5. Introduction of the wMelPop-CLA *Wolbachia* strain into *A. aegypti* reduces the ability of two arboviruses i.e., dengue virus and Chikungunya virus and one avian malaria parasite (*Plasmodium gallinaceum*) to

establish infection. *A. aegypti* with the wMelPop strain of *Wolbachia* results in changes in virulence that lead to behavioral effects that in reduce the blood sucking efficiency.

6. Presence of *Wolbachia* in *A. gambiae* increases the transcription of selected immune genes (e.g., TEP1) compared to control treatments.

7. There is reduction in numbers of *Brugia pahangi* parasites in *A. aegypti* somatically infected with Wolbachia.

8. In absence of native *Wigglesworthia* endosymbionts, there is increase in trypanosome parasites in tsetse fly.

9. Encapsulation ability of larvae when naturally infected with Wolbachia was estimated upon infection with the parasitoid wasp *Leptopilina heterotoma*. *D. simulans* larvae having *Wolbachia* were less able to encapsulate parasitoid eggs when compared to larvae lacking the endosymbionts. This shows that the presence of *Wolbachia* in *D. simulans* suppresses the host cellular immune response against parasitism.

10. Spiroplasma endosymbionts increases the ability of *Drosophila hydei* to survive when infected by Leptopilina wasps.

Conclusions And Future Prospects

Endosymbionts have very important role in associated insect's life system. Various insects feed on such plants which have some natural toxins like tobacco, coffee or neem and reason behind this is endosymbionts which neutralizes the toxins. Breaking the association of microorganism with insect can lead to large success in pest management. This can be achieved through genetic modification of host .

Control of natural populations of mosquitoes and various diseases such as Dengue, Chikungunya and Poultry malaria is possible with endosymbionts. Also, diseases of beneficial insects can be control through these microorganisms.

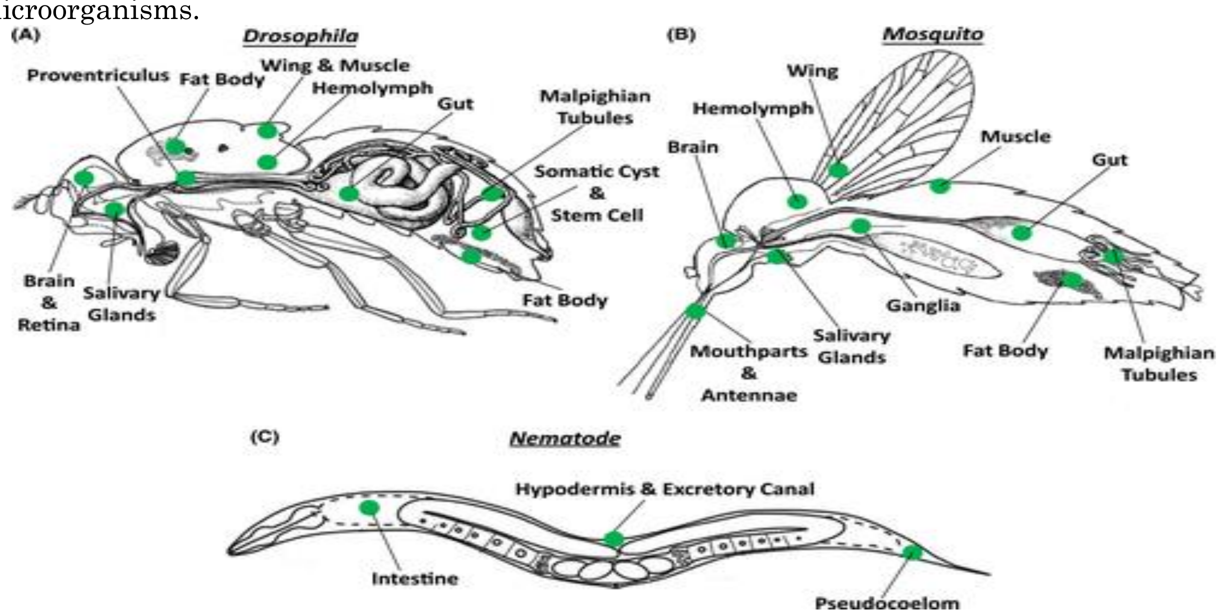

FIGURE | Location in insect body where endosymbionts are localized

Major Nursery Pests of Citrus and their Integrated Pest Management

Article ID: 11468

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Outline

The citrus fruit crop covers about 1078 thousand hectares in India, with a production of 115.15 million tonnes (NHB, 2014). Citrus is attacked by various pests in the nursery as well as in orchards. Citrus butterfly and leaf miner are two major nursery pests that causes economic losses. To minimize this loss during the early period i.e., at nursery, proper knowledge about the pests should be there so that could undertake effective management procedure.

Introduction

Major nursery pests of citrus:
1. Citrus butterfly: *Papilio demoleus, P. polytes* (Papilionidae: Lepidoptera).
2. Citrus leaf miner: *Phyllocnistis citrella* (Gracillariidae: Lepidoptera).

The caterpillars of citrus butterfly *(P. demoleus)* are a serious insect pest that feeds on citrus leaves and blossoms and a potential threat to citrus nursery stocks and other young citrus trees in Asia and the Middle East (Lewis; CABI). Damage is more prominent in Aug-Oct and in April -May.

Similarly, citrus leaf miner *(P. citrella)* is a common citrus nursery pest that can be found in low to moderate infection levels across the country. Infestation is mostly observed in monsoon or when there is a new flush.

Identification

Life stages	Citrus Butterfly	Citrus Leaf Miner
Larva	The early-stage larva resembles a bird dropping. Grown-up larva is cylindrical, stout, have a green and brown lateral bond. They protrude two fleshy horns from the neck when being disturbed. 	Yellow in colour with brown mandibles. 
Adult	Dark brown swallowtail butterfly with numerous yellow markings.	Small silver colour moth, fore wings with brown stripe and prominent black spot near the tip.

		

Biology

A precise understanding of insect pest life history is required for population monitoring and control:

Life cycle	Citrus Butterfly	Citrus Leaf Miner
Oviposition site	On the tender leaves	On the underside of leaves
Fecundity	70-180 eggs	36-76 eggs
Egg period	3-8 days	3-6 days
Larval period	2 weeks	5-30 days
Pupal period	10-15 days	5-25 days
Pupation site	On plants attached by silken threads	Inside the larval mines of leaves
Total life cycle	3-6 weeks (Summer) 13-15weeks (Winter)	12-55 days
No. of generation per year	4-6 generation	9-13 generation

Nature of Damage and Symptoms

Citrus Butterfly	Citrus Leaf Miner
Caterpillars prefer light-green tender leaves feeding voraciously and leaving only the mid-ribs.	On hatching, larva feeds on leaf tissues between upper and lower surfaces of leaves, making glistening zig-zag tunnel.
In severe infestation the entire tree gets defoliated.	The leaves turn pale, curl, and finally dry. Trees look sickly and devitalized. Mined leaves may get bacterial infection which leads to 'citrus canker'.
	

IPM for Citrus Butterfly and Citrus Leaf Miner

IPM utilizes all suitable techniques and methods in as compatible a manner as possible to maintain the pest population at levels below those causing economic injury, in the context of the associated environment and the population dynamics of the pest species (FAO, 1967) http://www.fao.org/3/x5048e/x5048E08.html. IPM includes biological control, genetic techniques, host plant resistance, and cultural, mechanical and chemical controls for suppression of pest population. It is an effort to bring together multidisciplinary methodologies in developing agroecosystem management strategies and decision-making tools that are workable and economically feasible, ecologically sound, and socially acceptable (Kenmore, 1983; Litsinger, 1984; Adalla, 1988).

IPM Measures	Citrus Butterfly	Citrus Leaf Miner
Cultural methods	• Citrus planting in heavy soil should be avoided. • Avoid excess use of fertilizer and irrigation. • Destroy the weeds like bavachi. • Grow attractant plants like sunflower, carrot, alfalfa	• The new flush of citrus plants attracts citrus leafminer moths. Avoid cutting live branches more than once a year to ensure that flushing cycles are brief. The pest will be unable to mine the leaves once they have hardened.
Mechanical methods	• Handpick and destroy the caterpillar, which looks like a bird dropping in the early stage.	• Use of pheromone traps. (5/acre) • During winter, prune all affected plant parts and burn.
Biological control	Use of natural enemies: • Egg parasitoid: *Trichogramma evanescens* and *Telenomus* spp @500 adults per tree • Larval parasitoid: *Cotesia* spp and *Brachymeria* spp • Pupal parasitoid: Pterolus sp., *Holcojoppa coelopyga*	Use of natural enemies: • Parasitoids like *Tetrastichus phyllocnistoides, Cirrospillus quadristriatus*, Simpieses purpurea and black chalcid, *Ageniaspis* sp. larvae
Chemical control	• Spray Bacillus thuringiensis formulation (1ml per 10lit water) or Beauveria bassiana (Vuillemin) formulation @ 4 x 106 cfu per ml (0.1 per cent) followed by NSKE (5 per cent) or NSKE 5 per cent at the appearance of the larvae on leaves gives good results. • Spray the infested trees /seedlings with any of : Acephate 75 SP @ 7 g in 10lit water or Chlorantraniliprole 18.5 SC @ 150 ml/ ha using water @ 500-600 L/ha	• Spray of Neem seed kernel extract (NSKE) 5% or azadirachtin 300 ppm @ 100 ml during the commencement of fresh foliage. • Avoid repeated use of synthetic pyrethroids, which may cause resistance development and enhance mite damage. • Spray Imidacloprid 17.8 SL @ 2.5 ml or Thiamethoxam 25 WG @ 1 g in 10lit of water at the initiation of leaf miner infestation.

Conclusion

IPM programmes are intended to maintain plants healthy and productive while reducing environmental impact. It is important to select different insecticides for the control of targeted pests and vital to choose for the proper dose, stages of the crop, time of application to avoid harmful effects to the natural enemies and the environment. On these aspects, more research works are required.

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Tissue Culture Technique for Crop Improvement and Protection

Article ID: 11469

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Introduction

Crop protection technology is extremely important in modern agriculture. On the one hand, the population is rapidly increasing, while agricultural land is shrinking at a much faster rate than previously thought. If this trend continues, the day will come when feeding the world's growing population will be extremely difficult, even with the best technologies and infrastructure. The search for alternative chemicals or resistant crop lines has become a serious challenge that requires a focused and systematic strategy. The problem is grave, and the only way to find a reliable solution is to employ appropriate biotechnological approaches. It is now possible to create disease-resistant and disease-free plants for future use because of advances in biotechnology methods. The development of transgenics, especially for greater resistance to numerous diseases and pests, is a rapidly developing and successful sector with a lot of potential. The identification and subsequent introduction into the vulnerable host of particular tolerance genes from microbes or naturally resistant plant species confers resistance to specific diseases.

Tissue culture has emerged as the most important platform for all genetic alterations involving plant systems. The method has aided transformation experiments leading to transgenics, starting with simple callus induction and root and shoot regeneration. The totipotency characteristic is used in plant tissue culture procedures (the capacity to grow and regenerate). Compared to traditional techniques, this aseptic technique has a few benefits.

The Process of Tissue Culture for Producing New Plants is as Follows

1. A tiny bit of plant tissue is removed from the plant's growth point or tip and put on a sterile jelly containing nutrients and plant hormones. Hormones cause the cells in plant tissue to divide rapidly, resulting in a large number of cells that create a shapeless mass known as a callus.
2. The callus is then moved to another jelly containing plant hormones that promote root development in the callus.
3. The callus with grown roots is then placed on another jelly containing various hormones that promote the growth of shoots.
4. The callus, which has roots and shoots, divides into small plantlets. Many small plantlets are generated in this manner from only a few initial plant cells or tissue.
5. The resulting plantlets are transferred into pots or soil where they can develop into full plants.

Various Types of Tissue Culture

1. Seed Culture.
2. Embryo Culture.
3. Callus Culture.
4. Organ Culture.
5. Protoplast Culture.

Advantages of Tissue Culture

Following are the various advantages of tissue culture technique:
1. Plantlets are produced in a relatively short period of time using a little amount of plant tissue.
2. The young plantlets and plants are less likely to be infected with viruses or illnesses.

3. In the seed potato business, this approach aids in the maintenance and establishment of virus-free stock.
4. The process is not seasonal and can be carried out at any time of year.
5. The tissue culture technique does not require a huge amount of area to produce plants.
6. This approach is used to grow ornamental plants such as dahlias, chrysanthemums, orchids, and so on.

Applications of Plant Tissue Culture in Crop Improvement

1. Perform wider crosses with a higher number of related wild plant species to gain access to a much wider variety of genes that may be exploited for crop plant genetic improvement.
2. Aids in the bulk multiplication of plants that are difficult to cultivate using traditional methods.
3. Aids in the fast multiplication of ornamentals, fruits, and aromatics that cannot be propagated by traditional techniques.
4. Create "Double Haploid (DH)" mapping populations for QTL analysis.
5. Expands the pool of attractive germplasms available to plant breeders.
6. A significant channel for regeneration and the creation of artificial seeds.
7. Plant tissue culture can be used to create virus-free plants.
8. Production of secondary metabolites. Eg:- Nicotine from *Nicotiana rustica*.
9. Using the embryo rescue approach, interspecific and intergeneric hybrids can be generated, which is not achievable using traditional techniques.
10. Widely utilised for DNA transformation (creating genetically modified animals), because the cell wall would otherwise prevent DNA from entering the cell.
11. The use of foreign DNA to create novel (and usually desired) genetic combinations for the purpose of studying gene function.

Use of Tissue Culture Techniques in Plant Protection

Some innovative uses of tissue culture include the production of haploids, the development of useful genetic diversity (somaclonal variation), somatic hybrids, genetically modified (genetically engineered) plants, and micropropagation. As a result, in vitro techniques provide a tool for cellular and DNA-mediated intervention, variant selection, and clone multiplication. The incubation of apical meristems has proven to be an efficient method of eradicating the virus. In fact, repeated in vitro subcultures of tomato roots by White (1934) and later work by Limasset and Cornuet (1949) led Morel and Martini (1952) to propose that the apical meristem of systemically infected plants may be isolated and grown in vitro to produce virus-free plants. Since then, the technology of apical meristem cultivation has been effectively applied to a significant number of important plant varieties. In certain situations, the terminal and axillary/lateral buds are also accessible for meristem culture.

Transgenic Plants

A transgene is a gene that has been transferred from one creature to another via genetic engineering. When one of these transplanted genes is present in an organism, the organism is referred to as a transgenic organism. Transgene-modified cells may be utilised to create platelets, and these platelets can subsequently develop into plants that are highly sought after due to their transgenic properties.

Transgenic Bt has shown to be a valuable instrument in the development of an IPM program. Only Bt cotton is commercially available in India. Cotton plants have been genetically engineered to include an insecticidal protein gene (Cry1AC) obtained from the naturally occurring soil bacteria Bacillus thuringiensis (Bt) var. Kurstaki. Lepidopteran larvae stop feeding after ingesting Bt toxin owing to the development of paralysis in the midgut, altered permeability, and epithelial disintegration, which leads to hunger and death of the insect after 2-3 days of exposure.

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Climate Change and Risk to Agriculture

Article ID: 11470

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Abstract

The paper highlights the need for scaling up development efforts in the country to reduce vulnerability and become resilient to climate change. The ICAR report on ‘Risk Assessment for Climate Change’ identified 34% of the districts in India at high risk from climate change. In the next 20 years, the intensity of climate change is likely to increase and almost 50% of the districts will be at high risk. It is, therefore, imperative that strategic efforts are taken in those districts which are currently rated as ‘High Vulnerable Risk’.

Keywords: Climate Change, Agriculture, Vulnerability.

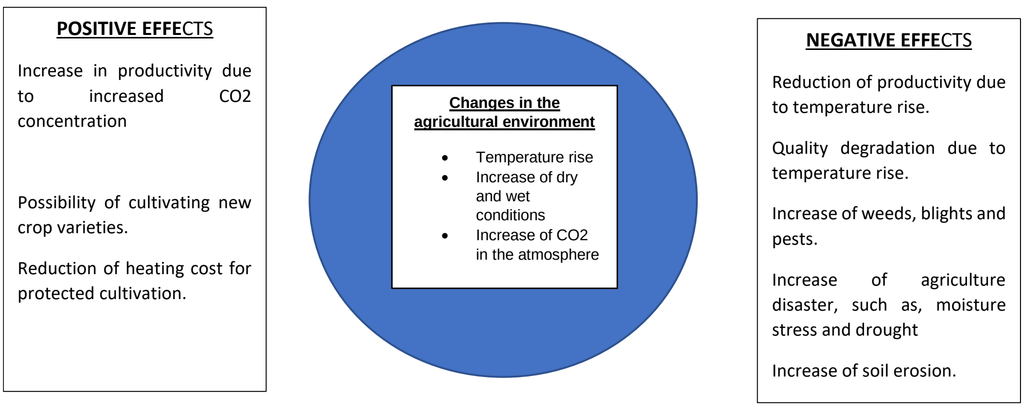
Introduction

The gradual change in the climate system resulting from both natural and artificial causes is a growing concern for the environmental activists and policy makers. ‘Climate change’ refers to the increasing changes in the measures of climate over a long period of time -including precipitation, temperature and wind patterns (EPA,2017). The causes of climate change can be either natural or human induced. The natural causes include change in solar activity, volcanic eruption, sea water temperature, ice cap distribution, westerly waves and atmospheric waves on the other hand, artificial causes include carbon dioxide emission from industry and agricultural production activities, deforestation, acid rain and the destruction of the ozone layer by Freon gas (Presidential Advisory Council on Education, Science & Technology: PACEST, 2007).

Global warming is one of the aspects of climate change. It refers to the continuous increase of the Earth’s temperature due to the greenhouse effect, started from the time of the Industrial Revolution which was accompanied by a rapid increase of fossil fuel consumption (Brevik, 2013). This has been a key area of concern since the 1970s and it has been widely accepted by scientists that the anthropogenic greenhouse gas emissions are the cause of global warming.

Agriculture contributes a significant share of the greenhouse gas emissions that are causing climate change. The main direct agricultural GHG emissions are nitrous oxide emissions from soils, fertilisers, manure and urine from grazing animals and methane production by ruminant animals and from paddy rice cultivation. Both gases have a significantly higher global warming potential than carbon dioxide (OECD, 2016).

Agriculture is not only the cause of climate change, but also the effects of climate change is felt most in this sector. Some of the consequences of climate change in agriculture as illustrated by several researchers is presented below:



Source: Kim, Chang-Gil and et al. (2009), p.38

As illustrated above, climate change can lead to rise in temperature, extreme weather events, like, drought or flood and increased concentration of CO_2 in the atmosphere. All of these can impact agriculture significantly. Some researchers also cited positive impacts on agriculture. For instance, increased concentration of CO_2 can lead to higher productivity. Change in weather pattern can open up scope for cultivating new crop varieties (Mall et.al, 2007).

However, the negative effects can outweigh the positives. Mall and Singh (2000) observed that small changes in the growing season temperature over the years appeared to be the key aspect of weather affecting yearly wheat yield fluctuations. Pathak et al. (2003) showed that the negative trends in solar radiation and an increase in minimum temperature, resulted in declining trends of potential yields of rice and wheat in the Indo-Gangetic plains of India. Since solar radiation is closely related to crop growth, any decrease in this will significantly reduce agricultural productivity. The accompanied increase in minimum temperatures increases maintenance respiration requirement of the crops and thus further reduces net growth and productivity (Aggarwal, 2003).

Thus, agriculture is a cause as well as a part of the problem of climate change. Nevertheless, agriculture has the potential to be an important part of the solution. However, self-initiated efforts by farmers to adapt to climate change while decreasing the GHG footprint of agriculture are unlikely to be sufficient, given uncertainties surrounding the timing and nature of climate change.

Climate Change and Challenging Issues in India

India's status as a developing country mainly on agriculture makes it particularly susceptible to the effects of climate change. Like most other developing countries, India does not have adequate monitoring systems for the prediction of likelihood of occurrences of extreme events or the assessment of possible changes in weather patterns, thus, making the task of developing short term response or disaster management strategies extremely difficult.

In order to develop technologies and strategies for enhancing resilience of Indian agriculture to climate change, the Indian Council of Agriculture (ICAR), Ministry of Agriculture and Farmers' Welfare (MoFW), Govt. of India (GoI), initiated the project 'National Initiative on Climate Resilient Agriculture' in 2011 and 'National Innovations in Climate Resilient Agriculture' in 2017. It was recognised that vulnerability to climate change varies by type and degree significantly across regions and therefore climate resilient solutions should be specific to the needs of the region.

Vulnerability is essentially a dynamic concept, ex ante in nature (Ionescu et al., 2008) and responds to development efforts. As per the Inter- Governmental Panel Change (IPCC) framework, vulnerability captures two dimensions:
1. Ability or propensity of the system to be adversely or positively affected by an external shock such as 'climate change' which is referred to as exposure.
2. Adaptive capacity refers to the ability of the system to respond to climate change to minimise the impact and is a function of factors, such as, wealth, technology, education, infrastructure, access to resources, etc. (McCarthy, et al., 2001).

The Indian Council of Agriculture Research (ICAR) released a report identifying the districts that are at risk from climate change. Evident from the table below, 30% of the districts in India had regular occurrence of climate hazards. The historical hazards are computed based on three hazards of drought, flood and cyclone. Gujarat and Punjab were the worst affected with majority of the districts under regular occurrence of climatic hazard. Haryana, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal are the other states with high occurrence of climatic hazards.

The vulnerability risk which is measured in terms of development indicators measures the resilience to climate change. Abouts 34% of the districts across the country is found to be high at vulnerability, i.e., these districts are not resilient to the climatic change. Many of them are in the states of Rajasthan, Maharashtra, Jharkhand, Odisha, Arunachal Pradesh, Chhattisgarh, Madhya Pradesh, Karnataka, etc.

The future hazard, which is computed based on a number of agriculturally relevant indicators computed using climate projections, shows future climate is likely to more unfavourable. About 68% of the districts will come under the extreme climatic events. This implies a worsening situation in most states of the country.

The climate change risk is the resultant of interaction among exposure, vulnerability and hazard. The study suggests 50% of the districts will be at high risk. In at least 15 states more than 50% of the districts will be at high risk. This includes the big agricultural states, i.e., Uttar Pradesh, Rajasthan, West Bengal, Bihar, Orissa, Haryana, Karnataka and Punjab.

Table1 : State-wise proportion of districts under risks due to climate change:

States	Proportion of districts categorised as 'Risk' Districts			
	Historical hazard	**Vulnerability Risk**	**Future hazard**	**Future intensity of climate change risk**
Meghalaya	57%	86%	100%	100%
Kerala	36%	0%	93%	93%
Mizoram	25%	88%	100%	88%
Rajasthan	53%	88%	50%	84%
West Bengal	59%	6%	88%	82%
Nagaland	0%	75%	100%	75%
Uttar Pradesh	37%	10%	89%	69%
Himachal Pradesh	0%	58%	100%	67%
Manipur	0%	56%	100%	67%
Odisha	30%	47%	93%	63%
Bihar	22%	3%	84%	62%
Haryana	74%	0%	95%	58%
Karnataka	11%	41%	70%	56%
Arunachal Pradesh	0%	100%	100%	54%
Punjab	94%	0%	82%	53%
Maharashtra	9%	52%	42%	39%
Chhattisgarh	0%	75%	94%	38%
Madhya Pradesh	4%	29%	78%	36%
Jharkhand	0%	83%	72%	33%
Gujarat	92%	16%	8%	32%
Andhra Pradesh	31%	31%	54%	31%
Assam	17%	9%	100%	30%
Telangana	0%	22%	78%	22%
Tamil Nadu	69%	3%	3%	17%

Source: ICAR Report on 'Risk and Vulnerability assessment to climate change in Indian agriculture, 2021

Conclusion

Climate and climate change is a spatial phenomenon and hence climate change risk also varies spatially. The adverse impact of climate change is well known, yet large number of districts in India are vulnerable to any climate change risk. The intensity of climate change will only increase in future. Unless strategic efforts are taken to reduce vulnerability through development efforts, agriculture in India will be severely impacted.

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Impact of Climate Change on Rice Production: An Indian Perspective

Article ID: 11471

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Introduction

There is a saying that change is the only constant in the world. This proverb seems to be true in case of climate also. Climate change is the most important environmental event that is threatening the current world and will affect the sustainability of future generation especially in agriculture sector as we know climate contributes more than 50% variability in yield of crop. Among various crops, rice is the most important crop of India and it is the 2nd most important crop of the world. Under the current population change scenario, we have to keep on increasing the production for maintaining the sustainability and here comes the effect of climate change on yield variability of rice. Climate change basically means long term changes in temperature and various weather parameters as well as increased frequency of extreme events. Increasing global average temperature, decreased range of diurnal temperature, increased atmospheric CO_2 concentration, fewer rainy days but more amount of rain per event, faster snow melting, higher level of tropospheric ozone, increased severe storms, flooding, more drought etc these all associated with climate change. To cope up with these unprecedented changes in climatic phenomena, appropriate adoption and mitigation strategies need to be developed. In this article we will majorly discuss on the consequences of climate change that can alter the phonological growth of the crop and hamper the productivity.

Biotic and Abiotic Stresses on Crop Growth

In most of the cases it imparts changes in plant which cause stress on them i.e., abiotic stress and biotic stress. Among abiotic stress , Heat stress, drought , salinity and submergence are the foremost threats. Increase in CO_2 will trap more terrestrial radiation causing heat stress. Heat stress affects the plant mainly by two ways, first, high temperature along with high humidity causes spikelet sterility and also effects grain quality; secondly, assimilate accumulation may reduce by increased night temperature. Effect of heat stress is stage dependent on rice ,like in vegetative stage it can tolerate a relatively high temperature but reproductive change is very sensitive (Yoshida et al 1981). In 1998, Satake and Yoshida identified anthesis (mainly anther dehiscence) followed by micro gametogenesis is the most sensitive process to high temperature. Decreased grain weight and grain filling, higher % of white chalky rice are some effects of high temperature on ripening stage. Increased average temperature along with decrease effective rainfall will lead aggravate the problem of drought. Rice, as a semiaquatic plant, is very much vulnerable to this, especially in rainfed condition, affecting 10 million ha of upland rice and over 13 million ha of rainfed lowland rice in Asia alone (Pandey et al 2007).Drought reduces leaf area, photosynthetic rate, above ground biomass but accelerate leaf senescence etc. Salinity problem also indirectly linked with high temperature .High temperature increases High temperature increases snow melt down and this in turns increases sea level rise, affecting the coastal wetlands salinity. High temperature also aggravates the problem of secondary salinization. Salinization problem brings osmotic stress and problems like Na+ toxicity. The problem of submergence is also an important issue although rice is a semiaquatic plant but it is generally not tolerant to complete submergence. Among biotic stress, weeds, insects, pathogens etc are the major concern which also most likely to be affected by climate change. Here also increasing temperature, increasing humidity, increasing CO_2 concentration these all factors are affecting the biotic factors and possessing potential threats to rice. An increase of 0.4°C average surface temperature over past century in India has led to rice insect pest losses increase from 10% during the pre-green revolution period (Dhaliwal et al,2004) to 25% during the post green revolution period (NAPCC, 2008). Insect pests like GLH and BPH have reported recent outbreaks in relation to climate change (Sharma et al, 2016). Climate change may also alter pathogen life cycle, developmental rates and dissemination. Their geographical distribution may also alter due to climate change.

Impact on Nutrient Availability, Water Relation and Weed Dynamics

Climate change will also play a crucial role with nutrient management of rice. As most of the N kinetics are microbe dependent, so change in soil temperature and soil moisture distribution due to climate change ,will affect N dynamics of rice. Increased temperature may lead to increase mineralization but on the other hand it will also increase volatilization loss. Climate change will aggravate soil degradation problem also. Increased CO_2 concentration will lead to the less nutritious rice, may be due to dilution effect. Climate change may also lead to depletion of the soil organic matter due to increase in temperature.Climate change will also affect the water cycle and water relations of rice. Rice in temperature will increase Evaporation loss. Variability in the amount and distribution of rainfall is the most important factor that will affect rainfed rice. Variability in onset of monsoon will affect time of sowing which in turn will affect yield. Sudden break in monsoon specially during the critical stages of rice will drastically reduce yield. The number of rainy days will decrease but precipitation per rainfall event will be intense which can lead to problem of flooding in low lying areas when submergence is more than 14 days. Climate change will lead more frequent occurrence of drought as well as flood. We know that under high temperature , plants with C_4 carbon fixation pathway have more competitive advantage due to absence of photorespiration. Most of the weeds in rice have C_4 carbon fixation pathway. Although the effect of increase CO_2 might be beneficial to C_3 crop like rice ,but the effect of high temperature may be more ,so the net competitive advantage is more to C_4weeds. For example, weeds species like *Dactylocteniumaegyptium*, *E.colona, C.dactylon*, weedy rice (*O.sativa* L.) responds more strongly than cultivated rice to rising level of CO_2 , which means weeds may become more problematic in future. Increased level of CO2 may also increase weeds resistance to various herbicides like glyphosate so decreasing its efficiency. Temperature change and change in microclimate may result in shift of weed flora both in spatial and temporal dimension. Thus, various crop management practices are going to be affected by climate change.

Projected Impact on India

In India, climate change will reduce rice yield by 3 to 5% under medium emission scenario and 3.5 to 10% under high emission scenario (Palanisami et al 2017). According to another study , change in temperature and rainfall in India will reduce the yield of rice by 15-25% (Kavikumar and Parikh ,1998). According to Singh et al 2010, increase in temperature by 2.5oC during vegetative and reproductive stage of rice can reduce the yield of grain by 23 and 27% respectively.

But one important aspect in this regard is, these all estimates focus on yield reduction only ; not variability in yield. Like , some of the studies also concluded that there might be possible net increase in production due to increase amount of CO2 in the air. Most of the studies does not addressed the climate change impact at regional level. According to these types of studies, it is generally assumed that , in case of south india, there may be slight increase in production under both medium and high emission scenario. In case of eastern india also, this type of trend can be seen. But in case of north India and central India ,there will be decreasing trend in total production. So, the overall impact will be going to be negative in all over the India.

Viable Mitigation Strategies

Now comes the possible solutions to combat against this type of problems. To tackle the problem of various abiotic or biotic stress , one of the important strategies is crop improvement .Like breeding for pest and disease resistance, varieties suitable for various abiotic stress conditions like salinity tolerant rice varieties, drought tolerant rice varieties, heat tolerant rice varieties may be a possible solution.

Similarly, submergence tolerance gene sub1 isolated from FR13A variety has an important role in breeding against submerge tolerance. Precise and better agronomic approaches like modified SRI, Direct seeding of rice , Alternate wetting and Drying technique, Community nursery and staggered planting, optimization in seed rate according to situation, better nutrient management practice like use of coated fertilizer, 4R nutrient stewardship, INM, use of more organic matter in soil, Crop rotation, Crop residue management etc should be followed to alleviate the obstacles of global climate change.

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Importance of Colour Food for Healthy Living

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Introduction

To eat a variety of colour fruits and vegetables every day is to maintain our body in good health and wellbeing. All colour foods have phytochemical property, which have unique health benefits to our body. Eating in a diverse way of colour foods can be in an easy way to get a complete range of vitamins and minerals.

A healthy diet throughout life promotes healthy outcomes, supports normal growth and development and protects from diseases. We should have to eat a well-balanced diet to increase our immune system and lower the risk of lifestyle diseases. A large number of fruit intake (3 servings/day) during aidolescence time reduces the risk of breast cancer. Fruits and vegetables have enormous healing powers.

What is Healthy Diet?

A diet consisting of a variety of different types of colour fruits and vegetables providing adequate amount of nutrients that helps to protect against malnutrition as well as non-communicable diseases such as diabetes, heart disease, stroke and cancer. A healthy diet provides the body with essential nutrition, fluid, micronutrients macronutrients and adequate calories.

According to WHO a healthy diet helps to protect against different diseases. The exact makeup of diversified balanced and healthy diet varies depending on individual characteristics such as age, gender , lifestyle and degree of physical activity. The variety of vitamins and minerals antioxidants and phytochemicals present in fruits and vegetables have enormous healthy powers. Phytochemicals are naturally occurring in plants and provide colour, aroma and flavour. People who eat more generous amounts of fruits and vegetables as part of healthy diet.

Components of Healthy Diet

A healthy diet consists of the following components:
1. Carbohydrates
2. Proteins
3. Fats
4. Vitamins and minerals.
5. Water.

Foods can be Categorised According to the Function

Energy rich foods: Carbohydrates and fats. e.g., Whole grain, Cereal, vegetable oils, ghee, sugars etc.
Body building foods: Proteins. e.g., Pulses, nuts, milk and milk products, meat, fish and poultry products.

Protective Foods

Vitamins and minerals, Green leafy vegetables, fruits, eggs, milk and milk products.

Healthy Reasons to Eat a Rainbow of Colourful Fruits and Vegetables

The colour signals the food to indicate various healthful properties. Research has discovered the link between specific health benefits and their corresponding food colour. Remember, food that looks good, tastes even better. When your kitchen, table or plate look dull and colourless, get creative like nature's rainbow colour. Whatever you do, be sure to add some colour to your plate. It looks beautiful, tastes great, and yields many health benefits.

Red colour: Naturally red colours contain the red pigment called lycopene or anthocyanins. Lycopene in tomatoes, watermelon and pink grapefruit which may help to reduce risk of several types of cancer especially prostate cancer. Anthocyanins in strawberries, raspberries, red grapes and other fruits and vegetables act as powerful antioxidants that protect cells from damage are linked with keeping our hearts healthy. Apples and watermelons contain lycopene which reduces have to eat a well-balanced diet to increase our immune system and lower the risk of lifestyle diseases such as cancer risk. These red pigments protect against certain cancers, lower risk of diabetes, support eye health and improve skin appearance.

Orange and yellow colours: Orange and yellow colours are usually present pigments called carotenoids. Beta carotene in sweet potatoes, pumpkins and carrots is converted to vit-A , which helps maintain healthy mucous membranes and healthy eyes. Scientists have reported that carotenoid rich foods can help reduce risk of cancer, heart disease and can improve immune system function. Carotenoids also may be good for your heart. Orange foods such as oranges, papaya, carrot, muskmelon, mangoes contain alpha and beta carotenes that help improve cell communication throughout the body. Yellow fruits like turmeric, corn, or banana, contain carotenoids, lutein, and zeaxanthin. These are good for eye health.

Green colours: Green plants are full of chlorophylls and one of the healthiest food we can eat. Some members of the green plants including spinach and other dark leafy greens, green peppers, peas, cucumber and celery contain lutein. Lutein works with another chemicals zeaxanthin, found in corn, redpeppers, oranges, grapes and egg yolks to help keeps eye healthy. These chemicals may help reduce risk of cataracts and age-related macular degeneration. The indoles in broccoli, cauliflower, cabbage and other cruciferous vegetables may help protect against some types of cancer. Leafy greens such as spinach and broccoli, are excellent sources of folate. Folic acid plays an important role in mental and emotional health. It supports the brain function.

White colour: White colour contains the pigment called anthoxanthins. Garlic contain health promoting chemicals such as allicin which may help lower cholesterol and blood pressure and may help reduce risk of stomach cancer and heart disease. Some members of the white groups such as bananas and potatoes are good sources of the mineral and potassium. White foods like onions, garlic and pears act as antioxidants and protect the cell membrane.

Blue and purple colours: They are rich in phytonutrients anthocyanins and reversterol. Anthocyanins in blueberries, grapes, and raisins act as powerful antioxidants that protect cells from damage. Red cabbage has the highest antioxidant property. Purple foods including grapes and eggplant contain anthocyanins that increase blood flow and improve the function of the kidneys and eyes. Other studies have shown that eating more blueberries is linked with improved memory function and healthy aging.

Some Suggestions

1. Lack of awareness on the health benefits of locally available fruits and vegetables, we should give awareness programme.

2. Antioxidant properties of fruit and vegetables is to protect against free radical .Antioxidants are one of the contributing factors in increasing the human life spans achieving healthy ageing reducing cardiovascular diseases and more.

3. Free radical causes cancer. We should require awareness programme on cancer.

4. Many diseases such as diabetes, heart disease, hypertension this are all dependent diet. We should eat fruits and vegetables more for a healthy future.

Conclusion

We should eat rainbow colour of food every day to protect ourselves against non-communicable diseases. Increase in fruit intake can also help low blood pressure and reduce oxidative stress which may decrease the risk of heart disease.

Fruits and vegetable are the rich sources of fibre a low content of fat. Lastly, we should add a variety of fruits and vegetables in our plate. Increasing the number of fruits and vegetables in our diet can help reduce our risk of developing chronic health conditions such as stroke, cataract, Parkinson's disease or even cancer. We should add some colour fruits and vegetables to each meal or snack daily for better happy and healthy life.

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First Generation Bioethanol from Corn and Sugarcane: Not a Green Technology for USA and Brazil

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Introduction

The carbon emission from combustion of fossil fuels (coal, petroleum, liquefied petroleum gas etc.) became threat to global climate change. Besides, its limiting reserves caused fluctuations in supply over demand. As a result, high cost these energy sources made them unreliable for long run application. Over the years scientists have focused on the utilization of renewable energy sources (solar, wind, water, geothermal energy etc.) for mitigating these problems but lower efficiency and higher input cost (construction of photovoltaic panels) and their maintenance made these practices very cost intensive. During the time, introduction of biodiesel by Belgium in 1937 seemed to boost the renewable energy utilization concept and treated as a carbon neutral energy source. Currently, ethanol is most prevalent liquid biofuel used in motor vehicles. In 1978, first introduction of bioethanol was established by Fiat Automobiles S.p.A in Brazil. The lower carbon footprints in bioethanol, produced from USA based corns (44.9 g CO_2 equivalent MJ─1) and Brazilian sugarcanes (38.5 g CO_2 equivalent MJ─1) make it a combat suite against global warming and climate change (Mekonnen et. al., 2018). Thus, a rapid growth of bioethanol in global market has increasing with time. Brazil and the USA are known as major producer of bioethanol because together they produce nearly 83% of world bioethanol from sugarcane (21 million m^3) and corn (60 million m^3), respectively (Bertrand et. al., 2016). This large-scale bioethanol is produced from corn starch in USA and sugarcane sucrose in Brazil. However, recent studies indicate some major impacts on countries' modern economy, land use, fresh water reserves, energy wastage, biodiversity loss, and food security.

Sugarcane Based Bioethanol Production in Brazil

Brazil is considered as the largest producer of sugarcane with an area of 10 million hectares and a production of 632 billion tonnes (Unica, 2015). In 1975, the ProAlcool programme was introduced by Brazilian Government to substitute fossil fuel (gasoline) with sugarcane-based ethanol up to a certain extent (Bertrand et. al., 2016). As a result, nearly 39% of the energy produced in Brazil is renewable and most of this energy directly comes from sugarcane bioethanol which is nearly 157% (Unica, 2015). That is why agricultural practices in Brazil have mainly focused on the sugarcane cultivation for the last few decades and the productivity is estimated to increase at 1.3% per year up to 2020 (Bertrand et. al., 2016). Besides, adding nearly 25% of the sugarcane-based bioethanol into gasoline has cut down the CO2 evolution (110 million tons) and also the foreign oil (about 550 million barrels) imports (Bertrand et. al., 2016). However, this industry has been strictly regulated by the Brazilian government and in 2020, the estimated production (31.35 billion litre) was somehow found 16% lower than 2019 when it was 37.38 billion litre (USDA Foreign Agricultural Service, 2020). This was because the Government has been diverting sugarcane from bioethanol to sugar production.

Corn Based Bioethanol Production in USA

Following Brazil's performance on energy security, USA started corn grain-based bioethanol production because about 65-76% of starch was extracted from grain corns (Bertrand et. al., 2016). About 40% of the harvest has been used in bioethanol production, rest has been both exported (13%) and used for livestock feeding. Before that corn is mainly grown for animal feed (55%) and too some extent for human consumption (Mekonnen et. al., 2018). The Federal Agriculture Improvement and Reform Act in 1996 increased the corn area which was fixed to 60.2 million hectares previously (USDA Economic Research Service, 2013). Through two ways bioethanol is produced in USA: dry-milling (90% of the bioethanol) and wet-milling (10% of the bioethanol). United States Department of Energy reported that nearly 5.60 billion bushels of corn were used for bioethanol production in 2019 out of 14.62 billion of harvested corn bushels (Alternative Fuels Data Center, 2019).

Impact of Bioethanol Production

Different studies have assessed the cost of converting a huge landscape for corn and sugarcane cultivations to generate bioethanol instead of food.

1. Impact on environment: Bioethanol production technology from corn and sugarcane is treated as carbon neutral because crops (corn and sugarcane) absorb atmospheric CO_2 during their growth, they; while, upon combustion, the bioethanol (produced from corn and sugarcane) offsets the captured CO_2. Since, the areas for corn (in USA) and sugarcane (in Brazil) have been increased; there is always a carbon opportunity cost for planting bioenergy crops on the lands of food crops (direct land use change) or on forested/abandoned/surplus lands (indirect land use change). This not only destroyed the biodiversity but also released the soil carbon reserves into environment through liberating CO_2. USEPA reported that indirect land use change has contributed 26.5 g CO_2equivalent MJ^{-1} and 3.8 g CO_2equivalent MJ^{-1} emissions from sugarcane (14%) and corn (40%) bioethanol, respectively (Mekonnen *et. al.,* 2018). In order to properly evaluate the bioethanol production for energy generation, the carbon opportunity cost needs to be subtracted from the benefit.

2. Fresh water wastage: More fresh water is needed for sugarcane cultivation as it takes nearly 7000 L of water to produce 12 kg sugarcane which can generate about 1 L of bioethanol (Pimentel and *Patzek,* 2008); while, nearly 3 kg of corn is required to generate about 1 L of bioethanol and around 2250 L of water is required to produce the same (Mekonnen *et. al.,* 2018). Besides, excess of water is added during fermentation and distillation, accounting 10 L (from sugarcane) and 12 L (from corn) of wastewater (Pimentel and *Patzek,* 2008). Upon release, these wastewaters increase 20 kg of BOD (biological oxygen demand; Table 1) per 1000 L of bioethanol produced (Pimentel and *Patzek,* 2008; Pimentel *et. al.,* 2009).

3. Energy loss: The input energy for 1000 L of corn-based ethanol (USA) production is 7474000 kcal (Table 1); while, it is 2242000 kcal for Brazilian sugarcane-based ethanol (Pimentel and *Patzek,* 2008). A thousand litre of bioethanol possess 5130000 kcal energy output. So, the positive energy return from sugarcane-based bioethanol is 2.29-times higher. A net loss of 2344000 kcal energy for corn-based bioethanol can be compensated by 46% of fossil fuel energy again a sugarcane feedstock needs 40% more energy for pre-treatment (Pimentel and *Patzek,* 2008). Energy requirement for 129 billion litres of bioethanol production is equivalent to 5% of petroleum consumption (Pimentel *et. al.,* 2009). Thus, in terms of energy it is still not sustainable.

Table 1 Input required for producing 1000 L of 99.5% bioethanol (Pimentel and Patzek, 2008; Pimentel et. al., 2009):

Inputs	USA Corn			Brazilian Sugarcane	
	Quantity	kcal		Quantity	Kcal
Grain/Stalk	2690 kg	2355000		12,000 kg	612000
Transport	2690 kg	322000		12000 kg	1434000
Water	15000 L	90000		21000 L	90000
Stainless steel	3 kg	165000		3 kg	165000
Steel	4 kg	92000		4 kg	92000
Cement	8 kg	384000		8 kg	384000
Steam	2646000 kcal	2646000		2546000 kcal	0
Electricity	392 kWh	1011000		392 kWh	0
95% ethanol to 99.5%	9 kcal L–1	9000		9 kcal L–1	9000
Sewage effluent	20 kg BOD	69000		20 kg BOD	69000
Distribution	331 kcal L–1	331000		331 kcal L–1	331000
Total Energy		7474000			2242000

BOD: Biological oxygen demand

4. Economic loss: Capital for new plant establishment needs an expense of $1.05 to $3 per gallon of bioethanol produced (Pimentel et. al., 2009). Manufacturing of one gallon 99.5% corn-based bioethanol costs

$3.97; while, for 99.5% sugarcane-based bioethanol production, it amounts 26¢ per litre (Pimentel and Patzek, 2008; Pimentel et. al., 2009). The cost of crop production (i.e., labour, fertilizer, irrigation, transport etc.) incurs more expenditure. Thus, without huge amount of Government subsidies, these industries would have shut down long ago.

5. Impact on food security: Expansion of bioethanol production from sugarcane and corn is having a drastic impact over food production and food price. These lands could have supplied more foods to mitigate global hunger. Again, increasing fossil fuels during bioethanol production in these countries resulted in price hike on general basis. Some protest against price hike has already been seen in Mexico over time.

Conclusion

Recent bioethanol production from corn starch and sugarcane stalk is not desirable during COVID-19 food shortage. Again, cost and land degradation become crucial limitation for these industries to run in the future. Therefore, bio-wastes to green energy must be implemented on a global scale to avoid the fuel verses food competition because these wastes are lingo-cellulosic which are cheap and abundant. An estimate suggests that these lingo-cellulosic wastes have a potential to produce 491 billion litres bioethanol per year which is nearly 16-times higher than the sugarcane/corn-based bioethanol (Bertrand et. al., 2016).

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Cultivation Practices of Rose Under Open Condition

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Introduction

Common name- Rose
Hindi name- Gulab
Scientific name-Rosa spp.
Family- Rosaceae
Botanical description-stem is prickly, leaves are alternate and compound and its fruit is known as hip.
Origin-Most species are native to Asia, with smaller numbers native to Europe, North America and North West Africa.

Area and Distribution

Roses are cultivated in France, Cyprus, Greece, India, Iran, Italy, Morocco, USA, Bulgaria for production of perfume. In India major Rose producing areas are Karnataka, Maharashtra, Punjab, Uttar Pradesh, New Delhi and Chandigarh. While in Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh, Rajasthan, Tamil Nadu and West Bengal they are grown in limited extent.

Climate

Roses need bright sunshine and free ventilation. Sunshine for six hours is ideal for better growth and flowering. Humidity-Humidity plays an important role in the incidence of pests and diseases affecting the growth and flowering.

Soil Requirement and Preparation

The ideal soil should be medium loam having sufficient organic matter, with a pH of 6.0 and 7.5. If the soil is deficit of organic matter, then 10-12 per cent of additional organic matter may be added to it. Upon land preparation, beds/ plots of 1- 1.5m wide and 30-40m long should be prepared.

Planting Distance

It depends on the types of roses and location. For cut flower production, a spacing of 60 x 30 cm is recommended. Normally roses are planted at 60 x 60 cm spacing.

Preparation of Field

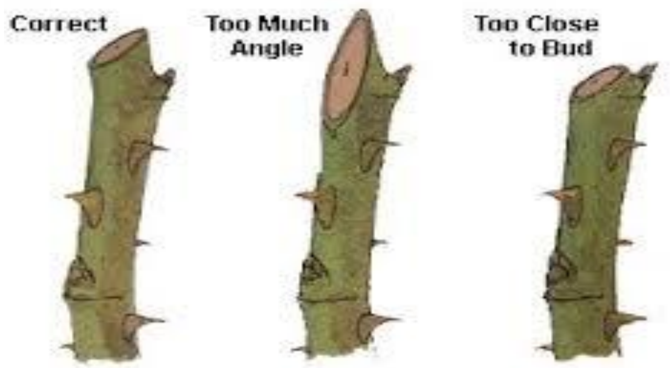
Raised bed should be prepared. Pits must be dug before the onset of rain so that the soil may settle down. Pits of 20-30 cm wide & 30 cm deep should be prepared.

Care should be taken that the top soil should remain on the top.

Propagation

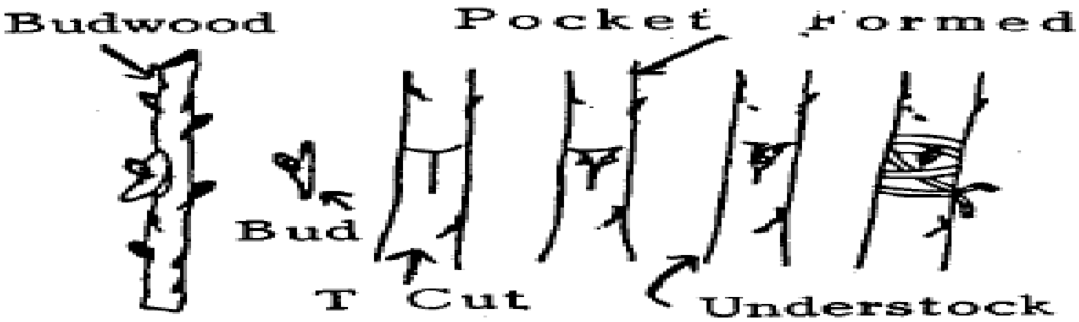
Cutting:

a. Mainly scented roses, polyanthas, climbers, ramblers and miniature are propagated by cutting.
b. Cuttings are collected from healthier plants with 15-20 cm length and 3-4 nodes.
c. Treated with IAA, BA 100ppm.



Budding:

a. Hybrid and Floribunda roses mainly propagated through budding.
b. 'T' budding is the common method.
c. Root stocks used are *R. multiflora* (Briar root stock), *R. indica var.odorata, R. bourboniana, R. canina* and *R. noisettiana.*



Preparation of Beds and Pits

1. The beds or pits for planting are prepared at least a month before the date of planting.
2. The preparation of beds may be taken up during May or June.
3. The beds are prepared to a depth of 60-75 cm and a trench of 45-60 cm across is dug to 30 cm depth.
4. If the soil of the bed is heavy clay with poor drainage, the beds are raised to a level of 40 cm above the ground.

Season

1. In plains roses can be best planted during Sep-Oct after the cessation of the rains.
2. In hills, planting can be done during Oct-Nov/ Feb-Mar.

Spacing

1. Cut flower production – 60 x 30 cm.
2. Oil extraction – 2.5 x 0.5 m.
3. Vigorously growing cultivars- 60 x 75 cm / 75 x 75 cm.
4. Polyanthas – 45 cm.
5. Miniatures – 30 cm.
6. Climbing types – 3 m.

Manuring and Fertilization

1. Roses should be fed both organic and inorganic sources. 100 g of mixture containing groundnut cake-5kg, bonemeal-5kg, amorphous (11:48)-2kg, Ammonium sulhpate-1kg, super phosphate (single)- 2kg and potassium sulphate- 1kg should be applied per bush for better results.

2. 6o g N, 20 g of P_2O_5 and K_2O should be applied per square metre containing nine plants. These fertilizers should be applied in two split doses i.e., half amount of N, full dose of P and K at the tie of pruning and remaining half one month after the first application.
3. For better effects foliar feeding of roses had been found very useful.
4. Foliar sprays of 30 g of a mixture of 2 parts urea, 1 part of Dehydrogenase ammonium phosphate, 1 part of potassium nitrate and 1 part of potassium phosphate in 10 litres of water at weekly or fortnightly interval, improve growth and flowering of roses.
5. A weekly spray of 30 g urea /10 L of water, with an insecticide is also recommended.

Intercultural Operations

1. Irrigation-Water requirement of roses depend upon soil type and seasons. Light soils require more frequent irrigation than heavy soils. During summer, water requirement is more than winter. During rainy season, watering is generally not done except during drought period. During winter, irrigation is done at about 7-10 days interval whereas during summer it should be done at an interval of 5-6 days.

2. Weeding- Mulching 2 to 4 inches of organic material like wood chips if found to reduce annual weeds and make hand weeding easier. Manual weeding is effective. Effective control of broad-leaved weeds by spraying with 2,4-Dichlorophenoxyacetic acid, at the rate of 2 kg/600 litre of water/hectare 25–30 days before flowering.

Pruning in Rose

Pruning is the removal of unwanted and unproductive portions of the plant and makes the plant more vigorous and productive.

Time of Pruning

1. Exactly 45 days prior to the date of requirement of flowers during October-December. Pruning is necessary when the yield and quality declines.
2. Method 1st Year: Cut back the shoots to four developed buds remain. Allow the lateral shoots.
3. 2nd Year: Retain all strong shoots and remove weak and diseased shoots. Cut back the strong shoots to 4-5 buds. 3rd Year: Cut back vigorous shoot to half of its growth.
4. Rejuvenation: After 5-6 years the plants are to be rejuvenated. Cut back all the main branches at 15-20 cm from the base. Apply Bordeaux paste over cut ends to prevent diseases.

Varieties of Rose

There are different classes of roses according to the type of flowers they bear:

Hybrid tea varieties	Red-First red, Avon, Happiness, Mr. Lincoln, Raktagandha, Black lady , Montezuma etc. Yellow- Aalmeer Gold, Gold Medal, Golden Star, Star golden, Yellow success, Pusa Sonia Orange- Super Star, Summer Holiday, President and Grand Gala BI-colour- Anvil spark, Mudhosh, Double delight, Supriya, Kiss of fire, Abhisarika, Tata century. Scented-Avon, Grand, Papa, Meiland, Blue perfume, tower, Oklahma.
Floribunda	White-Iceberg, Summer snow, Margette Maril,Chitchor, Chandrama Pink-Prema, Sadabahar, King Arthur, Bridal Pink Yellow- Arther bell, Dr.Foun, Allgold, Sea pearl, Golden times Mauve- Neelambour, Angel face, Africa star Orange- Doris normal, Suryakiran, Jorina jombra Bi-colour- Rare addition, Red gold, Mask red Scented- Angel face, Delhi Princess
Polyantha	The varieties of this class are small and the flowers come in cluster.The main varieties of this class are Anjani,Rashmi,Nartaki, Swati etc.
Miniature	Red- Beauty secret, Dark beauty, Fast fire White- Green ice, Z-Trail, Aany Pink-Windy city, Sweet fairy,Dizzler

	Mauve-Silver tip, Blue bird Orange-Angel ripyance, Petayit foly B-colour- Star and strip, Jainy willius, over rainbow

Harvesting and Handling

Flowering starts from 1st year onwards. Economic yield 2nd to 10th year. Flowers are harvested when the flower buds are in half open stage. For cut flowers, they are harvested at tight bud stage with long stalks. Handling As soon as the flowers are harvested, the stems are harvested the stems are lowered in to clean buckets containing water with preservative. The flowers are then cooled down to 2-4^{0}C for 5-6 hours. The flowers are graded according to the length of the flower stalk. It varies from 40-110 cm depending on the variety and packed 20 per bunch.

Flower Yield

1. Loose flowers: 7.5 t/ha.
2. Cut flowers:
   - 1st year: 100-120 flowers/m^2
   - 2nd year: 200-240 flowers/m^2
   - 3rd year: 300-360 flowers/m^2

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Role of Plant Bio-Stimulants in Crop Production

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A plant biostimulant is any substance or micro-organism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content. Bio-stimulants are distinguished from agrochemicals because they only influence the vigour of plants and have neither direct action against neither pests nor diseases. Bio-stimulants cannot be defined as fertilizers because they do not provide nutrients directly to plants (Drobek et al., 2019). Rather, they uniquely facilitate the uptake of existing and applied nutrients, resistance toabiotic stress such as salinity or drought and contribute to sustainable, high-output low-input crop productions. They do not directly control crop pests such as insects, disease, or weed competition. Moreover, they might achieve this by helping to improve nutrient-use efficiency, helping plants tolerate abiotic stresses like heat, cold, drought, and too much water, helping to improve quality attributes like nutritional content, appearance and shelf-life. Natural stimulants often included under the term bio-stimulants encompass a diverse group of product technologies and may include bacterial or microbial inoculants, biochemical materials, amino acids, humic acids, fulvic acids, sea weed extracts, protein hydrolysates and more (Jardin et al., 2015).

Definition of Bio-Stimulant

A plant biostimulant is any substance or micro-organism applied to crop or soils with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits regardless of its nutrients content (Jardin et al., 2015). By extension, they are an emerging category of crop management products which can enhance crop productivity under abiotic stress conditions (Goni et al., 2028). According to Association of American Plant Food Control Officials (AAPFCO), biostimulant is any natural substance or compound other than primary, secondary and micro plant nutrients that can be demonstrated by scientific research tobe beneficial to one or more species of plants when applied exogenously to the plant or soil (Anon., 2019). The European Bio-stimulants Industry Council (EBIC) defines bio-stimulants as substance(s) and/or micro-organisms whose function when applied to crops or the rhizosphere is tostimulate natural processes to enhance/benefit nutrientuptake, nutrient efficiency, tolerance to abiotic stress, andcrop quality (Anon., 2019). According to Indian Fertilizers Control Order bio-stimulants means compounds, substances and products including microorganisms whose function when applied to plant/seeds/rhizosphere is to regulate and enhance a crops physiological processes independent of the product nutrient contents to improve input use efficiency, growth, yield, quality and/or stress tolerance.

The bio-stimulants may include products of plants/animals or microbial origin.

1. Bio-stimulants are found to enhance the crop growth, yield and quality through improving the efficiency of the crop's metabolism toinduce yield increases and enhanced crop qualitythrough plant health and vigour.
2. Increasing crop tolerance and recovery from abioticstresses.
3. Facilitating nutrient assimilation, translocation and use.
4. Enhancing quality attributes of produce, including sugar content, color, fruit seeding etc.
5. Rendering water use more efficient.
6. Enhance uptake and efficient use of nutrients, bothapplied and existing.

The effects of the stimulators may be multifaceted. Theeffects of their biological activities vary depending on the bio-stimulants used and the crop variety. However, it should be noted that most of them have a beneficial effect on crops.

Categories of Bio-Stimulants According to Indian Fertilizer Control Order

1. Botanical extracts, including seaweed extracts.

2. Bio-chemicals.
3. Protein hydrolysates and amino acids.
4. Vitamins.
5. Cell free microbial products.
6. Antioxidants.
7. Anti-transpirants.
8. Humic and fulvic acid and their derivations.

Humic and Fulvic Acids

Humic substances (HS) are natural constituents of the soil organic matter, resulting from the decomposition of plant, animal and microbial residues, but also from the metabolic activity of soil microbes using these substrates. HS are collections of heterogeneous compounds, originally categorized according to their molecular weights and solubility into humins, humic acids and fulvic acids. These compounds also show complex dynamics of association/dissociation into supra-molecular colloids, and this is influenced by plant roots via the release of protons and exudates. Humic substances and their complexes in the soil thus result from the interplay between the organic matter, microbes and plant roots. Any attempt to use humic substances for promoting plant growth and crop yield needs to optimize these interactions to achieve the expected outputs.

Protein Hydrolysates and Other N-Containing Compounds

Amino-acids and peptides mixtures are obtained by chemical and enzymatic protein hydrolysis from agro industrial by-products, from both plant sources (crop residues) and animal wastes (e.g., collagen, epithelial tissues) (du Jardin, 2012). Chemical synthesis can also be used for single or mixed compounds. Other nitrogenous molecules include betaines, polyamines and 'non-protein amino acids', which are diversified in higher plants but poorly characterized with regard to their physiological and ecological roles (Vranova et al., 2011). Glycine betaine is a special case of amino acid derivative with well-known anti-stress.

Seaweed Extracts and Botanicals

The use of fresh sea weeds as source of organic matter and as fertiliser is ancient in agriculture, but biostimulant effects have been recorded only recently. This prompts the commercial use of seaweed extracts and of purified compounds, which include the polysaccharides laminarin, alginates and carrageenans and their breakdown products. Other constituents contributing to the plant growth promotion include micro- and macronutrients, sterols, N-containing compounds like betaines, and hormones. Several of these compounds are indeed unique to their algal source, explaining the increasing interest of the scientific community and of the industry for these taxonomic groups. Most of the algal species belong to the phylum of brown algae – with Ascophyllum, Fucus, Laminaria as main genera-, but carrageenans originate from red seaweeds, which correspond to a distinct phylogenetic line. Product names of more than 20 seaweed products used as plant growth biostimulant have been listed by Khan et al. (2009).

Chitosan and Other Biopolymers

Chitosan is a deacetylated form of the biopolymer chitin, produced naturally and industrially. Poly- and oligomers of variable, controlled sizes are used in the food, cosmetic, medical and agricultural sectors. The physiological effects of chitosan oligomers in plants are the results of the capacity of this polycationic compound to bind a wide range of cellular components, including DNA, plasma membrane and cell wall constituents, but also to bind specific receptors involved in defense gene activation, in a similar way as plant defense elicitors. Chitin and chitosan apparently use distinct receptors and signalling pathways. Among the cellular consequences of the binding of chitosan to more or less specific cell receptors, hydrogen peroxide accumulation and Ca^{2+} leakage into the cell have been demonstrated, which are expected to cause large physiological changes, as these are key players in the signalling of stress responses and in the development regulation. Analysis of the proteome (Ferri et al., 2014) or trans criptome of plant tissues treated with chitosan confirm this assumption. In consequence, agricultural applications of chitosan have been developed over the years, focusing on plant protection against fungal pathogens, but broader agricultural uses bear on tolerance to abiotic stress (drought, salinity, cold stress) and on quality traits related to primary and secondary metabolisms. Stomatal closure induced by chitosan via an ABA-dependent mechanism participates to the environmental stress protection confered by this biostimulant.

Inorganic Compounds

Chemical elements that promote plant growth and may be essential to particular taxa but are not required by all plants are called beneficial elements (Pilon-Smits et al., 2009). The five main beneficial elements are Al, Co, Na, Se and Si, present in soils and in plants as different inorganic salts and as insoluble forms like amorphous silica ($SiO_2.nH_2O$) in graminaceaous species. These beneficial functions can be constitutive, like the strengthening of cell walls by silica deposits or expressed in defined environmental conditions, like pathogen attack for selenium and osmotic stress for sodium. Definition of beneficial elements is thus not limited to their chemical natures, but must also refer to the special contexts where the positive effects on plant growth and stress response may be observed. It may be assumed that the bioactivity of some complex biostimulants, like extracts of seaweeds, of crop residues or animal wastes, involves the physiological functions of the contained beneficial elements.

Beneficial Fungi

Fungi interact with plant roots in different ways, from mutualistic symbioses (i.e., when both organisms live in direct contact with each other and establish mutually beneficial relationships) to parasitim (Behie and Bidochka, 2014). Plants and fungi have co-evolved since the origin of terrestrial plants and the concept of mutualism – parasitism continuum is useful to describe the extended range of relationships that developed over the evolutionary times. Mycorrhizal fungi are a heterogeneous group of taxa which establish symbioses with over 90 % of all plant species. Among the different forms of physical interactions and taxa involved, the Arbuscule-Forming Mycorrhiza (AMF) are a widespread type of endomycorrhiza associated with crop and horticultural plants, where fungal hyphae of Glomeromycota species penetrate root cortical cells and form branched structures called arbuscules. There is an increasing interest for the use of mycorrhiza to promote sustainable agriculture, considering the widely accepted benefits of the symbioses to nutrition efficiency (for both macronutrients, especially P and micronutrients), water balance, biotic and abiotic stress protection of plants. Recent knowledge also points to the existence of hyphal networks which interconnect not only fungal and plant partners but also individual plants within a plant community. This could have significant ecological and agricultural implications since there is evidence that the fungal conduits allow for interplant signalling. As a further area of research, AMF form tripartite associations with plants and rhizobacteria which are relevant in practical field situations. In order to reap the benefits of the mycorrhizal associations, crop management practices and plant cultivars should be adapted to the interaction with microorganisms. Metagenomics are an interesting tool to monitor and study microbial associations in the rhizosphere. Inoculation of plant propagules and soils complements these approaches.

Beneficial Bacteria

Bacteria interact with plants in all possible ways (Ahmad et al., 2008):
1. As for fungi there is a continuum between mutualism and parasitism.
2. Bacterial niches extend from the soil to the interior of cells, with intermediate locations called the rhizosphere and the rhizoplane.
3. Associations may be transient or permanent, some bacteria being even vertically transmitted via the seed.
4. Functions influencing plant life cover participation to the biogeochemical cycles, supply of nutrients, increase in nutrient use efficiency, induction of disease resistance, enhancement of abiotic stress tolerance, modulation of morphogenesis by plant growth regulators.

Conclusion

A plant biostimulant is any substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content. By extension, plant biostimulants also designate commercial products containing mixtures of such substances and/or microorganisms. The definition proposed by this article is supported by arguments related to the scientific knowledge about the nature, modes of action and types of effects of biostimulants on crop and horticultural plants. Many biostimulants improve nutrition and they do so regardless of their nutrients contents. Biofertilisers, which we propose as a subcategory of biostimulants, increase nutrient use efficiency and open new routes of nutrients acquisition by plants. In this sense, microbial biostimulants include mycorrhizal and non-mycorrhizal fungi, bacterial endosymbionts (like Rhizobium) and Plant Growth-Promoting Rhizobacteria. Thus, microorganisms applied to plants can have a dual function of biocontrol agent and of biostimulant, and the claimed agricultural effect will be instrumental in their regulatory categorization.

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Value Addition in Bael Fruit

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Abstract

Bael fruit has been known in India since ancient times and is native to northern India. Bael fruit was once primarily used in medicine purpose. But, now most commonly used in food as a source of nourishment. In this fruit, there are various functional and bioactive combinations such as carotenoids, phenolics, alkaloids, coumarins, flavonoids, and terpenoids, which have numerous medicinal benefits. As a result, some value-added items from Bael fruit have emerged. Many value additions such as Bael Preserve and Candy, squash, toffee, Bael RTS, Bael jam, juice, toffee, and also nectar, squash, and toffee are done in order to reap nutritional content and increase the Bael fruit demand in the market. As a result of their medicinal and therapeutic properties, future research efforts could focus on raising the value addition of Bael fruits.

Introduction

Bael fruit is known in India from the ancient times and it is local to northern India and after that broadly found in all Indian penninsula. It also found in Srilanka, Pakisthan, Bangaladesh, Burma and Thailand. Three lobed leaves of Bael tree are generally utilized as terrified contributions to Lord Shiva as per the Hindus customs. It has been said that these trees show the nearness of underground water. The utility of Bael natural product is referenced in the Indian ancient system of medicine. Every part of the tree, for example, root, stem, leaves, flower, bark, seed and even its latex are vital in a few customary arrangements of medicine, that is the reason it is a standout amongst the most essential trees in India. The root bark is helpful in irregular fever, hypo-chondriasis, melancholia, and cardiovascular diseases(Singh, Sharma et al. 2014).

The Bael fruit pulp contains various functional and bioactive components, for example, carotenoids, phenolics, alkaloids, flavonoids, terpenoids, and different cancer prevention agents, which may secure us against endless diseases. This agricultural product's total dietary fiber can be divided into two types: insoluble dietary fiber and soluble dietary fiber (mucilage and gelatin). Vitamin C, vitamin A, thiamine, riboflavin, niacin, calcium, and phosphorus are among the nutrients and minerals found in it. As a result, Bael natural product may demonstrate that it is one of the most important plants used in traditional indigenous medicine (Charoensiddhi and Anprung 2008). There are numerous references to its usage in traditional medicine. In ancient times, Bael fruit is utilized for the most part in medicine in earlier days yet nowadays it is more likely used in nourishment application in food because of its high nutritional properties in them, so it emerges some value-added products from Bael fruit(Singh and Chaurasiya 2014). The nutritional composition of Bael fruit is represented in Table1.

Table 1 Nutritional composition of Bael fruit:

Constituents	Composition(Per 100 g)
Moisture	54.96-61.5 g
Carbohydrates	28.11-31.8 g
Protein	1.8-2.62 g
Ash	1.04-1.7 g
Fat	0.2-0.39 g
Carotene	55 mg
Ascorbic Acid	8-60 mg
Tartaric Acid	2.11 mg
2.11 mg	1.19 mg

Niacin	1.1 mg
Thiamine	0.13 mg

(Source: Julia and Miami, 1987)

Fig. 1 Bael fruit

Value Added Products from Bael Fruit

Harvested Bael fruit at full maturity can be stored for 15 days, whereas ripened Bael fruit can be stored nearly 1 week at 30˚C and at 9˚C, it can be stored for 3 months. There is various technology available for the production of value-added products in Bael fruit. Inorder to reap nutritional content and to increase the Bael fruit demand in market, many values addition is done like Bael Preserve and candy, squash, toffee, Bael RTS(Ankita S et al 2008) whereas Bael jam, juice, toffee(K.Y. Ullikashi et al,2017) and also nectar, squash, sherbet, jam, marmalade, and cream(Mortan,1987) ,Bael wine(Panda, Sahu et al. 2014).

Bael Preserve and Candy

Candy and preserve are made from matured Bael fruit It also has least total soluble solids 55 and 70%, respectively. Drying of fruits prevents the microbial spoilage. Here Osmotic dehydration is done with the highly concentrated sugar solution and it helps in preserving colour, flavor and texture as well as it prevents the microbial spoilage and also it increases the shelf life. Fruit pieces dipped in sugar solution and then drained, dried at 55-60˚C in oven is known as "candied fruit"(Ankita S et al, 2008).

Fig. 2 Bael candy

Dehydrated Bael

Dehydrated bael is obtained by treating the fruit slices with sulphur di oxide. After that, it is dehydrated (55-60˚C), packed and followed by storage (Singh and Chaurasiya 2014).

Fig. 3 Dehydrated bael

Bael Slab

Fig. 4 Bael slab

It is otherwise called leather. In its preparation, ripened bael fruit is used. Pulp is taken from ripe fruit, while seeds, fibers, and seeds are filtered through a stainless-steel mesh sieve. Approximately 200-300 ml water is added to 1 kilogram of fruit pulp and boiled at 80°C, then sugar, potassium metabisulphate (KMS), and citric acid are added to the extracted pulp, resulting in 35 percent total soluble solids. After that, the treated pulp is dried to a moisture content of around 14.5 percent. (Singh and Chaurasiya 2014).

Bael Toffee

Bael fruit toffees are more nutrient-dense than regular toffees because of its medicinal properties. Bael toffees were successfully made by combining 40 parts cane sugar, 10 parts skim milk powder, 4.5 parts glucose, and 6 parts hydrogenated fat to 100 parts pulps. Bael fruit toffees final moisture content was 8.5 percent. (Ankita S et al 2008).

Fig. 5 Bael toffee

Bael Powder

Fruits were sliced and treated with hot water at 70°C, then with hot sand, then in the oven for 2 hours at 70°C, after which the rind was broken and the pulp was extracted. After extracting the pulp, it was dried in the sun until it had a moisture content of 4% and then ground to make dried bael powder. Bael powder, ground and stored in plastic bags in a dry location. (Singh and Chaurasiya 2014).

Bael Jam

Jam is a concentrated fruit product with a good set due to the pectin in the fruit. It is made by boiling pulp with sugar until it reaches a thick consistency. Bael jam should have a fruit content of 45 percent and a total soluble solids content of 68 percent. (Amit Kumar Singh and A. K. Chaurasiya, 2014).

Fig. 6 Bael Jam

Conclusion

Bael fruit has therapeutic and regenerative capabilities, and its medicinal properties have led to its use as a food additive. A fundamental innovative work ought to be embraced for the advancement of items for their better financial and remedial usage. As a result, future research efforts may concentrate on increasing the value addition on Bael fruits as a result of their medicinal and therapeutic properties.

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Success Story on Enhancing Dairy Farm Income Through Adoption of Round the Year Green Fodder Production

Article ID: 11477

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Introduction

In Sehore district majority of the farmers are small and marginal, the income from agriculture sector in their farm is not at all sufficient to run their families. Due to fragmentation of land holdings, even after adoption of improved agricultural technology and practices, their economy condition has not improved. In general, the crop husbandry alone under the vagaries of nature cannot improve the living standard of the rural areas. Livestock forms an integral and sustainable part of rural household system. Dairy entrepreneur generates cash income to farmers almost on a daily basis, besides being a source of liquidity and insurance against crop failure. The round the year green fodder production and used balance feeding in animals with green fodder increase productivity and reduce cost of production.

Brief Profile

Name	Mr. Sohan Kalmodiya S/o Sri Ram Singh
Address	Village- Golukhedi, Block – Ichhawar, District- Sehore (M.P.)
Mobile No.	9977197699
Age	35 years
Education	12th
Land holding	05 Acre
Farming Experience	By birth
Live Stock	Cows (HF cross) – 07 Heifers – 05
Technologies adopted	Balance feeding with round the year fodder production Breed improvement Health management Housing Management

Description of Entrepreneurship

Village Golukhedi is situated 14 Kms. away from Tehsil – Ichhawar and 21 Kms. from Krishi Vigyan Kendra. Mr. Sohan Kalmodiya 35-year-old & 12th passed & he was searching government service. He was participating in Krishi Vigyan Kendra activity & contact to KVK scientist. He was inspired with thought of KVK scientist & established improved dairy. The Scientist of Krishi Vigyan Kendra, Sewania, District Sehore (M.P) is suggested for establishing improved dairy with adoption of advance technologies like- housing management, breeding management, vaccination & deworming of Animals, Round the year green fodder production, balance feeding management etc. He is actively participated in Krishi Vigyan Kendra activities like OFT & FLD, training & extension activities - Field days, Sangosthi, farmers fair, KMA &

whats app etc. Now he obtains 41 litter milk productions per day and attached to cooperative Sanchi dairy for marketing of milk. Presently he was motivated for organic farming. He prepares biogas, vermi compost unit & compost used in crops. He cultivated the Round the year green fodder production & observed the impact of balance feeding with green fodder enhance the milk productivity & reduce the cost of milk Production. Mr. Sohan gets Success & Satisfy with the dairy farming. He got reorganization in local area & well-known youth farmers for dairy management.

Out Come of Entrepreneurship

Mr. Sohan Kalmodiya is established good dairy with regular contact with Krishi Vigyan Kendra. He observed more profit with adoption of latest technologies in dairy especially round the year green fodder production. He also gains organic manure which is used in crop & they found reduce the cost of cultivation in crop & enhance the net profit.

Economic Impact

Year	Name of enterprises	No of Milch Animal	Average total Milk yield (Lit/ year)	Total Income (Rs./year)	Net Income (Rs./year)
2013-14	Dairy	04	4380	109500	43800
2014-15	Dairy	05	7665	191625	95813
2015-16	Dairy	06	12045	301125	180675
2016-17	Dairy	06	12775	319375	207595
2017-18	Dairy	07	14965	374125	243180
Mean	-	-	10366	259150	154213

Conclusion

Round the year green fodder production reduce the cost of cow rearing and increases milk production and net profit of farmer. The success of Mr. Sohan Kalmodiya has also motivated many farmers and other unemployed youths have come forward to start this enterprise in their village. Scientific dairy farming needs to be popularized to address the issues for enhancing household income and socio-economic status of farming community. He recognizes as low cost of milk production & high Productivity of Milk in the Village.




Water Crisis in India Present Situation and Future Prospects

Article ID: 11478

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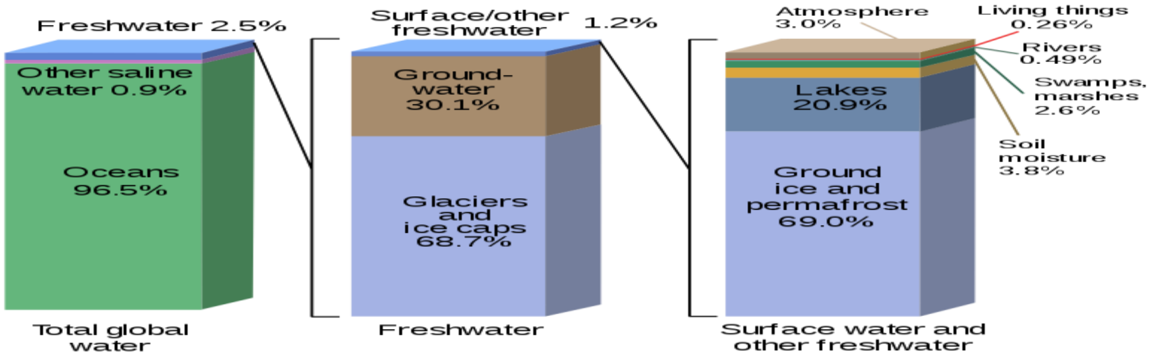
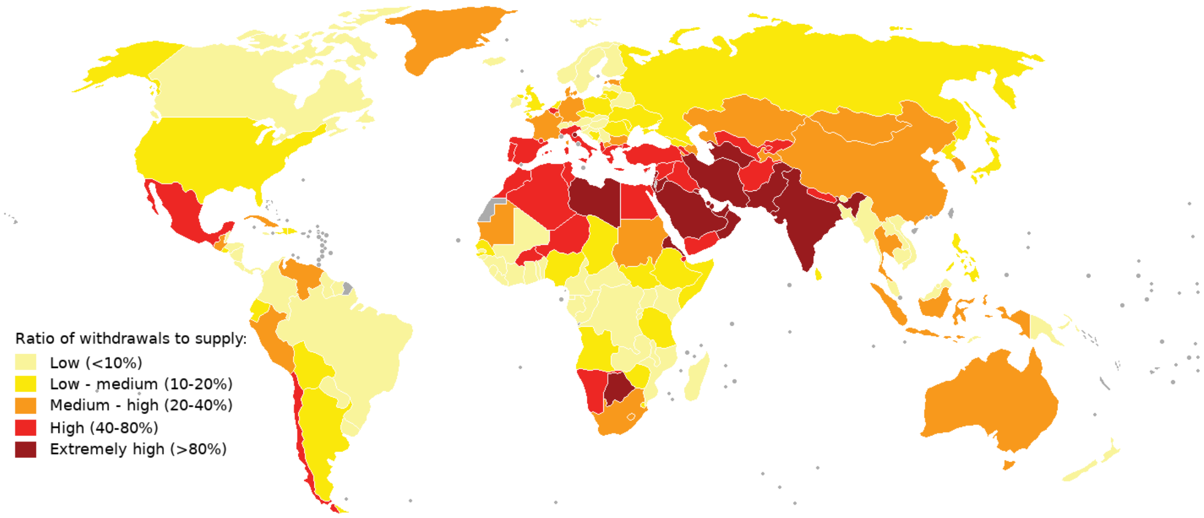
Water is life because plants and animals cannot live without water. Water is needed to ensure food security, feed livestock, maintain organic life, take up industrial production and to conserve the biodiversity and environment. India is one of the water-stressed countries of the world and is going to become water scarce in due course. Unfortunately, the scarcity of water gets accentuated more by its inefficient use than by its physical availability. Currently, about 85 percent of water in India is used in agriculture (Ministry of Water Resources 2018). 70% of the earth surface is covered with water, which amounts to 1400 million cubic kilometers (M km3). However, 96.5% of this water being sea water, it is salty. Fresh water availability is only 35 m km3 and only 40% of this can be used by human beings. Out of the total fresh water, 68.7% is frozen in ice caps, 30% is stored underground and only 0.3% water is available on the surface of the earth. Out of the surface water, 87% is stored in lakes, 11% in swamp and 2% in rivers (Anonymous.2006).



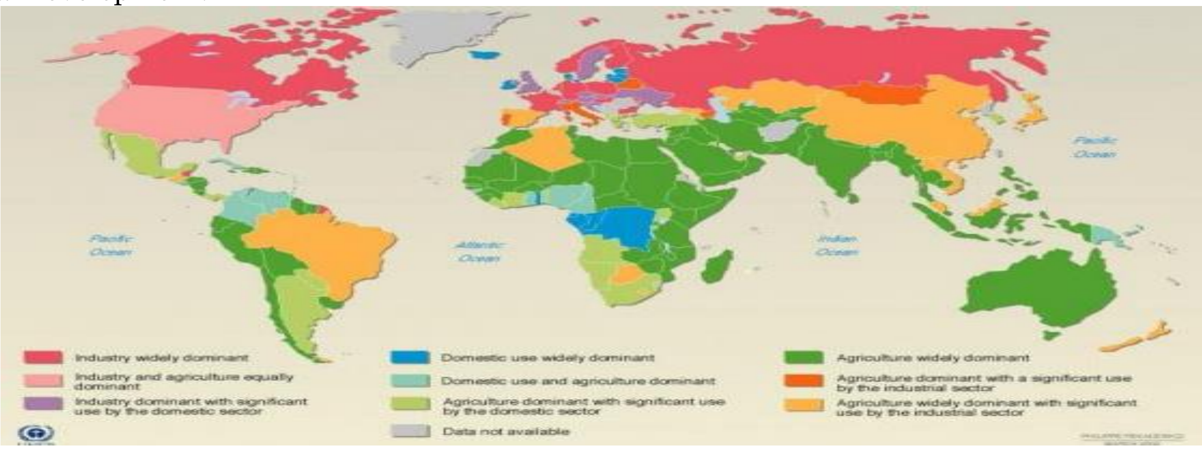
Asia has 36% of the available fresh water reserves, with over 60% of the world population where water is a scarce commodity. Compared to Asia, Africa is in a better situation, where 13% of the population has access to 11% of the fresh water reserves.



Australia and Oceana have plenty of water with 1% population owning 5% of the fresh water reserves, followed by North and Central America, with 8% population and 15% water reserves and South America with 6% global population and 26% fresh water reserves. Major consumption of water is for agriculture, industrial production and domestic purposes, apart from being used for fishery, hydro-power generation, transportation and maintaining biodiversity and ecological balance.

Fresh Water Availability

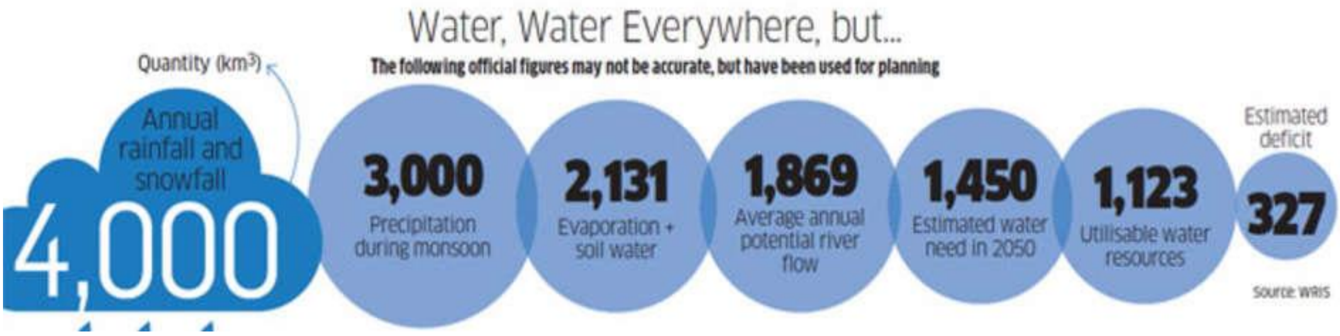
The proportion of water used for agriculture and industries varies from country to country depending on the lifestyle, extent of industrial development and water use efficiency. Developing countries are using comparatively less water for agriculture and more for industrial and domestic purposes, while the developing countries in Asia and Africa use 80-90% of the water for agriculture and only 5-12% of the water for industrial use. This is reflecting on inefficient use of water in agriculture and poor investments in industrial development.



Global freshwater withdrawal - Country profile based on agricultural, industrial and domestic use.

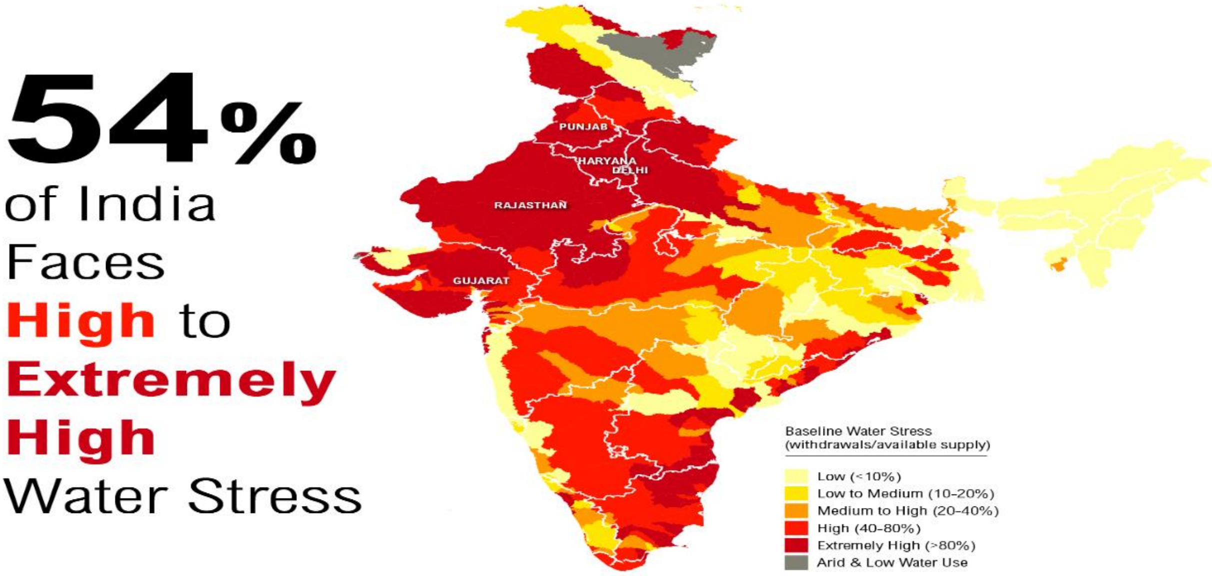
Water Resources in India

India is blessed with good rainfall well distributed over 5-6 months in the year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cherapunji. The total available sweet water in the country is 4000 billion m3 per annum. Out of this, over 1047 billion m3 water is lost due to evaporation, transpiration and runoff, reducing the available water to 1953 billion m3 and the usable water to 1123 billion m3. It is disturbing to note that only 18% of the rainwater is used effectively while 48% enters the river and most of which reaches the ocean. Out of the total usable water, 728 billion m3 is contributed from surface water and 395 billion m3 is contributed by replenishable ground water.



Water resources in India

Growing population in India, as everyone is aware, is a serious concern as it will create further burden on the per capita water availability in the future. As can be seen in Table 4, the per capita water availability in 1951 was 5177 m^3 per year when the total population was only 361 million. In 2001, as the population increased to 1027 million, the per capita water availability reduced drastically to 1820 m^3 per year. By 2025, the per capita water availability will further drop down to 1341 m3 and to 1140 m3 in 2050. Presently, inspite of good rainfall distribution, the country is unable to make good use of rain water, because of lack of awareness and poor infrastructure to construct dams and reservoirs. As a result, only about 35-40% of the cropping area receives irrigation to take 1-2 crops in a year. By 2025, 60 million ha will be irrigated by using ground water and by 2050, the area underground water will increase to 70 million ha. In 2000, the area under canal irrigation was 17 million ha, which will increase to 27 million ha by 2050 (Government of India, 2009). The threat of water scarcity in India is real and of frightening proportions. The report, Composite Water Management Index, prepared by Niti Aayog, a policy think tank run by the Union government, confirmed that critical groundwater resources have depleted at an alarming rate.



It said that 600 million people in India have got exposed to "high to extreme water stress." The report further noted that efforts of conservation have so far not borne any noticeable outcome. Cities and villages that have been identified as "parched" have managed to push further their "Day Zero," or the day when their taps would run dry, but not significantly, the report pointed out (Deora and Nanore. 2019).

Management of Water Crisis

The 2030 Water Resources Group has brought together case studies from around the world of currently available, replicable and practical solutions for water use transformation. The solutions have been collected in this online catalogue 'Managing Water Use in Scarce Environments' and is meant to inspire action and use by leading industry, policy makers and the 2030 WRG country programs (Ngaachan, S. V. 2015).

Contour Bund

1. Contour bunds are effective methods to conserve soil moisture in watershed for long duration.
2. These are suitable in low rain fall areas where monsoon run off can be impounded by constructing bunds on the sloping ground all along the contour of equal elevation.

Gully Plug

Gully plugs are built using local stones, clay and bushes across small gullies and streams running down the hill slopes carrying drainage to tiny catchments during rainy season. Gully Plugs help in conservation of soil and moisture.

Percolation Tank

Percolation tank is an artificially created surface water body, submerging in its reservoir a highly permeable land, so that surface runoff is made to percolate and recharge the ground water storage.

Check Dams / Cement Plugs / Nala Bunds

Check dams are constructed across small streams having gentle slope. The site selected should have sufficient thickness of permeable bed or weathered formation to facilitate recharge of stored water within short span of time.

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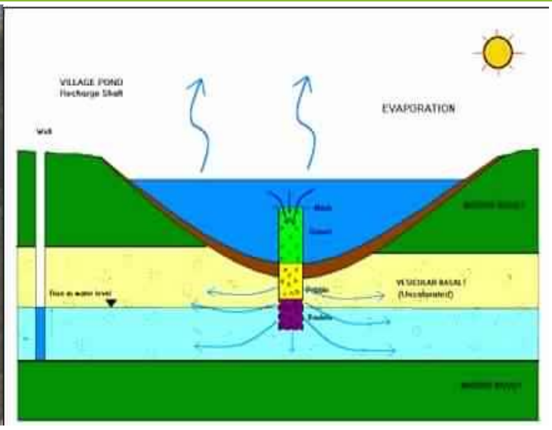
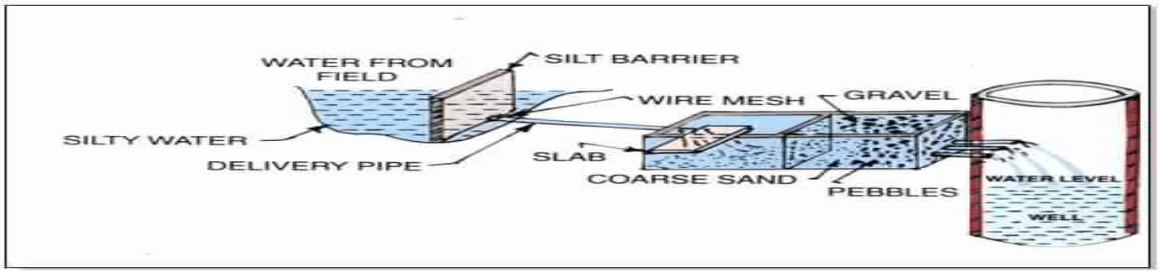


Dug Well Recharge

Abandoned Dug Well

Abandoned Dug Well fitted with Rain Water Harvesting Mechanism



Dug well recharge

Approach of the Government and Harsh Reality

The current government, on many occasions has mentioned its priorities for the well-being of Farmer. Considering the fact that out of 140 Mha of NSA in India, only about 46 percent or 65 Mha is irrigated, the government, with the objective of increasing irrigated cultivation, has announced Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).

The components are:

1. Accelerated Irrigation Benefit Programme (AIBP).
2. PMKSY (har khet ko pani): this includes command area development; strengthening and creation of distribution network from source to the farm; and repair, restoration, and renovation of water bodies.
3. PMKSY (per drop more crop): this includes programme management, preparation of State/District Irrigation Plans, approval of annual action plan, and monitoring; promoting precision water application devices like drips, sprinklers, pivots, and rain-guns in the farm (Jal Sinchan); construction of micro irrigation structures like tube wells and dug wells.
4. PMKSY (watershed development; erstwhile Integrated Watershed Management Programme, or IWMP)

An outlay of Rs. 50,000 crores were announced for this project for the next five years, that is, from FY16 to FY20, the total allocation for FY17 being Rs. 5767 crores. However, two prominent questions arise. First is whether the central government is allocating more for increase of irrigation than what they were before as claimed, to answer that, one has to see which old projects have been included in PMKSY. The old projects clubbed with PMKSY are as follows:

a. Accelerated Irrigation Benefit and Flood Management Programme or, AIBFMP. This consists of four components.
b. AIBP and National Projects.
c. Command Area Development and Water Management (CAD&WM).
d. Flood Management Programme (FMP).

e. Repair, Renovation, and Restoration of water bodies (RRR).

5. Integrated Watershed Management Programme (IWMP).

Apart from that, PMKSY has allocations under the Ministry of Agriculture and Ministry of Water Resources, River Development and Ganga Rejuvenation also. Twelfth Plan outlay (FY13- FY17) for AIBFMP alone was Rs. 86,435 crores (Rs.55,200 crore, Rs.15,000 crore, Rs.10,000 crore, and Rs.6235 crore, respectively for AIBP, CAD&WM, FMP, and RRR, respectively) against five-year outlay of Rs.50,000 crore for PMKSY as a whole in FY16. Also, if one compares budgeted and actual expenditures for the schemes for last three years with a budgeted figure of FY17, one can see that there has been, in fact, a sizeable decrease in terms of budgeted figures.

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Diseases and Management Strategy for Button Mushroom

Article ID: 11479

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A standard white mushroom is the button mushroom botanically spelled as *Agaricus bisporus*, which belongs to class of Basidiomycetes is a fleshy, spore-bearing fruiting body of a fungus, typically produced above ground, on soil, or on its food source. It consists of a stem (stipe), a cap (pileus), and gills (lamellae, sing. lamella) on the underside of the cap. The spores in the gills helps the fungus in spreading across the ground or its occupant surface. Mushrooms are considered as an edible low-calorie diet food which are loaded with many nutritional components like vitamins (especially Vitamin D), minerals, and antioxidants. They are friends of human as they are helpful in boosting immune system, aids in weight loss, prevents aging, healthy heart, bone and brain health.

Despite this, they also suffer from many bacterial, fungal, or viral diseases and disorders during their course of development and cultivation. Reasons maybe improper pasteurization methodology followed for preparing compost or in casing soil, where the diseases are spread through various agencies like air, water, wind, machinery, man etc. which are discussed as follows.

Fungal and Bacterial Diseases

1. On Compost:

a. Early symptoms of olive-green mould:

Casual organism: *Cheatomium olivaceum, C. globosum*

Symptoms: The fungus is initially white followed by olive green color.

Predisposing Factors: The olive-green mould is favoured by anaerobic conditions during peak heat which may occur when the compost is too wet, over composted (temp. 620C) and not adequately aerated during peak heat.

Management:

i. Fermentation period of the compost should not be too short. Provide active compost that is not too wet.
ii. Do not add nitrogen, ammonium sulphate, urea, chicken manure just before filling.
iii. High temperature for longer time should be avoided.
iv. Fungicides like benomyl, Thiophanate methyl, Vitavax, Dithane Z-78, Dithane M-45, Thiram and Captan are effective.

b. Green mould: *Trichoderma* spp.

Symptoms: Forms green patches on spawn as well as cased trays. It usually grows on dead decomposed mushroom tissues and thus aids in yield loss

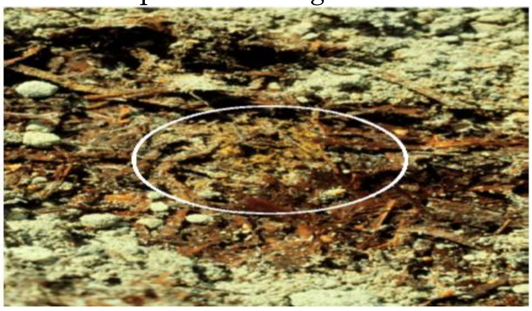
Predisposing Factors: Low casing pH and high humidity. Air borne dust and mites are, observed to be the main infection routes.

Management:

i. Proper hygiene to be maintained at different stages of growth
ii. Proper pasteurization and conditioning of compost
'iii. Use correct concentration of formalin (2%) as high conc. encourages green mould
iv. Weekly sprays of mancozeb (0.2%) or Bavistin (0.1%) or treatment with zineb dust or Calcium hypochlorite (15%) is effective.

c. Yellow Mould: *Myceliophthora lutea*, *Chryso sporium luteum* and *C. sulphurem:*

Predisposing Factors: Spores of the yellow mould fungi m ay come through the inadequately sterilized soil or these may survive peak heat within the compost and germinate later on in the compost or casing.



Management:

i. Proper pasteurization of casing material is essential.
ii. Benomyl (4g-5g/10 lt of water) and blitox (4g/10lt) sprays are effective.
iii. Spray calcium hypochlorite solution (15%) for eradication of the mould.

d. Inky Caps: *Coprinus* sp.

Symptoms: A small thin cap with long cylindrical stalk appears which turns to black ink like liquid mass which indicates the presence of ammonia component in the compost.
Predisposing Factors: Unpasteurized compost/ casing soil and air, excess nitrogen.

Management:

i. Use properly pasteurized compost and casing soil.
ii. Avoid excessive watering.
iii. Compost trays should be ammonia free
iv. Rogue out young fruit bodies of the weed fungus to avoid its further spread.

e. Lipstic Mould: *Sporendonema purpurescens*

Predisposing Factors: Soil, casing mixture and spent compost are sources of primary inocolum. It is also disseminated by water splashes or pickers.

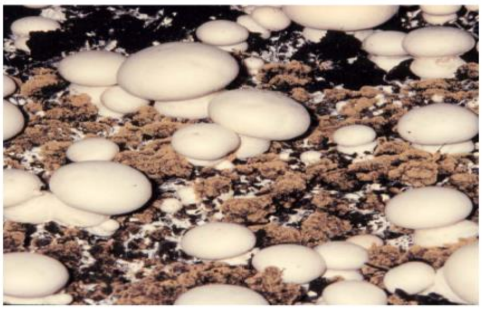
Management:

i. Good hygiene is essential.
ii. Good pasteurization and conditioning of the compost will eliminate the pathogen.

f. Cinnamon Brown Mould: *Papulospora byssina*

Symptoms: It has cloudy white appearance initially, later turning to brown colour.

Predisposing Factors: It has been found to be the problem of over, wet composting in Phase I and over composting in Phase II.



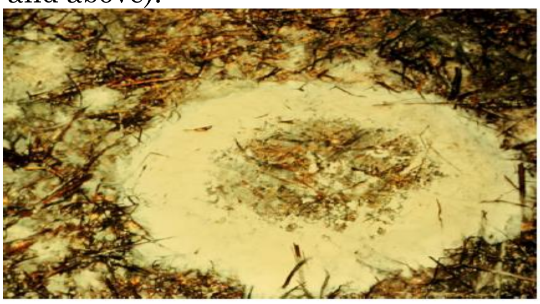
Management:

i. Casing soil should not be made completely sterile by steam or formaldehyde.
ii. Newly cased beds should be sprayed with dithane Z-78 and maintain proper moisture content in casing layer.

g. White plaster mould: *Scopulariopsis fimicola*

Symptoms: It has a resemblance with brown mould but changes to pink colour later.

Predisposing Factors: Under composting and excessively high pH during anaerobic peak of the compost (8.2 and above).



Management:

i. Proper aeration and RH is essential.
ii. Spray benomyl / bavistin twice.

2. Casing Soil:

a. Dry Bubble: *Verticillium fungicola*

Symptoms: Also known as brown spot disease, as the name suggests causes brown spots and irregular patches on the cap. In severe conditions, it may lead to distortion and leathering of mushroom.

Predisposing Factors: Infected casing soil. Spread is carried out by infected equipments, hands and clothing, phorid and scarid flies.

Management:

i. Use sterilized casing soil
ii. Proper disposal of spent compost
iii. Proper hygiene and sanitation to avoid primary infection.
iv. Heat treatment of infected casing layer at 63 C for 1 hr completely prevented spore germination.
v. Spray Zineb (0.1-1.2%) or Dithane Z-78 at 0.25% or 0.50%.

b. Wet bubble symptom: *Mycogone perniciosa*

Symptoms: There is a formation of white mycelium mat, along with swollen stalk and smallens the cap size at early stage.

Predisposing Factors: Spread is primarily through unpasteurized casing soil but introduction of pathogen is also through spent compost also.

Management:

i. Sterilize the beds using 2% formaldehyde.
ii. Spray dithane Z-78 at 0.2% will be effective.

c. Truffle disease: *Pseudobalsamia microspore*

Symptoms: A round, creamy white, wrinkled and convulated structure which resembles to brain like appearance grows, which on maturity turns reddish brown and releases its spores.

Predisposing Factors: Lack of proper aeration and high humidity are main causes.

Management:

i. Spawn run temperature should be less than18 degree C.
ii. Maintain proper ventilation and humidity conditions.

d. Cob Web: *Cladobotryum/ Dactylium dentroides*

Symptoms: it forms like white fluffy cobweb like structure on surface of casing soil which later turns to pink colour.

Predisposing Factors: Higher casing moistures and/or lower evaporation rates provide conditions more conducive to disease development.

Management:

i. Maintain good ventilation conditions.
ii. Spray of dithane Z-78 at 0.2% will be beneficial.

e. Bacterial Blotch: ***Pseudomonas tolasii***

Symptoms: There is appearance of sunken blotches which are slightly brown in colour over the surface of mushroom cap. The spots turn to irregular and yellowish to dark brown in colour in later stages.

Predisposing Factors: Casing and airborne dust, mites and nematodes.

Management:

i. Proper sterilization and aeration of casing soil.
ii. Use of chlorinated water.
iii. Spraying terramycin on beds will be useful.

Viral Diseases

There are certain deadly diseases of mushroom like Brown disease and watery stripe, X disease, dieback diseases of which virus is the main cause leading to declining yield. The mushrooms turn brown in colour and they are forced to become shriveled and leathery following delay in pinhead formation

Management:

a. Proper sanitation measures should be followed.
b. Disinfecting walls, doors, floor and chamber with about 4% formalin.

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Burn Fat - Stay Fit

Article ID: 11480

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Introduction

Obesity is a condition, in which you have too much body weight for your height, it results when intake of calories is more than are burned by exercise and normal daily activities. Overweight and obesity are due to accumulation of excessive fat. Obesity has grown to epidemic proportions with over 4 million people dyeing each year as a result of being overweight or obese in 2017 according to global burden of disease.

Industrialization and urbanization have been shown to play a role in determining the nutritional status of population groups living in urban area. Recent studies suggest that the technological advances are largely responsible for obesity epidemics. It is estimated that over 250 million people in low- & middle-income countries suffer from obesity. Different surveys have put the number of overweight and obese in India at 100 million.

Obesity results from a complex interaction of genetic, metabolic, psychological and environmental factors causing an imbalance between energy intake and energy expenditure.

Ace to NIH, USA an increase in body weight of 20% or more above desirable weight is the point at which excess weight becomes an established health hazard.

A complete evaluation of obesity includes persons' age, height, weight ,fat composition and distribution. It is determined by BMI, which compares a person's weight with his height. It correlates well with obesity.

$$BMI = \frac{\text{weight in kg}}{(\text{Height in meter})^2}$$

BMI -25-39.9 GARADE I obesity.

BMI 30-39.9 – GRADE II obesity.

BMI >40 – GRADE III obesity.

A BMI of 25-27 is considered warning sign and may warrant intervention especially in the presence of additional risk factors. During childhood increase in weight correlates due to junk foods, T.V viewing & Computer games. In the early years of life fat cells increases both in size & number, multiplication of fat cells continues throughout the growing years. After puberty fat is stored primarily by increasing the size of the adiposities that already exists. Although the total number increase may occur under some circumstances. Obesity in early life is always hyper cellular in type.

Increasing purchasing capacity of people, easy access to a variety of foods in the market, media and peer group influence, change in life style of people are some of the significant factors responsible for changes in the dietary habits of most population groups in the country today.

The traditional thali type of diet is gradually paving way off for the fast food and street food culture. Eating out has become a common practice among people irrespective of socio- economic status which is responsible for the increased occurrence of Food borne diseases. Unsafe food handling, insanitary food, poor food hygiene and lack of awareness on food safety issues among food handlers, sellers are some vital causative factors for the problem.

Microbial contamination happens to be the one of the big factors for food borne illness. Bacteria virus, parasites and fungi are the major contaminants affecting food safety. In addition, chemical contaminants like pesticides, fertilizers and food colours, environmental pollutant like dioxin, environmental pollutants like lead, dioxin and certain other food additives may also leads to the problem of obesity in adults.

Imbalance between food intake, exercise and body's resting metabolic rate results in obesity among adults. Onset of obesity in adults however occurs due to an increase in the size of adipocytes rather than in numbers and there is increased risk of medical complications associated with it.

Weight – Loss: Some Tips

Your body needs a certain number of calories and nutrients each day in order to work properly. If you skip meals during the day, you will be more likely to make up for those missing calories by snacking or eating more during the next meal. A healthier way to lose weight is to eat many small meals or to eat minimum of three meals, which include a variety of nutritious, low fat and low- calorie foods.

The best way to lose weight is to cut back on the number of calories you eat and be more physically active and develop positive thinking.

It does not matter what time of day you eat and how much you eat during the whole day, but it is the amount and type of physical exercise you indulge in which matters most.

Try not to snack while doing other things like watching television, playing video games or using the computer, if you want to snack while watching T V then keep small amounts of food with you.

No foods can burn fat: Some with caffeine may speed up your metabolism for a short time, but they do not cause weight loss.

Do not stop when hungry because impulse buying of 'Junk' food is likely to occur.
Reduce stress: find relaxation methods that work for you to limit the excess eating triggered by stress.
Exercises regularly: It helps burn the body fat and also strengthen the muscles.
Slow and steady weight loss: of more pounds per week is the safest way to lose weight. Very rapid weight loss can cause you to lose muscles rather than fats.

Substituent Foods which Help in Weight-Loss

Try to eat a variety of foods, especially whole –grain foods and lots of fruits and vegetables. These foods will fill you up and are lower in calories than foods full oils or fat.

Complex carbohydrates take longer time to digest, so we stay full for longer. Foods that are rich in complex carbohydrates, low in fat and high in fiber are very beneficial for an individual's health and well-being.

Potatoes, rice peas and some vegetables like yam, sweet potato, turnips, beet- root and carrots are rich in complex carbohydrates.

Nuts are a good source of proteins and fiber and in small amounts, they can be part of a healthy weight loss program.

Low fat and not –fat dairy products are as nutritious as whole milk dairy products, but they are only lower fat and calories.

Eating lean meat (meat without a lot of visible fat) in small amounts can be part of a healthy weight loss plan. They have nutrients that are important for good health like the number of calories depends on the amount of carbohydrate, protein and fat in the food. Carbohydrates and proteins contain about four calories per grain and fat has more than twice that amount (9 calories per gram).Excess protein or carbohydrate intake is also converted to fat and stored in the body. Cut down on sugar and avoid fried foods. Do not count out fat altogether. Fat is necessary to maintain to healthy body and it help to keep up both energy level and metabolism. Some foods labels may show ' low-fat' or 'no fat' claims. but these foods may still have a lot of calories. These foods have extra sugar, flour or starch thickness to make them taste better. These ingredients can add calories, which in turn can lead to weight gain. It is also important to drink enough water each day. You may need to drink a minimum of 8-10 glasses of water daily.

Alcohol has a high calorie content and a part from endangering health. It may act as a causative factor for obesity. Fruits and vegetables are the main sources of nutrients in vegetarian diets. Most fruits and vegetables are naturally low in fat and calories .Nutrients normally found in animal products but are not always found in a vegetarian diet are iron, Calcium, vitamin, D1, B12, and zinc. Here are some foods that contain these nutrients.

Whole iron grain cereals, pulses (especially soy beans, chick pea), dark green vegetables, dried fruits especially figs, raisins, apricots, pumpkin seeds and sun flower seeds. Dairy calcium products, Broccoli. Zinc whole grains (especially the germ and bran of the grain), dairy products , nuts leafy vegetables and root vegetables (onion, potatoes, carrots, radish).

B12 cereals, dairy products Vitamin D milk soya milk or a small amount of sunlight

Vegetarians must eat a variety of plant foods over the course of a day to get enough protein. Those plant foods that have the most protein are lentils, nuts, seeds and peas.

Conclusion

Obesity, like many other chronic disorders is more often controllable than curable. Research suggests that losing 1 /2-2 pounds a week by eating better and exercising more is the best way to lose weight and keep away from this problem. It should be a major priority for the whole family to undertake more exercises, eat healthy and develop a healthier life style. Sensible calorie restriction coupled with an enjoyable exercise program offers the greatest potential for success.

Despite the advances in research, however, children, adolescents and adults are continuing to become overweight and obese, Due to the complexity of obesity more research is needed for prevention and control of this major public health problem.

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Enhancement of Productivity of Wheat through Fertilizer Use Efficiency in District - Sehore (M.P.)

Article ID: 11481

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Location of District

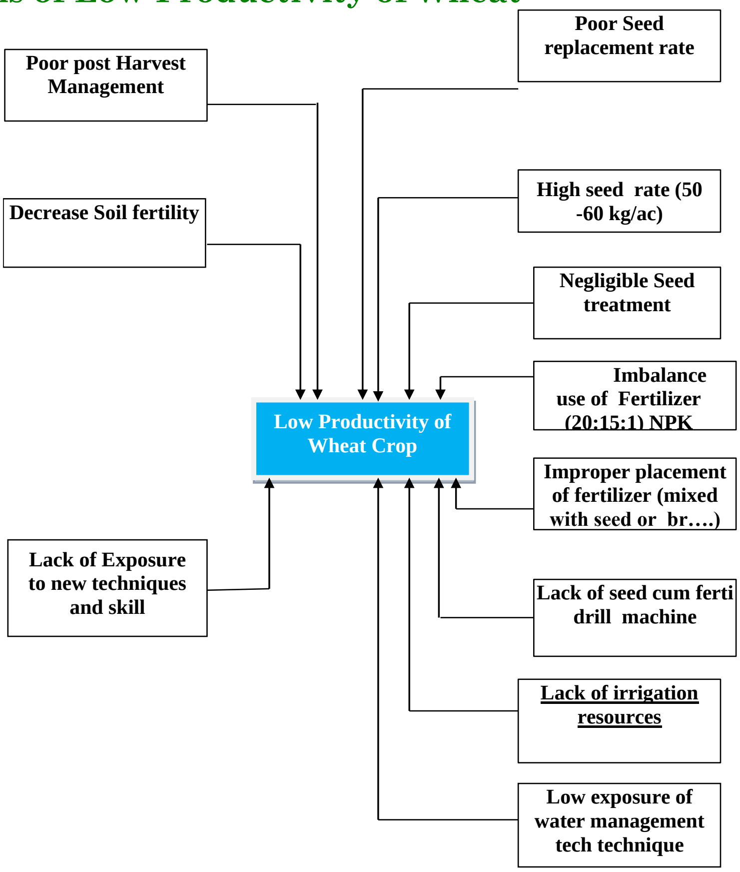
The District Sehore is situated Central Part of the Madhya Pradesh with latitude 22031 to 230 40 North and 76022 to 78008 East respectively. It is stand in the agro-climatic zone of Vindhyan Platue of Malwa region. The district is spread over and area of 85782 km. The district has total population 1078000 as per census of 2001.

The district is categories by Black Soil mostly medium in depth. The district expiries the sub-tropical climate. The Annual rainfall of district is almost 126 mm. Average temperature in summer is varies from 25^0C to 45^0C and average temperature in winter is varies from 10^0C to 25^0C. The major crop grown in Kharif are Soybean, Maize and rise and Wheat, Chick pea and Sugarcane are popular crops in Rabi Season.

Total area under wheat crop was 1,56,480 ha and productivity were found 2121 kg/ha in the year of 2007-08. District is famous for producing good quality of sharvati Wheat. The main Wheat varieties grown in the district are Lok-1, GW- 322, GW- 273, in irrigated situation and Sujata, C- 306, H1- 1500, Amar in limited irrigation situation.

The consumption of fertilizer in Rabi season is about 95 kg/ha. Fertilizer consumption ratio is about 20:15:1. Fertilizer Use Efficiency (FUE) is low due to unbalance and improper which resulted low productivity of Wheat crop.

Identified Problems of Low Productivity of Wheat



Methodology

Krishi Vigyan Kendra and IFFCO Sehore agreed upon to pouch a campaign to enhance the productivity by increasing Fertilizer Use Efficiency in Wheat Crop in the district. Two-year action plan as prepare after group discussion with the farmers and consultant of Department of Agriculture Distt- Sehore. Brief methodology applies in the implementation of program as under:

1. Selection of Block – Sehore.
2. Selection of villages - 10 (2008-09).

2008-09		2009-10	
1. Roal	6. Chhatra…	1. Roal	5. Beragar…
2. Bheelkhedi	7. Jharkheda	2. Bheelkhedi	6.Semara dangi
3.Gudbhela	8. Bijlon	3.Gudbhela	
4. Muskara	9. Pipliameera	4. Muskara	
5. Beragar…	10.Semara dangi		

3. Selection of farmers:
    a. 50 (2008-09).
    b. 25 (2009-10).
4. Selection of Plots for demonstration.
5. Plot Size - 0.4 ha.

Technology Uses

1. Plot area (0.4 ha) divided in two equal parts (0.2 ha). One part for recommended practice and one for farmer's practice.
2. Collection of Soil Sample of individual plot to work out nutrients' requirement.
3. Supply seed for one entire plot of foundation gra…. at the rate of 100 kg/ha.
4. Applied recommended dose of fertilizer on the basis of soil test value in RP plot of recommended practice.
5. Properly placement of fertilizer was ensured in RP through use of seed cum fertilizer drill machine.
6. Spacing of 22.5 cm line to line was ensured.

Observation

Observation was collected on the yield attributing parameter i.e., Plant population/m^2, No. of effective tiller/ha, No. of grains/ ear, test weight (1000 grains), yield qtl/ha.

Extension Activities

In addition to the Demonstration of technology in the farmer's field. No. of training programmes at different crop growth stages, Exposure visit, Field Days, Crop Seminar & Field visit for monitoring of the programme were organized during the crop period.

Result

Collected data for the both the year (2008-09 & 2009-10) were entirely analyse by the KVK. This Summary of the result given as under:

S.N.	Yield attributes	2008-09			2009-10		
		RP	FP	Increase in %	RP	FP	Increase in %
1.	No. of effective tillers/ plant	6.34	5.88	7.8	7.07	6.24	13.30
2.	No. of grains /ear	36.7	34.1	7.6	40.5	38.6	4.92
3.	Test weight /1000 gm	36.80	35.5	3.66	40.01	39.69	0.80
4.	Yield q/ha	38.53	32.03	20.29	51.55	43.01	19.85

Economic Impact

1. Additional cost Rs./ha:

a. 41925.00 (2008-09)
b. 2150.00 (2009-10)

2. Additional Yield qtl/ha:
a. 6.5 q/ha (2008-09).
b. 8.54 q/ha (2009-10).

3. Additional Income Rs./ha:
a. Rs.7150.00 (2008-09).
b. Rs. 10248.00 (2009-10).

It is evident from above table that in 2008-09 the productivity of Wheat was 38.53 qtl/ha in recommended practice as compare to 32.03 qtl/ha in farmers practices which is 20.29% more over farmers' practice. In 2009-10 the productivity of Wheat was 51.55 qtl/ha in recommended practice as compare to 43.01 qtl/ha in farmers practices which is 19.85% more over farmers' practice.

Spread of Technology

Adoption of technology has been wide spread in selected as well as adjoining villages due to concentrated efforts made by CRDE- Krishi Vigyan Kendra & IFFCO through training, Demonstration, Field Day, Crop Seminar & Field Visits in the year 2009-10. It was observed that increase in the area under balance use fertilizer as per soil test value and its proper placement. The spread effect was evaluated in selected villages (10 No.) and was found an extent of 1:34 in 2009-10.

In course of time demand for seed cum fertilizer drill had increased tremendously in the district. The data collected from MP Agro, Sehore revealed that before the campaign purchasing of seed cum fertilizer drill was almost nil. During the year 2008-09 & 2009-10 MP Agro of Sehore supplied 11 & 98 seed cum fertilizer drill to the farmers in the district.

Summary

Concerted made by CRDE- KVK and IFFCO on enhancement of productivity of Wheat crop through increasing fertilizer use efficiency in the district found very effective in adoption of technology. The adopting the technology farmers get more economic return & had been a spread to other farmers in the district. The Krishi Vigyan Kendra still bears the responsibilities to provide technical knowledge to farmers, Extension worker of the line department, NGO and private institution through its technical manpower & available resources.

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Benefits of Fruits and Vegetable Waste Material

Article ID: 11482

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Introduction

The present-day society has become increasingly concerned about the environmental safety and social costs involved in treating the wastes generated in the processing industry. These public concerns have led several countries to pass legislation that severely curtail past practices of disposing the wastes in flowing streams. Every processing unit should adopt new legislations that require strict compliance of proper waste management. Production of waste can greatly be reduced by improving the efficiency of the operation. Characterization of wastes in processing operation is probably the step in any waste management programme. These methods identify and take inventory of waste material generated in a particular processing industry, produce primarily the solid waste having higher BOD than the dairy or the meat processing industries. The characterization of waste materials can be used as tool for developing more efficient processing technologies. The best example of this is the introduction of ley peeling to increase the recovery of salable product and thereby significantly reducing the production waste of waste during juice extraction. These newer technologies ensure safety, reduce energy use, maintain nutritional quality, reduce food losses and waste and it also increases turnover of the operation.

The peels, rags, rind, core, trimmings and seeds of fruits and vegetables left over after juice extraction, canning, jam and jelly etc, can be used to produce certain products of commercial importance.

Uses of Fruit Waste

The fruits waste material used for methane gas preparation. The other fruits, such as dried culls and surplus grapes, apple and oranges are used for the production of brandy. The fruit waste has so many beneficial effects which are discuss under following heads:

Pineapple: Pineapple peels and cores from canning operation are used for making syrups for addition to canned pineapple, producing juice and for making vinegar. The juice has also been fermented to produce industrial alcohol and can be used to produce citric acid by treating with lime in order to produce citrate from which citric acid can be recovered.

Apple: The peels and cores of apple left after apple sauce canneries and apple driers can be utilized for producing vinegar and for jelly stock. In jelly manufacturing, the dried material is cooked with water to produce a jelly juice that can be combined with other juices, sugar and citric acid and boiled to form a gel. Apple peel and the waste left after the juice extraction can also be used to produce natural flavourings.

Mango: The mango peels can be extracted with water and fermented into fruit vinegar. The kernel of the stone can be dried, powered and utilized for edible purposes. The possibility of utilizing mango stones which form a fairly large proportion of the fruit, as a source of food at the time of scarcity of cereal foods is of considerable importance.

Banana: In processing of banana for canning and dehydration, the banana peel is a waste product. The pulpy portion scraped from the thick peel of the banana can be utilized for the preparation of banana cheese. The pseudostem of the banana plant which is cut down after harvesting the bunch can be utilized as raw material for the preparation of paper pulp.

Citrus: Citrus processing produces a large amount of waste material which can be divided into three categories; animal feed, raw material used for extraction of marketable components and food products. Dried citrus meal that is used for animal feed is probably the main waste recovery product. Citrus seeds can be used for oil extraction and also the production of a citrus seed meal for animal feed. The raw material that is further extracted citrus peels oils, citrus pectin, flavonoids and citrus seed oils. The various items like brined and candied peels, marmalades, syrups and peels products used in food seasoning.

Vegetable Processing Waste

Tomato: Tomato seeds contain oil that can be recovered and even the seed has potential for food use since its amino acid composition is similar to soyabean protein. Most of tomato processing waste, attention has been centered on the utilization of the tomato pulp and pomace as animal feed.

Peas: The vines and pea hulls can be dehydrated and used in the preparation of stock feeds by suitable blending with other materials.

Okra: Seeds contain 6% essential oil and are also used as a condiment. The mucous leaves of this species are also used as a leafy vegetable.

Cassava: Starch extract from the root is also used to make a wide range of sweet and savoy foods like tapioca pearls, noodles and cheese bread. It is also consumed as fermented beverage, roasted gari sticky porridge.

Sweet potato: Beta carotene found in the peel is an antioxidant that is converted to vitamin A in the body. This conversion helps to improve eyesight and build a healthy immune system. The peel contains a high level of 542 milligram of potassium and also a great source of iron.

Watermelon: The rind of watermelon is safe to eat because rind contains high concentration of vitamin C, Vitamin A, Vitamin B6, potassium and zinc.

Conclusion

Lastly, we concluded that fruits and vegetable parts like core, rind, seeds and even stem roots and leaves also contain appreciable amount of nutrients that gives beneficial effects to human beings. So, we have to adopt more new techniques for utilization of these parts.

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Drumstick (Moringa) The Superfood

Article ID: 11483

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Moringa Cultivation

Indian land is known for its delicious cuisines. There are many greens which are cultivated on this land having many health benefits and magnificent taste. Drumstick is also one of them. Drumstick, commonly known as Moringa, is a tall and slender fast-growing tree usually grown for its leaves, seed pods or pericarp. Leaves are used as vegetable and pods are also added in many luscious dishes. Apart from the taste, Moringa also possess many nutritional values, it is rich in iron, calcium and vitamin A and C.

The Utility of Drumstick (DS)

Every part of the drumstick is useful. Tender leaves and sticks have a high amount of Protein, Carbohydrates, Vitamin A, Vitamin C and minerals. Each part is used as medicine. In addition to sticks and leaves, flowers of DS (drumstick) are valued ingredients of food that are not only tasty but nutritive too. Its juice is useful as protection from bacterial diseases.

Nutritional Facts

Drumstick pods and leaves are a storehouse of essential nutrients, whereas the leaves are the most nutrient part of the plant and one of the finest sources of calcium, iron, zinc, selenium and magnesium. Fresh pods and seeds are a great source of oleic acid, a healthy fatty acid which is known to promote heart health. Moringa leaves is unique among all the greens as it is heaped with a good amount of protein about 9.8 gram of protein per 100 grams. Dry powdered leaves are an amazing source of good quality essential amino acids.

Nutritional Value of Drumstick Per 100 Grams

Energy	64 kcal
Carbohydrates	8.28 g

Dietary fibre	2.0 g
Fat	1.40 g
Protein	9.40 g

Leaves Nutrition

Moringa leaves are an incredible source of essential vitamins such as vitamin B complex, C, K and beta carotene. The leaves are imbued with a rich array of minerals like calcium, iron, zinc, manganese and magnesium and a good amount of protein and dietary fibre. Moringa leaves are a powerhouse of antioxidants quercetin and chlorogenic acid. Moreover, moringa leaves supplement are well-known to enhance blood antioxidant levels.

Seeds Nutrition

Seeds are mostly used to extract oil and the mature pods are roasted and enjoyed as snack like peas or nuts which comes with a high amount of vitamin C, B and minerals.

Uses of Drumstick

Drumstick is praised as a tree of life as almost all the parts of the tree are beneficial and used for various purposes. The edible parts of the tree include leaves, stalks, stems, immature green fruit or seed pods, aromatic flower and young seeds and roots are made into nutritious and delicious dishes.

The mature seeds yield edible oil called ben oil, which is odourless, clear with high strength of behenic acid and resists rancidity. Seed cake after oil extraction is used as manure or as a floc to purify water. The shredded root with a distinct flavour is used as a condiment. Furthermore, the bark, sap, roots, leaves, seeds and flower find a prominent place in traditional medicine.

Wellness Incentives of Drumstick

1	Strengthens Bone	Drumstick being an incredible source of essential mineral's calcium, iron and phosphorus, strengthens the bones in growing children.
2	Augments Immune System	High on vitamin C and antioxidants, drumstick helps to combat against common cold, flu and stave off several common infections. The anti-inflammatory and anti-bacterial properties of drumstick assists in lessening the symptoms of asthma, cough, wheezing and other respiratory problems.
3	Promotes Gut Health	Drumstick blessed with a richness of essential B vitamins like thiamine, riboflavin, niacin and vitamin B12 plays a crucial role in stimulating the secretion of digestive juices and helps in the smooth functioning of the digestive system.
4	Regulates Hypertension	The goodness of bioactive compounds niaziminin and isothiocyanate in drumstick assists to circumvent the thickening of the arteries and lessens the chance of developing high blood pressure.
5	Kidney Health	Regular addition of drumstick in the diet may help in reducing the development of stones in the kidney and bladder.
6	Lowers the Risk of Cancer	Regular addition of drumstick to your meal plan is a great way to boosts up the antioxidant profile. The abundance of vitamins A, C, beta-carotene and niazimicin help in suppressing the formation of cancer cells.
7	Improves Liver Health	Drumstick stimulates the production of glutathione – the detox antioxidants known to counter free radicals that increase the stress to the liver.
8	Regulates Diabetes	Drumsticks being naturally low in calories and heaped with essential minerals, vitamins and fibre help to significantly bring down blood sugar spikes. Several studies reveal that the plant compound isothiocyanates in moringa are effective in reducing weight, improving glucose tolerance and regulating blood sugar levels.

9	Promotes Good Vision	The richness of antioxidants in drumstick is beneficial in treating cataracts and dry eyes. The eye-friendly nutrients in drumstick avert the thickening of the capillary membrane and impede retinal dysfunction.

Soil and Climate

It can be grown in a variety of soils, but loamy, sandy loam soils are better suited. Sadie soils and also dry conditions are quite ok.

Varieties of Drumstick

Moringa can be classified into different varieties on the basis of Ayurveda and varieties developed by public sector.

On the basis of Ayurveda, Moringa has three varieties, Shyama (black variety), Shveta (Red variety) and Rakta (Red variety).

On the basis of varieties developed by public sector, Moringa has KM1, PKM1, PKM2, GKVK1, GKVK2, GKVK3, Dhanraj, Bhagya (KDM1), Konkan Ruchira, Anupama and Rohit 1 varieties.

Sowing and Land Preparation

1. Soil preparation and sowing: Soil mixture should be light, i.e., one part of sand to three parts of soil, and slightly acidic (6.2 to 7.0 pH). Moringa is warm season plant. So, its seeds are sown in late winters. 30 cm deep and 30 cm wide holes are dug and seeds are sown and then remaining space in the holes can be filled with loose soil and manure.

2. After sowing care: Seeds will start germinating after 5-10 days of sowing. The area between the plants should be kept free of weeds. Generally, Drumstick plants do not need too much watering but during summers and dry conditions water regularly.

Deep ploughing is done for DS cultivation. Pits measuring 1ft x 1ft x 1ft at a distance of 2.5 m is prepared during summer months. Pits are filled with 2 kg of FYM and soil. On the onset of monsoon, the seedlings are planted in the pits. About 1500 plants are needed for a ha of land. Seedlings prepared by vegetative propagation also can be planted in the pits after filling with the manures. The banks of ponds and wastelands can be conveniently used for DS planting.

Intercultural Operation

Timely and proper weeding at the initial stage of growth is needed. Seedlings raised from seeds need to be pruned when plants reach a height of about 3 ft. This helps in the branching of the plants and many fruits could be had from a lower height.

Fertilizer Application

After 3 months of planting, 50 g N, 20 g P20 5, and 25 g of K 20 are added per pits. In addition, about 5 kg FYM /vermicompost is to be added per plant.

Irrigation

During dry season irrigation helps for better growth of DS plants.

Pests and Treatment

Drumstick plants are obstructive to most of the pests but can be attacked by some pests such as hairy caterpillar, moringa worm, pod fly, leaf caterpillar, and bark caterpillar. To protect moringa from these pests, following practices can be done:

1. Plough during summers and destroy the alternate host plants.
2. Avoid overlapping of plants in nearby area.
3. Provide proper nutrients to moringa by spreading 7-8 kg of compost per hole.
4. Remove previous crop residues and plan to grow legumes and ginger intercrops.
5. Use light soil with proper drainage.
6. Spray NSKE (Neem seed kernel extract) 5% during 50% plant growth and after 35 days to protect it from pod fly.

7. Soil solarisation using clear plastic sheet to burn weeds.

Drumsticks also need to be protected from livestock as cattle, goats, sheep will eat its pods and leaves. Installation of proper fencing around plants will protect the plants.

Harvesting of Drumstick

Harvesting of drumstick pods should be done when pods are immature (1 cm diameter). Mature pods are also edible but they develop tough outer structure.

Leaves of drumstick can be harvested when plant grows 150 -200 cm tall, which take 3-4 months in fertile soil. After 6 months of 'planting. On average 200 fruits could be obtained. After harvesting, the pruning of plants is done to get more branches and fruits in the next season. From the vegetative propagation tall plants are obtained. Therefore, after harvesting, branches have to be axed. Initially, about 90 fruits per plant are obtained but with the passage of times about 800 - 1000 DS are obtained / plant.

Conclusion

Drumstick is highly valued for its indispensable therapeutic properties and nutritional benefits. This versatile vegetable is imbued with immense amounts of essentials vitamins A, C, K, B complex and minerals iron, calcium, magnesium to name a few. Regular addition of drumstick in the diet is well-known to control diabetes and high blood pressure fortifies the bone, improves skin health, treats erectile dysfunction and enhances libido. Right from the root, bark, leaves, pod, flowers, fruits and seeds are used extensively in traditional medicine.

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FORMAT OF ARTICLE

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Maximum limit: 2-3 pages (If authors exceed page limit article may be rejected instantly)

Times New Roman, 12 font, 1 spacing

Title of article (must be short and catchy)

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Summary of Article: 1 paragraph

INTRODUCTION: May contain multiple paragraphs, figures, tables and HD images.

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- → **Singh *and Mishra,* 2015) found that ABCDEFG HIJK LMNO PQR**

Personal opinion column can be added

Summary/ Conclusion:

HD Photographs (if available)

References format:

[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.

[2]. Ho H., Cheu Y. and Luo I., (1953). The detection of vitamin B, and C in Chinese drugs. *Journal of Taiwan Pharmacy Association*. 5(1):5-20.

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