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An Introduction to Organic Farming

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Ashruti kesharwani[1], Abhisek Tripathy[2], Pooja Konhar[3], Aditya Kumar Malla[4] and Jeebanjyoti Behera[5]
[1]Ph.D. Research Scholar, Dept. of Plant Pathology, I.G.K.V., Raipur
[2]Ph.D. Research Scholar, Dept. of Plant Pathology, O.U.A.T., Bhubaneswar
[3]Ph.D. Research Scholar, Dept. of Agricultural Entomology, I.G.K.V., Raipur
[4,5]Ph.D. Research Scholar, Dept. of Extension Education, O.U.A.T., Bhubaneswar

INTRODUCTION

Organic farming is a technique, which involves cultivation of plants and rearing of animals in natural ways. This process involves the use of biological materials, avoiding synthetic substances to maintain soil fertility and ecological balance thereby minimizing pollution and wastage. In other words, organic farming is a farming method that involves growing and nurturing crops without the use of synthetic based fertilizers and pesticides. Also, no genetically modified organisms are permitted. It relies on ecologically balanced agricultural principles like crop rotation, green manure, organic waste, biological pest control, mineral and rock additives. Organic farming makes use of pesticides and fertilizers if they are considered natural and avoids the use of various petrochemical fertilizers and pesticides. International Federation of Organic Agriculture Movements (IFOAM), an international organization established in 1972 for organic farming organizations defines goal of organic farming as: “Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved…”

Reasons for Organic Farming

The population of the planet is skyrocketing and providing food for the world is becoming extremely difficult. The need of the hour is sustainable cultivation and production of food for all. The Green Revolution and its chemical based technology are losing its appeal as dividends are falling and returns are unsustainable. Pollution and climate change are other negative externalities caused by use of fossil fuel based chemicals. In spite of our diet choices, organic food is the best choice you’ll ever make, and this means embracing organic farming methods. Here are the reasons why we need to take up organic farming methods:

1. To accrue the benefits of nutrients
2. Stay away from GMOs
3. Natural and better taste
4. Direct support to farming
5. To conserve agricultural diversity
6. To prevent antibiotics, drugs, and hormones in animal products

Differences between Organic and Conventional Farming Methods

In conventional farming method, before seeds are sown, the farmer will have to treat or fumigate his farm using harsh chemicals to exterminate any naturally existing fungicides. He will fertilize the soil using petroleum based fertilizers. On the flip side, the organic farmer will prepare and enrich his land before sowing by sprinkling natural based fertilizers such as manure, bone meal or shellfish fertilizer. Before planting seeds, the organic farmer will soak the seeds in fungicides and pesticides to keep insects and pests at bay. Chemical are also incorporated in the irrigation water to prevent insects from stealing the planted seeds. On the other hand, the organic farmer will not soak his seeds in any chemical solution nor irrigate the newly planted seeds using water with added chemicals. In fact, he will not even irrigate with council water, which is normally chlorinated to kill any bacteria. He will depend on natural rain or harvest and stored rainwater to use during dry months. When the seeds have sprung up, and it's time to get rid of weeds, the conventional farmer will use weedicide to exterminate weeds. The organic farmer will not use such chemicals to get rid of the weed problem. Instead, he will physically weed out the farm, although it's very labour intensive. Better still, the organic farmer can use a flame weeder to exterminate weeds or use animals to eat away the weeds. When it comes to consumption, it's a no-brainer that anyone consuming products from the conventional farmer will absorb the pesticide and weedicide residues into the body, which could lead to developing dangerous diseases like cancer. People understand that health is important to them and that's why they are going organic in record numbers today.

Key Features of Organic Farming

- Protecting soil quality using organic material and encouraging biological activity
- Indirect provision of crop nutrients using soil microorganisms
- Nitrogen fixation in soils using legumes
- Weed and pest control based on methods like crop rotation, biological diversity, natural predators, organic manures and suitable chemical, thermal and biological intervention
- Rearing of livestock, taking care of housing, nutrition, health, rearing and breeding
- Care for the larger environment and conservation of natural habitats and wildlife

Four Principles of Organic Farming

- **Principle of Health:** Organic agriculture must contribute to the health and well-being of soil, plants, animals, humans and the earth. It is the sustenance of mental, physical, ecological and social well-being. For instance, it provides pollution and chemical free, nutritious food items for humans.
- **Principle of Fairness:** Fairness is evident in maintaining equity and justice of the shared planet both among humans and other living beings. Organic farming provides good quality of life and helps in reducing poverty. Natural resources must be judiciously used and preserved for future generations.
- **Principle of Ecological Balance:** Organic farming must be modelled on living ecological systems. Organic farming methods must fit the ecological balances and cycles in nature.
- **Principle of Care:** Organic agriculture should be practiced in a careful and responsible manner to benefit the present and future generations and the environment.

Why is modern farming unsustainable?

- Loss of soil fertility due to excessive use of chemical fertilizers and lack of crop rotation.
- Nitrate run off during rains contaminates water resources.
- Soil erosion due to deep ploughing and heavy rains.
- More requirement of fuel for cultivation.
- Use of poisonous bio-cide sprays to curb pest and weeds.
- Cruelty to animals in their housing, feeding, breeding and slaughtering.
- Loss of biodiversity due to mono culture.
- Native animals and plants lose space to exotic species and hybrids.

Benefits of Organically Grown Food Items and Agricultural Produce

Better Nutrition: As compared to a longer time conventionally grown food, organic food is much richer in nutrients. Nutritional value of a food item is determined by its mineral and vitamin content. Organic farming enhances the nutrients of the soil which is passed on to the plants and animals.

Helps us stay healthy: Organic foods do not contain any chemical. This is because organic farmers don't use chemicals at any stage of the food-growing process like their commercial counterparts. Organic farmers use natural farming techniques that don't harm humans and environment. These foods keep dangerous diseases like cancer and diabetes at bay.

Free of poison: Organic farming does not make use of poisonous chemicals, pesticides and weedicides. Studies reveal that a large section of the population fed on toxic substances used in conventional agriculture have fallen prey to diseases like cancer. As organic farming avoids these toxins, it reduces the sickness and diseases due to them.

Organic foods are highly authenticated: For any produce to qualify as organic food, it must undergo quality checks and the creation process rigorously investigated. The same rule applies to international markets. This is a great victory for consumers because they are getting the real organic foods. These quality checks and investigations weed out quacks who want to benefit from the organic food label by delivering commercially produced foods instead.

Lower prices: There is a big misconception that organic foods are relatively expensive. The truth is they are actually cheaper because they don't require application of expensive pesticides, insecticides, and weedicides. In fact, you can get organic foods direct from the source at really reasonable prices.

Enhanced Taste: The quality of food is also determined by its taste. Organic food often tastes better than other food. The sugar content in organically grown fruits and vegetables provides them with extra taste. The quality of fruits and vegetables can be measured using Brix analysis.

Organic farming methods are eco-friendly: In commercial farms, the chemicals applied infiltrate into the soil and severely contaminate it and nearby water sources. Plant life, animals, and humans are all impacted by this phenomenon. Organic farming does not utilize these harsh chemicals so; the environment remains protected.

Longer shelf–life: Organic plants have greater metabolic and structural integrity in their cellular structure than conventional crops. This enables storage of organic food for a longer time.

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CONCLUSION

Interest in organic agriculture methods is growing, especially in areas where the present farming system has degraded resources essential to agricultural production (especially land). Non-production factors, such as the farmer's health, are also mentioned as a reason for shifting to organic management. Consumers also have an interest in organic agriculture. Consumer awareness of the environmental costs of agriculture (such as the deteriorating quality of drinking water and soil, and the impact of agriculture on landscape and wildlife) is increasing. The awareness of environmental quality and health is often promoted by environmental groups, especially in developed countries. The resulting demand for organic products creates the opportunity to sell organic products at premium prices, enabling organic farmers to continue, and often expand. Some governments have begun to recognize the possibility that it may be cheaper to support organic agriculture than to rectify problems associated with certain resource-destruction production practices. For this reason, several governments have introduced subsidies for organic agriculture. These subsidies come in many forms, such as direct payments to farmers (both for those in the conversion stage and also for established organic farmers), and indirect aid (such as for education, research, extension and marketing). However, if the emphasis is on future improvements, land tenure conditions are of utmost importance, where tenure is important for interest in future possibilities. An additional, but debatable issue is that production in organic agriculture is often said to be less variable than under other management systems. In climatically adverse years, yields on organic farms can be observed to be relatively high; in areas where drought conditions are common, this can be an important point in relation to availability of and accessibility to food. More frequently, farmers switch to organic agriculture in order to secure market premiums. In this second case, the increased income can help in improving the local food security situation, but variations in price over time should be anticipated. At present the size of the organic market is small (typically less than one per cent in most countries), and therefore a small change in organic production will mean a large percentage change in quantity available, influencing price. Increased organic production in the future may have a depressing influence on prices; however, increased consumption may offset any downward pressure on prices.

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Enhancing farmers' income through integrated farming system: prospects and potentials

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Suman Sen
PhD Scholar, Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110 012

Integrated farming system is a promising approach for increasing productivity and income through efficient utilization of available farm resources and multiple use of farm land. It helps in risk minimization of farming and creates additional income round the year and thus alleviating poverty and improving the livelihoods of small and marginal farmers.

INTRODUCTION

Indian economy much depends on the advancement of agriculture. Indian agriculture has challenge of providing national as well as household food and nutritional security to its billion people. The human population of the country has increased to ~1.3 billion and likely to increase to more than 1.6 billion before near-stabilization by 2030. Likewise, the food demand is expected to rise up to 300 and 350 million tonnes (MT) in 2020 and 2030, respectively and even up to 400 MT by the year 2050 (Anonymous, 2015). The average land holding of the farmers in India has been declining and marginal and small farmers constitute more than 85% of operational holdings, cultivating ~47% of total operated area (Table 1). Sustaining household food and nutritional security has been an issue of prime importance to majority of the farmers, especially marginal and small farmers. Under gradual shrinkage of land holding, horizontal expansion of land is limited. Thus, integrated farming systems *i.e.* integration various farm enterprises like dairy, fishery, poultry, duckery, apiary, field and horticultural crops, mushroom, agro-forestry etc. can make farming more profitable and dependable, thereby ensuring higher productivity and livelihood security.

Integrated farming systems (IFS) are less prone to risks as they integrate different synergistic enterprises and optimize the use of farm and associated resources. IFS provide diversity in the farm produce and it is environmentally sound too (Behera and France, 2016). IFS potentially generate more employment for the farm family round the year, ideally for small and marginal land holdings. Thus, IFS can potentially upswing agricultural growth rate on a sustainable basis.

Principle

The integrated farming system is a component of farming system which is the scientific integration of different inter-dependent and interacting farm enterprises for the efficient use of land, labour and other resources of a farm family which provide year round income to the farmers. Food and Agriculture Organization (2001) defined farming system as the household, its resources, resource flows and their interaction at the individual levels. The IFS use multiple crops (cereals, legumes, tree crops, vegetables etc.) and multiple enterprises (livestock, bee keeping, fish farming etc.) in a single farm in an integrated manner. It aims to maximize production in a cropping pattern and takes care of optimal utilization of resources (by-product of one system as input of other system). It increases farm income and generates employment for small holdings by integrating various farm enterprises and recycling crop residues and by-products within the farm.

Table 1: Percentage and average size of operational holdings by size group

Category	Percentage of holdings			Average size of holdings (ha)		
	2005-06	2010-11	2015-16*	2005-06	2010-11	2015-16*
Marginal (<1 ha)	64.8	67.1	68.52	0.38	0.39	0.38
Small (1-2 ha)	18.5	17.9	17.69	1.38	1.42	1.41

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Semi-medium (2-4 ha)	10.9	10.0	9.45	2.68	2.71	2.70
Medium (4-10 ha)	4.9	4.2	3.76	5.74	5.76	5.72
Large (≥10 ha)	0.8	0.7	0.57	17.08	17.38	17.1
All Holdings	100.0	100.0	100.0	1.23	1.15	1.08

*Provisional; Source: Agricultural Statistics at a Glance 2018

Benefits accrued from IFS

- Improves productivity, profitability and income round the year, thus improves livelihood of the farmers,
- *In-situ* recycling of organic residues including farm wastes to reduce the dependency on synthetic inputs,
- Decrease in cost of cultivation through enhanced input-use efficiency,
- Effective use of by-products/wastes of one component for the benefit of other component(s),
- Upgrading of soil and water quality and bio-diversity with lower environmental footprints,
- Balanced, nutritious and quality foods through minimizing chemical residues in soil-plant-animal-human food chain (nutritional security)

Different types of IFS

Cropping system based	**Mixed farming system**
Crop-livestock	Agri-horticultural system
Crop-livestock-fishery	Dairy-based
Crop-livestock-poultry-fishery	Poultry-based
Crop-poultry-fishery-mushroom	Fish-cum-pig farming
Crop-fishery-poultry	Paddy-cum-fish culture
Crop-livestock-fishery-vermicomposting	Rice-fish-azolla farming
Crop-livestock-forestry	Rice-fish-vegetable farming
Agri-silvi-horticulture system	Crop and fish farming (Pond system)
Agri-horti-silvi-pastoral system	Fish-cum-poultry farming
Home garden agro-forestry system	Fish cum horticulture

Efficient and optimum resource flow among components

Figure 1 depicts the resources flow in a typical IFS (crop-livestock integrated farming system), where crop residue is used as feed for livestock and dung is used in the crop field (as manure) and bio-gas pit. Dairy products and meat from livestock; grains, vegetables and fruits etc. from crop field and bio-gas from bio-gas pit are used/consumed by farming family. So the farming family gets foods and income from both the enterprises. In return farming family provides labour, capital and management to the crop and livestock. Thus, the key aspects of integrated crop-livestock farming system are (i) nutrient cycling, (ii) forage crops, (iii) crop residues and (iv) livestock production. Thus with continuing population growth, intensifying crop and livestock systems could play a vital role in maintaining rural livelihoods.

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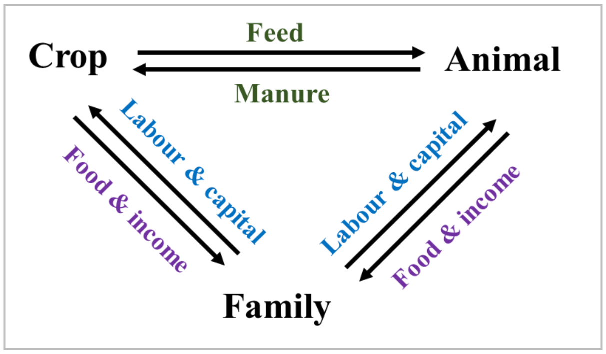

Fig. 1: Resources flow in crop-livestock integrated farming system

IFS models with potentials of enhancing productivity and income

Integration of cropping with the other enterprises (dairy, poultry and fishery) could markedly increase the system productivity and profitability than the cropping alone as evident from previous researches. Results of numerous experiments have portrayed the additional benefits of adoption of IFS and few of these have been mentioned here. Diversifying rice-wheat cropping system with dairy, piggery, fishery and poultry could generate 186%, 154% and 144% more income over the existing system for marginal, small and medium farmers, respectively (Table 2). Moreover, IFS involving crop, dairy, piggery, fishery, poultry and agro-forestry generated higher income of 6-86% for marginal, 6-77% for small and 5-44% for medium farms compared to existing rice-wheat system under north Indian conditions (Behera *et al*., 2014).

Table 2: Income benefits accrued from IFS models for different farm categories

Enterprise combination	Net returns (Rs.)		
	Marginal farm	Small farm	Medium farm
Rice-Wheat (R-W)	53221	106442	212884
R-W + Dairy (D)	56676	113351	223248
R-W+ Piggery (Pi)	89990	179980	286422
R-W + Pi + Fishery (F)	92355	184414	296767
R-W+D+Pi +F+ Poultry	99113	164285	307570

Adapted from Behera *et al*. (2014)

In an another experiment, Ravisankar *et al*. (2007) compared the economics of crops-based IFS and crop cultivation alone at Port Blair and found that diversification of crop with cattle, poultry and fish generated an additional benefit of Rs. 83399/ha over crop cultivation alone. Moreover, 346 man-days/ha/year employment was generated under the IFS model with an addition benefit of 121 man-days (54% more) over crop cultivation alone (Table 3).

Table 3: Productivity, profitability and employment generation in IFS

System	Gross income (Rs/ha)	Net income (Rs./ha)	Employment (man-days)
Crops + Cattle + Poultry + Fish	575214	441165	346
Crop Cultivation alone	453819	357766	225
Additional benefit	121395	83399	121

Adapted from Ravisankar *et al*. (2007)

Likewise, farming system constituting crop + dairy + poultry + fishery resulted in the highest system productivity of 1,237.5 q/ha rice equivalent yield with 1331.6% and 624.2% increase over the traditional rice-wheat system and the most remunerative cropping sequence (rice-pea-okra), respectively (Singh *et al*., 2007). Rathore and Bhatt (2008) found that IFS model with components of rice-vegetable pea-beans (crop components) + fishery + piggery + dairy + duckery resulted in the maximum system productivity of 126.5 t/ha of rice equivalent yield. This system was more profitable and generated maximum employment opportunities (890 man-days/ha/year) than the traditional *jhum* rice crop in north-east India.

The IFS models are not only productive and profitable, but self-sustained too, as they integrate different synergistic enterprises and optimally use the farm and associated resources. About 95% of nutritional requirement of IFS is self-sustained through resource recycling (Gill *et al*., 2009). Therefore, integrated farming system is extremely important for the efficient management of available resources at the farm level with the aim of generating adequate income and employment for the rural community and improves their livelihoods in a sustainable manner.

CONCLUSION

Integrated farming system is a promising approach for increasing overall productivity and profitability through recycling the farm by-products, and efficient utilization of available resources. It also helps in minimizing risk of farming especially for small and marginal farmers and keeps harmony with the environment by combining appropriate components under specific agro-climatic condition. Thus, identifying effective IFS models in different agro-climatic regions and optimizing different enterprises as per the availability of resources to suit specific agro-climatic and socio-economic conditions could potentially improve the livelihood standards of millions of farmers in India.

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Using Plastic Mulches and Drip Irrigation for Vegetable Gardens

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Ravi Kumar Meena[1], M. L. Meena[2], Babu Lal Meena[1], Hema Meena[3], Y K Sharma[1]
[1]Assistant Professor,CoA, Lalsot, SKN Agriculture University.
[2]Associate Professor, CoA, Lalsot,SKN Agriculture University.
[3]Techanical Assistant, IASRI, New Delhi.

What is Plastic Mulch?

Plastic mulch is considered as a type of inorganic mulch. This type of mulching utilizes polyethylene film to shield plants from the elements. It was in the 1950s when plastic mulching became popular among US growers. Plastic mulching was used in commercial berry and vegetable production. However, this method is now being adapted to home gardens too. The polyethylene film is usually a sheet of black plastic and it works the same way as organic mulch, the film insulates the soil, prevents soil erosion, and reduces moisture evaporation. While plastic mulching certainly has its benefits, it's important to dispose of the mulching material properly to reduce its effects on the environment. The fact is, the use of plastic films as mulch material raises environmental concerns because plastic is a type of petroleum product. Apart from utilizing a lot of energy to make plastic materials, these are difficult to recycle too.

Basic Types of Plastic Mulching

There are 2 basic types of plastic mulching: black polyethylene film and clear polyethylene. The black plastic film is ideal for eliminating weeds, warming up the soil during the cold season, as well as retaining the soil's moisture. On the other hand, the clear plastic film works best for warming up the soil and encouraging faster growth early in the growing season. Clear plastic film, however, isn't as effective when it comes to suppressing weed growth.

The Benefits of Using Plastic Mulching

Improves Soil Structure

Using plastic mulching helps prevent soil from clumping together into a compacted mess. The material traps moisture and heat, which limits the loss of plant nutrients. Of all the mulching materials available on the market, plastic mulch is the most restrictive so it pairs well with a drip irrigation method. In addition, the plastic film discourages people and pets from walking into the area, which further enhances the structure of the soil.

Insulates the Soil

Most plants are temperature sensitive, vegetables, in particular, cannot stand the winter cold. One of the reasons why growers use mulch is to help the soil retain heat as the cold months set in. Inorganic mulch like plastic mulch warms up the soil up to 5 degrees Fahrenheit. Plastic mulching regulates the soil temperature evenly, insulating temperature sensitive plants during the cooler months.

Fruit-bearing trees and tender perennials are more likely to break from their winter dormancy by using plastic mulch too. Plastic mulch is also effective in protecting trees and shrubs from winter damage.

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Muskmelons, tomatoes, peppers, cucumbers, squash, eggplant, watermelons, and okra are vegetable crops that have shown significant increases in earliness, yield, and fruit quality when grown on plastic mulch. Some less-valuable crops such as sweet corn, snap beans, southern peas, and pumpkins have shown similar responses. Some of the advantages and disadvantages of using plastic mulches are outlined below.

Advantages

1. **Increased soil temperature --** At a 2-inch depth: 4 to 5^{0}F under black mulch, 5 to 8^{o}F with infrared transmitting (IRT) (clear green), or 8 to 10^{0}F under clear mulch.
2. **Reduced soil compaction --** Soil under plastic mulch remains loose, friable and well-aerated. Roots have access to adequate oxygen and microbial activity is excellent.
3. **Reduced fertilizer leaching --** Water runs off the impervious mulch, resulting in maximum utilization of the fertilizer.
4. **Reduced drowning of crops --** Water is shed from the row area and excess water runs off the field thus reducing drowning and other excess soil water stresses.
5. **Reduced evaporation --** Soil water does not escape from under plastic mulch. Plant growth on mulch is often at least twice that on bare soil. The resulting larger plants will require more water, so mulching is *not* a substitute for irrigation.
6. **Cleaner product --** A mulched crop is cleaner and less subject to rots due to elimination of soil splashing on the plants or fruits.

   Note: Beds should be firm and tapered away from the row center. Plastic should be tight to promote run-off. **There should be no puddles on the mulched beds!**

7. **Root pruning eliminated --** Cultivation is not necessary except for the area between the mulched strips. Therefore, roots are not pruned.
8. **Reduced weed problems --** Black and IRT plastic mulch provides good weed control in the row. Clear plastic will require use of a herbicide, fumigation or lifting the mulch and cultivating. Often, weeds between mulch strips can be controlled by a herbicide.
9. **Earlier crops --** Black plastic mulch can result in 2 to 14 days earlier harvest while clear plastic can result in a 21-day earlier harvest.
10. **Increased growth --** Plastic mulch is practically impervious to carbon dioxide (CO_2), a gas that is of prime importance in photosynthesis. Very high levels of CO_2 build up under the plastic, because the film does not allow it to escape. It has to come through the holes made in the plastic for the plants and a "chimney effect" is created, resulting in localized concentrations of abundant CO_2 for the actively growing leaves.

Disadvantages.

1. **Costly to remove --** Plastic mulch and drip irrigation tube must be removed from the field annually. Black plastic does not break down and should never be tilled into the soil. Clear plastic does break down with time but leaves a messy garden. Photo- and bio-degradable plastics hold promise.

2. **Greater initial costs --** Plastic mulch and drip irrigation will increase cost of production. These costs should be offset by increased income due to earlier harvests, better quality fruit and higher yields.
3. **Increased management --** Plastic mulch and drip irrigation must be carefully monitored (daily) to be successful.
4. **Increased soil erosion** -- Soil erosion increases in middles between plastic strips.
5. **Increased crop/weed competition** -- Weeds can grow out of the holes in close proximity with crops.

Preparation of the Soil -- The first step is to take 2 soil samples in early fall. Have one sample assayed for mineral content and one for nematodes. If the soil test suggests applying lime, apply enough in the fall to reach pH 6.0 to 6.5 using dolomitic lime if magnesium is low.

Fertilization -- Using the soil test report as a guide, apply fertilizer during bed preparation. Consult Horticultural Information Leaflets for specific crop recommendations. Amounts to be side dressed need to be included in the total fertilizer requirements. **Caution:** Using fertilizers with ammoniacal N in fumigated soils can result in ammonium toxicity to the crop. Normally, at least 50% of the nitrogen (N) should be in the nitrate (NO_3) form. Use calcium nitrate (15.5-0-0), sodium nitrate (16-0-0) or ammonium nitrate (33.5-0-0) as a nitrate sidedress source. When using drip irrigation with plastic mulch, one half of the N and K and all of the P should be incorporated at bedding. The remaining N and K should be applied through the drip tube using soluble fertilizers (e.g. calcium nitrate, sodium nitrate, 20-20-20, 15-0-14, or potassium nitrate). Overhead irrigation and fertigation can be used by perforating the plastic. One can make a small hole about 6 inches from the plant in the plastic and apply $^1/4$ cup of fertilizer. The entire amount of fertilizer may be incorporated in the bed but utilization by plants might be less efficient than with fertigation.

Bedding the Soil -- Raised beds should be used. Be sure that enough soil is pulled up so that the bed has good sharp corners. Bedded rows should be spaced on 5- or 6-ft centers. A bed with a 30 inch top should slope from the center to the edge with a drop of 1.25 inches, allowing excess rainfall to run off the mulch.

The plastic mulch is generally 4 or 5 ft wide, 1.25 to 1.50 mil thick, *embossed* (diamond-shaped design on film, which helps hold mulch tight against the soil) or *slick*. For single-row crops such as tomatoes, cucumbers, muskmelons, honeydews, watermelons and pumpkins, the drip tube should be placed 4 to 5 inches from the center of the bed and 1 to 2 inches deep with the emitters facing upward. For double row crops like summer squash, okra, eggplant, peppers, beans, peas, lettuce and sweet corn, the drip tube should be placed directly on the center of the bed and buried 2 to 3 inches deep. Take time to adjust the plastic so that it is held firmly against the bed and soil is placed halfway up the side of the bed but not on top of the bed. Also, anchor the plastic and drip tube when starting applications. Covering them with soil by digging a trench perpendicular to the row direction and putting soil on top provides a good anchor.

Pest Management

Weed Control -- For information on weed control under clear plastic mulch and in the row middles between black plastic mulch consult the *1999 North Carolina Commercial Vegetable Recommendations*(AG-586) or your county Extension center. Only approved herbicides can be used between rows of plastic, because this is not a fallow area.

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Insect and Disease Control -- Good insect and disease control is essential. Consult the current SCVRB or your county extension center for recommendations.

Transplanting -- For extra earliness in peppers and tomatoes, large containers (cell sizes 3 to 4 inches) should be used. For the other vegetable crops use 1 to 2 inch cell sizes. Transplants can be set by punching a hole in the plastic and placing the plant in the hole. When transplanting by hand, several tools can be used to make holes in the plastic such as a long handled bulb setter or a sturdy can or cylinder welded onto the end of a handle. The hole should be 2 to 4 inches wide and deep enough for the plants to be transplanted. A hand tobacco plant setter or long handled bulbsetter works well. The use of a "starter solution", a soluble fertilizer high in phosphorous (P) will often get the plants off to a good start. Examples are 12-52-12, 10-20-10, or 12-48-8.

Irrigation -- Drip irrigation is recommended for use with plastic mulches although other types can be used successfully. The frequency of irrigation will depend on soil type and stage of crop growth.Irrometers at the 6-inch and 12-inch depth in the mulched bed are recommended as an aid in determining irrigation needs. Frequent probing with a soil tube near the plant row will also help to keep a check on soil moisture. Normally, the area around the drip tube is very soft to the touch and the side of the row away from the tube should be only slightly soft. For more detailed information on trickle/drip irrigation, consult Horticultural Information Leaflet Nos. 33-A and 33-B, *Plasticulture for Vegetable Crops* (AG-489), *Trickle Irrigation in the Eastern United States* prepared by Northeast Regional Agricultural Engineering Service, Cornell University, Ithaca, NY 14853, an irrigation specialist, or your county Extension center office. **Do not use plastic mulch without irrigation**.

Double Cropping the Plastic Mulch -- Once the first crop has been harvested, it is recommended that a second crop be grown on the mulch (**See Table 1**). This "intensive cropping" results in two acres of production from each acre of actual land. The second crop can be fertilized (1) through the drip line using soluble fertilizers and a fertilizer injector, (2) through overhead fertigation, or (3) by placing fertilizer in holes in the plastic between plants. Consult Horticultural Information Leaflet No. 33-C for additional information on injecting fertilizers through the drip line.

Windbreaks -- Strips of rye should be established to protect vegetable seedlings from prevailing winds. Each rye strip should be 4 to 6 ft wide (6 to 8 rows) and far enough apart to plant 5 or 6 rows of vegetable seedlings. Well-grown rye strips planted in the fall will promote earliness and provide protection for the young transplants. Spring topdressing in February will help assure a good thick rye stand.

When laying plastic in the spring, plant the entire area with rye, but be sure to work up the crop area early enough in the spring to minimize crop debris interference with fumigating and plastic laying. Once wind protection is no longer required, mow the rye and use this area as a drive row for harvesting.

Reflective Plastic Mulches -- The reflective properties of aluminum-faced plastic have been shown to interfere with the movement of aphids which spread the watermelon mosaic virus. This virus causes the

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green streaking in yellow squash during fall planting. By using this mulch, a gardener is able to harvest solid green or yellow squash for a longer period of time in the fall. Also, painting the plastic with aluminum paint or white paint increases its reflectivity and cools soil for later planted crops, thus causing less stress and resulting in better fruit quality.

Infrared Transmitting (IRT) Mulch -- Infrared transmitting (IRT) mulch is a recent development. These plastics transmit the warming wavelengths of the sun, but not those that allow weeds to grow. These materials result in warmer soils than black plastic, but cooler soils than clear plastics. The IRT mulches retard the growth of weeds including nutsedge. Crops grown on IRT mulch will develop 7 to 10 days earlier than crops grown on black plastic.

Never plant a bed to the same crop twice in one year. Suggested spring-fall sequences are listed in Table 1 below.

Table 1: Suggested spring-fall sequences for planting.

Spring	Fall
Peppers	Summer squash, cucumbers or cole crops
Tomatoes	Cucumbers, summer squash or cole crops
Summer squash	Tomatoes or cole crops
Eggplant	Summer squash
Cucumbers	Tomatoes
Muskmelons	Tomatoes
Watermelons	Tomatoes
Honeydews	Tomatoes
Cole crops	Summer squash, pumpkins, muskmelons, tomatoes
Cauliflower	Summer squash, pumpkins, muskmelons, tomatoes
Snap beans	Summer squash, pumpkins, muskmelons, tomatoes
Southern peas	Summer squash, pumpkins, muskmelons, tomatoes
Lettuce	Summer squash, pumpkins, muskmelons, tomatoes
Sweet Corn	Summer squash, tomatoes, or cucumbers
Strawberries	Tomatoes, summer squash

Simply pull out the first crop and plant the second in holes appropriately spaced for the crop.
Note: Take care to avoid damaging the trickle/drip tube when planting.

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DNA isolation from soft bodied insects

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Ambarish, S*. and Nagaratna Wangi
Department of Agricultural Entomology
University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India-577204

- Insects were ground in 100 µl of extraction buffer containing 2 per cent CTAB, 100mM Tris-Hcl (Ph 8.0), 1.4 M sodium chloride, 20mM EDTA and 0.1 per cent of 2-mercaptoethanol using a sterile micropestle in a 1.5ml microcentrifuge tube.
- The samples were incubated at 56^0 C for 2 hours followed by gentle swirling.
- Added 2 µl of proteinase K and incubated at 37^0 C for 10 minutes.
- Added equal volume of chloroform and isoamyl alcohol (24:1) and mixed by inverting
- The suspension was centrifuged at 10000 rpm for 10 minutes at 8^0 C. The upper aqueous layer was collected and transferred to a fresh microcentrifuge tube.
- DNA was precipitated by adding an equal volume of chilled isopropanol and centrifuged at 10000 rpm for 10 minutes.
- Discard the supernatant and DNA pellet was washed with 70 per cent alcohol. Dried pellets were dissolved in 20 µl TE buffer
- DNA was stored at -20^0 C.
- The quality of the DNA was checked on 0.8 per cent agarose gel. 2 µl of DNA sample was loaded on agarose gel and the gel was run at 90 volts for 30 minutes. There after the DNA bands were visualized under ultraviolet light.

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Banana Bunchy Top Virus and Their Management

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Krishna Kumar [1], Akshay Kumar [2] and Ankit [3]

[1]Ph.D. Scholar, Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India

[2]Ph.D. Scholar, Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India

[3]M.Sc. (Ag.), Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India

INTRODUCTION

Bunchy top is most widely distributed in banana (*Musa paradisica*) growing countries of the world and best known viral disease of this crop. Banana bunchy top disease has been reported occurring in Australia, Asia, Pacific Island and Africa. In India, Bihar, Kerala and Orissa. The disease is prevalent in most of the banana growing states but it occurs in Kerala and it was first reported in 1940 (Singh 2016). Reports suggest an annual loss of Rs. 60 million in the states of Kerala.

Symptoms

The disease symptom appears at any stage of the growth. Symptoms Initially BBTV consist of dark green streaks in the veins of lower portions of the leaf midrib and the leaf stem (petiole). The streaks also occur, but are less prominent, in the veins of the leaf blade (lamina). This symptom is sometimes referred to as "Morse code streaking" because the streaks are irregular and resemble a series of "dots" and "dashes." The hook-like extensions of the leaf lamina veins can be seen in the narrow, light-green zone between the midrib and the lamina, hooks point down along the midrib toward the petiole. Leaves are typically bunched together at the apex, forming a dense rosette shaped orientation. Plants are stunted with narrow and erect leaves. The fruit bunches are not produced or fail to emerge from infected banana pseudostem.

Causal Organism

The disease is caused by *Banana Bunchy Top Virus* (BBTV). The virus belongs to genus Nanovirus and family Nanoviridae. The virus is isometric with 18-22nm and contains circular ssDNA with multipartite. The coat protein of virus has a molecular weight of about 21 K.

Disease Cycle

The virus survive in infected suckers used for planting provides primary inoculums. The disease spread and development propagative materials such as rhizomes, suckers, or tissue- cultured meristems and over short distances by the banana aphid *Pentalonia nigronervosa*. Banana aphid acquires the virus after at least four (but usually about 18) hours of feeding on an infected plant. Remains for a period of 15-20 days, i.e. through its adult life. The virus is transmitted by the banana aphid (*Pentalonia nigronervosa*) in a persistent manner and virus is not transmitted by mechanically.

Management

1. Use only virus free planting materials.
2. Destroying all volunteer banana plants.
3. Locating new plantations away from older infected ones.
4. Use of resistant cultivars- Taiwan local and Lan-ya-chiao is reported to be resistant.
5. Quarantine measures, the use of virus-free propagating materials.
6. Reduction in spread: Roguing of infected and nearby plants seems to reduce the rate of virus spread.
7. Insecticidal soaps. Attempts to control the aphid vector with insecticides have little effect on the spread of this virus.
8. Aphid vector control with spraying of Rogor 0.02%.Harding, Robert M., Thomas M. Burns, and James L. Dale. "Virus-like Particles Associated with Banana Bunchy Top.

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AEROPONICS - NOVEL HI-TECH SEED PRODUCTION IN POTATO

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D. Srikanth
[1]Ph. D Scholar, Department of Vegetable Science, College of Horticulture, Dr. Y.S.R.H.U., West Godavari, Andhra Pradesh, 534101.

INTRODUCTION:

Availability of quality planting material has always been a limitation in vegetatively propagated crops. Potato, largely being a vegetatively propagated crop, is subjected to large number of seed-borne diseases responsible for yield degeneration. Hence, it is imperative to use good quality healthy seed for sustainable and economic production of potato. The conventional seed production technology based on "seed plot technique" is successfully being used in India since last five decades for quality potato seed production. Aeroponics offers the potential to improve production and reduce costs compared to conventional methods or to the other soilless method of hydroponics (growth in water). Aeroponics effectively exploits the vertical space of the greenhouse and air humidity balance to optimize the development of roots, tubers, and foliage. The aeroponic system has been perfected in the year 2011 and so far it has been commercialized to 14 firms from different states like Uttar Pradesh, West Bengal, Punjab and Haryana. Each firm is licensed to produce 10 lakh minitubers by aeroponic system. Even if each firm is operating at half of its potential, about 6.5 million minitubers are currently being produced by those firms. At the Huancayo, Peru facility of the International Potato Center, yields of more than 100 minitubers/plants have been obtained using relatively simple materials. Absolutely there is a considerable decrease of agricultural soils in the world, the "soil-less method" will be an important production alternative in urban and peri-urban areas, and particularly in developing countries affected by climate change since this method is adaptable to any climate. Aeroponics yield higher production using fewer natural resources and no harmful chemicals compared to conventional methods; this efficiency is win-win for the environment and producers.

Most potato growers in developing countries do not use quality seed, because of high costs and lack of access. As a result, there is a high need for cost-effective methods to produce quality seed that can be accessed by small farmers at affordable cost. Aeroponics offers the potential to improve production and reduce costs compared to conventional methods or to the other soilless method of hydroponics (growth in water). Aeroponics effectively exploits the vertical space of the greenhouse and air humidity balance to optimize the development of roots, tubers, and foliage. Commercial production of potato seed using aeroponics is already progressing in Korea and China. In the Central Andean Region of South America, the technology has been used successfully since 2006. At the Huancayo, Peru facility of the International Potato Center, yields of more than 100 minitubers/plants have been obtained using relatively simple materials.

Keeping that in view, ICAR-CPRI, Shimla has standardized a number of high-tech seed production systems based on tissue culture and micropropagation technologies. Adoption of those systems of seed production will improve the quality of breeder seed, enhance seed multiplication rate and reduce field exposure of seed crop by at least 2 years. The systems were thoroughly tested at seed production farm of ICAR-CPRI before passing them on to farmers and other stakeholders. Adoption of high-tech seed production systems developed by the institute has led to opening of more than 20 tissue culture production units throughout the country. Several Government/Private seed producing organizations procure virus-free *in vitro* mother cultures of important notified and released potato varieties every year from ICAR-CPRI, Shimla for further multiplication in their high-tech seed production programmes.

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The latest hi-tech seed production system standardized by the institute is based on the concept of soil-less, aeroponic technology. The aeroponic system of seed production has the potential to once again revolutionize potato seed sector after about 50 years of introduction of “seed plot technique” by the institute. The aeroponic system has been perfected in the year 2011 and so far it has been commercialized to 14 firms from different states like Uttar Pradesh, West Bengal, Punjab and Haryana. Each firm is licensed to produce 10 lakh minitubers by aeroponic system. Even if each firm is operating at half of its potential, about 6.5 million minitubers are currently being produced by those firms. ICAR-CPRI produces ~ 3,187 metric tonnes of nucleus and breeder seed of 25 popular potato varieties; out of which 70% is through conventional system whereas, 30% through high-tech systems. As there is limited scope to increase quantity of breeder seed production at ICAR-CPRI farms due to limitation of farm land, possibilities are being explored with the help of SAUs/KVKs/Pvt. farmers to identify the new areas of seed production, multiplication of breeder seed into FS-I, FS-II and Certified Seed under MOU and to produce seed through hi-tech systems with the help of entrepreneurs/private companies.

Benefits of potato seed production by aeroponics:

The vertical Aeroponics growing system is a game changer for the farmers and the commercial plant growing industry. Air grown system benefits include:

- 100% ensure of availability of seed
- Save money and transportation
- International mileage
- Good for carbon food chain reduces food mileage
- Greater yield, Superior taste &Ease of harvest
- Eco- friendly
- Organic certification relatively easy
- Aeroponics can significantly increase income or reduce the production costs of quality potato seed to make it more accessible to growers

Special features of aeroponics technology for potato seed production:

- Aeroponics is a relatively new technique, especially for seed potato production.
- Potato seed production can be increased dramatically in the greenhouse.
- Aeroponics production is particularly sensitive to climate.
- Sequential harvests are needed.
- Vegetative period of plants is increased in 1 to 2 months.
- Minimized use of nutrients and water due to recycling capability.
- Independence from local land and climate conditions when grown in the controlled environment of a greenhouse.
- Initial investment can be recovered rapidly.
- Aeroponics can significantly increase income or reduce the production costs of quality potato seed to make it more accessible to growers.

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Plant Parasitic Nematode a Hidden Enemy in Guava Cultivation

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Saroj Yadav, J.A. Patil and Anil Kumar
Department of Nematology, College of Agriculture
CCS Haryana Agricultural University, Hisar

Plant parasitic nematodes are obligate parasites feeding on roots of different agricultural crops. Globally, plant parasitic nematodes accounts for an annual yield loss of 173 billiondollars (Elling, 2013). Among the plant parasitic nematodes, *Meloidogyne* spp. is one of the most damaging nematode genera which is widely distributed andinfecting important horticultural crops. Their polyphagus nature and their ability to infect a variety of important crops makes them one of thenotorious pests. There are so many plant parasitic nematodes attacks on guava among them root-knot one of the major pest. Some root-knot nematode species attack on guava but recently *Meloidogyne enterolobii* was reported. It was first reported on a perennial, Pacaraearpod tree (*Enterolobiumcontortisiliquum*Vell) from Hainan island, China (Baojun and Eisenback, 1983).

The guava root-knot nematode (*Meloidogyne*spp.) is considered to be the most damaging root-knotnematode in the world because of its wide host range, aggressiveness, and ability to overcome theresistance that has been developed against root-knot nematodes in many crops. Because of the damage it can cause to the roots of susceptible host plants, root-knot nematode is considered a major economic pest of many horticultural crops. The guava root-knot nematode reproduces at a very high rate and can go from low levels to severe infestations in only a year or two.

Root knot nematodes (*Meloidogyne* spp.)

Globally, there is more than 100 root-knot nematode species reported. Among them, *M. incognita, M. javanica, M. arenaria*, and *M. hapla* are considered as major root-knot nematode species infecting most of the cultivated crops. Among these minor root knotnematodes, *M.enterolobii* is now spreading quickly to different cultivated crops and new areas where it was not existing earlier. Like most of the other root knotnematodes, *M.enterolobii* is also polyphagus and can infect vegetable crops like tomato, okra, capsicum, sweet potato, ornamentals and fruit crops like guava,melon, fig etc.

Impact on guava cultivation

Root knot nematode (*M. enterolobii*) is posing a serious threat to guava (*Psidium guajava*) cultivation throughout the world. Now a day it was reported from India on guava orchards ofTamil nadu (Poornima, *et al*., 2016). It was also identified from guava orchards of AndhraPradesh,Telangana. More recently it was also reported from uttarakhand, India (Kumar and Rawat, 2018).

Biology and life cycle

The guava root-knot nematode life cycle is very similar to that of the southern root-knot and other *Meloidogyne* species. Immature (juvenile) nematodes hatch from eggs in roots and migrate in the soil to roots of susceptible hosts. The nematodes penetrate these roots and set up a permanent feeding site where they develop to adult females. As with other root-knot nematodes, the developing females cause

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root tissue to swell, producing galls on roots.During warm weather, each female can produce approximately 500 eggs within about a month. Once these eggs hatch, the cycle is continued. The nematodes survive the winter primarily as eggs attached to females on roots in the soil.

Symptoms

Symptoms showed by this nematode include yellowing and stunting, reduced fruit size, drying of branches, shredding of leaves and reduced yields (Fig:1). Severeinfestation by this nematode leads to heavy root galling which succumbs the tree to decline and death(Fig:1). Susceptible plants have very large galls associated with the roots.It can causesevere damage to plants, reducing yields and causing early death. Stunting, yellowing of the foliage andearly wilting during drought are also typical symptoms of nematodes. If the guava root-knot nematode is present, large galls will be evident on these plants.

Interaction with other microorganism

Guava root-knot nematode interacts with other different organisms present in the soil biota. Synergistic effect has been seen when this nematode is associated with other fungal pathogens like *Fusarium solani, Verticillium* spp., *Pythium*spp and can causes death of guava trees within few months (Gomes *et al*., 2010).

Spread and dissemination

This nematode is spreading to new fields through infected guava saplings. Infested soil, slips and ornamental plants are also potential ways for nematodes to spread to new areas

Fig:1. Left: Below ground symptoms. Right: Above ground symptoms

Management

Management of this nematode is a challenge because of it is polyphagus in nature and ability to survive on weed hosts. Some of management options to prevent nematode entry into new orchards include

Prevention

- Use of resistant root stocks such as Horana White HoranaGaint, Pubudu and Kanthi (all are moderately resistant)
- Use nematode free planting material
- Use sterilized potting media (e.g. sterilized by steam or roasting)
- Use clean implements and tools
- Do not use previously infested fields for planting.
- Deep plough to expose nematode expose to sunlight.
- Use recommended fertilizers to improve crop vigour.
- Green manuring with repellent crop before planting like sunhemp and mustard

Monitoring

- Regularly observe nursery plants for the characteristic symptoms of root-knot on roots.
- Sample the side roots of mature plants to observe for root knots.
- Observe above ground symptoms like leaf yellowing, withering scorching of leaf edges with purple patches followed by examination of root systems for knots.

Curative measures

- Avoid surface irrigation from infested field to healthy field
- Add compost to the soil to reduce the effect of nematodes (after infestation)
- Remove weed and infested crop residues to protect nearby healthy tree
- Intercrop with crucifers like mustard, cabbage and incorporate into soil (before flowering) to suppress nematodes
- Add poultry manure, cowdung, goat dung, coconut and rubber ponac, neem cake and green manure (Adathoda, Tithonia, Gliricidia, Neem and kalawel) in planting pit as a soil amendment.
- Remove infested plants from fields.

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Biological control of insect pests of medicinal plants

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Shriti Moses*, Manoj Kumar and Deepak Ranjan Kishor
Shriti Moses, Ph.D. Research Scholar, Department of Entomology.
Uttar Banga Krishi Viswavidyalaya, Cooch Behar, W.B.-736165.
Manoj Kumar, Assistant Professor, Department of Entomology.
Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur), Bihar-848125.
Deepak Ranjan Kishor, Senior Research Fellow, Entomology.
ICAR-RCER, Patna, Bihar-800014

INTRODUCTION

Medicinal plants play a very important role in supporting healthcare system for the majority of the population in India and are a critical source of income for rural population. Biological control is a process in which population of one species lowers the numbers of another species by mechanisms such as predation, parasitism, pathogenesis or competition. It can be an important component of integrated pest management (IPM) programs. Natural enemies are already adapted to the habitat and to the target pest, and their conservation can be simple and cost-effective. Biological control can have side-effects on biodiversity through attacks on non-target species by any of the same mechanisms, especially when a species is introduced without thorough understanding of the possible consequences.

TECHNIQUES IN BIOLOGICAL CONTROL:

INTRODUCTION

Introduction, where a natural enemy of a pest is introduced in the hope of achieving control. It involves importation or bringing of new natural enemies from their homeland or other area to the target area for the reduction of pests population.

AUGMENTATION

Augmentation, in which a large population of natural enemies are administered for quick pest control. It involves the supplemental release of natural enemies that occur in a particular area, boosting the naturally occurring populations there. In inoculative release, small numbers of the control agents are released at intervals to allow them to reproduce, in the hope of setting up longer-term control, and thus keeping the pest down to a low level, constituting prevention rather than cure. In inundative release, in contrast, large numbers are released in the hope of rapidly reducing a damaging pest population, correcting a problem that has already arisen.

CONSERVATION

Conservation, in which measures are taken to maintain natural enemies through regular re-establishment. It is the most frequently used biological control method in IPM and is defined as the actions to preserve and increase natural enemies by environmental manipulation. The goal of conservation is to enhance the enemy survival and reproduction in relative to pests so that pests population growth rates are lowered over time.

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MAJOR CLASSES OF BIOPESTICIDES:

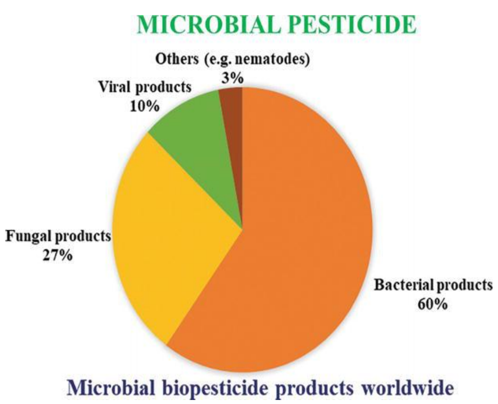
In biopesticide, there are certain of pesticide derived from natural materials as bacteria, certain minerals, animals, and plants. There are two types of major classes of biopesticides.

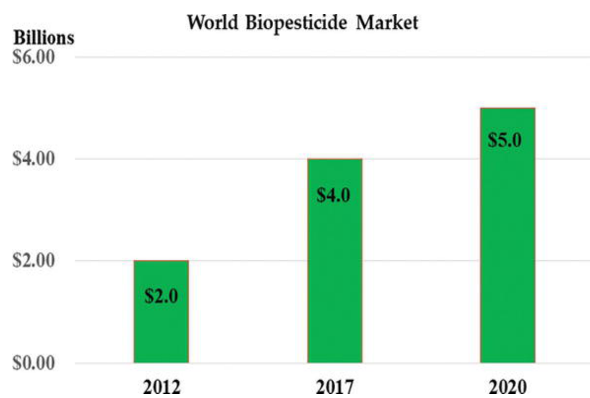
Biochemical pesticides

These are naturally occurring substances that control pests by nontoxic mechanisms. The conventional pesticides kill or disable the pest by contrast. Biochemical pesticides have some substance that interferes in mating, like sex pheromones, also different fragrance of plant extract attracts the pests to trap.

Microbial pesticides

The microorganisms like virus, fungus, protozoan, or bacterium are the active ingredient in this type of pesticides. Each microorganism have specific active ingredient to control the specific pests, but microbial pesticides can control or kill many kinds of pests which damage the crop production. One fungus can control the weeds and other control or kill the insects-pests.





CONCLUSION

Bio-control is environmentally friendly and active means of decreasing or mitigating pests and pest effects through the use of natural enemies. The goal of biocontrol is to promote the technology and science. Biological control is a technique of controlling pests, that is, mites, insects, weeds, and plant diseases by using other microorganisms.

Biopesticide is used for the modification of development of insect and behavior exerts unique approach for management of insect population. The application of biopesticide is based on the principle that is to provide safety to the human and environment. Wide research is going on, and it is required much more in future to achieve the improvement. The future of biopesticide would fully depend on adoption of application of biopesticide. Versatile use of biopesticide must meet the aims. They must able to control/suppress/kill the harmful insects pests and also prevent them, relatively in proper manner to conventional methods. Researchers, producers, and farmers should widely explore the use and find the safe environment and also maximum production of crops.

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MAJOR PESTS OF MEDICINAL PLANTS

SARPAGANDHA


Cutworm


Epilachna beetle


Aphid


Ash weevil

COLEUS


Mealy bug


White fly

Spider mite

Slug

ASWAGANDHA


Fruit borer


Epilachna beetle


Cutworm

ALOE VERA


Aloe Vera Aphid

Biological control agents of some major pests of medicinal plants

1. Cutworm – Entomopathogenic nematodes *Steinernema carpocapse* and *Heterorhabditis bacteriophora*
2. Epilachna Beetle – Predator Reduvid bug (*Rhinoris fuscipes*), several larval parasites
3. Ash weevil - Entomopathogenic nematodes *Steinernema carpocapse*
4. Mealy bug – Parasitic wasp (*Anagyrus* sp.)
5. Whitefly – *Encarsia Formosa*
6. Spider mite – Predatory mite *Phytoseilus persimilus*
7. Slug – Slug parasitic nematodes different genera of *Steinernema* and *Heterorhabditis*
8. Aphid – *Aphidus* or *Aphidoletes* or combination of both

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Precision Agriculture and its Importance

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Chandrasekhar, Basavaraj and Venkata Reddy HK
Kelappaji College of Agricultural Engineering & Technology, Tavanur, Kerala- 679573

The precision agriculture is a technique or approach to farm management to enhance the production, productivity and prevent the wastage of agricultural inputs by using specialized equipment, software and information technology. Precision agriculture is having main objective to produce maximum yield from limited area by providing limited inputs at right place and right time. It mainly involves specialized advance equipment (Rotavator, sprayer, duster, seed cum fertilizer drill, happy seeder and trans-planter), software and information technology service. It indicates the actual timing of tillage, sowing, intercultural operation, spraying of chemicals, irrigation and harvesting. The purpose of precision agriculture is to enhance the production and productivity by providing minimum requirement inputs like seed, fertilizer, irrigation and chemicals. The sensor used in precision agriculture in-order to find -out soil physical properties like soil moisture content and soil temperature and it also indicates the requirement quantity of water to add to the soil, when to add and where to add the soil.

In precision agriculture satellite and robotics are used for to get the actual images of individual's plants. By the help of these images can be processed and integrated with sensor and other software's to guide the farmer for their immediate and future decisions. The precision agricultural helps to the farmer avoid wasting resources and preventing runoff ensuring that the soil has just right amount of additives for optimum for health, while also reducing costs and controlling the farms environmental impact.

IMPORTANCE OF PRECISION AGRICULTURE

- It is a practice to managing variability in space and time
- It pays the attention to advance technology and sensor
- It has a potential at all scale and levels of agricultural development
- It gives the information about appropriate used inputs
- It deals guidance tool, rate controllers and automated data collection assist in the large scale application
- It helps to observation, evaluation, interpretation targeted area

Data collection ⇒ Record ⇒ Analysis & decision ⇒ Implementation ⇒ Evaluation

Goals of precision agriculture

There are mainly three goals in precision agriculture as given below

a) Profitability
b) Sustainability and
c) Environment protection

Precision agriculture depends on

a) Specialized equipment
b) Software and
c) Information technology service

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Major Insect-pests of litchi and their management

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Rani Kumari[1], Ruby Rani[2], Manoj Kumar[3], Mehjabeen[4] and Bipul Kumar[5]
[1]Ph.D Scholar, Department of Horticulture (F&FT), BAU, Sabour (Bhagalpur)
[2]Assistant Professor, Department of Horticulture (F&FT), BAU, Sabour (Bhagalpur)
[3]Assistant Professor, Department of Entomology, DRPCAU, Pusa (Samastipur)
[4]Ph.D Scholar, Deptt.of Soil Science & Agricultural Chemistry, BAU, Sabour (Bhagalpur)
[5]Department of Extension Education, DRPCAU, Pusa (Samastipur)

INTRODUCTION

Litchi (*Litchi chinensis* Sonn.) is sweet and a very fragnant fruit, member of family Sapindaceae and sub-family Napheleae. It includes about 125 genera and more than 1000 species. It's an important sub-tropical and evergreen fruit tree originated in tropical and sub-tropical region of southern China. It was introduced to India by the end of 17th century. In India, although commercially predominant in the Indo-Gangetic plains of Uttar Pradesh, Bihar, Uttarakhand and West Bengal, suitable climatic conditions in the sub-tropical states of Punjab, Himachal Pradesh and Jammu & Kashmir has further expands its cultivation.

India being the 2nd largest producer of litchi after China produces 686 thousand MT in an area of 92000 ha. Bihar in litchi production is known not only at national level but also globally and is the leading state with annual production of around 300 thousand MT of litchi from an area of 32 thousand ha. Despite of unique and desirable characteristics, litchi fruit is seriously affected by insect-pest that causes significant loss of yield and commercial value.

However, the production of Litchi is hampered by a variety of insect-pest infestations. It is attacked by many insect- pests from nursery stage to fruiting stage and these insect- pests causes heavy crop losses.

Major insect- pests of litchi with their nature of damage :

1. **Erinose mite** (*Eriophyes litchi*): Major pest of foliage, severe infection may damage developing flowers and fruit and kill the growing point.

Nature of damage

- Hatched larva start feeding immediately and thus damage occur while leaves are expanding
- Shoots become distorted
- Causing curling of leaf
- Out growth like leaf hairs
- Brown valvety erineum formation, in which mite continue to survive
- Erineum is light brown to dark reddish brown

Control

- Spray of Dimethoate @ 100ml/100Lt or Wettable Sulphur @450g/100Lt just before bud break at 10-14 days interval.
- Spray of dicofol @ 3ml/Lt thrice during leaf emergence

2. **Leaf roller** (*Platypeplus aprobola* and *Isotenes miserana*): It is a serious pest.

Nature of damage

- Insect roll or web leaves together in which they feed and pupate
- Feed on them during vegetative flushing
- Attacks flower during flowering
- Incidence from August to March when new leaves are available

Control

- Application of contact insecticide with fumigant action may control (Wait, 1986)
- Sprays of carbyl, phosphamidon, endosulfan should be applied
- Dimethoate also give effective control

3. Catterpillar (*Indarbela tetraonis*): It is important insect-pest of Litchi in India.

Nature of damage

- Bores into trunk, scaffold branches and secondary branches of litchi
- Adult lays eggs on old branches cut and crevices in May and June
- Larvae form shelter on wood and feed on the surface of bark
- Translocation of sap is hampered, growth is seized and yield is reduced
- Larvae full grown in December month and pupate in April

Control

- Plastering of cut,crevices and holes with mud
- Spraying monocrotophos @ 0.05%
- Fumigation of holes with formalin, petroleum or carbon bisulphide

4. Litchi fruit or nut borer (*Conopomorpha cramerella* Shell): It is a serious pest damaging litchi fruits.

Nature of damge

- Larvae of this insect species damage the fruit near the attachment of peduncle to the fruit
- Fruit with larvae beneath the fruit calyxis not suitable consumption
- Reduces the marketability of fruit
- Larvae resembles the colour of larvae with brown head

Control

- Spays of fenvelrate and quinalphos gives effective controls
- Spray of malathion @ 0.5% or carbyl @ 0.1% gives better results

5. Leaf miner (*Conopomorpha litchiella* Bradley): It is a serious pest.

Nature of damage

- Larvae of this pest creamy white in colour and bores into shoot and leaf blades
- Wilting occur in damaged shoot

Control

- Spraying of neem based pesticide

6. Litchi bug (*Tessarotoma javanica* Thunberg.) : It is a serious pest damaging tender litchi plant.

Nature of damage

- Adults and nymph both attack on tender part of litchi like growing buds, leaf petioles and twigs
- Heavy infestation causes drying of buds, tender shoots and fruit drop

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Control

- Pest control by shaking of tree in winter, collecting and dropping into kerosene
- Controlled by application of dimethoate and fenthion

Shoot borer (*Chlumetia transversa* Walker): It is a pest damaging tender litchi plant.

Nature of damage

- Drooping of shoot, dry and wither
- Upper and lower part greatly infested
- Stunted growth of plant
- Young tree are more susceptible

Control

- Removal of damaged part and destroyed
- Spay of malathion

7. New threat of litchi crop: NRC Litchi recently recorded few pest in litchi as emerging threat

Red weevil (*Apoderus blandus* Faust.) :

Nature of damage

- Damage tender leaves and shoot
- Damage is more severe at the time of shoot emergence

Control

- Hand picking of adult
- Spraying of carbaryl @ 2ml/L

8. Semilooper (*Anisodes illepidaria* Guenee):

Nature of damage

- Attack on tender shoot
- Defoliation of new shoot

Control

- Spray of chlorpyriphos @ 1.5/L of water

9. Bagworm (*Eumeta crameri Westwood*)

Nature of damage

- Pest feed whole green leaf, leaving vein and veinlet of leaf
- Brown patches appear on leaves after infestation
- Disappearece of green tissues of leave and plant looked bronze in colour

Control

- Hand picking and destroy them
- Spray of malathion
- Application of *Bacillus thuringiensis*

Litchi fruit borer

Litchi mite

CONCLUSION:

Heavy pest attack serves as limiting factor in the production. Therefore, regular intervention is required to manage threshold level of pest population because the insect-pest may become a prominent constraints to the litchi production.To manage the afore mentioned pests of litchi crop we should use chemical insecticide but in a judicious way. Although, integrated management is best for management in this high value fruit crop.

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The role of agroforestry in ecological sustainability

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Ravi Kumar Meena[1], M. L. Meena[2], Babu Lal Meena[1], Hema Meena[3], Y K Sharma[1]
[1]Assistant Professor,CoA, Lalsot, SKN Agriculture University.
[2]Associate Professor, CoA, Lalsot,SKN Agriculture University.
[3]Techanical Assistant, IASRI, New Delhi.

The increased pressure on the world natural resources which arises from population growth as well as economic pressure has resulted in unsustainable use of natural resources and ecological instability. The unstable nature of the world climate, attributed to human activities, depletion of forest cover due to increased hunger for forest and non-forest products has caused a lot of environmental problems such as, land erosion, flooding, frequent and severe storm, depletion of soil fertility, natural disaster as well as seasonal changes of world climate: These negative effect on the world ecosystem required a crucial attention. This paper reviews the importance of agroforestry and discusses various agroforestry practices that are capable of enhancing the sustainability of the environment. Agroforestry is a means of halting the vicious circle of deforestation, soil erosion and other environmental problems facing the country. Agroforestry refers to the combination of agriculture and forestry practices within a farming system. As a land-use system, it serves the diverse needs of individual farmers in harnessing the natural resources around them, as this cannot be reconciled by the traditional cropping system. It involves the combination of trees and crops that increase the medicinal, environmental, and economic value of land with the much-needed profit and food security. Hence Agroforestry systems such as live fence, home garden, shelterbelt, alley farming, taungya system, improved fallow and agrosilvopastoral are highly recommended as solution to environmental problems.

INTRODUCTION

Agroforestry system in which agricultural crops and woody perennials are grown on the same land management unit (Owunubi and Otegbeye 2012). Agroforestry practices encompass an entire spectrum of land use systems in which woody perennials are deliberately combined with agricultural crops and/or animals in some spatial or temporal arrangement (Lundgren and Raintree, 1982). Advocates have contended that soil conservation is one of its primary benefits. The presence of woody perennials in agroforestry systems may affect several bio-physical and bio-chemical processes that determine the health of the soil substrate (Nair, 1993). The less disputed of the effects of trees on soil include: amelioration of erosion, primarily through surface litter cover and under story vegetation; maintenance or increase of organic matter and diversity, through continuous degeneration of roots and decomposition of litter; nitrogen fixation; enhancement of physical properties such as soil structure, porosity, and moisture retention through the extensive root system and canopy cover; and enhanced efficiency of nutrient use because the-tree-root system can intercept, absorb and recycle nutrients in the soil that would otherwise be lost through leaching (Sanchez, 1987). India is blessed with a large area of land and vegetations, but the use of this important resource has been abused, not sustainably used or managed. Ladipo (2010) pointed out that the forest has been treated in the past by many rural dwellers as inexhaustible. Recently everyone now realise that forest is at the verge of going to extinction if nothing is done to reverse the unsustainable use. Evans (1992) is of the view that the depletion of forest reserves in india is due to hunger for more agricultural land that could be used for food production, shifting cultivation, as well as urbanisation. It is a

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known fact that Agriculture, forestry and urban development remained the three major uses to which land is subjected. Unanaonwi and Bada (2004) maintained that these various uses to which land is subjected to are the consequence of environmental stress and degradation which invariably lead to reduction in the land area available for farming. Hence farmers have been restricted to consistent farming on the same land area for a long time, which has often resulted into decline in crop yield as well as environmental degradation. Agro-forestry practices are being increasingly advocated as possible remedies. As it is a land use system that has the potential of improving agricultural land use while providing lasting benefits and alleviating adverse environmental effects at local and global levels. It has been known to have the capability of reducing emissions from deforestation and forest degradation; it promotes sustainable forest management as well as the conservation and sustainability of the environment. It is therefore imperative to employ, agroforestry, a land use system which encourage increase productivity as well as environmental stability.

Importance of Agroforestry: The importance of agroforestry cannot be overemphasised, as it has several advantages in the provision of food and other basic needs (i.e. fuel wood, staking materials, fibres, timber, medicinal concentrates, oils, fruits, and fodder for animals) for a large proportion of the rural population as well as its role in soil fertility restoration and the control of weeds in addition to amelioration of environmental degradation. Agro-forestry practices are being increasingly advocated as possible remedies and had been claimed, to have the potential of improving agricultural land use systems, providing lasting benefits and alleviating adverse environmental effects at local and global level. Adedire (2004); Adekunle (2005) and Oke (2008); agreed that agroforestry can provide new and useful solutions to many of the adverse consequences of human land use, including increased diversification of agricultural production system, increased yield of crops and livestock, reduction of non-point source pollution and increased rural development by contributing to an ecosystem-based management system, that guarantees sustainability and environmental quality. Agroforestry should therefore be seen as a system that addresses the declining quality of the environment, including the soil, while also increasing the variety of produce by the farmer. This will not only increase the farmers' income but also help ensure food security and balance. The retention of trees in farming systems has been recognized to increase crop output in the semi-arid region of Adamawa state (Amadi et al; 2003). Ajake (2012) also recognized the function of forest trees in term of income generation, good medicare, employment generation, raw materials, and provision of food among others. Agro forestry is increasingly promoted for restoring forest, degraded environment, reducing greenhouse gases, and gaining other co-benefits, (Richard et al; 2009) Richard et al; (2009) also pointed out some of the key benefits that agro-forestry puts into sustainable development programmes, these include: Biodiversity conservation, environmental (watershed) Protection, and Climate change mitigation and adaptation. It was therefore viewed as being useful in promoting afforestation /reforestation and in the unfurling mechanism for forestry development: “Reduction of Emissions from Deforestation and forest Degradation (REDD)” has also been recognized, as well as, meeting (inter)national climate change objectives. Agroforestry is also being known for, its role in traditional employment generation, thus it has the capability to deliver several benefits (e.g. income generation for poor farmers, environmental and ecosystem stabilization including control of desertification and deforestation).

Role of Agroforestry: In Environmental Sustainability The contribution of agroforestry to the environmental sustainability is very significant through its environmental, economic and social functions. Not creating negative impact to the environment, while improving the production capacity of the soil. It is known for its ability to conserve natural resources at the same time as maintaining human activities. The ever increasing world population has made the traditional system of African farming unsustainable. There is upsurge demand for food, leading to more pressure on forestlands and forest products has contributed greatly to unsustainable use of the nations natural resources In view of these, agroforestry as a technique is considered as one of the sustainable management system for land that increases production, ecological stability and supports sustainable environmental development (Wilson, 1990). Apart from providing wood, food and/or animal products, the integration of trees in the farming system could go a long way to help ameliorate environmental problems: specifically by creating microclimates favourable for crop growth, and enhancing the recycling of minerals to provide a more complete ground cover which could help to protect the soil from erosion and moderate extreme temperatures (Adedire, 2004). Evans (1992) also stated that the contribution of agroforestry to the sustainable development is very significant through its economical, environmental, and social functions. They further maintained that agroforestry has been proved to meet the criteria of sustainable development that has no negative impact on the environment.

Role of Agroforestry In Climate Change Mitigation: Climate change is a global phenomenon that imposes economic, social, and ecological challenges to the global community. Research has shown that climate change is attributed to human activities, which bring about CO2 emissions, through the removal of forest cover (Owolabi, 2010). Deforestation, human induced conversion of forests to non forestland uses, is typically associated with large immediate reductions in forest carbon stock through land clearance. Poor forest management policies and illegal encroachment into forest reserves, urban development, road construction, fossil fuel combustion and excessive harvesting of fuel wood, contribute to the depletion of the ozone layer. Food and Agricultural Organisation of the United Nation FAO (2010), observed that deforestation account for approximately 18% of global carbon emissions. It was further reported by FAO (2001) that reduced deforestration, forest regeneratiuon, increased plantations development and agroforestry accounts for 12 to 15% of global sequestration of carbon emission from fossil fuels. Agroforestry has high potential to reduce atmospheric concentration of carbon dioxide (CO2) and mitigate climate change. It is an established fact that planting of more trees, to increase the amount of forested land or to increase the density of the existing forest in Nigeria would help mitigate climate change impacts in the country and at global level. Morgan et al (2001) also supported the fact that rising level of atmospheric carbon dioxide and associated global warming can only be addressed by adopting CO2 reduction strategies. Agroforestry, as a system that combines trees and/or shrubs (perennial) with agronomic crops (annual or perennial), offers great promise to sequester Carbon, both above and below-ground. Agroforestry systems even though not primarily designed for carbon sequestration have been reported to present a unique opportunity to increase carbon stock in terrestrial biosphere (Jacob et al; 2013).

Role of Agroforestry In Economic Sustainability: Nuga and Iheanacho (2011), recognised soil erosion as another long time serious environmental problem that has adverse effect on the economy of Nigeria. This has several environmental and economic impacts, especially in West Africa where the resilience ability of

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soil is limited. Hence an agroforestry practice through the incorporation of woody perennial has the potentials of mitigating the impact of soil erosion, through the incorporation of both the above and below tree biomass. Bamigbade et al; (2011) stated that when the system of agroforestry is properly enhanced and place in the right perspectives by all environmental stakeholders, this will help in addressing some issues of economic instability in the country. Trees in agroforestry system are known to provide fuel wood, food, shelter, drugs, income, raw materials and improvement of soil fertility for crop growth. As well as wide range o f environmental protection, the products and services forest product provides are essential to every aspect of life. Asinwa et al; (2012) conducted a survey on the economics of some forest fruit trees and found out that harvesting, processing and marketing of products from economic forest trees plays an important role in food security, employment and income generation.

Variety of Agroforestry Systems For Environmental Sustainability: This system has been used as a method of establishing forestry plantation. This consists of growing annual agricultural crops along with the forestry species during the early years of establishment of the forestry plantation. Usually the land belongs to the forestry department or their large scale leases, who allow the subsistence farmers to raise their crops. The farmers are required to tend the forestry seedlings and, in return, retain a part or all of the agricultural produce. It is an agreement that will last for two or three years, during which time the forestry species would grow and expand its canopy (Adekunle and Bakare, 2004). It was described as a way of completely utilisation of forest soil for increase agricultural production in developing nations. It is an avenue for farmers to participate in tree planting and be directly involved in afforestation project of the government. Otegbeye and Famuyide (2005) also indicated that, farming was widely adopted in the arid and semi-a rid land of Nigeria, as a method of reforestation. Improved Fallow: This is a rotational system that uses preferred tree species as the fallow species in rotation with cultivated crops as in traditional shifting cultivation. The reason for such trees is production of an economic product, or improvement of the rate of soil amelioration, or both. The potential of improved fallow systems was tested by the world agroforestry centre for controlling soil erosion using fast growing shrubs such as Crotalaria spp and Tephrosia spp. In addition a significant improvement in soil moisture content has been observed in improved fallow system (Jacob et al; 2013). An ideal fallow species would be one that grows fast and efficiently take up and recycles available nutrients within the system, thus shortening the time required to restore fertility. Examples of such species are Gliricidia sepium, Leucaena leucocephala, Fardherbia albida Live fence: This is an agroforestry system which involves fencing of farmlands with living plants to prevent animals from entering or serve as boundary demarcation. In this system, various fodder trees and hedges are planted as live fence to protect the property from stray animals or other biotic influences. Usually, species used for live fencing must be species that produce very little shade on farmlands; tolerant of animal browsing or are not browsed by animal at all. Such examples are: Gliricidia sepium , Sesbania grandiflora, Erythrina sp, Acacia sp. This system is commonly adopted among farmers as the woody species, apart from serving as boundary demarcation, it also enhance fuel wood supplies of the family (Adedire,1992).

CONCLUSION

The problem of environmental instability brought about by mounting pressure on the available land resources as a result of persistent rise in population, has probe lot of disturbance on the existing natural ecosystems. These human disturbances and unsustainable use of natural ecosystem which posed a lot threat to local biodiversity; leading to environmental degradation need to be addressed. Therefore there is need to embrace agroforestry a promising land use system that involves the integration of variety of trees species with herbaceous crops and / animal in some form of spacial arrangement or temporal sequence. These systems have the ability to increase the biodiversity and increase the overall productivity consumed by household. It also reduces soil loss and improves the physical, chemical properties of soil and at the same time helps in climate change mitigation for the sustainability of the environment. In order to exploit the full potential of agroforestry system and practices, suitable model has to be appropriated towards the sustainability of the environment.

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Honeybee Communication - A signal for their food

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Manoj Kumari[1], Bipul Kumar[2], Rani Kumari[3] and Deepak Ranjan Kishor[4]
[1]Assistant Professor, Department of Entomology, DRPCAU, Pusa (Samastipur)
[2]Department of Extension Education, DRPCAU, Pusa (Samastipur)
[3]Ph.D Scholar, Department of Horticulture (F&FT), BAU, Sabour (Bhagalpur)
[4]Department of Entomology, DRPCAU, Pusa (Samastipur)

INTRODUCTION

Bee foraging in the field is directly by their communication dances which establishes a link between the hive and the field from where food comes. It is through this remarkable behaviour of the bees that Von Frisch (1967) solved the mystery of their communication and even called in their "*Language*" which word has been criticized lately in the scientific circles (Wenner & Johnson, 1967; Gould, 1975). Karl Von Frisch demonstrated that the bees could locate the food source with just the dance information. Wenner (1971) found that the bees were unable to locate the food source with dance alone. Gould (1975) concluded that Von Frisch and Wenner were simply examing different part of the same process. He concluded that, depending upon conditions, honeybee recruits use either the dance language and odour information or odours alone. Wenner and Wells (1990) concluded from an experiment which was so designed, so that the recruit bees could use either dance language or odour cues. The scout bees were able to communicate information of the dish and its location to other bees in the hive. The subsequent studies proved that bees achieve this by an ingenius and elaborate method of communication. Since, the environment inside a hive is dark it is perhaps not the vision but other stimuli like odour, touch, sound etc., that play the crucial role. Von Frisch (1967) described in his book how he solved the mystery communication as also the colour perception and for this contribution he shared a Noble Prize in 1973. He also observed that the behaviour through a glass walled hive and bees dancing and communicating the information to others.

Bee communication:

The most fascinating aspects of bee behaviour is the dance performed by worker bees to till others about food sources in the field. Bees communicate their floral findings to other foragers. A bee that returns from an area with many flowers producing much necar performs a dance on the comb. The orientation of her movements and the frequency of her vibrations indicate the direction and distance of the flowers from the hive. Thus other bees, observing her dance, will know where to find his wonderful source of food. This amazing level of learning and communication benefit both bee and plant. There are basically two types of dances i.e. round dance & wagtail dance (Agrawal and Singh, 2005).

Round dances continues for few seconds but changes the direction of the run after few cicles are completed. *Apis mellifera* bee dance does not repeat turnings in the direction more than twice but *Apis cerana indica* turns in the same direction for number of times (Goyal and Atwal, 1976). They also reported that *Apis cerana indica* performed round dances when the food was at a distance of 0.3 to 7.0 m and *Apis mellifera* this dance was performed when the food was at a distance of 0.5 to 27.0 m. The dance attracts other bees in the hive, who touch the performance with their antennae. Besides, the above dances, bees also perform sickle, joy or DVAV, cleaning & alarm dances (Atwal, 2000).

Other mode of Communication: In addition to sound & visual mode of communication various organisms also use chemical signals for transmitting information among the individuals belonging to same species. In insect,

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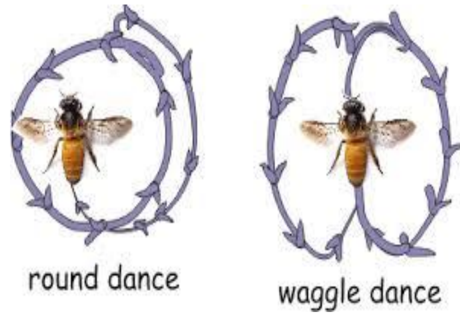
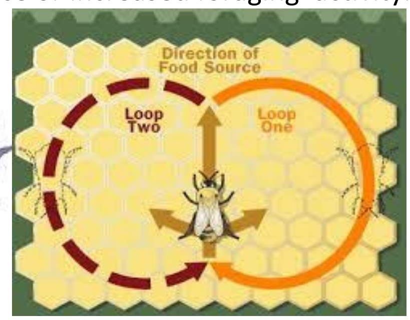
this phenomenon of chemical communication has been known since 1837. Certain types of chemical released by insects have been recently given the name of pheromone by Karlson and these are defined as “Chemical substances which are secreted to the outside by an individual & received by the second individual of the same species in which they release a specific reaction”. Thus, the pheromones could be termed as chemicals used for intraspecific communication. Other types of pheromones released are alarm pheromones & recruitment pheromones by social insects. These are utilized for defence or increased foraging activity.





Honeybees collecting Nectar & Pollen

Honeybees collecting Nectar & Pollen

CONCLUSION:

Honeybee is a social insect and lives together in the hive in a organised manner. They are foraging in the field is directed by their communication dances which established a link between the hive & the field from where food comes. The honeybees communicate about their floral findings to other foragers of their community. A bee that returns from an area with many flowers producing much necar performs a dance on the comb.

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Plant Acoustic Frequency Technology: Sound Waves in Crop Improvement

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Shouvik Gorai* and Soham Hazra
Ph.D. Scholar, Department of Genetics and Plant Breeding, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Mohanpur, Nadia, West Bengal

INTRODUCTION

Does plant like light music or rock music? How plants respond to music?

Is it sounds odd? But now it is one of the most emerging research areas in plant biology. Plants, complex multicellular organisms, in natural system interact with different types of physical stimuli (light, temperature) and mechanical stimuli (wind, rain, touch) and change the pattern of growth and development according to the response. But sound vibration as a physical stimulus to plant system is quite uncommon.

Sound is a vibration that is transmitted through gas, liquid or solid medium as a wave of pressure. The classification of the acoustic spectrum is- Infrasound (frequency less than 20 Hz), audible sound (20 Hz to 20,000 Hz) and ultrasound (more than 20,000 Hz). Infrasound and ultrasound are acoustic waves that are widely used in medical diagnosis and therapies.

Plant Acoustic Frequency Technology (PAFT)

Music therapy to heal the mental and behavioral problems in animal systems has already been recognized. Similarly use of sound waves for improvement of plant biology has been started using a new cutting age technology, Plant Acoustic Frequency Technology (PAFT). Sound waves with appropriate length of action time and proper intensity or frequency are known to stimulate cell growth in some plants. Numerous studies worldwide have indicated that sound vibrations have a role in increased photosynthesis, nutrient uptake, protoplasmic movement, cell division, hormonal changes and plant defense mechanisms against biotic and abiotic stresses. Sound waves of different frequencies, pressure level, duration and distance from the source influence the plant growth differently.

Acoustic mechanism and plants

The role of sound in animal kingdom is well studied as they have some specialized mechanosensory system through which they communicate with the environment. But sound based communication in plants has not that much been elucidated as they are lacking such organ to perceive sound vibrations.

How plants respond to sound? (Sound signaling in plants)

Signals from outer environment can be perceived by cells through receptors situated on plasma-membrane or differences in voltage across the membrane (membrane potential mediated). Telewski, 2006 reported stretch activated ion channel mediated signal transduction of sound vibrations. Similar type of signal transduction mechanism is also present in bacterial membrane for sensing mechanical stimuli.

Sound vibrations change the tension of the cell membrane which ultimately results in microfibrillar rearrangement. Activation of some Ca^{2+} specific and non-selective protein channels on sensing mechanical stimuli brings a change in cellular Ca^{2+} concentration by altering efflux/influx. Ca^{2+} is one of the major

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secondary messengers involved in signal transduction. Vibrations affecting Ca^{2+} channel brings about an increased calcium ion concentration in cytoplasm, called Ca^{2+} transient. Ca^{2+} transient evokes a signaling cascade by sensing Ca^{2+} through various cytosolic Ca^{2+} sensors (CDPKs, CBLs). These sensor proteins phosphorylate the target protein and/or transcription factors and thus lead to up-regulation of responsive genes. Electrochemical gradient mediated signal transduction is regulated by activity of H^+-ATPase. H^+-ATPase is activated by Ca^{2+} Dependent Protein Kinases (CDPKs) and CDPKs are activated by Ca^{2+} transients. Reactive Oxygen Species (ROS) associated signaling has been reported in sound stimulated plant cells. Increased amount of ROS is accumulated in response to sound vibration. ROS and polyamines regulate the activity of Ca^{2+} and K^+ ion channels. Thus regulation of stomatal opening through increased activity of K^+ channel helps to withstand the plant against several stresses. Changes in growth and development by alteration in the level of phytohormones are also associated with sound vibrations stimulated individuals.

Effect of sound vibrations in different plant processes

1. **Sound waves and seed germination:** sound directly affect different biological processes including those involved in seed germination. Creath and Schwartz (2004) first reported significant enhance in seed germination of okra and zucchini by exposing the seed in fixed sound frequency and pressure. Sound affects the physical integrity of the pericarp of the seed. Loose integrity results in entry of water and oxygen more, which ultimately improve germination. Fast green staining of the pericarp cell supports the sound induced physical damage in seed surface.
2. **Sound waves and drought tolerance:** the drought induced acoustic signals helps in communication between drought affected and healthy plants. Plants exposed to water stress condition can generate a 'drought alarm'. This alarm is transmitted from stressed to healthy plants through root surface in soil medium to alert the plants for impending stress and to close stomata accordingly. This whole idea is based on perceive and production of sound vibrations by root. Production of sound by root is due to formation of air bubbles (cavitation) in the xylem. During water stress transpiration pull in xylem produce audible sound due to bursting of popping-up air bubbles. Jeong *et al.* (2014) reported that sound vibration treatment in rice enhanced relative water content, stomatal conductance in drought affected plants.
3. **Sound waves and plant defense:** elicitation of plant defense response for combating pest attack through acoustic signaling has drawn the attention of plant biologists in recent time. Appel and Cocroft (2014) in their study found that *Arabidopsis* developed better defence against *Pieris* caterpillar sensing the sound vibrations produced by insect herbivore chewing. Perception of sound vibrations caused by insect's feeding elicit the plant signaling mechanism for enhancing defense against herbivore by producing some metabolites that are having deterrent or repellent properties. Accumulation of higher amount of glucosinolate and anthocyanin has been reported in sound vibrations treated *Arabidopsis*, which are generally not preferred by insects. Plants have developed a mechanism to sense ecologically important sound frequencies and use this vibration as a long-distance signaling mechanism in plant-insect interactions. Beside plant's own systemic acquired resistance, acoustic signaling acts as a first line of defense to make the defense system more robust.
4. **Sound waves and fruit ripening:** Fruit ripening and softening is associated with increased biosynthesis of ethylene. Biosynthesis of ethylene is controlled by the activity of *ACO1, ACS2, ACS4, RIN, HB-1,*

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TAGL1, NOR genes. Kim et al. (2015) showed that 1 KHz sound treated tomato fruit remain firm for a longer period. This delaying in ripening is due to sound vibrations induced lower expression of genes encoding transcription factors *RIN, HB-1*.

Application of sound wave in agriculture and biotechnology

Several studies revealed the role of sound vibrations with particular frequency and pressure for a specified time period can influence the plant growth and developmental processes which improves photosynthesis, germination, nutrient uptake efficiency, stress resistance, senescence, fruit quality, yield like economically important traits.

Table1: Application of sound waves in different plants

Plant	Target tissues	Frequency (Hz)	Magnitude (dB)	Growth indexes	References
Rice	shoot	125, 250	65-70	Increased photosynthesis	Jeong *et al.*, 2008
	shoot	800-1000	100	Drought tolerance	Jeong *et al.*, 2014
Wheat	shoot	100-1000	70	Yield increase	Hassanien *et al.*, 2014
Maize	Root	100, 200, 300	-	Root tip bending	Gagliano *et al.*, 2012
Cotton	shoot	100-1000	70	Shelf life of boll	Hassanien *et al.*, 2014
Tobacco	shoot	400	90	Fluidity of cell membrane	Zhao *et al.*, 2002
Arabidopsis	Shoot	500	80	Increased defense against stress	Ghosh *et al.*, 2016
Tomato	Shoot	80-2000	100	Chlorophyll content, number of flowers and fruits	Hou and Mooneyham, 1999
	Fruit	1000	10	Delayed ripening	Kim *et al.*, 2015
Chrysanthemum	Mature cells	1400	95	Changes in hormone level	Bochu *et al.*, 2004
	shoot	1000	100	Increased soluble protein	Yi *et al.*, 2003

Source: Jung *et al.*, 2018

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Future prospects and conclusion

The concept that sound act as a source of signaling in plant is comparatively new and plant acoustic biology is in its infancy. Still sound has shown its great potential in altering plant growth influencing at transcriptional level. But the exact mechanism of sound signaling in plant at molecular level is still to be explored unambiguously. Different plant species show various responses to sound waves in different growth stages. So this is a matter of extensive research to validate the results and standardize acoustic frequency and magnitude for different plant species. Beside these side effects of sound waves in animal and microbes must be considered as well. Sound vibrations has already shown its potential to cut down the use of pesticide and other chemicals by improving plant defense system and nutrient uptake efficiency. So in future plant acoustic frequency technology may emerge as a smart and green technology for global food production.

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DNA extraction from viral infected plant leaves

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Ambarish, S* and Nagaratna Wangi
Department of Agricultural Entomology
University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India-577204

1. The CTAB extraction buffer (2 % (w/v) CTAB, 1.4M Nacl, 20mM EDTA, 100mM Tris-Hcl (pH 8.0), 1 % PVP and 1% (v/v) 2-mercaptoethanol) was preheated to 60^0 C for 10 minutes
2. Approximately 0.5g of diseased leaf tissue was placed in to a pestle and mortar. The tissue was ground using liquid nitrogen and mixed with 3 volumes (900 µl) of CTAB buffer and samples were heated at 60^0 C for 10-30 minutes
3. Add equal volume of chloroform: isoamyl alcohol (24:1) mixture to the sample and mix it gently
4. Centrifuge at 9500 rpm for 10 minutes
5. Transfer the top aqueous layer in to a fresh micro centrifuge tube
6. Add 0.8 volume of cold (- 20^0 C) isopropanol and incubated at -20^0 C for at least 2 hours
7. Centrifuge at 4^0 C for 15 minutes
8. Discard the supernatant and wash the pellet in 0.5 ml (500 µl) of 70 % ethanol and dry the pellet
9. Then pellet was suspended in 100 µl of 1x TE buffer add 4 µl RNase and keep it for 40 minutes at 37^0 C.
10. Add equal volume of chloroform: isoamyl alcohol (24:1) and centrifuged at 9500 rpm for 10 min.
11. Collect the supernatant and discard pellets.
12. Then add $1/10^{th}$ volume of 7.5M ammonium acetate and two volumes of 75 % ethanol stored at -20^0 C
13. Centrifuged at 13000 rpm at 4^0 C for 30 minutes and the supernatant was discarded and dry the pellet
14. Suspend the pellet in 100 µl 1x TE buffer or sterile distilled water and stored at -20^0 C.

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Concepts of organization behavioural model

Article id: 23314

Jeebanjyoti Behera[1], Aditya Kumar Malla[2], Abhisek Tripathy[3], Kalyan Mandi[4], Pooja Konhar[5], Ashruti Kesharwani[6]
[1&2] Ph.D. Research Scholar, Department of Extension Education, OUAT, Bhubaneswar
[3] Ph.D. Research Scholar, Department of Plant Pathology, OUAT, Bhubaneswar
[4] Ph.D. Research Scholar, Department of Agricultural Extension, ICAR-NDRI, Karnal
[5] Ph.D. Research Scholar, Department of Agricultural Entomology, IGKV, Raipur
[6] Ph.D. Research Scholar, Department of Plant Pathology, IGKV, Raipur

INTRODUCTION

Models are the techniques which help us to understand complex things and ideas in a clear manner. Models are frameworks or possible explanations why do people behave as they do at work. There are so many models as many are organizations. Varying results across the organizations are substantially caused by differences in the models of organizational behaviour. All the models of organizational behaviour are broadly classified into four types: autocratic, custodial, supportive and collegial. We discuss these four models beginning with the autocratic. O.B. is the study of human behaviour in organizations, the interface between human behaviour and the organization and the organization itself. The following figures shows, this interrelationship clearly.

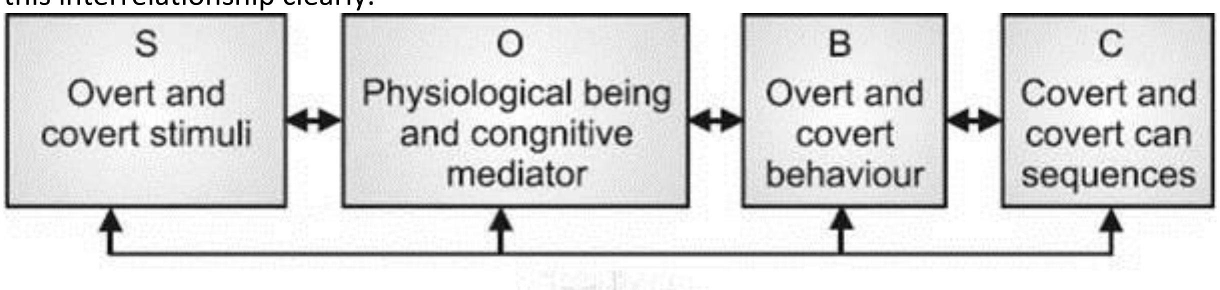

Fig 1: S-O-B-C Model of human behaviour

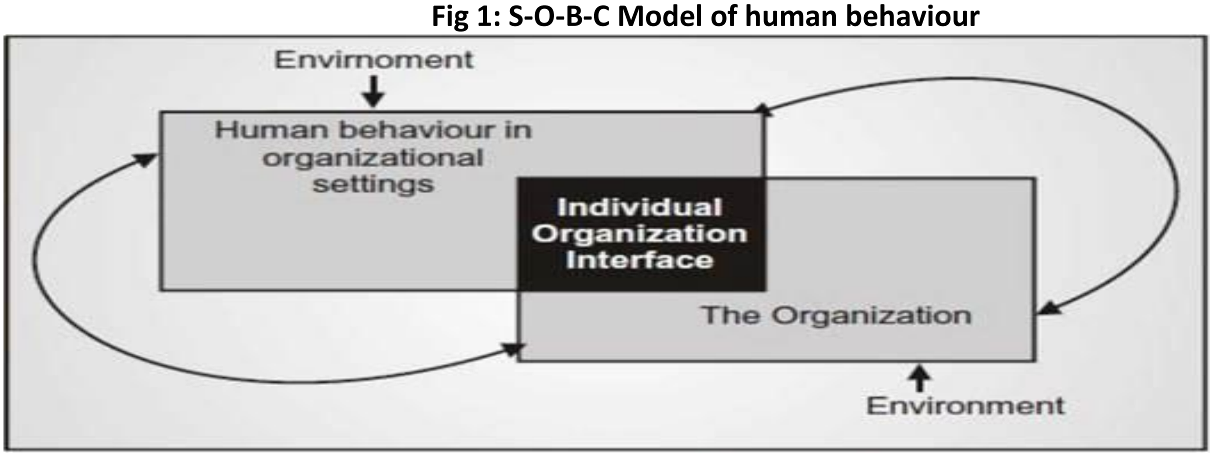

Fig 2: Model of Organizational Behaviour

Source: Gregory Moorhead and Rickyw Griffin: Organizational Behaviour.

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The Autocratic Model

The basis of this model is power with a managerial orientation of authority. The employees in turn are oriented towards obedience and dependence on the boss. The employee need that is met is subsistence. The performance result is minimal.

In case of an autocratic model, the managerial orientation is doctorial. The managers exercise their commands over employees. The managers give orders and the employees have to obey the orders. Thus, the employee's orientation towards the managers/bosses is obedience. Under autocratic conditions, employees give higher performance either because of their achievement drive or their personal liking to the boss or because of some other factor.

Evidences such as the industrial civilization of the United States and organizational crises do suggest that the autocratic model produced results. However, its principal weakness is its high human cost. The combination of emerging knowledge about the needs of the employees and ever changing societal values and norms suggested managers to adopt alternative and better ways to manage people at work. This gave genesis to the second type of models or organizational behaviour.

The Custodial Model

The basis of this model is economic resources with a managerial orientation of money. The employees in turn are oriented towards security and benefits and dependence on the organization. The employee need that is met is security. The performance result is passive cooperation.

While studying the employees, the managers realized and recognized that although the employees managed under autocratic style do not talk back to their boss they certainly think back about the system. Such employees filled with frustration and aggression vent them on their co-workers, families and neighbours. This made the managers think how to develop better employee satisfaction and security. It was realized that this can be done by dispelling employees' insecurities, frustration and aggression. This called for introduction of welfare programmers to satisfy security needs of employees. Provision for an on site day-care centre for quality child care is an example of welfare programme meant for employees. Welfare programmes lead to employee dependence on the organization. Stating more accurately, employees having dependence on organization may not afford to quit even there seem greener pastures around. The welfare programmes for employees started by the Indira Gandhi National Open University (IGNOU), New Delhi are worth citing in this context, IGNOU, in the beginning provided its employees facilities like house-lease facility, subsidized transport facility, day-time child care centre in the campus, etc. These made employees dependent on IGNOU which, in turn, became custodian of its employees.

The basis of this model is partnership with a managerial orientation of teamwork. The employees in turn are oriented towards responsible behaviour and self-discipline. Although the custodian approach brings security and satisfaction, it suffers from certain flaws also. Employees produce anywhere near their capacities. They are also not motivated to increase their capacities of which they are capable. Though the employees are satisfied, still they do not feel motivated or fulfilled in their work they do. This is in conformity with the research finding that the happy employees are not necessarily most productive employees. Consequently managers and researchers started to address yet another question. "Is there better approach/way to manage people?" The quest for a better way provided a foundation for evolvement to the supportive type of model of organizational behaviour.

The Supportive Model

The basis of this model is leadership with a managerial orientation of support. The employees in turn are oriented towards job performance and participation. The employee need that is met is status and recognition. The performance result is awakened drives.

The supportive model is founded on leadership, not on money or authority. In fact, it is the managerial leadership style that provides an atmosphere to help employees grow and accomplish their tasks successfully. The managers recognize that the workers are not by nature passive and disinterested to organizational needs, but they are made so by an inappropriate leadership style. The managers believe that given due and appropriate changes, the workers become ready to share responsibility, develop a drive to contribute their mite and improve themselves. Thus, under supportive approach, the management's orientation is to support the employee's job performance for meeting both organizational and individual goals.

However, the supportive model of organizational behaviour is found more useful and effective in developed nations and less effective in developing nations like ours because of employee's more awakening in the former and less one in the latter nations.

The Collegial Model

The collegial model is an extension of the supportive model. As the literal meaning of the work 'college' means a group of persons having the common purpose, the collegial model relates to a team work/concept. The basic foundation of the collegial model lies on management's building a feeling of partnership with employee. Under collegial approach, employees feel needed and useful. They consider managers as joint contributors to organizational success rather than as bosses.

Its greatest benefit is that the employee becomes self-discipline. Feeling responsible backed by self-discipline creates a feeling of team work just like what the members of a football team feel. The research studies report that compared to traditional management model, the more open, participative, collegial managerial approach produced improved results in situations where it is appropriate.

Although there are four separate models, almost no organization operates exclusively in one. There will usually be a predominate one, with one or more areas overlapping in the other models. The first model, autocratic, had its roots in the industrial revolution. The managers of this type of organization operate out of McGregor's Theory X. The next three models begin to build on McGregor's Theory Y. They have each evolved over a period of time and there is no one "best" model. The collegial model should not be thought as the last or best model, but the beginning of a new model or paradigm.

Interpretation of Different Models:

Various conclusions may be drawn from the study of different models as follows:

(i) As soon as the understanding of human behaviour develops or social conditions change, the model is bound to change. No one model is best for all times.

(ii) Models or organizational behaviour are related to hierarchy of human needs. As society advances on the need hierarchy, new models are developed to serve the higher order needs that is paramount at that time.

(iii) Present tendency towards more democratic models of organizational behaviour will continue to develop for long run.

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(iv) Different models will remain in use though new model predominates as most appropriate for general use at any given time as task conditions differ from time to time and organization to organization.

CONCLUSIONS

Although there are four clear separate models, almost no organisation operates exclusively in one. There will usually be a predominate one, with one or more areas over-lapping in the other models. Although one model may be used at any one point in time, some appropriate uses will remain for other models. Some jobs may require routine, low-skilled, highly programmed work that will provide mostly material rewards and security (autocratic and custodial conditions). Other jobs will be programmed, intellectual and unstructured, requiring team work and self-motivation. They generally respond to the supportive and collegial approaches. Organisations differ in the quality of organisational behaviour that they develop. These differences are substantially caused by various models of organisational behaviour that influence the management's thought in each organisation. Models of organisational behaviour help the managers to adopt organisational practices that best suit their requirements. The evolving nature of models of organisational behaviour makes it very clear that change is the normal condition of these models. As our understanding of human behaviour changes or as new social and organisational conditions evolve, our organisational behaviour models are also likely to change.

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Brinjal Shoot and Fruit Borer and its Management

Article id: 23315

Akshay Kumar[1], Krishna Kumar[2] and Ankit[3]
[1]Ph.D. Scholar, Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India
[2]Ph.D. Scholar, Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India
[3]M.Sc. (Ag.) Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India

INTRODUCTION:

Brinjal or Eggplant, *Solanum melongena* (Linn.), family Solanaceae is native of India. Brinjal is worldwide known as aubergine or guinea squash which is most popular and principle vegetable crop hence regarded as "King of vegetable". It is important due to its nutritional, medicinal as well as commercial value. 100 g edible portion of brinjal supply 40 g carbohydrate, 1.40 g proteins, 0.30 g mineral and vitamins *viz*., A, B and C. It is one of the most common and popular crop grown in India and also other parts of the world. Among the major insect pests of brinjal, the shoot and fruit borer, *Leucinodes orbonalis* (Guen.) is considered as the main constraint as it damages the crop throughout the year. The yield loss due to the pest is to the extent of 70 to 92 per cent.

Brinjal Shoot and Fruit borer, *Leucinodes orbonalis* (Guen.)
(Family: Pyraustidae, Order: Lepidoptera)

Brinjal crop is attacked by a wide array of insects and non-insect pests that cause considerable quantitative and qualitative loss to the crop during different stages of its growth. The yield losses due to the damage by *Leucinodes orbonalis* (Guen.) was reported to be as high as 70-92 per cent. The biological activities of *Leucinodes orbonalis* (Guen.) are very peak during *Rabi* season**.**

Mark and Identification:

Females preferred to lay eggs on the lower surface of the tender leaves or the twigs of plant, flowers, calycies of the fruits. Eggs were oval or somewhat elongated in shape and creamy white in colour which changed to orange with prominent black spot before hatching. Newly hatched larva was tiny, creamy or dirty white in colour with a prominent dark brown or light black head, three pairs of thoracic legs and five pairs of prolegs. They observed that pupae were dark brown in colour with wider cephalic lobe and narrow anal end with eight hook shaped fine spines at the posterior end of abdomen. The moth was white in colour with blackish brown head and thorax. The whitish wings had pinkish brown markings which are bigger on the forewings. The males were smaller in size, lesser in wing- expanse and narrow/slender abdomen which tapered posteriorly while the females were bigger in size, more in wing expanse and broader abdomen with rounded posterior end.

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Nature of Damage: Damage is caused by the caterpillar which attacks top shoots of young plants as well as. Larvae bore into the shoot and eat internal tissues causing the attacked, portion to droop and wither away. When the terminal shoots are attacked the growing points are killed. In young fruits, newly hatched larvae bore into the fruit and entry hole is too small to be easily noticeable. The large holes usually seen on fruits are the exit holes of the caterpillars. The infested fruits become unfit for human consumption. Damage to the fruits, particularly in the autumn is very sever and the whole crop may be destroyed by the borers. A single caterpillar may destroy 4-6 fruits.


Infested shoots by *L. orbonalis*


Infested Fruit by *L. orbonalis*

Life Cycle:

A single female could lay 5 to 242 eggs in her life time. Eggs were laid mostly singly and sometimes in the batches of 2 to 4 eggs. Larvae passed through five instars before entering the pupal stage. They observed average duration of 1st, 2nd, 3rd, 4th and 5th larval instars *viz.,* 1-2, 2-3, 2-3, 2-4 and 2-4 days, respectively. Average larval period lasted for 12.3 to 14.0 days. Pupation took place on glass jars, soil, and muslin cloth, on the fruits and sometimes on the leaves of plant. Pupal period varied between 6 to 8 days. Male moths lived for 1 to 3 days and female moths lived for 2 to 5.8 days.

Management:

- Application of neem cake (250 kg/ha) decreased the incidence of borer to 8 per cent and increased the yield to nearly 68 per cent.
- Establishment of Pheromone traps with height 1.5 metre from the surface of brinjal field.
- *B. thuringiensis* (*Bt*) formulations in comparison with neem and chemical insecticides against brinjal shoot and fruit borer.
- IPM module using spinosad 0.01% + *Metarhizium anisoplae* + chelating agent Fe-EDTA + cartap hydrochloride 0.1% was found as the most effective against shoot and fruit borer, *L. orbonalis* with minimum shoot infestation (7.47%) and highest yield (81.82 q/ha).
- Among the different treatments, five sprays of Dipel 8L @ 0.2 per cent at 10 days interval resulted in minimum shoot (9.56%) as well as fruit (11.78%) infestation and maximum yield of marketable fruits (196.96 q/ha).

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- Application of deltamethrin @ 25 g a.i./ha or chlorpyriphos @ 500 g a.i/ha or Imidacloprid @ 0.025 kg a.i. ha or fenvalerate @ 0.150 kg a.i. ha or rynaxypy 20SC or flubendiamide 480 SC.

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Role of bio-fertilizers in spices crop

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Pooja* and Patel, D.K.
PhD Scholar, Department of Agronomy, College of Agriculture, Junagadh Agriculture University, Junagadh-362001
PhD Scholar, Department of Horticulture, College of Agriculture, Junagadh Agriculture University, Junagadh-362001

INTRODUCTION - With the increasing prices of fertilizers and associated problems of global warming and environmental pollution, there is a need for identifying organic options for increasing food quality and yields. Spice crops are now gaining more importance, not only as ingredients in the preparation of tastier and spicier food with more flavor, but also for their pharmaceutical and cosmetic properties in several industries. India is long known as the "Land of Spices" as it produces as many as 75 out of the 109 spices listed by the ISO (International Organization of Standards), in its various agro-climatic regions. Additionally, current problems that need to be tackled include the demands of different importing countries regarding imposing different standards for quality regulations, which often result in hampering smooth trade and commerce. Hence, there is an urgent need to reduce residue limits and concentrate on major issues, especially quality control and sustainability of these crops in the long run. In this context, microbial inoculation/bio-fertilizer can be a promising option.

Types of Bio-fertilizer

1. Biological N fixing microorganism- Biological nitrogen fixation (BNF), discovered by Beijerinck in 1901, is carried out by a specialized group of prokaryotes. These organisms utilize the enzyme nitrogenase to catalyze the conversion of atmospheric nitrogen (N_2) to ammonia (NH_3). Plants can readily assimilate $NH_3$to produce the aforementioned nitrogenous biomolecules. These prokaryotes include aquatic organisms, such as cyanobacteria, free-living soil bacteria, such as *Azotobacter*, bacteria that form associative relationships with plants, such as *Azospirillum*, and most importantly, bacteria, such as *Rhizobium* and *Bradyrhizobium*, that form symbioses with legumes and other plants.

Microorganisms that fix nitrogen require 16 moles of adenosine triphosphate (ATP) to reduce each mole of nitrogen. These organisms obtain this energy by oxidizing organic molecules. Non-photosynthetic free-living microorganisms must obtain these molecules from other organisms, while photosynthetic microorganisms, such as cyanobacteria, use sugars produced by photosynthesis. Associative and symbiotic nitrogen-fixing microorganisms obtain these compounds from their host plant's rhizospheres. Application of inorganic N (100%) of RDF + Azospirillum @ 15 kg/ha + FYM - 5t/ha gave significant effect as compared to control regarding growth parameters and yield of fennel (Singh, 2012). Nitrogen fixation by free-living heterotrophs- *Azotobacter*, *Bacillus*, *Clostridium*, and *Klebsiella* Symbiotic nitrogen fixation- water fern *Azolla*'s symbiosis with a cyanobacterium *Anabaena azollae*, symbiosis between actinorhizal trees and shrubs, such as Alder (*Alnus* sp.), with the actinomycete *Frankia*.

2. Phosphate solubilizing microorganisms (PSM) – These are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds. The use of PSB as inoculants increases P uptake by plants. Simple inoculation of seeds with PSB gives crop yield responses equivalent to 30 kg P_2O_5 /ha or 50 percent of the need for phosphatic fertilizers. Alternatively, PSB can be applied through fertigation or in hydroponic operations. Many different strains of these bacteria have been identified as PSB, including *Pantoea agglomerans* (P5), *Microbacterium laevaniformans* (P7) and *Pseudomonas putida* (P13) strains are highly efficient insoluble phosphate solubilizers. Application of PSB @ 5kg/ha gave significantly higher weight of primary rhizomes, weight of secondary rhizomes, fresh weight of rhizomes and rhizomes yield per hectare (q) in turmeric (Singh, 2013).

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3. Potash solubilizing microorganisms- K solubilization is done by a wide range of saprophytic bacteria, fungal strains and actinomycetes. There is considerable population of KSB in soil and in plant rhizosphere. These include both aerobic and anaerobic isolates that the most frequently KSB in soil are aerobic. A considerably higher concentration of KSB is commonly found in the rhizosphere in comparison with non-rhizosphere soil. Solubilization of K by KSB from insoluble and fixed forms is an import aspect regarding K availability in soils. The ability to solubilize the silicate rocks by *B. mucilaginosus*, *B. circulanscan*, *B. edaphicus*, *Burkholderia, A. ferrooxidans*, *Arthrobacter* sp., *Enterobacter hormaechei* , *Paenibacillus mucilaginosus*, *P. frequentans*, *Cladosporium* , *Aminobacter, Sphingomonas, Burkholderia*, and *Paenibacillus glucanolyticus* has been reported (Meena *et al.,* 2016). Among the soil bacterial communities, *B. mucilaginosus, B. edaphicus* and *B. circulanscan* have been described as effective K solubilizers. KSB are usually present in all soils and have been isolated from rhizosphere soil, non-rhizosphere soil, paddy soil (Bakhshandeh *et al.,* 2017) and saline soil.

4. Sulphur solubilizing microorganisms- The most important organism in this respect is a group of bacteria belonging to the genus *Thiobacillus*. Most of these bacteria determine the degree to which sulphur is converted to SO4 - - in soil. *Thiobacillus* are involved in oxidation of elemental sulphur to convert fixed and unavailable form of soil sulphur to available form of sulphur for plant.

5. Silicate solubilizing bacteria (SSB)- Silicate solubilizing bacteria (SSB) can play an efficient role not only in solubilizing insoluble forms of silicates but also potassium and phosphates, hence increasing soil fertility and thereby enhancing plant productivity(Han and Lee, 2005).

6. Plant Growth Promoting Rhizobacteria (PGPR) - Plant growth-promoting rhizobacteria (PGPRs) release soluble and volatile compounds, which are implicated in antibiosis, cell signalling, induction of resistance and tolerance in plants against biotic and abiotic stresses.The PGPR comprises the following bacterial species : *Pseudomonas* , *Azospirillum* , *Azotobacter* , *Klebsiella* , *Enterobacte r*, *Alcaligenes*, *Arthrobacter*, *Burkholderia*, *Bacillus*, and *Serratia*, which enhance plant growth and yield production.

CONCLUSION

Bio-fertilizers play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric nitrogen, mobilizing fixed macro and micro nutrients in the soil into forms available to plants. Research finding shown that 25 to 50% N and P could meet through bio-fertilizers for cultivated spices crop in our country. In context of both the cost and environmental impact of chemical fertilizers, biofertilizers would be the viable and eco-friendly option for farmers to increase productivity per unit area.

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Pest surveillance and pest forecasting in insect pest management

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Deepak Ranjan Kishor*, Shriti Moses and Manoj Kumar
Deepak Ranjan Kishor, Senior Research Fellow, Entomology.
ICAR-RCER, Patna, Bihar-800014
Shriti Moses, Ph.D. Research Scholar, Department of Entomology.
Uttar Banga Krishi Viswavidyalaya, Cooch Behar, W.B.-736165.
Manoj Kumar, Assistant Professor, Department of Entomology.
Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur), Bihar-848125.

PEST SURVEILLANCE

Pest surveillance is the watch kept on a pest for the purpose of decision making. It is the systematic monitoring of biotic and abiotic factors of the crop ecosystem in order to predict the pest outbreak or it is the study of the ecology of the pest which provides the necessary information to determine the feasibility of a pest management programme. By the Pest surveillance programmes, the population dynamics and the key natural mortality factors operating under field conditions can be known which in turn helps in devising the appropriate management strategies.

Advantages:

1. One can know how a pest is multiplying in an area and when it is expected.
2. Minimize the cost of plant protection by reducing the amount of pesticides used and in turn reduce environmental pollution.
3. Pest control measures can be initiated in time due to advance forecasting.
4. Useful for pest forecasting.
5. To find out natural enemy population
6. To study the influence of weather parameters on pests
7. Mark endemic areas
8. Maintain the stability of the agro ecosystem.

Components of pest surveillance:

1. Identification of the pest.
2. Distribution and prevalence of the pest and its severity.
3. The different levels of incidence and the loss due to the incidence.
4. Pest population dynamics.
5. Assessment of weather.
6. Assessment of natural enemies etc.

This study will give advance knowledge of probable pest infestation and will help to plan cropping patterns and to get best advantage of pest control measures.

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PEST FORECASTING

Forecasting is the prediction of the type of fluctuation which will occur in the near future. It is the advance knowledge of probable infestation by the pests in a crop. Forecasting pest incidence often requires systematically recorded specific field data in an elaborate manner over considerable period of time which can be easily retrieved and analyzed. The Pest surveillance programmes are highly useful in forecasting of the pests.

Pest forecasting service may thus serve:

1. To predict the forthcoming infestation levels of a pest which is very useful in taking control measures and
2. To find out the critical stages at which the application of insecticides would afford maximum protection.

During 1941 a nations wide pest forecasting system was established in Japan. Locust warning station in India was established in 1939.

Types of forecasting:

1. Short term forecasting: Covers one or two seasons mainly based on the populations of the pest within the crop by sampling methods.
2. Long term forecasting: It covers large areas and based mainly on the possible effects of weather on the insect abundance. Eg.: Locust warning stations.

Forecasting is made through:

1. Population studies carried over several years.
2. Studies on the pest life history.
3. Field studies on the effect of climate on the pest and its environment.
4. Predictions form the empirical data on the pests of the previous season.

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Management of Early and Late Blight of Potato

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Mahesh Singh, Ganesh Datt Bhatt and Amit Maurya*
School of Agriculture, Galgotias University, Greater Noida, Uttar Pradesh, 203201.
*Department of Plant Pathology , Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) 211007.

Potato (*Solanum tuberosum* L.) is an important vegetable crop, grown in many parts of the world. Early blight and late blight; two serious diseases of potato, are reported throughout the world. The terms "early" and "late" indicated that the relative time of their appearance in the field. Both diseases are caused by fungal pathogens namely; *Alternaria solani* and *Phytophthora infestans.* The diseases not cause only loss of yields but also reduce the quality of the crops.

Early Blight

Early blight of potato is caused by a fungal pathogen *Alternaria solani*; it is destructive disease in several states, causes heavy yield loss. The disease affects leaves, stems and tubers as well as it reduces size and quality of tubers. Premature defoliation may lead to considerable reduction in yield. The disease can also be severe on tomatoes, and can occur on other solanaceous crops and weeds.

Disease Symptoms:

The initial symptoms of early blight appear as small, circular or irregular, dark-brown to black spots on the lower leaves. At later stage these spots enlarge size and spread all over the plant parts. The spots develop with concentric rings looks like target board pattern. Spots may also develop on the tubers -- these spots are sunken or raised with a definite margin. The internal tuber tissues are brown to purple in color, some time with a yellowish margin.

Disease Cycle:

The fungus survives either on potato tubers or as infected crop residue either in the soil. The concentration of initial or primary inoculum from these reservoirs is usually low. The primary infection can occur from months November and early December, when frequent rains or dews occur and daytime temperatures remain near 22-25 ^{0}C. The fungus spores can penetrate the leaf surface directly through the epidermal cells and spots begin appearing within 3-4 days. The secondary spread takes place by wind-borne conidia between plants to plant and fields to fields.

Disease Management:

- Eradicate and destroy weeds and volunteer solanaceous crop plants.
- Use only disease free seeds for sowing.
- Crop rotation with non-susceptible crops at least 2-3 years.
- Maintain proper spacing between plants to plants and row to row.
- Avoid sprinkler or other overhead irrigation.
- Use optimum dose of fertilizers.
- Harvest when skin is mature to avoid infection of tubers.

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- Spray the solution of Mancozeb 75 WP + 10 g urea per liter of water at 15 days interval when symptoms start or apply copper fungicides at early stage of disease infection.

Late Blight

Late blight of potato is also known as potato blight. This disease was responsible for the Irish famine in the 1843-45. The organism can also infect some other members of the solanaceous crops. The pathogen was first described by M. J. Berkeley and subsequently named *Phytophthora infestans* by Anton de Bary. The disease can infect and destroy the leaves, stems and tubers of potato plants. The average annual losses due to late blight have been reported about 35% of total production in the country.

Disease Symptoms:

The first appearance of the disease is seen in the month of January. Small, dead, and brownish to purplish black lesions on the tips and margins of the leaflets shows at initial stage of the infection. Under favorable conditions (12–18°C temperature and more than 80% RH) the lesions rapidly increase in size and cover the whole surface of the leaf. The blighted leaves become curl and shrivel in dry weather and under moist conditions they decay and emit a characteristic odor. In the infected plant tubers get also infected. When the tuber is cut and open, there is a tan-brown, dry, granular rot appearance may be seen. Such infected tubers get easily rot in storage under warm or humid conditions.

Disease Cycle:

The pathogen survives with infected tubers between season to season on infected potato tubers as in the storage or in the soil after harvest. Infected tubers that are planted or other volunteer plants that survive the winter may be sources of the pathogen for primary infection. The pathogen is favored to high moisture and cool to moderate temperatures. Night temperatures of 11^0C to 15^0C and day temperatures of 16^0C to 20^0C are most favorable for disease development. Rain, dew and overhead sprinkler irrigation provide the water necessary for pathogen infection and development.

Disease Management:

- Destroy infected plant debris and other volunteer plants.
- Select disease free seed tubers for sowing.
- Do not mixes seed lots with infected tubers because cutting can transmit late blight.
- Treat the tubers with suitable fungicides.
- Avoid nighttime and flood irrigation.
- Select resistance variety such as Kufri Anand, Kufri Badshah, Kufri Arun, Kufri Himsona, Kufri Lalit, Kufri Pukhraj, Kufri Sadabahar, Kufri Sutlej for cultivation.
- Apply foliar fungicides application to overcome disease severity. Once late blight is start, only foliar fungicide applications can manage this infection in the field.
- Spray Dithane M-45 or Dithane Z-78 @ 2.5 kg/1000 liters of water per hectare. It should be repeated at 10-12 days interval.

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Enemies of Honey bees and their Management

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Chandresh B. Solanki, Birari Vaishali V., Manishkumar J. Joshi, Prithiv Raj V.
Ph.D. Scholar, Department of Entomology, S.D. Agricultural University, Sardarkrushinagar, Dantiwada, B. K., Gujarat (India) -385 506

INTRODUCTION

Beekeeping is an art and a mesmerizing science. In India beekeeping is mostly practised as a full-time occupation and an engrossing hobby to produce handsome income and table honey. Honeybees (*Apis spp*.) are special gift to mankind because beekeeping can be done for both their pollination services and their cherished products such as honey, beeswax, propolis, bee venom, etc. These products have their widespread use in different small and large scale industries in India. Because of the different climatic zones in India, there is a massive multiplicity of flora which helps in potential beekeeping. People of India have a long connection with beekeeping and honey since ancient times. Ancient Indians gifted some records about beekeeping as paintings or carvings on rocks. Honey and its medicinal uses were mentioned in the old Ayurveda books of India. Right now approximately there are about 1.5 million bee colonies in India, which produce 55,000 tonnes of honey annually. India is one of the honey-exporting countries. The major markets for Indian honey are Germany, the USA, the UK, Japan, France, Italy and Spain (Tej *et al*., 2017).

Species of Honeybee in India

Rock Bee or giant bee (*Apis dorsata*)

They are huge and ferocious bees that construct a single comb in the open usually about 3-4 feet tall. They can be seen all over the subcontinent mainly in the forests and also in concrete jungles. In hilly regions they construct their nest up to an altitude of 2700 m.

Little Bee or dwarf honeybee (*Apis florea*)

Apis florea is also a wild honeybee spp., but these bees are small and less ferocious when compared to the rock bees. These bees build single vertical combs. They also construct palm- sized combs in the bushes, hedges, buildings, caves, empty cases, etc.The honey produced by these bees is dramatically less when compared to the rock bee as these bees produce only about half a kilo of honey per year per hive. These bees are found only in plains and not in hills above 450 MSL.

Indian Bee (*Apis cerana*)

Indian honeybee is a well-known bee species in India.
It is also found and has been domesticated in Pakistan, Nepal, Burma, Bangladesh, Sri Lanka and Thailand. It produce 7–9 kg of honey per colony per year.

European Bee or Italian Bee (*Apis mellifera*)

Italian bee is one of the sub species of *A. mellifera* and is not native to India and was introduced from Europe during the second half of 20th century. The introduction was primarily because the native Indian bee colonies were vanishing because of the Thai sac brood virus. Presently they are well established in India and mostly present in northern India because of the rich flora such as mustard, safflower, sun flower, etc. They are bigger than all other honeybees except *Apis dorsata*. They produce 25–40 kg of honey per colony per year.

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Stingless Bee

Stingless or dammar bees are of smallest size compared to other honey-yielding bees (less than 5 mm). They belong to the family Apidae and subfamily Meliponinae. It consists of two genera Melipona and Trigona. Meliponinae includes eight genera, having 15 subgenera and more than 500 species. The stingless bees are important pollinators of various food crops and can be domesticated.

ENEMIES OF HONEYBEES

1. Death's hawk moth (*Acherontia styx*)

Nature of Damage

Enters the bee hive at night and drinks up honey

Management

The moths are thrown out by strong colony

2. Greater wax moth (*Galleria mellonella*)

Nature of Damage

The caterpillars make tunnels through near the midrib of a comb during stess

Management

It will not attack the bee directly, but feed on wax

Use of para dichlorobenzene

Simplest way is to prevent wax moth getting into the hive through gaps and space. Use of traps to draw the moth away from the hive area. Strong hive need no treatment to control wax moth; the bee themselves will kill and clean out the moth larvae and webs. Healthy hive will keep wax moth under control by ejecting the larvae. Wax moth larvae and eggs are killed by freezing for 24 hours. Wax moths can be control in stored comb by application of the aizawai variety of Bt (*Bacillus thuringiensis*) spores by spraying

3. Lesser wax moth (*Achoria grisella*)

Nature of Damage

The caterpillars make tunnels through near the midrib of a comb

Management

Lesser wax moths need warm climates to thrive hence, freezing beeswax combs reduce moth infestation. Fumigation with paradichlorobenzene(PDB) when combs are not filled with honey . Fumigation with carbon dioxide for combs that are filled with honey

4. Predatory wasps (*Vespa orientalis*, *Vespa magnifera*)

Nature of Damage

Pray the bee. The wasps macerate the bee and feed their larvae

Management

Destruction wasps nests by burning or with insecticides

5. Ants (*Dorylus labiatus*, *Componotus compressus*)

Nature of Damage

Take away honey and brood. Weaken and destroy the bee colony

Management

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- Destruction of ant nests by fumigation or with insecticides.
- Treating the legs of apiaries with a repellent

6. African small hive beetle (*Aethina tumida*)

Nature of Damage

It lives in beehives. Comb slimed by hive beetle larvae and drive out bee colonies

Management

- Use of para dichlorobenzene
- Use of chemical inside the corrugations of a piece of cardboard
- Use of cooking oil based bottom board traps

Fig. 1: Death's hawk moth Adult

Fig. 2:Wax moth Adult

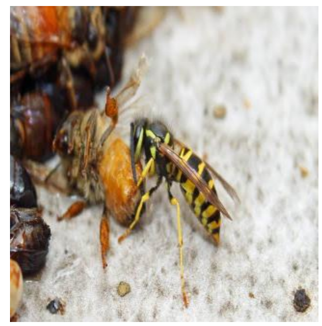

Fig.3 : Predatory wasp

Fig. 4:Ant

Fig.5 :African small hive beetle

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Farmer Producer Companies/Organizations (FPO): Platform to increase farmer's income

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Nenavath Manikyam and K. Mithun
Ph.D. scholars S.V. College of Agricultural Engineering and Technology & research station,
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh

Introduction to farmer's producer company

The producer company concept has emerged as a new generation farmer's organization in India. It was introduced in 2002 by introducing a new part IX A in to the Companies Act 1956. Since then Indian farmers got a new opportunity to start expedition towards livelihood sustainability. The first producer company was registered in 2004. As per the companies act, 2002, section 58 1B, the main objectives of Producer Company are procurement of inputs, production, harvesting, grading, pooling, handling, storage, marketing, selling or exporting the primary produce of the company members or import of goods or services for them in addition, processing of produce of members, manufacturing, sale or supply of machinery, consumables, conducting training and awareness programme, insurance of crop and livestock and providing guidance for efficient natural resource management etc to members.

India has witnessed a rapid alteration and uncertainty in agricultural commodity markets. Prominent among them are changes in the world trade scenario, scarcity of irrigation water, menace of wild animal, shortage of labour growing inter-farm as well as inter-regional disparity, unequal household income and low productivity as a combined outcome of climate change and globalization. Under these circumstances, it is mainly the small and marginal farmers who are exposed to the high risk of farming, arising from climate vagaries and uncertainties around production; lack of access to support services; alternate markets and poor infrastructure. The problems have imposed critical implications on farming community and as a result every day more than 2000 farmers have left agriculture since 1991 (Sainath 2013) and many more rural youth have migrated to cities for other professions. Although, overall economy has performed commendably in the last decade due to huge growth in service sector but sluggish agricultural growth continuously has kept millions in poverty and hunger. The 59th round of National Sample Survey Organization (NSSO 2003) survey revealed that nearly 40% of farmers would like to quit farming, if they have the option to do so. Slightly more than half (52%) of the work force is in agriculture. The whole farming community of India is burdened with these problems which need serious attention.

In this scenario the solution is possible through exploring innovative market led extension models in order to integrate the farmers, especially the small farmers; with the value chain so that the net return at the farmers end is remunerative enough for them to remain in agriculture. Several institutional models have been tried in India to integrate farmers with production and value chain like Self Help Groups, Farmers Interest Groups, and Farmers' Cooperatives etc. The recent model is Farmers Producers' Company, which enables farmers to organize themselves as collective, provides them a business outlook to agriculture and links them to market.

Advantages of Farmers' Producer Company

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- Economies of scale which reduces the cost of production
- Better negotiation and bargaining positions
- Capacity building of members
- Vertical and horizontal coordination and value chain management
- Enhance producers share in consumers rupee
- Risk mitigation
- Diminish cost of seeking information
- Empowering small and marginal farmers economically and socially
- Provides technical help in production and creation of social capital.
- Can protect small farmers from ill effects of globalization

Status of Farmers' Producer Companies in India

It reveals that there are 1048 Farmers' Producer Companies registered in India. The highest number is in Uttar Pradesh (204) followed by Madhya Pradesh (127), Karnataka (111), Maharashtra (85), Tamil Nadu and West Bengal (62).

Table 1: Farmers' Producer Company and their performance

FPC	Registration	Members	Area of operation	Products	Equity base	Avg. gross monthly turn over/membEr (Rupees)
Grameen Aloe Producer Company Ltd	2009	325	30 Villages of Ajmer, Rajasthan	Aloe Vera	250000	128
Krushi Dhan Producer Company Ltd	2005	200	4 districts of Gujarat	Agri inputs; Agri produce	100000	270
Mahila Umang Producer Company Ltd	2009	2500	Almora dist of Uttarakhand	Hand knitted woolen items, pickles, honey and spices	170800	700
Vasundhara Agri- Horti Producers Company Ltd	2004	54 PCs total 50000 producer	Chhattisgarh, Gujarat, Maharashtra, Karnataka, Madhya Pradesh, Rajasthan,	Cashew and Mango	20000000	74

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			Uttar Pradesh			
Indian Organic Farmers' Producer Company Ltd	2004	1404	3 districts of Kerala	Spices, coconut, cashew & rice	604000	833
Masuta Producer Company Ltd	2005	1937	Jharkhand, Chattisgarh and Bihar	Tasar yarns (Job work to members)	14665400	1390
Rangasutra Producer Company Ltd	2004	1025	Rajasthan	Textile garments (Job Work to members)	495000	2500

Factors for high growth of Farmers' Producer Companies

- Internal social capital: local leadership well connected with markets and state agencies
- Market opportunities: connections with extra-local financial investors and technical experts
- Marketing success: better bargaining power fostered by trustworthy trading partners outside communities
- External social capital: technology adoption and profitability dependant on the strength of farmers' information networks, farmers with higher linking social capital better able to manage the institutional relationships and sustainable land management

Challenges faced by FPCs

- Huge equity capital requirements in starting FPCs
- Lack of collateral security in availing loan
- Huge tax burden (up to 30%)
- Weak value chain management infrastructure
- Favourism in organization
- Lack of basic infrastructures
- Lack of skill to maintain business records
- Competition with rich middlemen
- Lack of hand holding from state governments

Strategies for effective Farmers' Producer Companies

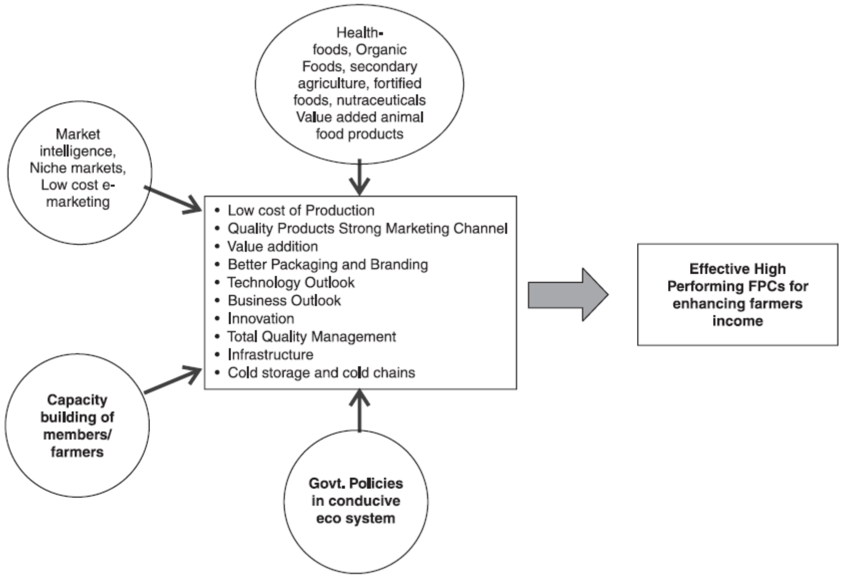

Fig 1: Strategies for effective Farmers' Producer Companies

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Gene Stacking For Crop Improvement

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Sachin Arunrao Tajne[1], Sandip Gorknath Rathod[2] and Kuldeep Gajanan Kandarkar[3]
[1]PhD Research Scholar., Department of Plant Molecular Biology and Biotechnology., IGKV Raipur
[2]Assistant Professor., SDMVM College of Agricultural Biotechnology, Aurangabad
[3]PhD Research Scholar. Center for Plant Breeding and Genetics. TNAU, Coimbatore

INTRODUCTION

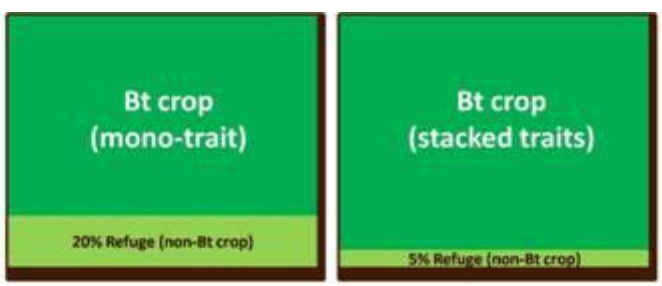
Gene stacking refers to the process of combining two or more genes of interest into a single plant. Gene pyramiding and multigene transfer are other monikers in the scientific literature referring to the same process. The combined traits resulting from this process are called stacked traits. A biotech crop variety that bears stacked traits is called a biotech stack or simply stack. An example of a stack is a plant transformed with two or more genes that code for *Bacillus thuringiensis* (*Bt)* proteins having different modes of action. It is a hybrid plant expressing both insect resistance and herbicide tolerance genes derived from two parent plants

Need of gene stacking

Compared to mono-trait crop varieties, stacks offer broader agronomic enhancements that allow farmers to meet their needs under complex farming conditions. Biotech stacks are engineered to have better chances of overcoming the myriad of problems in the field such as insect pests, diseases, weeds, and environmental stresses so that farmers can increase their productivity.

Gene stacking enhances and simplifies pest management for biotech crops as demonstrated by multiple insect resistance based on Bt gene technology. Experience has shown that the resistance conferred by a single Bt gene has the potential to break down as the target insect pest mutates and adapts to defeat the Bt trait.

To prevent or delay the emergence of resistance to the *Bt* gene, many regulatory agencies require a refuge or an area planted to a non-*Bt* variety alongside the *Bt* crop. Typically a refuge is about 20 percent of the total crop area for a mono-*Bt* trait variety.



While the refuge strategy lessens the chance for the insect pest to overcome the *Bt* trait, farmers cannot realize the full production benefit of the *Bt* crop. The next generation of *Bt* crops with multiple modes of action for insect control were then developed by stacking several classes of Bt genes. This gene stacking approach has reduced the potential of resistance breakdown as it is more difficult for the pest to overcome

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multiple insecticidal proteins. This greater durability of *Bt* stacks allow a lower refuge area requirement that somehow limits yield.

The *Bt* gene stacking principle is also used in weed management. Weed resistance to commercial herbicides has been documented for different herbicidal modes of action. To catch up in countering weed resistance, biotech seed developers have stacked up genes to broaden the herbicidal mode of actions. For example, this is done by combining the glyphosate resistance gene *epsps* with the *pat* gene conferring resistance to herbicide glufosinate and/or with the *dmo* gene conferring resistance to herbicide dicamba.

Gene stacking is especially useful in metabolic engineering of plants since most metabolic processes and biochemical pathways involve numerous genes interacting with each other.[3] For example, the entire pathway for provitamin A (beta carotene) biosynthesis was engineered in the rice endosperm by stacking three carotenoid genes into rice. The biotech rose with modified flower color was produced by stacking two genes in the anthocyanin biosynthetic pathway that altered the flower pigmentation process, giving the biotech rose flowers novel shades of blue.

Differences between Gene Stacking and Gene Pyramiding

- Assembling multiple desirable genes/QTLs from multiple parents into a single genotype for specific/multiple trait through conventional breeding (Yunbi Xu, 2010).
- A pyramid could be constructed with major genes, minor genes, defeated genes, effective genes, ineffective genes, race-specific genes, non racespecific genes or any other type of host gene that confers resistance.
- Gene stacking is the process of including more than one transgenic event in one plant to produce stacked traits, stacked transformation events through genetic engineering.
- Biotech stacks are engineered to have better chances of overcoming the numerous of problems in the field such as insect pests, diseases, weeds, and environmental stresses so that farmers can increase their productivity.

Strategy of Gene Stacking

There are mainly two types of gene stacking process viz: hybrid stacking and molecular stacking.

Hybrid Stacking

It is easiest and earliest method of developing stacks. In hybrid stacking (Fig.2) plants containing several transgenes can be produced by crossing parents with different transgenes until all the required genes are present in the progeny. Development of multi stack hybrid occurs via iterative hybridization. plants containing several transgenes can be produced by crossing parents with different transgenes until all the required genes are present in the progeny. Development of multi stack hybrid occurs via iterative hybridization. An early example of the power of this strategy was the production of secretory IgA antibodies in plants by crossbreeding of tobacco to combine, in one plant, four genes encoding different immunoglobulin polypeptides (Ma *et al.* 1995).

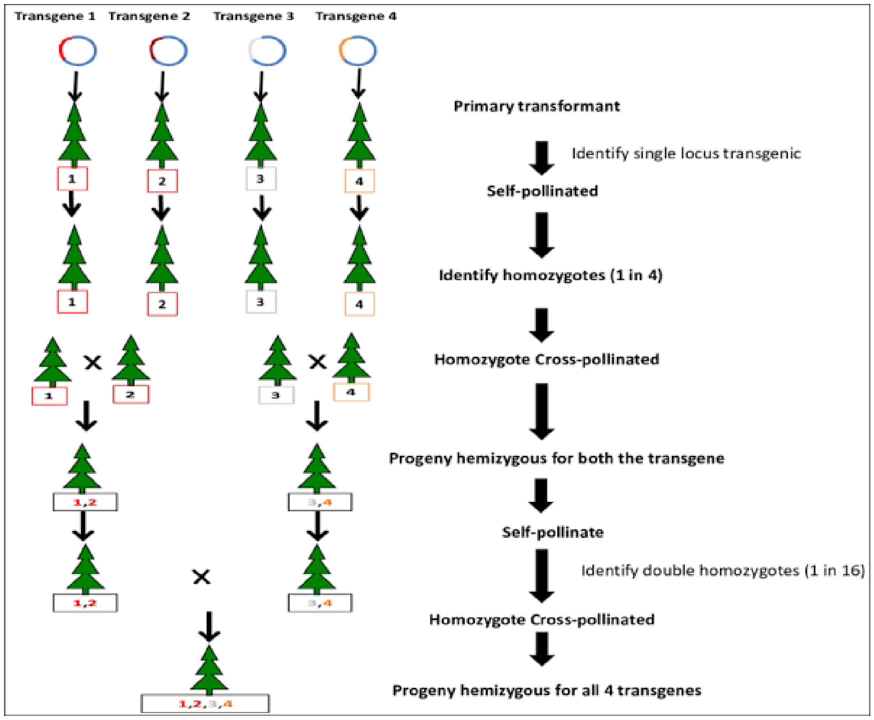

Fig 1: Hybrid Stacking.

There are some limitations like transgenes not linked & can segregate; obtaining homozygous plants for all transgenes is a difficult task. Breeding cost will be increase; variety of selectable markers needed in the re-transformation; marker removal slow, multistep process; labour intensive and time consuming process. Some stacks developed through this hybrid stacking are: In maize-Agrisure TM, VipteraTM 3220; In Cotton- Roundup ReadyTM, Flex BollguardTM II (examples are taken from the GM approval database 2017).

Molecular Stacking

It has two approaches i,e Co transformation and retransformation

Co transformation

It can be done by either single plasmid co-transformation of linked transgene, where genes to be introduced are linked as single piece of DNA with each gene having its own promoter or by multiple plasmid co-transformation of unlinked transgene, which consist of several plasmid or discrete fragment DNA (if biolistic), each caring a different transgene (including a promoter), that are transformed together via Agrobacterium mediated transformation or biolistic method into the plant. Example: Maize-Knock outTM, NaturgardTM, Bt XtraTM (examples are taken from the GM approval database 2017).

The main limitation of this co-transformation are difficulty to assemble complex plasmids with multiple gene cassettes; Problem of Gene silencing if same promoter is used with each transgene; high copy number integrating; undesirable incorporation of a complex T-DNA molecules from multiple sources. Transgenes derived from different sources typically integrate at different locations in plant genome, which may lead to various expression patterns and possible segregation of the transgenes in the offspring.

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Retransformation

In this process a plant harbouring a transgene is transferred again with other gene. It is a multi-trait or combined trait event with separate inserts. The GM plant produced by iterative event with separate inserts transformation with vectors containing different transgenes/traits. The transgenic inserts are integrated in multiple loci. Multiple transgenes either harboured within different t-DNA in single Agrobacterium strain or harboured separately within different strain. The production blue shaded rose in collaboration of Australian Florigene Company with Japanese company Suntory is a good example of it. Generally the flower colour of wild roses is mainly due to the pelargonidin cyanidin based anthocyanins, which are the two main endogenous flavonoid expressed in rose petals. Blue coloured flower contain the delphinidin based anthocyanin and roses don't have the pigments. Thus, they lack violet/blue varieties. This is ascribed to their deficiency of flavonoid 3',5'- hydroxylase (F3'5'H), a key enzyme in the synthesis of delphinidin (Fig. 4) (Holton and Tanaka 1994)

Commercial Stacked Transgenic Crop

Liang *et al., 2010*

Trait developer(s)	Crop	Product name	Transgenic event(s)	Trait genes	Trait targets
Bayer CropScience	Canola	InVigor® SeedLink®	MS8 (DBN230-0028), RF3 (DBN212-0005)	*bar*, barnase, barstar	Weeds; Male fertility
Monsanto	Canola	Genuity® Roundup Ready®	GT73 (RT73)	CP4 EPSPS, *gox*	Weeds
Bayer CropScience	Cotton	FiberMax® LibertyLink® Bollgar II®	LLCotton25, MON15985	*bar*, Cry1Ac, Cry2Ab	Lepidopteran pests; Weeds
Dow AgroSciences	Cotton	WideStrike®	DAS-21023-5, DAS-24236-5	*pat*, Cry1Ac, Cry1Fa	Lepidopteran pests; Weeds
Dow AgroSciences	Cotton	WideStrike®/Roundup Ready®	DAS-21023-5, DAS-24236-5, MON-01445-2	*pat*, Cry1Ac, Cry1Fa, CP4 EPSPS	Lepidopteran pests; Weeds
Dow AgroSciences	Cotton	WideStrike®/Roundup Ready® Flex	DAS-21023-5, DAS-24236-5, MON-88913-8	*pat*, Cry1Ac, Cry1Fa, CP4 EPSPS	Lepidopteran pests; Weeds
Monsanto	Cotton	Roundup Ready®, Bollgard®	MON531, MON1445-2	Cry1Ac, CP4 EPSPS	Lepidopteran pests; Weeds
Monsanto	Cotton	Bollgard II/Roundup Ready® Flex	MON88913-8, MON15985	CP4 EPSPS, Cry1Ac, Cry2Ab	Lepidopteran pests; Weeds
Dow AgroSciences and Pioneer Hi-Bred	Maize	Herculex® CB	TC1507	Cry 1Fa, *pat*	Lepidopteran pests (European corn borer); Weeds
Dow AgroSciences and Pioneer Hi-Bred	Maize	Herculex® RW	DAS 59122-7	Cry34Ab1/Cry35Ab1, *pat*	Coleopteran pests (Corn rootworm); Weeds
Dow AgroSciences and Pioneer Hi-Bred	Maize	Herculex® XTRA	TC1507, DAS-59122-7	Cry 1Fa, Cry34Ab1, Cry35Ab1, *pat*	Lepidopteran and coleopteran pests; Weeds
Dow AgroSciences and Pioneer Hi-Bred	Maize	Herculex® XTRA/Roundup Ready® 2	DAS-59122-7, TC1507, NK603	*pat*, CP4 EPSPS, Cry34Ab1, Cry35Ab1, Cry1Fa2	Lepidopteran and coleopteran pests; Weeds
Monsanto	Maize	Yieldgard® VT Pro®	MON89034	Cry1A.105, Cry2Ab2	Lepidopteran pests
Monsanto	Maize	Yieldgard® VT	MON88017	CP4 EPSPS, Cry3Bb1	Coleoptera pests (corn rootworm); Weeds
Monsanto	Maize	Yieldgard® VT Triple	MON810, MON88017	Cry1Ab, Cry3Bb1, CP4 EPSPS	Lepidopteran and coleoptera pests; Weeds
Monsanto	Maize	Genuity® VT Triple Pro®	MON89034, MON88017	Cry1A.105, Cry2Ab2, Cry3Bb	Lepidopteran and coleopteran pests; Weeds
Monsanto and Dow AgroSciences	Maize	Genuity® SmartStax™	MON89034, TC1507, MON88017, DAS-59122-7	PAT, CP4 EPSPS, Cry1Fa2, Cry1A.105, Cry2Ab, Cry3Bb1, Cry34Ab1, Cry35Ab1	Lepidopteran and coleopteran pests; Weeds
Syngenta	Maize	Agrisure® GT/CB/LL	Bt11, GA21	Cry1Ab, *pat*, mutant maize EPSPS	Lepidopteran pests (European corn borer); Weeds
Syngenta	Maize	Agrisure® CB/LL/RW	Bt11, MIR604	Cry1Ab, mCry3Aa, *pat*	Lepidopteran and coleopteran pests; Weeds
Syngenta	Maize	Agrisure® 3000GT (GT/CB/LL/RW)	GA21, Bt11, MIR604	*pat*, Cry1Ab, mCry3Aa, mutant maize EPSPS	Lepidopteran and coleopteran pests; Weeds

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CONCLUSION

The first stacked get regulatory approval in 1995 is dual hybrid cotton stack producing by crossing BollgardTM cotton that express Bt toxin Cry IA(b) and Round up ReadyTM cotton that express epsps gene conferring resistance to herbicide glyphosate. However there are some technological concerns in molecular stacking w including the design of large multigene constructs, method of delivery into plant cells and the stability of expression of multiple genes. Molecular biologists are developing new genetic engineering approaches to address these concerns.

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IFS-Ensuring Livelihood Security to Small and Marginal Farmers

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Basant Kumar[1] and Ayesha Fatima[2]
[1]Ph.D. Scholar, Department of Agronomy, Palli Siksha Bhavana, Sriniketan, West Bengal-731236
[2]Ph.D. Scholar, Division of Agronomy, ICAR-IARI, New Delhi-110012

INTRODUCTION

Ever since Green revolution, agriculture research has focused on development of high yielding crop varieties/hybrids, good farm machineries, crop production and plant protection technologies which has enabled the farmers to harvest higher yield but at the same time this has led to over-exploitation of the resource base thus severely affecting the productivity and profitability. The share of agriculture in gross domestic product is declining, average size of land holding is contracting and number of operational holdings is increasing. Therefore, it is imperative to develop strategies that enable adequate employment and income generation, especially for small and marginal farmers who comprise more than 80 percent of the farming community. Due to the gradual shrinking of land holding, horizontal expansion of land based enterprises is not possible. Hence, vertical integration of land based enterprises within the socioeconomic environment of the farmers will make farming more profitable and dependable. Integrated Farming System can act as a better tool to address these problems as it ensures the consolidation of natural resources base at farm level and provides an opportunity to arrive at appropriate combination of the enterprise through interlinking of different farm enterprise for the effective use of natural resources and recycling of nutrients on the farm.

Integrated Farming System (IFS) is a complex interrelated matrix of soil, plants, animals, implements, power, labour, capital and other inputs controlled in part by farming families and influence to varying degree by political, economical, institutional and other factors that operate at farm level. It is a resource management strategy to achieve economic and sustained production to meet diverse requirements of farm household while preserving the resource base and maintaining a high level of environmental quality. It represents the integration of farm enterprises such as cropping systems, animal husbandry, fisheries, forestry, sericulture, poultry *etc*. for optimal utilization of resources thus improving the livelihood of farmers.

The potential integration of dairy, poultry, vegetable cultivation, floriculture with suitable cropping system should be exploited to make judicious use of farm inputs and natural resources so as to provide regular income and employment to small land holders for maximum number of days. These farmers generally practice subsistence farming where they need to produce a continuous reliable and balanced supply of food as well as cash for basic needs and recurrent farm expenditure. Therefore, there is need to develop suitable integrated farming system for such farmers. Single crop production enterprises are subjected to high degree of risk and uncertainty because of seasonal variability, irregular and employment to the farmers. IFS may pave the way for realizing increased productivity and profitability to small and marginal farmers and which would be the potential way to decrease production costs by synergistic recycling of bio-products of various components within the system and also to provide a regular source of income and employment. Thus, IFS is a reliable way to obtain higher productivity with sustainable nutrient economy in combining with max compatibility and replacement of organic matters and integration between each enterprise.

Different components of IFS:

Some of the common enterprises that can be easily adopted by small and marginal farmers in appropriate combination are:

Crop production

The cultivation of cereals, vegetables, fruits with other enterprises should be integrated in such a way that various parts can be complimentary and supportive to each other. The cultivation of diverse group of crops can provide round the year income to the farmers.

Animal husbandry

The integration of livestock with crop component is an age-old practice. The waste generated from livestock can be used to prepare vermicompost or FYM thus reducing the need for external inputs and cost saving. The waste product of crop enterprise can be used as feed for livestock thereby reducing the external feed requirement. The livestock product such as milk can be used for home consumption and the surplus can be taken to the market thus generating income.

Fisheries

About one-tenth of the total area of IFS can be allocated for pond in which fishes can be reared effectively. Otherwise, paddy cum fish culture can be practiced. Paddy field is a rich source of organisms (plankton, algae, molluscs, worms, insects, larvae of insects *etc*.), which serve as an excellent food for the growing fish and fish excreta serves as fertilizer for the crop (enhanced rice yield). The bio-control of rice pests is one of the prominent features of rice–fish farming which further minimizes the use of pesticides in rice crop *i.e.* minimizes the cost of production because insects and pests are consumed by the fish (Chaubey *et al*., 2018). Fish farmers have gained an increased level of satisfaction by means of fish culture production growth along with corresponding economic gain (Kumar *et al.*, 2017).

Agro-forestry

Agroforestry is an integrated self-sustained land management system, which provides materials like timber, pulp, pole, fuel wood, food and medicine with agricultural crops on the same unit of land, meeting the ecological and socio-economic needs of farmers. This system also provides to varied needs of the farmer enhance employment opportunities by spreading labour needs which otherwise are concentrated in the farming system (Anonymous. 2013).

Apiculture

Honey bees act as excellent pollinators and therefore help in improving the yield of various agricultural crops. Integration of apiculture can boost the production as well as increase the income of small and marginal farmers. Maintenance of honeybees requires very small investment and fetches good market price in the market.

Mushroom production

There is a considerable demand of medicinal mushrooms in addition to edible mushroom species in India. Paddy straw can be used effectively for mushroom production. With a small investment, it has the potential to generate quite handsome income to the farmers.

Poultry

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Poultry contributes significantly to animal protein consumption in recent times. Construction of poultry shed over the pond doesn't even need extra area and the bits acts as feed for the fishes. Various breeds of poultry such as *kadaknath, aseel, vanraja etc*. are suitable for normal Indian conditions. The meat and eggs fetches a good market price to the farmers.

Duck rearing

Ducks are quite hardy, more easily brooded and are resistant to common avian diseases. Among the duck breeds *Khaki Campbell* is known to be the highest egg producer in the World. Duck eggs are comparatively higher in price as compared to poultry eggs and this enterprise can be very remunerative to the farmers.

CONCLUSION

The government's flagship programme of "Doubling the farmers' income by 2022" is challenging the status of all involved stakeholders. Increase in production and productivity alone will not ensure doubling farmers' income (Srinivasan, 2017). Therefore, there is a need for adoption of sustainable farming systems with appropriate combination of different enterprises which are location-specific to address the problem of shrinking agricultural economy thus enhancing the livelihood security of small and marginal farmers.

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MICROGREENS: Micro-scale vegetable production & a new beginning towards nutrition and livelihood in urban-periurban and rural area

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Dishaben K. Patel
Ph.D. Scholar, Dept. of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh-362001

INTRODUCTION

Interest in fresh, functional foods is on the rise, compelled by the growing interest of Consumers for diets that support health and longevity. Microgreens garner immense potential for adapting leafy vegetable production to a micro-scale and for improving nutritional value in human diet. The spectrum of life in terms of income, life style and spending is changing rapidly with economic development leading to major challenge of numerous diseases related to nutritional deficiencies. Non- availability of fresh and pesticide residue free vegetables for consumption**.** Diet related diseases – imbalanced food consumption patterns. The present per capita availability of vegetables in India is only 210 g against the requirement of 300g/ capita / day for normal health as per the Recommended Daily Allowance (RDA). Households in large cities in low-income countries like India spend 50-80 per cent of their incomes on food and nutritional deficits in macronutrients and essential micronutrients are common.

Now-a days, non-availability of fresh and pesticide residue free vegetables for consumption is increasingly becoming major concern for vegetarian population of our country. So, Microgreens: a new class of edible vegetables with lots of potential in term of nutritional ability to cure various deficiencies presents a homestead option towards nutritional security. As these can easily be grown in urban or peri-urban areas, where land is often a limiting factor, either by specialized vegetable farmers or the consumers themselves. Simultaneously, they also offer opportunities for rural population of our country to enhance dietary status of their food. Microgreens can easily be grown with and without soil organically in short period of span of 10-15 days around or inside residential areas. Moreover, microgreens are usually consumed raw; hence there is no loss or degradation of micronutrients through food processing. In recent years, consumption of microgreens has increased along with consumer awareness and appreciation for their tender texture, distinctive fresh flavours, vivid colours and concentrated bio-active compounds such as vitamins, minerals, antioxidants *etc.*

Scope and approach:

Major preharvest factors of microgreens production, such as species selection, fertilization, biofortification, lighting and growth stage at harvest are addressed with respect to crop physiology and quality, as well as postharvest handling and applications, temperature, atmospheric composition, lighting and packaging technology which influence shelf-life and microbial safety. Key prospects for future research aiming to enhance quality and shelf-life of microgreens are highlighted.

Microgreens:

Microgreens are a new class of edible vegetables, a very specific type which includes seedlings of edible vegetables, herbs or other plants, ranging in size from 8 to 10 cm. Microgreens contain three part central stem, cotyledon leaves and first pair of very young true leaves. Based on growth stages of plant, microgreens fall in the stage older than "Sprouts" and younger than "Babygreens".

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Sprouts: Germinated seeds with emerging root.	
Micro greens: 2-3 inches in height; 7- 21 days (harvest stem, cotyledons and emerging true leaves).	
Baby greens: 4-6inches in height ; 21 -40 days	

Nutritional status:

- Phytonutrient levels differ according to the growth stage and colour of the plant and often decrease from the seedling to the fully developed stage.
- Seven days after germination, lettuce microgreens had the highest total phenolic concentration and antioxidant capacity in comparison to the mature plants.
- Spinach microgreens generally had higher levels of phytonutrients and the carotenoids than mature leaves.
- Micro greens from *Brassica* species are good sources of phenols.
- Microgreens = 'Functional Foods'.
- Nutritional miracle food.

Health benefits of microgreens:

- Cure anaemia
- Anti – cancer properties (rich in antioxidants).
- Anti – septic and anti – inflammatory properties.
- Reduce the constipation.
- Protects the body from harmful effects of free radicals.
- Reduce the risk of eye diseases.
- Maintains the strong and healthy bones.
- Promotes blood clotting.

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Important vegetable crops as Micro greens:

Red Amaranth	Beetroot	Broccoli
Sweet and tangy flavour, add vibrant dash colour to salad, used in garnishing. 	Attractive, deep reddish metallic purple leaves, high antioxidant properties and rich in vitamins. 	Rich in vitamins, minerals, enzymes, protein and chlorophyll, stimulate the immune system. 
Cress	**Dill**	**Fenugreek**
Peppery flavor, garnishing and addition to salads and sandwiches, source of vitamins A, C and S. 	Fine, feathery foliage and a great flavor, blends well with cucumbers, cheese, salmon and cabbage. 	Rich in protein, vitamins A, D, E, B and minerals, stimulate the appetite and effective against anaemia and fatigue. 
Kale	**Linseed / Flaxseed**	**Radish**

Cabbage like flavour, colourful leaves, add vibrancy to salads, antioxidants, prevent macula degeneration. 	Spicy, tender, nutritious, rich in Omega-3 fatty acids, good source of vitamins, minerals, anti-oxidants and amino acids. 	Rich in Ca, Fe, K, Zn, carotene, antioxidants, vitamins and protein, Stimulate immune system. 
Red Cabbage	**Fennel**	**Mustard**
Rich in vitamins A, B, C, E, K, minerals and chlorophyll, stimulate immune system. 	Higher in K, vitamins C, B and Phytonutrient, Decrease risk of heart disease. 	High in antioxidants, protein, vitamins, and minerals, Stimulate blood circulation and effective against fever and cold. 
Onion	**Pea**	**Red Veined Sorrel**
Full of vitamins, minerals such as Ca, K, S, protein, enzymes and chlorophyll. 	Nutritious and source of vitamins A, C, K and minerals Ca, Fe, Mg, P, K, amino acids and protein. 	Boost eye sight, strengthen the immune system, build strong bones, prevent cancer, lower down blood pressure. 
Golden Corn	**Carrot**	

Sweet flavor, used in garnishing, good source of vitamin B, antioxidant and carotenoids. 	Rich in β-carotene, phytonutrient like lutein and zeaxanthin, Good for beautiful skin, cancer prevention and anti-aging. 

Homestead utility:

Microgreens are vivid in colour, so can be used in plate presentation and garnishing, which introduce hidden tangy flavours dishes. A tiny pile of microgreens can also be used to add flavours in salad. India represent vide variety of eatables in daily diet, nutritional enrichment of which can be done with microgreens. Some of the homestead utilities of microgreens are presented below:

Idada with mustard microgreens

Mix vegetable soup with microgreens

Khaman with microgreens

Commercial Utility:

Microgreens are highly perishable in nature and it can't be stored for a long time in open as well as refrigerator conditions. To overcome this problem and to fulfill commercial utility of microgreens, they are sold as living microgreens. Living microgreens are the freshest and most nutritious greens and can be stored in the refrigerator for up to 14 days or at room temperature for 4-6 days with daily watering. They are sold in the market at rate of Rs. 200 per 100. However, branding of microgreens is very important to make commercial utility successful, so proper packaging of living microgreens is essential to attract masses particularly new generation towards this new class of edible vegetable as is being done in developed countries like USA.

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NANOTECHNOLOGY: A promising technique in pest management

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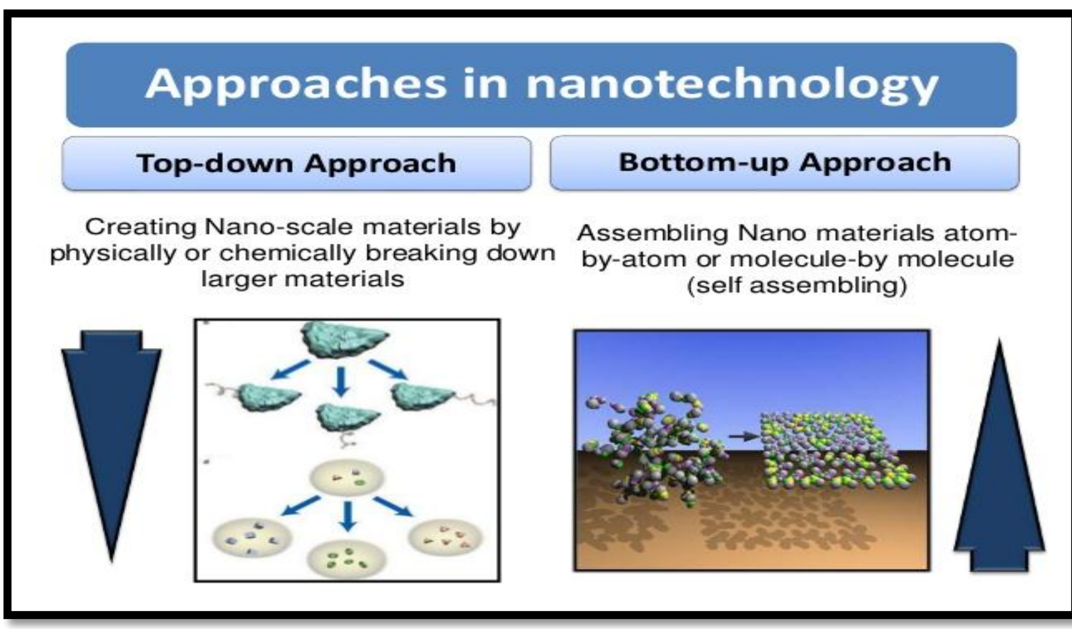
Babli Bagri*, Saswati Premkumari and Rohit Chauhan
Reaserch Scholars, Department of Entomology and Agricultural Zoology
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005

INTRODUCTION

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. For example, a virus is roughly 100 nm in size. Naturally, the word nanotechnology evolved due to use of nanometer size particles (size of 1 to 100 nm). The potential uses and benefits of nanotechnology are enormous. These include agricultural productivity enhancement involving nanoporous zeolites for slow release and efficient dosage of water and fertilizer, nanocapsules for herbicide delivery and vector and pest management and nanosensors for pest detection. Traditional strategies like integrated pest management used in agriculture are insufficient, and application of chemical pesticides have adverse effects on animals and human beings apart from the decline in soil fertility. The atom by atom arrangement allows the manipulation of nanoparticles thus influencing their size, shape and orientation for reaction with the targeted tissues. It is now known that many insects possess ferromagnetic materials in the head, thorax and abdomen, which act as geomagnetic sensors. Focused on nanoparticles in insects and their potential for use in insect pest management. Leiderer and Dekorsy (2008) found that targeted nanoparticles often exhibit novel characteristics like extra ordinary strength, more chemical reactivity and possess a high electrical conductivity. Thus, nanotechnology has become one of the most promising new technologies in the recent decade. Nanoparticles possess distinct physical, biological and chemical properties associated with their atomic strength.



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Management of insect-pests using nanotechnology: as modern approaches

Applications of nanotechnology in agriculture, it can be suggested that the use of nanomaterials will result in the development of efficient and potential approaches for the management of insect pest in agriculture.

Nano-pesticides

Nano-pesticides defines as any formulation that intentionally includes elements in the nm size range and/or claims novel properties associated with these small size range, it would appear that some nano-pesticides have already been on the market for several years. Nano-pesticides encompass a great variety of products and can't be considered as a single category. Nano-pesticides can consist of organic ingredients (e.g., a.i., polymers) and/or inorganic ingredients (e.g., metal oxides) in various forms (e.g., particles and micelles). The aims of nano-formulations are generally common to other pesticide formulations and consist in:

1- Increasing the apparent solubility of poorly soluble active ingredient,
2- Releasing the active ingredient in a slow/targeted manner and/or protecting the active ingredient against premature degradation.

Formulations of Nano-pesticides:

1. Nano-encapsulation

Nano-encapsulation is a process through which a chemical is slowly but efficiently released to the particular host for insect pests control. Release mechanisms include dissolution, biodegradation, diffusion and osmotic pressure with specific pH (Vidyalakshmi et al., 2009). Encapsulated citronella oil nano-emulsion is prepared by high-pressure homogenization of 2.5% surfactant and 100% glycerol, to create stable droplets that increase the retention of the oil and slow release. The release rate depends upon the protection time; consequently a decrease in release rate can prolong mosquito protection time. A nanogel has been prepared from a pheromone, methyl eugenol (ME) using a low-molecular mass gelator. This was very stable at open ambient conditions and slowed down the evaporation of pheromone significantly. This enabled its easy handling and transportation without refrigeration, and reduction in the frequency of pheromone recharging in the orchard. Notably the involvement of the nanogelled pheromone brought about an effective management of oriental fruit fly, Bactrocera dorsalis, a prevalent harmful pest for a number of fruits including guava.

2. Nano-particles

The pediculocidal and larvicidal activity of synthesized silver nanoparticles using an aqueous leaf extract of *Tinospora cordifolia* showed maximum mortality against the head louse *Pediculus humanus* and fourth instar larvae of *Anopheles subpictus* and *Culex-quinque fasciatus* (Jayaseelan *et al*., 2011). Nanoparticles loaded with garlic essential oil are efficacious against *Tribolium castaneum* Herbst (Yang *et al*., 2009). Nanotube filled with aluminosilicate can stick to plant surfaces, while ingredients of nanotube have the ability to stick to the surface hair of insect pests and ultimately enter the body and influence certain physiological functions (Patil, 2009). Nanoparticles present possibilities for more efficient and effective control of pests, but our relative lack of information on how they act and how they can be contained are giving regulators pause before allowing their release into the environment (Khot *et al*. 2012). Nanopesticides hold promise for reducing the environmental footprint left by conventional pesticides.

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3. Nano-emulsions

Nano-emulsions (also referred to as mini-emulsions, ultrafine emulsions, and submicron emulsions; (Lawrence and Warisnoicharoen, 2006; Anton *et al*., 2008; Song *et al*., 2009) are emulsions with a droplet size that can be related with those of micro-emulsions. Even though there still appears to be some disagreement between authors regarding the appropriate terminology, the main difference between micro-emulsions and nano-emulsions is usually based on stability status. As micro-emulsions are thermodynamically constant, nano-emulsions have the affinity to divide into the component phases. Nano-emulsions may however acquire a comparatively high kinetic (meta-) strength (Gutierrez *et al*., 2008) and are often said to be metastable.

Table: Several examples of polymers often used in the nanoparticle production.

Polymer	Active compound	Nanomaterial	References
Lignin-polyethylene	Imidacloprid	Capsule	Flores-Cespedes *et al.,*(2012)
Polyethylene glycol	B-Cyfluthrin	Capsule	Loha *et al.,* (2012)
Chitosan	Etofenprox, Piperony	Capsule	Hwang *et al*., (2011)
Polyethylene	Butoxide And Deltamethrin	Capsule	Frandsen *et al.*, (2010)
Polyethylene glycol	Garlic Essential oil	Capsule	Yang *et al.,* (2009)
Alginate-bentonite	Imidacloprid or Cyromazine	Clay	Fernandez-Perez *et al.*, (2011)
Lignin	Imidacloprid or Cyromazine	Granules	Fernandez-Perez *et al.,* (2011)
Carboxymethyl chitosanricinoleic acid	Azadirachtin	Particlea	Feng and Peng (2012)
Vinylethylene and vinylacetate	Pheromones	Resin	Wright (1997)

CONCLUSION

Nanotechnology has the potential to revolutionize the existing technologies used in various sectors including agriculture. Nanotechnology may have concrete solutions against many agriculture-related problems like insect pest management using traditional methods, adverse effects of chemical pesticides, development of improved crop varieties, etc. Nanomaterials in different forms can be used for efficient management of insect pests and formulations of potential insecticides and pesticides. Nanoparticle mediated gene transfer would be useful for the development to new insect resistant varieties. Therefore, it can also be concluded that nanotechnology can provide green and eco-friendly alternatives for insect pest management without harming the nature.

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Management of nematode pests in crops

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Bolli Venu Babu* and Mogili Ramaiah[1]
Ph.D. Scholar's, Division of Nematology* & Division of Entomology1 , ICAR- IARI, New Delhi – 110012

INTRODUCTION

Plant parasitic nematodes are microscopic, thread like, soil-born organism, found in every conceivable environment. These organisms are basically root feeders causing injury to the plants, which adversely affect the function of the root to absorb and translocate nutrients and water efficiently result into nutrient deficiency like symptoms. The most important nematode is root-knot nematode, *Meloidogyne* sp. distributed worldwide and can infest more than 2000 species of plants. Cereal cyst nematode, *Heterodera avenae* - an important nematode pest of wheat, barley and oat, citrus nematode, *Tylenchulus semipenetrans* associated with citrus dieback and slow decline, burrowing nematode, *Radopholus similis* causing spreading decline in plantation crops, the reniform nematode, *Rotylenchulus reniformis* in vegetables and cotton and the rice root nematode, *Hirschmanniella* spp in lowland rice as well as rice root knot nematode *M. graminicola* in up land are few other damaging nematodes.

A number of management options based on physical, chemical, biological, and cultural methods have been found effective, to different degrees, in reducing nematode population densities and improving crop performance. Generally we focus on judicious combination of different control options suitable for location specific conditions. The main aim of management is to maintain nematode population densities at levels below the economic injury threshold or to reduce their levels such as to derive maximum profits out of the management cost incurred.

Cultural Control

Crop rotation: continuous growing of crop in a particular field lead to gradual reduction of productivity and a stage come when cultivation is no more profitable. From the scientific knowledge it has been confirmed that some of the pest problems could be better managed by if proper cropping system is adopted.

a. Root- knot disease of vegetable and pulse crops: Rotate the field at least for 1 year with wheat barley/ mustard/ toria/ African Marigold in rabi and rice/ bajra/sorghum during *kharif* season.

b. Molya disease of wheat: Replace wheat/barley with mustard, gram fenugreek or crops in *rabi* at least for 2-3 years in infested fields, helps in reducing the cyst population by 40-60%.

c. Intercropping: Root-knot nematode problem can also be managed by mix cropping or intercropping with *Tagetes* spp. either as 1:1 or 1:2 ratio of crop/tagetes. It is helpful in reducing the population by 20%.

Deep Summer Ploughing: Deep ploughing during peak summer May-June is very helpful to control harmful pest and diseases of soil born pests including controlling of nematodes. Besides, it also encourages beneficial microflora and help to improve the soil fertility.

Organic amendment: By incorporation of organic amendments like deoiled cakes of mustard, groundnut, mahua and Karanj C:N ratio of soil is improved which further help in availability of nutrients and consequently improved crop growth and yield and also encourages beneficial microflora and make the soil as soil suppressant of pest and diseases.

Solarization: Prepare the area for nursery bed for sowing, give light irrigation and cover with polythene sheets (40-100 µm thickness). Leave it for preferably 3 weeks. By this time most of the plant parasitic nematodes in the upper soil layers are killed.

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Use of resistant varieties: Resistant cultivars affect the multiplication of nematodes. This is easy, cheap and environmentally friendly. Grow resistant varieties to minimise the yield loss due to nematodes as under ;

1. Tomato: VFN-8, SL-120, PNR-7, Ronita, Hisar Lalit, Patriot against root-knot nematode.
2. Chilli: Malagachi yellow, Julandhari, Pusa Jwala against root-knot nematode.
3. Wheat: Raj-MR-1, against cereal cyst nematode, *Heterodera avenae*

Adjustment of sowing or planting time may help in avoiding nematode damage in regions with well defined winters, such as in the north Indian plains. Most tropical plant parasitic nematode species (except ear-cockle, potato cyst and cereal cyst nematodes) are slow in invasion and reproduction during winter than in summer.

Clean and healthy cultivation: It is always advised to use certified seed free of any disease causing organism. Earcockle disease of wheat is seed born caused by *Anguina tritici*.

Control of ear-cockle and tundu disease :

The control of this nematode can be obtained if the seed material is free from contaminated wheat seed galls. This is very easily achieved by :

i). Sieving (0.2 mm) the wheat seed material to eliminate gall, the one which passes through it should be discarded.

ii) Winnowing the seed in air to remove light seed galls.

iii). Dipping the wheat seed material in salt solution (500 g/10 litres of water), removing the floating seed galls.

Physical Control

- **Slash and burn farming**: By burning the crop residue for a period of 10 min. can raise the temperature of upper layer (10 cm depth) of soil to 45°C. This is not only helpful to reduce the pathogen and also but also kill aerial parasitic worm like *Anguina tritici*.
- **Hot water treatment:** Hot Water Treatment at about 50°C for 10 min and at 55°C for 3-4 min. The efficiency could also be enhanced by first giving cold water treatment for 2-3 wks, keep them for 37 °C for one day and then finally give hot water treatment of root system at 48°C for 30 min.

Biological Control

Besides, *Pasteuria penetrans*, a bacterium, several fungi like *Dactylella cynopaga*, *Dactylaria eudermata, Arthrobotrys* spp., *Cytopage* spp. and *Stylopage* spp. etc. have been reported as nematophagous. Also some of the endoparasite fungi like *Paceilomyecs lilacinus*, *Verticillium chlamydosperium*, *Trichoderma viride* and *Aspergillus niger* has shown potentialities against various nematodes and there is a scope of commercialization. Application of *P. penetrans* in nursery bed in combination with carbofuran @ 1.5 kg a.i./ha was as good as carbofuran applied @ 3 kg a.i./ha in respect to plant growth parameters and nematode reduction.

Chemical Control

Chemical nematicides have been found to give quick and demonstrable control of nematodes. Previously fumigants were used now systemic chemicals such as Nimitz, Flupyrum are entered in the market. They can be applied via various ways such as seed treatment, spot treatment, row application, nursery bed treatment chiesel application, spray, split dose etc.. Indiscriminate use of chemicals be avoided as it can cause pest resurgence. The most important nematicide recommended include carbofuran 3G @ 1-2 kg a.i./ha, Triazophos 40 EC.@ 1-2 l/ha, carbosulfan 25 ST as seed treatment @ 1-2% w/w are being recommended for transplanted and direct seeded crop plants:

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Transplanted crops

Nursery bed treatments: Prepare the nursery seed beds thoroughly. Apply carbofuran @ 0.3 g a.i./m^2 (Furadan 3.3g/m^2). Mix it in the upper 5 cm soil and sow the seed. The nursery so raised is healthier and establishes better under field condition with minimized nematode infestation and enhanced yields.

Bare root dip treatment: The nursery seedling raised in untreated / treated bed may be given bare root dip in triazophos (40 EC) solution @1000ppm (2.5ml/l water) for six hours during day time prior to its transplant in the main field.

Direct seeded crops

Seed Treatments

The seeds of directly seeded vegetable and pulse crops (okra, cucurbits, cowpea and beans) may be treated with carbosulfan (Marshal 25 ST) @ 3%w/w (120 g/kg seed) using need based gum as sticker. The plants raised from such treated seeds are healthier, carry reduced nematode infection and give more yield.

Integrated nematode management:

Summer: Two or three deep summer ploughing with a soil turning harrow at fortnightly intervals, preferably with a light irrigation between two ploughings; soil solarization of nursery-beds or pit soil using clear thin polyethylene mulch for 3 - 6 weeks before sowing; application of granular systemic nematicides to nursery-beds; growing of non-host or antagonistic commercial crop, and ploughing back non-commercial crop residues before monsoon.

Monsoon: Green manuring with non-host or trap crop or application of organic soil amendments/ manure.

Kharif**:** Growing non-host or resistant commercial crops; nematicidal treatment of nursery-beds and seed; spot application of systemic nematicides in high value crops; uprooting and burning of roots of host crops and weeds after harvest.

Rabi: Delaying sowing/ planting to mid-November (when soil temperature falls to 15-18^{o}C); restricting growing of susceptible or tolerant crops to *rabi* season with a suitable period of rotation; removal and burning of roots; ploughing back non-commercial but disease-free crop residues.

Thus management of nematodes is essential in order to prevent yield losses of plants by nematodes.For that different techniques are available to manage the nematode population below the level they cause economic damage

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Cultivation technology of button mushroom *Agaricus bisporus* (Lange) Sing

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Baby Kumari[1], Shruti kumari[2], Asharani patel[3] and S.K. Suman[4]
Department of Plant Pathology, BAU Sabour, Bhagalpur[1]
Division of seed science and technology ICAR-IARI New Delhi[2]
Division of Plant Pathology ICAR-IARI, New Delhi[3]
Home Science-Food and Nutrition, T.M. Bhagalpur University, Bhagalpur[4]

INTRODUCTION

Cultivation of mushroom is being considered as one of the most significant agriculture business that can be started with minimum investment and got maximum profit in less time. Today we have achieved food security by producing about 240 million tons of food grains. However, our struggle to achieve nutritional security is still on. (V. PRAKASAM*). Mushroom cultivation are environmental friendly that impart diversification and also help in addressing the problems of quality food, health and environmental sustainability the technology is most suitable for creating wealth out of wastes. In India, button mushroom are grown seasonally, during the winter months and in environment controlled cropping room. The growers can take average 3-4 crops of white button mushroom s in a year. Button mushroom cultivation consists of five steps.

Mushroom Growth Cycle

Phase I – Substrate Preparation

Exothermic fermentation during Phase 1 raises compost temperature to 170 ^{o}F

Compost filled into mushroom beds or transferred to tunnels for Phase II treatment.

Phase II –Spawning

Mushroom spawn on sterile grain introduced onto the pasteurized compost

Phase III–Spawn run

Mushroom compost fully colonized by mushroom mycelium and ready for casing application.

Air temp, substrate temp, % R.H., air circulation are controlled in growing rooms

Mushroom spores germinate and mycelium runs through substrate.

Phase IV –Casing and Cropping

Top Dressing of casing soil applied to beds to support growth of primordial fruiting bodies

Mushroom Buttons appear 16 days after casing. Hand harvesting begins and continues

Growing Room emptied, cleaned, sanitized and beds treated with steam to prepare for new crop.

Phase V – Harvesting

The mushrooms is plucked by holding the cap between the fingertips slightly pressed against the soil

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Compost is a mixture of decomposed organic and inorganic substances with nutrient composition selective for the growth of the common cultivated mushroom, the substrate in which the mushroom mycelium grows and on which it produces fruiting bodies. It is the product of a fermentation process brought out by a number of mesophilic and thermophilic microorganisms that decompose plant residues and other organic and inorganic matters. The quality of compost influences the yield of mushroom. A steam-sterilized grain colonized by the mycelium of the mushroom and used to "seed" mushroom compost. The process of mixing spawn with compost is called spawning. Three methods of spawning were employed for substrate inoculation. (Siddhant et al., 2013).

Surface Spawning- Compost filled in formalin sterilized wooden boxes or beds and the spawn evenly spread in the top layer of the compost and mixed. The top portion covered with a thin layer of compost and covered with formalin sterilized newspaper sheet to prevent loss of moisture content in mushroom beds.

Layer Spawning - In this process spawning done by scattering the spawn on boxes beds once when half-filled with compost and secondly, after the complete filling of the boxes. The spawn gently pressed down with the forefinger uniformly each time and trays covered with formalin sterilized newspaper sheets.

Mix Spawning- The spawn mixed with compost @ 500 gm / 100kg of compost and filled in formalin sterilized wooden boxes and covered with formalin sterilize newspaper.

Spawn Run -The process of colonization of compost from grain- inoculum is called spawn-run. The room in which spawning wooden boxes or beds placed , kept closed as only a small amount of fresh air recirculating within the crop room for maintain the carbon dioxide levels . Mushroom boxes were completely colonized by mushroom mycelium within (20-31days). The compost becomes lighter in colour and the mycelium seen as thin white-threads.

Casing- An organic material, usually consisting of a mixture of Garden soil, FYM, and vermincompost that has been sterilized and then cover the colonized by mushroom mycelium. The casing mixtures before application should be sterilized with formaldehyde (2%) and bavistin (75ppm). The treatment may be done 15 days before the materials used for casing. After spawn run the surface of compost uniformly layer about 2.5 to 3.5 cm by casing formulations (Ram and Kumar, 2010). The beds spray with water containing 2% formalin just after casing. One day later spray at the same rate with water containing 2% nuvan. The cased boxes were kept moist applying water spray once or twice. After casing daily checks of room and compost temperature which was 24^0c -26^0c and relative humidity was maintained at about 90% by spraying the walls and floors with water.

Cropping - No watering is done when pinheads in button mushrooms being formed. When they grow to the size of a pea, regular watering is starting to keep the surface moist. Watering is done according to (Libick *et al*., 2004) with a spraying machine, used to spray insecticides.

Harvesting- Pin head will start appear in the trays in 15-24 days after casing and the cropping continues for another three months. Regular periodical watering was done carefully by gentle spray. Mushrooms pluck

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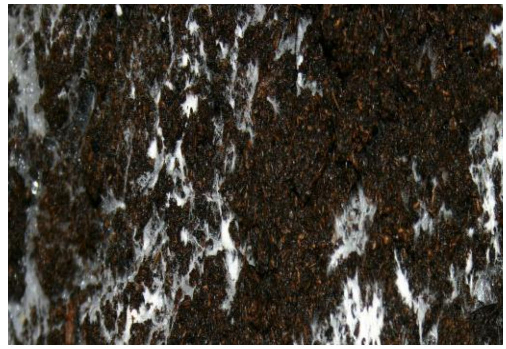
just before the cap expands. At this stage the caps measure 2.5-8 cm across. The mushrooms is pick by holding the cap between the fingertips slightly pressed against the soil, and gently twisted and pulling out from the soil and these holes is fill with fresh sterilized casing soil.

Photographs of different stages of Button mushroom cultivations.

Spawning



Running Mycelium

Pinhead initiations

Fruiting bodies

CONCLUSION - Successful mushroom production involves of interrelated factors. Production of compost that is selective for mushroom growth, different spawning techniques influence mycelium growth and casing materials which provides optimum conditions for fructification.

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Role of ICT in agricultural marketing

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Pooja Konhar[1], Aditya Kumar Malla[2], Abhisek Tripathy[3], Ashruti Kesharwani[4]
[1]Ph.D. Research Scholar, Dept. of Agricultural Entomology, IGKV, Raipur
[2]Ph.D. Research Scholar, Dept. of Extension Education, O.U.A.T, Bhubaneswar
[3]Ph.D. Research Scholar, Dept. of Plant Pathology, O.U.A.T, Bhubaneswar
[4]Ph.D. Research Scholar, Dept. of Plant Pathology, IGKV, Raipur

INTRODUCTION

Since the beginning of the civilization, agriculture has been the primary occupation of the majority of the people of India, be it ancient India, British India or modern India. 58 per cent of people earn for their livelihood from the agriculture and it is ranked second in the farm output of the world. It is the functionality of the small holder farming is the basic. They routes the small and marginal farmers to restore the problems to become the fulcrum of the green revolution ever with the enormous growth in the agricultural sector. Some of the factors that limit the farmers in the increase of their incomes are the difficulty in accessing the technology available, government policies, available resources, markets for the products, and other institutional services.

They are in front of a lot of problems in taking full advantage of the crop productivity and earning. In unkindness of triumphant research on new agricultural practices, the common of farmers are not getting high end yield due to quite a lot of reasons. One of them is that professional scientific guidance on crop production and selling is not getting the farming community in a timely manner. But the introduction of ICT in agriculture enables the dissemination of requisite information at right time in a cost-effective manner.

- The future lies in rural computing. Using ICTs for timely market and weather information is key to development in the farming sector. We should tailor our rural ICT Policies according to our requirements.
- There is a need for Integrated Website for all agencies, of both State and Central Government, involved in Agricultural marketing services using ICT like APEDA, APMCs, CWC, SWCs, CACP, CCI, DMI, FCI, JCI, KVKs, MPEDA, NAFED, TRIFED, NCDC, NDDB,NHB, SAMBs etc.
- Establishment of AGMARKNET Nodes at KVKs and Panchayats and computerization of all mandies/APMCs. Wholesale markets should have WiMAX based Internet Hubs.
- ICTs cannot succeed on a stand-alone basis and need to be supplemented by other programmes. e.g. Academic and research data in agriculture marketing needs to be digitalized and it is also necessary to make available the digitalized literature in local languages. Support is also needed to facilitate Cross-flow of information.
- The involvement of a local partner in the delivery of the services will be significant for a disciplined market.
- India needs to develop a structured nationwide common spot exchange.
- Arrangement should be made to introduce electronic scientific grading of agricultural commodities in the markets or for a cluster of markets.

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- The small and medium farmers are always lacking in resources. In spite of lowest price paid by wholesalers, most of the small and medium farmers sell their produce to the wholesalers in lien of receipt of advance borrowing from them. Adequate and timely on-line credit facilities should be made available, at reasonable rates of interest, by the financial institutions so that farmers can come out from the clutch of wholesaler.
- Tele-density in rural areas continues to be low, increase in tele-density as an important component of infrastructure development should be taken up.
- There is need for greater synergy between extension services and market.
- Strengthening of Agriculture Business Process through e-Form, e-Document, Workflow Computing should also be given importance

MARKET RESEARCH

Market research is a way of getting an overview of consumers' wants, needs and beliefs.

Factors that can be investigated through market research include:

MARKET INFORMATION

Through market information one can know the prices of different commodities in the market, as well as the supply and demand situation. Market researchers have a wider role than previously recognized by helping their clients to understand social, technical, and even legal aspects of markets.

MARKET SEGMENTATION

Market segmentation is the division of the market or population into subgroups with similar motivations. It is widely used for segmenting on geographic differences, demographic differences (age, gender,ethnicity,etc.), technographic differences, psychographic differences, and differences in product use. For B2B segmentation firm graphics is commonly used.

MARKET TRENDS

Market trends are the upward or downward movement of a market, during a period of time. Determining the market size may be more difficult if one is starting with a new innovation. In this case, you will have to derive the figures from the number of potential customers, or customer segments.

The following are the examples of interventions through ICT in various agriculture and allied activities:

(a) Crop Advice from Experts using Digital Photos:

Project e-Sagu of the International Institute of Information Technology (IIIT) in Hyderabad, India enables farmers to receive advice on planting, monitoring and harvesting crops and on pesticide and fertilizer usage based on digital photos taken by the farmers themselves.

(b) Weather and Pest Information for Farmers:

In Turkey, the agricultural department established five weather sites to monitor the need for pest control and frost prevention, and now provides this information to farmers via their cell phones. The

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service gathers information about when pests are likely to be prevalent by placing pest traps and observing temperature levels. Using the information, the farmers have been able to reduce their use of pesticides by 50 percent – lowering expenses and improving crop productivity. The tracking of temperatures also helps farmers to prevent losses from frost by monitoring temperatures hourly and sending text messages to the farmers, who can then take crisis management measures, such as burning dead leaves near their fields.

(c) Distance learning to help women in India overcome Drought and Pests:

In 2004, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) created a Virtual Academy that trains local women who then, with the help of remote scientists, provide critical information to farmers in 21 villages. These women meet ICRISAT scientists via audio and video conferences and exchange key information about droughts, planting practices, pest control, soil fertility, etc. For example, Rameswaramma, a 38-year old villager from Nijalapur village underwent computer and agricultural technical training from the Virtual Academy (and won an award for her efforts). She now helps local farmers experiment with drought-resistant crops, such as castor, and shares other agricultural practices, market prices and weather information with the help of the remote scientist experts.

(d) Sea Conditions for Fish Farmers:

The Chilean Aquaculture Project provides daily information about the sea surface temperature, the clarity of the seawater and the amount of chlorophyll in the water. Information on chlorophyll content enables fish farmers to take action when harmful algal blooms multiply to a level where they threaten farmed fish.

(e) AGRONET (Colombia):

A decentralized agricultural information and communication network aims to provide strategic, appropriate and concise information to smallholder farmers and policy-makers about new technologies for sustainable food security and crop diversity to improve productivity and market opportunities. The network is based on a technical platform that integrates several databases and provides data analysis and business intelligence tools.

CONCLUSION

This article deal with the role of ICT application in agriculture at global perspective. Many ICT applications for agriculture development reveal the importance and role of ICT applications for agriculture in global level. Many countries including developed and developing countries are giving much importance for ICT applications. The e-agriculture initiative focused the emerging trend and utilization of ICT in global level. But still many developing countries like African countries and others are lagging behind to have the fruitfulness of effective ICT utilization in agriculture sector.

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Strategies for Plastic Waste Mitigation

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Shikha Pandhi
Research Scholar, Department of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005

INTRODUCTION

Matter is annihilated and made constantly in the universe. Any conflict in this case, may be devastating to the universe. In this context, the major issue of concern is the excessive use of plastics or plastic bag for serving various purposes. Plastics are a ubiquitous packaging material of universal choice for Fast moving consumer goods (FMCG) products such as foods, beverages, medicines etc. Outrageously disposed plastic materials contribute significantly to environmental pollution, potentially harming life as they are typically idle and impervious to microbial attack and in this way they stay in the nature with no discharge for long time (Orhan et al 2004). Vital material utilized for making plastic are obtained from coal, oil and flammable gas. They include polymers such as polyethylene, polypropylene, polystyrene, polyvinylchloride, polyurethane, polyethylene terepthalate (PET), Nylon (Shah 2007). The plastic films or pouches prevent migration of water and air to go into earth resulting in infertile soil, preventing degradation of other ordinary substances, depletion of underground water source and threat to animal life (Cooper and Vaughan 1967). There had been much technological advancements made to mitigate plastic waste disposal related issues such as:

Preventive Measures:

1. Recycling

In the midst of the current measures for reducing the plastic waste generated, recycling stands out to be amongst the most advantageous and least demanding ways. There are different approaches to take part through government projects or projects keep running by environmental associations. As buyers, the recycling just requires one easy step i.e. putting plastic wastes in right bins for disposal. Isolating the plastic waste from other waste will counteract plastics to be land filled and will enable it to be reused with different plastics of a similar kind. Recycling procedures manages the tones of plastic waste that is gagging earth. So not withstanding creating more quick witted plastics that replaces customary plastics, there is an emerging need for managing the enormous amounts of lethal wastes officially out there and harming people and nature. More intelligent sorting of plastic Wastes, vitality effective methods for disposing of the plasticizers and expanding the size of this whole procedure is exceptionally crucial to overcome this challenge.

2. Reduced use of plastics

Plastic pollution can be reduced by using less plastics products and opting for other biodegradable alternatives. Source reduction (Reduce and Reuse) can occur by altering the look, manufacture, or use of plastic products and materials. Use of paper bags or bags made up of fabric also can be effective in reducing plastic abuse. Reduction in the single use plastic carrier bags is another important aspect for cutting down huge amount of generated plastic waste. Single use plastic carrier bags are used to carry goods from supermarkets and shops. They are called single use plastic bag in the sense that they are mainly use for only

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one single shopping trip (Koushal et al 2014). Reducing the use and reusing are the two main key factors for diminishing the plastic abuse condition.

Alternative solutions:

1. Biodegradable Polymers

In the current years, bio-based and biodegradable items have raised incredible enthusiasm as these sustainable advancement approaches have a tendency to extend with the diminishing reserve of non-renewable energy sources and the developing concern for the environment. These polymers convey a major contribution to the sustainable advancement in perspective of the more extensive disposal options with minor ecological effect. As plastics represent a major portion of waste accumulated at the nearby, state, and national levels. Various foundations are presently aware about of the appreciable funds that compostable or biodegradable materials would create. The capability of biodegradable polymers has been perceived for quite a while since they could be a fascinating method in order to overcome the constraint of the petrochemical assets later on.

The acceptance of biodegradable plastics is a promising and dynamic prospect and will significantly lessen the reliance on non-renewable energy sources. Right now, it is just a choice over conventional plastics, yet in the event that it is to replace traditional plastics totally, individuals would have no other alternative yet to utilize them. Incorporation of biodegradable plastics in daily use would take the weight off from petroleum products. A considerable amount of income from agricultural produce can be created if biodegradable plastics can be made standard. Beside the economic and ecological advantages, biodegradable plastics are dynamic from scientific perspective too.

Plastic Degradation:

1. Biodegradation

Various microorganisms have been studied for their potential to degrade different plastics (called as Biodegradation). Biodegradation also called as biotic degradation is a chemical degradation of materials (i.e. polymers) induced by the action of microorganisms such as bacteria, fungi and algae (David et al 1994; Chandra et al 1998; Lenz 1993; Mohanty et al 2000). The basic definition of a biodegradable polymer is "a degradable polymer which is primarily degraded by a mechanism through the action of metabolism by microorganisms" (Das and Chandran 2010). Different types of microorganisms degrade different groups of plastics indicating their vital role in degradation of plastics. The process of biodegradation using microorganisms had been accepted widely and still in process for enhancing its efficiency. Microorganisms such as bacteria, fungi and *actinomycetes* had shown to degrade both natural and synthetic plastics (Gu et al 2000). Microbial degradation of plastics mainly involves oxidation or hydrolysis that causes cleavage of large compound polymer into small molecule monomer units using microbial enzymes (both endoenzymes and exoenzymes) that are attached to the surface of large molecular substrate by the metabolic process (Albinas et al 2003; Huang et al 1990; Kumar et al 2013).

The mechanism involved in Biodegradation of Plastics converts a polymer into monomers and then these monomers are mineralized or biodegraded inside the cell mainly observed in case of synthetic polymers. Mainly, two types of enzymes are involved in biodegradation of polymers: intracellular and extracellular depolymerases. During the process of degradation various exoenzymes or extracellular depolymerases are produced by microorganisms that convert the long chain polymers into shorter chains. These molecules that obtained include monomers, dimers or oligomers that are small enough in size so as to pass through the semi permeable bacterial cell membrane. These are then utilized by the bacteria as a premium source of carbon and energy. This process is termed as depolymerisation. The process in which the end products are water, carbon dioxide or methane, is called mineralization (Shah et al 2008).

Some Bacterial species namely *Bacillus megatserium*, *Pseudomonas* sp., *Azotobacter sp*., *Ralstonia eutropha*, *Halomonas sp*. etc. are known to possess ability to degrade plastic polymers (Chee et al 2010). The growth of many fungi may results in small-scale swelling and bursting as soon as the fungi penetrate the polymer solids. In recent years fungal strains have been reported for plastic degradation such as *Aspergillus versicolar* , *Aspergillus flavus* (Pramila and Ramesh 2011), *Chaetomium spp* (Soumya et al 2012) *Mucor circinellodies* species etc. The polythene bags were found to be degraded by some fungal species identified as *Aspergillus niger*, *A. ornatus*, *A. cremeus*, *A. flavus*, *A. candidus* and *A. glaucus* were the predominant species. The two bacterial strains namely *Pseudomonas* and *Sphingomonas* have also been discovered to degrade HDPE and convert it into heat, H_2O, CO_2 and biomass (Smith 1964).

Plastic waste utilization:

1. Utilization in Asphalting of roads

The problems associated with disposal of plastic will not solve until successful practical steps are not developed and implemented at ground level. It is possible to enhance the performance of bituminous blend used in the surfacing course of roads. Various studies have indicated the use of recycled plastic particularly polyethylene in the process of manufacture of blended mix that reduces permanent deformation in the form of rutting and diminish low-temperature cracking of the pavement surfacing. The field tests that withstand the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. The waste plastic created can be used to partially replace the conventional material to improve desired mechanical characteristics of particular road mix. There are several techniques developed in order to use plastic waste for construction purpose of roads and flexible pavements (Gawandea et al 2012). In the conventional process of making road bitumen mix is used as binder. Such bitumen mix can be modified using plastic waste pieces. The resultant bitumen mix is then used as a top layer coat of flexible pavement. This waste plastic adjusted bitumen blend demonstrates better binding property, stability, density and more resistant to water.

2. Conversion to liquid fuel

All plastics are polymers generally containing carbon and hydrogen and couple of different components like chlorine, nitrogen and so forth polymers are comprised of little atoms called as monomers which join to form single large molecule called polymer. At the point when this long chain of monomers breaks at specific focuses or when bring down sub-atomic weight portions are framed this is named as corruption of polymer. This process is reverse of polymerization. In the event that such scission of bonds happens haphazardly it is called as 'Random De-Polymerization'. In the process of conversion of plastic waste into fuels Random De-Polymerization is mainly performed in a specially designed reactor in absence of oxygen and in the presence of coal and certain added synergist substance. The thermo-chemical process of depolymerization of plastic wastes into monomers or syngas followed by microbial fermentation can be used to serve various purpose for example, higher value biodegradable polymers has emerged as an

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exciting approach for plastic upcycling (Drzyzga et al 2015; Goff et al 2007; Guzik et al 2014; Kenny et al 2008; Ward et al 2006). By changing over plastics to fuel, we illuminate two issues, one of the substantial plastic oceans, and the other of the fuel deficiency. This double advantage, however will exist just as long as the waste plastics last, yet will without a doubt provide a strong base to us to expand sustainable, clean and green future (Raja and Murali 2011). By considering the money related advantages of such a task, it would be a great aid to our economy.

CONCLUSION

Plastics have turned into a crucial resource for humankind. In spite of the fact that broad research and new advancements have prompted design of more up to date and more secure plastics, yet disadvantages and difficulties of plastics have never been settled and affect is on the ascent. A portion of major compounds such as vinyl chloride, dioxins, and plasticizers are causative elements of hormone-disturbance, regenerative brokenness, breast development and testicular growths. Recycling of plastic waste is a standout amongst the most helpful and least demanding ways. More brilliant arranging, vitality effective ways, creating more quick witted plastics and research to build up specific microbes that fasten the degradation of conventional plastics are a portion of the present time needs. Source diminishment (Reduce and Reuse) can happen by modifying the design, make or lessened utilization of plastic items. Safe disposal of plastic waste via biodegradation should specialize in the foremost consumed polymers (i.e. polyethylene, polypropylene and polystyrene. Biodegradable plastics are plastics that are mainly obtained from sources having the capacity to naturally decompose and break into natural and safe byproducts. To finish up, it isn't the plastics to fault, yet it is the abuse of plastics. The present time requires search for newer mitigation strategies for plastic waste such as more reliable and efficient biodegradable measures and their successful execution.

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Thermo-morphogenesis: Temperature mediated plant growth and development

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Nitin Sharma
Division of Plant Physiology
ICAR- Indian Agricultural Research Institute, New Delhi - 110012

INTRODUCTION

Plants are sessile organisms and are subjected to temperature fluctuations characterized by maximum, minimum and average daily temperatures. Over the period of time these parameters changes, with the summer season exhibiting elevated values and amplitude. Temperature amplitude is highest at soil surface and decreases both above and below the soil surface. Shading from neighbors reduces maximum temperature experienced by the adjacent plant with little effect on night time temperature. These changes in plant tissue temperature depend on changes due to surrounding air (sensible heat loss) and soil (heat conduction), latent heat of vaporization. Thus temperature is one of the major factor governing distribution and seasonal behavior of plants.

The term thermo-morphogenesis is coined by Erwin et al in analogy to photomorphogenesis to describe the effect of temperature on morphological and architectural changes of plants. Thermo-morphogenesis can be categorized into three types viz. warm or cold air temperatures and rhythmic temperature fluctuations. Responses to cold average temperature include vernalisation and stratification and to warm average temperature includes increase in rate of growth and decreased duration of growth. Seed germination and stem growth are responses to the rhythmic temperature fluctuations.

Growth and developmental effect of temperature

Hypocotyl elongation is one of the earliest responses studied in *Arabidosis* seedlings in response to high ambient temperature. Hypocotyl elongation results in away movement of meristematic and photosynthetically active tissues from heat absorbing soil and promotes cooling by allowing access to the moving air.

Upon sensing ambient high temperature, rosette leaves and cotyledons show elongation of petiole. This growth is called as hyponastic growth. This results in reduction of direct heat flux from sun and cooling by the turbulent air. Along with petiole elongation, hyponasty results in an open rosette structure. Such phenotypes show greater transpirational cooling in comparison to their counterparts when subjected to high temperature. In addition, plants growing at high temperatures develop small and thinner leaves with fewer stomata that further assist in cooling by decreasing thickness of boundary layer that dissipates heat by convection and evaporation.

Unimodal shape of the response to temperature

Growth rate response to warm temperatures is unimodal that shows an initial increase, a transition and then decrease. Growth rates show approximately linear relationship between base temperature and optimum temperature. This gave rise to a new concept of growing degree days. Growing degree days is defined as mean daily temperature above a certain threshold base temperature accumulated on daily basis over a period of time. Base temperature is that temperature below which plant growth and development

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stops. For example, base temperature for cereal and forage crops is below 5˚C. In the absence of stress by other environmental factors, daily air temperature regulates rate of development from emergence to maturity. Since many developmental events in plant and insect life depends on quantity of heat accumulation, it is possible to predict growth stages of crop, maturity time, suitability of plant to a particular region etc.

Thermosensing

Phytochrome B in addition to photosensory receptor is also a temperature sensor. Downstream components of thermogenesis include chromatin remodeling, transcriptional changes, alternative splicing, PIF 4 and further downstream genes

Conclusion and future perspective

Major functions of thermomorphogenesis include adjustment to seasonal change, avoidance of heart and water stress. Thus it is likely to have role in crop productivity. Further challenges ahead lies in the identification of key regulators and downstream signaling components to understand how complex environmental signals are coordinating in plant growth and development. This will help in meeting the global challenges of plant productivity under the prevailing scenario of climate change.

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Unfruitfulness in fruit crops: causes and remedies

T. Adhikary
Article id: 23330
Deptartment of Fruits Science, Punjab Agricultural University, Ludhiana, Punjab (141001), India

Unfruitfulness is a major problem in many fruit crops and their varieties result in huge loss to growers and make fruit cultivation less profitable. Unfruitfulness in fruit crops refers to the state where the plant is not capable of flowering and bearing fruit. However, the causes of unfruitfulness can be broadly grouped into two categories: Internal and external factors. Among the internal factors, dichogamy prevents self pollination in perfect as well as monoecious flowers. The occurrence of flowers with variable style length (heterostyly) is common in Prunus fruits (Suranyi, 1976). The proportion of aborted pollen grains varied from 22.5 to 48.0% in cashewnut (Bhattacharya, 2005). In apricot cv. 'Trevatt Blue', multiple ovules and anthers with degenerated microspores resulted in both female and male sterility and in 'Tokaloglu', the reason for unfruitfulness is self incompatibility (Gulcan and Askin, 1991). External factors, like temperature that is above 32°C, result in desiccation of stigmatic surface and more rapid deterioration of embryo sac occurrence (Jindal *et al.,* 1993). For high productivity in delicious apple plant diploid, self-fruitful and compatible varieties ensure cross pollination. Sequential introduction of honeybee increases fruit set and yield of 'Spadona' pear by about 50 to 80% (Stern et al., 2001). Foliar application of boron at a concentration of 200 mgl-1 increases pollen germination rate and tube growth in pear (Lee et al., 2009).

Unfruitfulness can be due to lack of balance between growth and fruiting and lack of flowering and poor fruit-set as the result of various internal and external factors in different fruits and their cultivars. So, it is necessary to make necessary corrective measures which should begin from planning level and extends to an established orchard. The crop/variety should be chosen on the basis of climate and adaphic factors. Different varieties should be cultivated and the introduction of effective pollinizers' varieties and pollinator (Honey bee) is necessary. While selecting pollinators for apple styler, receptivity and pollen potency should be considered first. Therefore, in order to obtain high productivity in apple plant diploid, self-fruitful and compatible varieties are used to ensure cross pollination. Also, old orchards should be rejuvenated. Thinning and crop regulation should be practiced and regular bearing varieties should be planted. So, it is important to analyze the problem and then corrective measures could be suggested. Future strategies should be followed like that there should be less incidence of unfruitfulness of fruit crops. We need to develop regular bearing varieties as per Agro-climatic Zones. Appropriate cultural practices and effective chemical required to develop for increasing fruit set in fruit crops

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Thermal remote sensing as a tool for irrigation scheduling

Article id: 23331
Nitin Sharma
Division of Plant Physiology
ICAR- Indian Agricultural Research Institute, New Delhi - 110012

INTRODUCTION

Thermal remote sensing is a branch of remote sensing that deals with the measurement of radiation emitted from the surface of object and converting into temperature without establishment of the direct contact with object. Thermal remote sensing is different from optical remote sensing as it measures radiations emitted from the surface of targeted object rather than reflected radiations respectively. Thermal wavelength region ranges from 3-35 µm. Interpretation in the range of 3-5 µm is complicated due to overlap with solar reflection whereas 17-25 µm region is not well studied. 8-14 µm has been extensively utilized since to this region atmosphere is fairly transparent and signals is only light attenuated by atmospheric absorption.

All objects with temperature above absolute zero emit radiations in the infrared region of the electromagnetic spectrum. Amount of radiation emitted by an object is a function of surface temperature and emissivity of the surface. Thus, higher the body temperature implies greater the intensity of radiation emitted by an object. Approximately 80% of energy in thermal wavelength region is emitted by the surface of earth, making surface temperature as one of the easiest variable to be determined from the thermal infrared signal. Over the years with the development of infrared instruments or thermal sensors coupled with optical systems, it has found applications in industry, medicine, pharmacy, veterinary and agriculture. Application of thermography includes irrigation scheduling, disease and pathogen detection, detection of soil salinity, estimation of yield maturity evaluation etc.

Irrigation scheduling

Inadequate seasonal rainfall and non-uniform distribution of rainfall makes irrigation an essential part of agriculture. Getting to know when, where and how much water is to applied maximizes resource use efficiency and avoids water stress timely. Water demand by plant is basically determined by four factors viz. water availability in soil, crop water requirement, amount of rainfall and efficiency of irrigation system employed. To quantify these factors numbers of approaches are being employed that include determination of soil moisture, evapotranspiration and plant based temperature.

Soil moisture determination: Soil moisture plays an important role as a carrier of plant nutrients, support microbial growth and regulation of soil temperature. Triangle method and soil moisture index are most commonly used approaches that uses thermal images for soil moisture determination. Vegetation cover and surface soil water content are the major determinants of land surface temperature. Vegetation cover can be determined in visible (380-760nm) and near infrared (760nm-1µ) wavelength region while land surface temperature in thermal infrared band (8-13µ). By interpreting relationship between remotely sensed vegetation index (VI) and land surface temperature (LST), an envelope of data cloud (VI/LST) is created when sufficient number of pixels is present. Hence, a higher VI corresponds to low LST and higher

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surface soil moisture and vice versa. Isolines of surface wetness are thus determined in VI/LST space. This method is called as triangle method. Vegetation experiencing water stress compared to well waterd ones has higher radiant temperature. Shafian and Mass, 2015 developed Prependicular Soil Moisture Index (PSMI) using raw digital count data in near infrared, red and thermal bands of Landsat satellite images.

Crop water stress monitoring: Canopy temperature and stomatal conductance have long been used to monitor crop water stress. A significant rise in canopy temperature above ambient air temperature indicates stomatal closure and crop water stress. Using thermal imaging Jackson et al 1982 devised the concept of crop water stress index (CWSI). CWSI is defined as the difference between air temperature (Ta) and canopy temperature (Tc), normalized for the evaporative demand when canopy transpires to its potential rate (lower limit) and a non-transpiring canopy (upper limit).

$$\text{CWSI} = \frac{(Tc-Ta)-(Tc-Ta)LL}{(Tc-Ta)UL-(Tc-Ta)LL}$$

Whereas UL and LL are upper limit and lower limit respectively. There are analytical (Gonzalez-Dugo *et al.,* 2014) and empirical (Moller *et al.,* 2007) approaches to determine UL and LL.

Evapotranspiration: It is the process by which water is transferred from land to atmosphere by evaporation and transpiration. Reliable estimates of evapotranspiration are thus essential for crop water management. Evapotranspiration is an energy demanding process. Higher evapotranspiration result in decreased surface temperature of land and plants. Using thermal images various empirical indices has been developed and these are as follows (Choi *et al.,* 2013)

$$VHI = \frac{VCI + TCI}{2}$$

Whereas VHI, VCI and TCI are Vegetation health index, Vegetation condition index, Temperature condition index respectively and are calculated as follows

$$VCI = 100(NDVI - NDVImin)/(NDVImax - NDVImin)$$
$$TCI = 100(TBmax - TB)/(TBmax - TBmin)$$

Whereas NDVI, TB are Normalised difference vegetation index and brightness temperature respectively.

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Cyber extension: an advance approach of agricultural extension

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K. D. TANKODARA
Ph.D. Scholar, Department of Agricultural Extension & Communication, AAU- Anand

INTRODUCTION

The weak linkages among extension, research, marketing network and farmers limit the effectiveness of research and extension to contribute to agricultural development. The government of India has identified this problem and is addressing it through National programs. Continuous two-way interaction among the farmers, agricultural scientists and extension personnel is the most critical missing component of agricultural extension in current situations. To assist the farmers in these changing contexts, new strategies and innovative solutions are urgently required which in turn will require technological support. This can be achieved through 'Use of ICTs in agricultural extension as a body of knowledge, popularly known as 'cyber extension'.

CYBER EXTENSION:

The term “cyber extension” is made up from the following terms;

- **Cyber:** According to Oxford dictionary the word cyber means, 'relating to IT, the Internet, and virtual reality, the cyber space.'
- **The cyber space:** Cyber space can be defined as the imaginary space behind the interconnected telecommunications and computer networks and the virtual world.
- **Extension:** Extension stands for 'the action or process of enlarging or extending something.' It could be extension of area, time or space.

Thus, cyber extension can be defined as the 'extension over cyber space'. Cyber extension means ‘using the power of online computer networks with the help of communication channels to the content in the form of text graphics, audio and video either passively or interactively to facilitate dissemination of agricultural technology.’

It includes effective use of ICTs, national and international information networks, internet, expert systems, multimedia learning systems and computer based training systems to improve information access to the farmers, extension workers, research scientists and extension managers.

Why cyber extension is so important to farmers?

Simply the answer is “cyber extension opens the gates of information flow to reach their palmtop”. The main focus of it in agriculture is meeting the farmer needs for information. General agricultural news, information on latest techniques and technologies, weather forecasting, early warning and management of diseases and pests, post-harvest technology, input prices and availability, information on insurance, market information, information about rural development programs and subsidies, are some mandatory needs of farmers that seem to be essential for the growth and development of agriculture. To make cyber extension to be effective there are some ‘imperative tools’ to be set up. Websites, emails and e-newsletters, expert panels’ demonstrations, related internet browsing for extension information, video conferencing, call centers and satellite communication networks, TV programs, news and discussion groups are included in these tools. Implementation and blending of cyber extension systems into agricultural activities is revolutionary.

What is the need of cyber extension?

Major needs for cyber extension are as below;

1. To accelerate agricultural growth
2. To expand knowledge resource
3. To facilitate better information access

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4. To supplement inadequate technical manpower
5. For stronger research-extension – client system linkage
6. To develop efficient feedback mechanism
7. For cost-effective extension delivery
8. To develop knowledge managers
9. To ensure gender equity in technology transfer process
10. To empower small and marginal farmers
11. To serve the farm stakeholders beyond technology transfer role

CYBER EXTENSION: THE PROCESS

The process of cyber extension needs to have a clear vision at national, state and district levels and more importantly at State agricultural universities and research institutes levels. Learning the lessons from the various experiments needs to focus on following aspects;

1. Develop state-of-art ICT infrastructure to connect key stakeholders.
2. Creating ICT awareness in the entire developmental department.
3. Create information packaging mechanism at key participating agencies.
4. Network with e-governance initiative of concerned state or district;
5. Create a model cell in each state to monitor the progress of cyber extension;
6. Identify a national coordinating agency for cyber extension.

CYBER EXTENSION TOOLS & SERVICES:

The major Cyber Extension tools are

1. E-mail:

E-mail is the most often used communication tools in new age. In all sectors — education, business, services, e-mail has replaced letters, faxes and even telephone calls in the new generation working culture. In agriculture sector, the use of e-mail is limited by the non-availability of connectivity to the cutting-edge functionaries in the state department of agriculture. This limitation is being overcome very fast and most of the state governments have initiated projects to connect all their departments and also field level offices to provide on-line connectivity to the officers and staff. The e-mail should become the most powerful extension communication mechanism among the agricultural scientists, extension functionaries, agricultural processing and supply chain companies and the farmers. Even now some KVKs like Babhaleshwar (Ahmednagar) and Baramati (Pune) are using e-mail mechanism highly effectively to send extension messages to innovative farmers.

2. Interactive expert systems:

Expert systems are the programme written to solve problems or give advice in specific knowledge of a particular expert or a number of experts on crop-pests or disease is organized in a computer programme in such a way that a user (student, farmer or extension workers) can indicate the symptoms in text form, data form or digital image, the computer assists the user to diagnose the problem — the pest or disease and then depending on its extent and stage of problem suggests preventive as well as curative measures for the same. The additional information on pest life-cycle favorable conditions for their growth may also be indicated. Expert systems can be used both in on-line and off-line mode. In on-line mode, the users can interact with the research organization expert systems to diagnose the field problems and can offer advice to farmers and fisherman.

A number of ICAR institutions are working on development of crop specific expert systems to assist the field functionaries. The expert systems are thus very important tools for giber extension.

Rice Crop Doctor expert system which is developed by MANAGE, Wheat Crop expert system developed by IASRI (Indian Agricultural Statistics Research Institute) and AGREX system developed by Centre for informatics

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Research and Advancement – Kerala are some famous experts systems in India for agriculture field.

3. Internet browsing for extension information:

Browsing the World Wide Web (WWW) for the required information is the most often used 'Information Access' method on the internet. The agricultural scientists, students, extension functionaries, traders and farmers, all can access required information in a very short time, if the same is available on the internet. The information on crop science and package of practices is being hosted and up-loaded by ICAR institutes and SAUs, and the information on government programs, projects, schemes is being hosted by concerned state government or central government departments or agencies. It mainly includes various applications and websites for access the information which can be broadly understand through following information:

a) Applications-

Some famous applications related to agriculture are as below:

- Field crops related apps-
    - Kheti gyanm, Weed manager, Krishi sparsham, Farm calculator
- Horticulture related apps-
    - ICAR-NRCP Pomegranate, Mango cultivation-IIHR, Sabjee Gyan
- Livestock and Dairy related apps-
    - E- Pashupalan, Hoof Care, Eco dairy, Indigenous Dairy Products
- Market and other apps-
    - Agrimarket, Krishi Gyan, Kisan Mitra

b) Agricultural websites-

Some famous Indian agricultural websites are as below:

www.agricoop.nic.in	www.indiaagristat.com
www.isapindia.org	www.kisan.in
www.agriwatch.com	www.agri.gujarat.gov.in
www.indiaagristat.com	www.krishiworld.com
www.agricoop.nic.in	www.ikhedut.Gujarat.gov.in
www.isapindia.org	www.farmer.gov.in
www.agriwatch.com	www.icar.org
www.agriquest.info	www.agmarknet.in
www.aau.in	www.krishikosh.egranth.ac.in

4. Video conferencing:

Video conferencing has emerged as a form of teleconferencing and is perceived as a new, fast growing medium. It has potential of saving significantly both in terms of travel cost and time. Video conferencing is remote meeting between two or more individuals present at geographically dispersed locations. Video conferencing can be described as a method of conferencing between two or more locations where both sound and vision are conveyed electronically so as to enable simultaneous interactive communication. It can also open up new method of communication, e.g. linking many international sites simultaneously. Today, this is the new development tool in the hands of extension personnel. Video conferencing uses telecommunication of audio and video to bring people at different sites together for meeting. This can be as simple as a conversation between two people in private offices (point-to-point) or involve several sites (multi-point) with more than one person in large rooms at different sites. Besides, the audio and visual transmission of people, videoconferencing can be use can be used to share the documents, computer displayed information and white boards.

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5. ICT based agro advisory through various public and private sectors:

5.1 Public sectors' agro based advisory services:

According to Sarvanan and Bhattacharjee (2014), some famous public sectors' agro based advisory services are listed below:

1. Farmer Call Center (Kishan Call Center)-
2. Mobile Advisory Services by ICAR-KVKs-
3. vKVK (Voice Krishi Vigyan Kendra)-
4. Market Price Through SMS by Rubber Board, India-
5. Mobile Based Agro-Advisory System in North-East India (m4agriNEI)-
6. SMS Service to Farmers by the Department of Agriculture, Haryana State-
7. Dynamic Market Information (DMI), TNAU-C-DAC, Hyderabad-
8. Kishan Help Line-
9. Kishan Kerala-
10. Intelligent Advisory System for Farmers (IASF)-
11. AGMET Services by IMD-
12. Mandi on Mobile Service by BSNL-

5.2 Private sectors' agro based advisory services:

According to Sarvanan and Bhattacharjee (2014) there are so many private firms, business enterprises are in existence that provide mobile based agro advisory to the farmers via SMSs, voice messages as well as messages through WhatsApp. Here, list of some major initiates mentioned as below;

1. Lifelines India
2. Fisher Friend
3. Iffco Kishan Sanchar Limited (IKSL)
4. Kheti (Knowledge Help Extension Technology Initiative)
5. mkrishi by Tata Consultancy Services
6. Mandi Bhav
7. Kribhco Reliance Kisan Ltd.
8. Mobile Multimedia Agri. Advisory Service (MAAS)
9. Awaz De
10. Advisory Service by Reliance Foundation

CONCLUSION:

On the basis of above mention information, it can be concluded that the public and private actors are looking for effective solutions to address challenges in agriculture, including how to address the abundant information needs of farmers and make agriculture profitable for them. Farmers need updated information to empower themselves in taking research to land, avail timely and adequate credit, seek and act on market intelligence reports and access market and negotiate prices. This critical information may increase farmer's productivity, income as well as protect their food security and livelihoods. Using Information and Communication Technology (ICT) in innovative ways through ICT-enabled services helps in disseminating timely information on agricultural advisories, financial services and agricultural marketing and risk transfer to the farmer to improve their capacity and mitigate risks.

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Micronutrient enriched humic substance

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Sagar, R[1*] and Vivek, M. S[2]
[1*]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, UAHS, Shivamogga
[2] Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, UAS, Raichur

Organic matter is considered as the "Life of soil" because of its importance in maintaining soil fertility, the depletion of the same will turn into a noteworthy risk to the sustenance in the years to come. The organic matter provides a substantial quantity of nutrient elements as well as humus, which helps in improving the physical, chemical and biological properties of soil.

The use of bulky organic manures as an organic matter source was considered as a burden by the farmers as it requires a vast number of laboures for transportation and application to soil. Additionally, the use of bulky organic manures brings about the spreading of weed seeds in land and control of weeds would likewise be a major issue. In this situation, the extraction of humic substances from massive organic manures and their utilization may help in to take care of numerous issues related to the utilization of bulky organic manures. Humic substance, however, isn't a fertilizer, yet considered as complementary to fertilizer (Mackowiak *et al*., 2001).

Micronutrients have received a lot of significance in crop generation during these years due to their inadequacies in various parts of the nation. Keeping all this in mind, to upgrade the growth and yield of crops, humic substance can be an alternative and utilized as a supplement to chemical fertilizers. Enrichment of humic substance with micronutrients can improve the fertilizer value of humic substance. In this manner, including enrichment of humic substance is the principle advantage that the plant will have the capacity to retain and use the supplements in solution more effectively.

Enrichment of humic substance

Calculated amount of FYM can be incubated with micronutrients for two weeks maintaining proper moisture (60 %). The micronutrients (Zn, Fe and Mn) can be added at 200 mg kg^{-1} each and Cu added at 20 mg kg^{-1} on dry weight basis to FYM and thoroughly mixed with the FYM. The micronutrient salts for enrichment can be $ZnSO_4.H_2O$, $FeSO_4.7H_2O$, $MnSO_4.H_2O$ and $CuSO_4.5H_2O$, respectively.

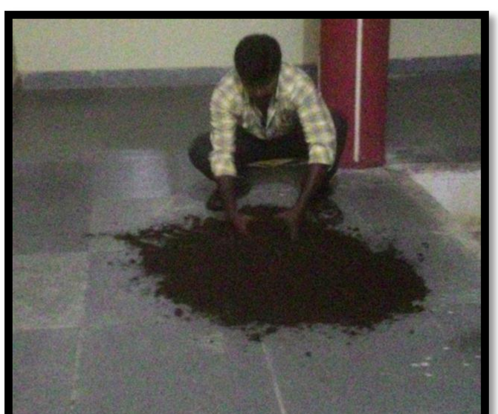

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Fig. 1: Mixing of micronutrients with FYM.

Extraction of humic substance enriched with micronutrients

After two weeks of incubation, the humic substance can be extracted from the FYM with micronutrients separately following the method proposed by Schnitzer and Skinner (1968). 5 kg FYM (on dry weight basis) sample can be taken in 100 L barrel to which 25 L of 0.1 N NaOH can be added and kept overnight with periodical turning (@ one-hour interval) the content with a wooden stick. The dark-colored supernatant can be separated by filtering using a muslin cloth. The residue should be re-extracted with 25 L of extractant for complete extraction of the humic substance and both should be pooled into clean 100 L barrels and labeled as humic substance with micronutrients (EHS).

Fig. 2: Extracted humic substance.

The percent humic substance present in the EHS extracts can be determined by the gravimetric method. The content of humic substance in the materials can be concentrated or diluted according to the need and used. The extracted humic substance with (EHS) micronutrients from FYM can be characterized for various properties as we did it in a trial.

The trial is as follows. The extracted humic substance with (EHS) micronutrients from FYM was characterized for pH, electrical conductivity, total nitrogen, phosphorus, potassium, calcium, magnesium, micronutrient content (Zn, Cu, Fe and Mn), C: N and E4/E6 ratio. For nutrient analysis, firstly, the humic substance liquid was dried by evaporating in a hot air oven. The dried EHS was then digested in a block digester using diacid ($HClO_4$ + HNO_3). After complete digestion, the digested residue was dissolved in doubled distilled water and the volume was made to 100 ml and nutrient contents were determined.

Table 1: Properties of farmyard manure.

Parameters	FYM	FYM after micronutrient addition
pH	7.11	7.07
EC (dS m^{-1})	1.48	1.49
Organic Carbon (%)	17.40	17.40
Maximum Water holding capacity (%)	44.68	44.86
Total N (%)	0.56	0.56
Total P (%)	0.39	0.40
Total K (%)	0.69	0.66
Total Ca (%)	1.52	1.60

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Total Mg (%)	0.87	0.82
Total S (%)	0.30	0.61
Total Fe (mg kg^{-1})	1898	2090
Total Mn (mg kg^{-1})	256.78	443.67
Total Cu (mg kg^{-1})	38.99	56.08
Total Zn (mg kg^{-1})	82.64	271.32
C: N ratio	31.07	31.07

Table 2: Properties of humic substance extracted from farmyard manure.

Parameters	Enriched humic substance
pH	7.07
EC(dS m^{-1})	0.79
Total N (%)	3.10
Total P (%)	0.07
Total K (%)	0.29
Total Ca (%)	0.18
Total Mg (%)	0.84
Total S (%)	1.11
Total Fe (mg kg^{-1})	3038
Total Mn (mg kg^{-1})	800.46
Total Cu (mg kg^{-1})	120.08
Total Zn (mg kg^{-1})	459.92
E_4/E_6 ratio	6.79

CONCLUSION

Humic substance extracted from farmyard manure enriched with micronutrients can be used as a rich source of nutrients in improving the growth and yield of crops and also to maintain soil nutrient status. The enrichment of humic substance also increases its fertilizer value.

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Climate resilient water managment in rice

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Anju Keisham* and Yumnam Sanatombi Devi
College of Agriculture, Central Agricultural University, Imphal

The global warming phenomenon is closely related to the rise in greenhouse gas (GHGs) emissions such as CO_2, CH_4 and N_2O contribute to global warming at a share of 60, 20 and 6 percent respectively (IPCC, 1996). The climate will continue to change over the coming decades as more and more heat trapping greenhouse gases emitted by human activities accumulate in the atmosphere. The contribution of agricultural sectors to climate change in India comprises of 28 per cent, of which 23 per cent is by rice cultivation (INCCA, 2010). Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to half of the Indian population. Globally rice is estimated to be responsible for 19 per cent of anthropogenic methane emissions, second only to ruminants 23 per cent (Chen and Prinn, 2006*)*. Methane is the major harmful gas that is released from rice fields. The prime matter of concern without affecting the crop yield is to modify methane emission in rice field. The most important option that can help in minimizing the amount of methane emitted from rice field is by proper management of water applied to the field. Methane emissions can be reduced by changing the water management strategies and understanding the trade-offs and nitrous oxide emissions before different methods of rice production are advocated on grounds of climate change. Therefore, developing sustainable methods, which focus at climate resilient future by reducing GHGs and energy consumption, will help in reducing the driving factors of climate change but also help in sustaining the rice productivity thereby minimizing the impact of incoming natural disaster.

INTRODUCTION

The changing climatic scenario has affected crop production in the adverse ways, and impact of it in agriculture is now emerging as a major priority among crop science researchers. Agriculture in this changing climatic scenario faces multiple diverse challenges due to a wide array of demands. Climate resilient agriculture is the need of the hour in many parts of the world. Understanding the adverse effects of climate change on crop growth and development and developing strategies to counter these effects are of paramount importance for a sustainable climate- resilient agriculture. In India paddy rice accounts about 44 million ha, the largest rice producing area in Asia, and accounts for 20% of the total rice production worldwide. India would need to produce upto 130 million tones of milled rice by 2030 to meet the growing demands. Rice field alone contribute 10% of the total methane emissions at global level. Data on trade-offs between yield increase in rice yield and reduction in greenhouse gas emissions are urgently needed for innovation in cropping techniques. Rice is a water loving plant and unlike other crops it requires standing water in the field. Flooding continuously in conventional rice cultivation system stimulates biological process of methane production by inducing the anaerobic condition in soil. Methane is produced by methanogenic bacteria that can metabolize only in the strict absence of free oxygen and at redox potentials of less than -150 mv. Most methanogens are neutrophilic, with an optimum pH of 6-8. Methanogens rely on a plethora of other organisms to provide them with the few substrates they can catabolize: hydrogen, carbon dioxide, formate, acetate, methanol, methylamines and methylsulfides (Conrad 1989 and Garcia,

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1990). In wetland rice soils, methane is largely produced by transmethylation of acetic acid and to some extent by the reduction of carbon dioxide (Takia, 1970). On flooding, short term evolution of hydrogen immediately follows the disappearance of oxygen, carbon dioxide increases and with decreasing carbon dioxide, methane formation increases (Neue and Scharpenseel, 1984). The rate and pattern of organic matter addition and decomposition determine the rate and pattern of methane formation. Methane production generally increases during the cropping season, although the population density of methanogens remains fairly stable. Easily degradable crop residues, fallow weeds and soil organic matter are the major source for initial methane production. At larger growth stages of rice, root exudates, decaying roots, and aquatic biomass seem to be more important. Methane production is enhanced in the rooted soil zones (Sass *et. al*., 1991). Methane in rice paddies is also produced by microscopic organisms that respire carbon dioxide. More carbon dioxide in the atmosphere makes rice plant grow faster and extra plant growth supplies soil microorganisms with extra energy, pumping up their metabolism. Increasing carbon dioxide level will also boosts rice yield but to a smaller extent than methane emissions. Methane has a global warming potential of 56 times higher than that of carbon dioxide.

Climate resilient water management practices in rice

The major user of the available fresh water is agriculture. The decline in water availability effect the agriculture productivity. Among the agriculture crops, rice is major consumer of water, slight changing in water resources of India effect the rice yield. Rice systems such as aerobic culture, alternative wetting and drying (AWD) system, system of rice intensification (SRI) and direct seeded rice are very effective in this regard. Some important rice production system suitable for resource poor rural farmers under various rice farming environment are discussed below.

Aerobic Rice Cultivation

Cultivation of suitable high yielding rice varieties in direct sown, non- puddle, aerated soils under supplementary irrigation and fertilizers to achieve high yield is called aerobic rice. The ecology for this type of rice is intermediate between upland and favourable shallow low lands. This type of cultivation practice can be adopted in target area like, tank irrigated areas, deep bore well/ well irrigated area and the places where presumed to receive delayed channel/ river water i.e. in delta region during *kharif* (June-July) and summer (February). Varieties like CR Dhan 200/ Piyari, CR Dhan 201, CR Dhan 202, CR Dhan 204 are suitable for aerobic rice cultivation, released from Central Rice Research Institute, Cuttack. Aerobic rice does not require continuous flooding. It can be irrigated like direct sown crops like maize, jowar and bajra. Irrigation can be provided with interval of 4-5 days and time of irrigation can be adjusted based on the soil type and moisture availability. Rice crop under aerobic situation could be successfully raised with 700 to 900 mm of total water in summer and during monsoon season the water utilization can be further reduced. Since the water resource is effectively utilized, 1 kg of rice is produced with 3000 to 3500 litre of water in contrary to 4500 to 5000 litre in transplanted rice system. After sowing in dry condition in fine tilth soil, surface irrigation should be done immediately. Surface irrigation should be given up to 50 days after sowing at the interval of 5 days. Irrigation should be given once in 3 days, in the critical stages like active tillering, panicle initiation, flowering and grain filling. Water must be withheld one week before harvest of the crop to

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facilitate uniform ripening of grains. By adopting aerobic rice cultivation method, water can be saved to the tune of 35- 45%.

Alternate wetting and drying system

Alternate wetting and drying (AWD) is a water management technique practiced to cultivate irrigated lowland rices with much less water than the usual system of maintaining continuous standing water in the crop field. It is a method of control and intermittent irrigation. A periodic drying and re-flooding irrigation scheduling approach is followed in which the fields are allowed to dry for few days before re-rrigation, without stressing the plants. This method reduces water demand for irrigation and greenhouse gas emissions without reducing crop yields. AWD can saved water by about 38% without affecting rice yields. This method increases water productivity by 16.9% compared with continuous flood irrigation. This method can even increase grain yield because of enhancement in grain-filling rate, root growth and remobilization of carbon reserves from vegetative tissues to grains. AWD reduce the labor costs by improving field conditions at harvest, allowing mechanical harvest. Several studies also indicate that AWD reduces methane emissions. Methane is produced by the anaerobic decomposition of the organic material in the wet/ flooded paddy field. Allowing to drop water level below soil surface removes the anaerobic condition for some time till re-flooded and pauses the production of methane from the rice field for several times and hence reduce the total amount of methane released during the rice growing season.

System of rice intensification (SRI)

SRI is a farming methodology aimed at increasing the yield of rice produced in farming. It is a low water, labor intensive method that uses younger seedlings singly spaced and typically hand weeded with special tools. It was developed in 1983 by the French Jesuit Father Henri de Laulanie in Madagascar. The purpose of irrigation in SRI is to wet the soil, just enough to saturate the soil with moisture. Subsequent irrigation is only done when soil develops fine cracks. Regular wetting and drying of soil results in increased microbial activity in the soil and easy availability of nutrients to plants. SRI can saved water by about 40% as compared to conventional practice.

Benefits of SRI:

- Higher yields- both grain and straw
- Reduced duration
- Lesser chemical inputs
- Less water requirement
- Less chaffy grain %
- Higher head rice recovery
- Cold tolerance
- Withstand cyclonic gales
- Soil health improves through biological activity.

Direct seeded rice

Rice can be directly seeded either though dry or wet (pregerminated) seeding. Direct seeding of drought tolerant varieties of rice in dry soil is done in June with pre-emergence herbicide application under sufficient soil moisture conditions followed by a post- emergence herbicide application at 25-35 days after sowing. Direct seeding in moist field with receipt of rains in June or by using ground water along with the application of pre-emergence herbicide is also practiced. In uplands, direct seeding of rice can be taken up with the onset of monsoon rains. Direct seeding of rice is done with a zero till drill. DSR with reduced tillage is an efficient resource conservation technology that holds great promise in the Indo- Gangetic Plains in view of the following advantages:

- Saving in water up to 25%
- Saving in energy up to 27% of diesel as pumping energy is saved for field preparation, nursery raising, puddling and reduced frequency of applying irrigation water
- Saving of 35-40 mandays/ ha
- Enhanced fertilizer use efficiency due to placement of fertilizer in the root zone
- Reduction in methane emissions and global warming potential
- Early maturity of crops by 7-10 days helps in timely sowing of succeeding crops
- Enhanced system productivity.

CONCLUSION

Today, conventional puddled transplanting is the most common practice of rice production. There is a need to shift from puddled transplanting to aerobic rice cultivation. Generally, every modification in current cultivation systems towards aerating the soil can suppress methane production and emission from paddy fields. Water management (irrigation water pattern and standing water level) and nutrient management are the main influencing factors in minimizing the emission of greenhouse gases. In conclusion, efficient water and nutrient management system can provide a sustainable rice production system considering both global warming issue and more rice demand in future resulted from fast growing population.

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Vegetative growth of plants as influenced by primary nutrients

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[1]Sirazuddin, [2]Rajnish Yadav and [3]Rajbeer Singh
[1]Division of Agronomy, College of Agriculture, GBPUAT-Pantnagar
[2]Division of Soil Science and Agricultural Chemistry, FoA, SKUAST-K, J&K
[3]Division of Agronomy, FoA, SKUAST-K, J&K

INTRODUCTION

All plants must obtain a number of inorganic mineral elements from their environment to ensure successful growth and development of both vegetative and reproductive tissues. These minerals serve numerous functions: as structural components in macromolecules, as cofactors in enzymatic reactions, as osmotic solutes needed to maintain proper water potential, or as ionized species to provide charge balance in cellular compartments.

Primary minerals and vegetative growth

Nitrogen

Depending on the plant species, developmental stage, and organ, the nitrogen content required for optimal growth varies between 2 and 5 % of the plant dry weight. As a constituent of all amino acids and proteins (and thus all enzymes), nitrogen serves a central role in cellular metabolism. Additionally, as a component of nucleotides and nucleic acids (deoxyribonucleic acid (DNA) and ribonucleic acid (RNA)), nitrogen is critical for the transcription, translation, and replication of genetic information. Nitrogen is obtained from the soil environment either as the ammonium or nitrate ions, with nitrate being chemically reduced within the plant to ammonium prior to incorporation into organic molecules. Nitrogen is also a major structural component of chlorophyll. When the supply of nitrogen is suboptimal, growth is retarded; nitrogen is mobilized in mature leaves and retranslocated to areas of new growth. Typical nitrogen-deficiency symptoms, such as enhanced senescence of older leaves, can be seen. An increase in nitrogen supply not only delays senescence and stimulates growth but also changes the plant morphology in a typical manner, particularly if the nitrogen availability is high in the rooting medium during early growth. An increase in shoot-root dry weight ratio with an increase in nitrogen supply takes place in both perennial and annual plant species (Levin *et al*., 1989; Olsthoorn *et al*., 1991). This increase in shoot-root ratio might even be larger in terms of shoot and root length (Klemn, 1966), a shift which is unfavorable for the acquisition of nutrients and water from soil at later growing stages. Yoshida *et al*. (1969) reported that the length, width and area of the leaf blades increase, but the thickness decreases. In addition, the leaves become increasingly droopy which interferes with the light interception. Nitrogen-deficient plants are characterized by the enhanced growth of the root system and retarded shoot growth, which are closely related to high cytokinin/ABA ratio in roots and low ratio in shoots (Mardanov *et al*., 1996). In cereals, the enhancement of stem elongation by nitrogen increases the susceptibility to lodging. Zhao *et al.* (2004) N deficiency suppressed plant growth and DM accumulation and allocation. Decreased plant biomass production due to N shortage was associated with reductions in both leaf area and leaf photosynthetic capacity (Sinclair, 1990) and was mainly attributed to a smaller leaf area in sorghum. Sergio and Andrade reported that nitrogen deficiency delayed both vegetative and reproductive phenological development, slightly reduced leaf emergence rate, and strongly diminished leaf expansion rate and leaf area duration.

Phosphorus

Phosphorus is a structural component of numerous macromolecules, including nucleic acids, phospholipids, certain amino acids, and several coenzymes. It has a significant role in energy transfer via the pyrophosphate bond in ATP, and the attachment of phosphate groups to many different sugars provides metabolic energy in photosynthesis and respiration. Phosphorus is absorbed by plants largely as the primary or secondary orthophosphate anions, $H2PO4^-$ and $HPO4^{2-}$. The phosphorus requirement for optimal growth is in the range of 0.3-0.5 % of the plant dry matter during the vegetative stage of growth. The probability of phosphorus toxicity increases at contents higher

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than 1% in the dry matter. However, many tropical food legumes are rather sensitive and toxicity may occur already at phosphorus contents in the shoot dry matter of 0.3-0.4 % in pigeon pea and 0.6-0.7 % in black gram. An adequate supply of P is essential from the earliest stages of plant growth. Early season deficiencies of P can lead to restrictions in crop growth from which the plant will not recover, even when P supply is increased to adequate levels. Moderate P stress may not produce obvious deficiency symptoms. However, with more severe P deficiency, plants become dark green to purplish in colour (Hoppo *et al*., 1999). Phosphorus deficiency can reduce both respiration and photosynthesis but, if respiration is reduced more than photosynthesis carbohydrates will accumulate, leading to dark green leaves (Glass *et al.*, 1980). A deficiency can also reduce protein and nucleic acid synthesis, leading to the accumulation of soluble nitrogen (N) compounds in the tissue, and ultimately resulting in cell growth being delayed and potentially stopped. As a result, symptoms of P deficiency include decreased plant height, delayed leaf emergence, reductions in tillering, secondary root development, and dry matter yield and seed production. In plants facing deficiency of phosphorus, reduction in leaf expansion, leaf surface area (Frendeen *et al*., 1989) and also number of leaves (Lynch *et al.,* 1991) are the most striking effects. Leaf expansion is strongly related to the expansion of epidermal cells and this process might be particularly impaired in phosphorus deficient plants for various reasons, for example low phosphorus content of epidermal cells and decrease in root hydraulic conductivity (Radin, 1990).

In addition, P deficiency has been suggested to reduce tillering (Woodward and Marshall, 1988; Sato, *et al*., 1996), the rate of individual leaf expansion (Radin and Eidenbock, 1984), and the rate of assimilate production per leaf area (Rao and Terry, 1989; Jacob and Lawlor, 1991). The root:shoot ratio of crops tends to increase with early season P deficiency (Brenchley 1929, Schjorring and Jensen 1984). Growth reduction is generally greater in the shoot than in the root, allowing the plant to maintain root growth and encounter and extract P from the soil. The growth of tops and roots closely paralleled the distribution of P between the plant parts. Where P supply was low, the proportion of P held in plant roots was higher than where the P supply was moderate. At higher P status, there was also a relative increase in root P as compared to shoot P. This may imply P retention by the root to meet its 65 requirements at low concentration, P export to the shoot at sufficient concentrations, and P retention by the root at high concentration to avoid P toxicity in the shoot (Schjorrring and Jensen 1984).

In spring wheat and intermediate wheat grass, maximum tiller production was obtained when P was supplied in the nutrient culture for the first five weeks of growth and longer periods of available P did not increase the number of tillers produced (Boatwright and Viets 1966). In field-grown corn, P deficiency slows the rate of leaf appearance and leaf size, particularly in the lower leaves (Barry and Miller 1989, Pellerin *et al.,* 2000). With less leaf growth and solar radiation interception caused by P deficiency, C nutrition of the plant may fall and so reduce subsequent nodal root emergence, which would have an additional impact on P uptake capacity.

Potassium

Potassium is absorbed as the cation, K^+, which is readily soluble in soil solutions. It is the most abundant cation in the cytoplasm and, because it is not metabolized, K^+ and its accompanying anions contribute significantly to the osmotic potential of cells. Next to nitrogen, potassium is the mineral nutrient required in the largest amount by plants. The potassium requirement for optimal plant growth is in the range 2-5% of the plant dry weight of vegetative parts. When potassium is deficient, growth is retarded, and net retranslocation of potassium is enhanced from mature leaves and stems, and under severe deficiency, these organs become chloritic and necrotic, depending on the light intensity to which the leaves are exposed (Marschner and Cakmak, 1989). Lignification of vascular bundles is also impaired (Pissarek, 1973), a factor which might contribute to the higher susceptibility of potassium-deficient plants to lodging. Potassium deficiency causes yellowing and chlorosis to the edge and tip of older leaves, with progressive senescence. Plants may be stunted and exhibit excessive basal tillering. During rapid vegetative growth, the rapid uptake of nitrogen as negatively charged nitrate ions ($NO3^-$) is normally balanced by a similar uptake of positively charged potash ions (K^+) which maintains the electrical neutrality of the plant. If potash supply is limiting, the uptake and utilization of nitrogen will be restricted and plant growth will be affected similarly to nitrogen deficient plants.

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Plant breeding to deliver climate change ready crops

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Meniari Taku*[1] and Nikki Kumari[2]
[1, 2] Ph.D. Scholar, Division of Genetics, ICAR-IARI, New Delhi

INTRODUCTION

The world population is estimated to be 9.2 billion in 2050. To sufficiently feed these people, the total food production will have to increase 60% - 70%. The global temperature has risen by an estimated 1.2°C over the past century and is expected to rise by another 3°C by 2100 (IPCC, 2018). Without effective adaptation, and genetic improvement, each degree-Celsius increase in global mean temperature would, on average, reduce global yields of wheat by 6.0%, rice by 3.2%, maize by 7.4%, and soybean by 3.1% (Zao *et al.,* 2017). Achieving this increase in food production in a stable environment would be challenging, but is undoubtedly much more so given the additional pressures created by global environmental changes. It is essential to mine and incorporate superior alleles adapted to harsh and extreme environmental conditions by resequencing and phenotyping many germplasm accessions for the crop species.

High-Throughput and Cost-Effective Genotyping and Phenotyping for Rapid Mapping of Climate Change Relevant Traits

Genotyping of all individual samples or selected recombinants of the targeted population either for trait mapping or product development is a critical step for identifying better alleles and/or superior lines for development of climate-resilient crops. Several genotyping platforms such as Next Generation Sequencing (NGS) platforms to discover and simultaneously genotype single nucleotide polymorphisms (SNPs) are currently available. The modern phenomics tools aim at recording data on traits like plant development, architecture, growth, biomass, photosynthesis etc. for hundreds to thousands of plants in a single day. Thus high-throughput phenotyping platforms allowed screening of large plant populations, germplasm collections (core collections), breeding material and mapping populations with increased precision and accuracy in phenotypic trait acquisition coupled with decreased labor input achieved by automation, remote control and data (image) analysis pipelines amenable to high-throughput. Advances in genomics have led to the development of NGS based trait mapping approaches, which have speed up trait mapping programs from a few years to just a few months. GBS and Whole Genome Re-sequencing (WGRS) of entire mapping populations or extreme pools provide large-scale genome- wide SNPs for conducting high-resolution trait mapping. Genome wide association studies (GWAS) identifies or studies the correlation between the genetic variants/traits/phenotypes in a population of any organism based on Single Nucleotide Polymorphism (SNPs) in the sequence data. Specialized mapping populations can be used to enhance the power and efficiency of (GWAS). Nested association mapping (NAM) populations and multi-parent advanced generation inter-Cross (MAGIC) both types of populations have been successfully developed and used to identify QTLs for a number of traits in diverse crop species for example, maize, wheat, rice and cowpea.

Pre-breeding for Linking Genetic Variability to Utilization

Pre-breeding is required to identify and transfer desirable traits and genes from un-adapted materials to intermediate materials. The breeders can use these intermediate materials further in producing new varieties. It is a first essential step in the use of diversity arising from CWR and other unadapted materials.

Genomics-Assisted Breeding (GAB)

Marker-assisted selection (MAS) is useful to introgress a few loci for improving elite varieties. It has been widely used in a number of crops to incorporate desired traits into elite cultivars through marker-assisted backcrossing (MABC). Marker-assisted recurrent selection may be appropriate for more complex traits controlled by up to 40 loci. This approach can be used to develop superior lines with an optimum combination of superior alleles through repeated inter-crossing. Genomic selection (GS) is a specialized form of MAS, in which information from genotype data on marker alleles covering the entire genome forms the basis of selection. It utilizes information from genome-wide marker data whether or not their associations with the concerned trait(s) are significant. This approach is advantageous for quantitative traits and increases selection efficiency by shortening breeding cycles. Genetic manipulation techniques using physical, chemical and biological mutagenesis have contributed majorly in studying the role of genes and identifying the biological mechanisms for the improvement of crop species in the past few decades. Programmable nucleases, particularly the CRISPR/Cas system, are already revolutionizing our ability to interrogate the function of the genome and can potentially be used clinically to correct or introduce genetic mutations to produce climate resilient traits. This implies that new varieties could be developed much faster than usual traditional or even molecular breeding methods.

Transgenic Breeding

The quaternary gene pool (GP-4) does not allow any transfer of DNA between the crop of interest or other organism by mating and sexual recombination. Advances in genetic engineering through recombinant DNA technology and spatial and temporal targeted expression of genes facilitated (i) the transfer of precise gene sequences and (ii) the transfer of genes across gene pools. Transgenic technology serves to introduce gene sequences for expression of a desired trait from distantly related organism.

Speed Breeding

In recent years, Speed Breeding (SB) has emerged as a potential tool in rapid generation advancement which predominantly uses prolonged photoperiods to accelerate the developmental rate of plants, thereby reducing generation time. This technique involve extending the photoperiod using supplementary lighting and temperature control, enabling rapid generation advancement in glasshouses with sodium vapour lamps (SVL) or growth chambers fitted with a mixture of metal halide and light-emitting diode (LED) lighting.

CONCLUSION

Plant breeding programs focused on and continue to focus on developing genotypes adapted to specific agricultural environments and lower inputs that could help attain sustainable, higher productions with lower energy costs to accommodate the growing population, while providing an adequate food supply and responsibly managing declining resources.

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Backcrossing in plants

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Prakriti Meshram (Ph.D. Scholar) and Pawankumar S. Kharate (Ph.D. Scholar)
INDIRA GANDHI KRISHI VISHWAVIDALAYA, RAIPUR (C.G.) 492012

The backcross breeding approach can be employed to introduce a specific trait, such as disease resistance, from one line, often an unimproved line, to another line that is typically an elite breeding line. Backcross breeding is an effective method to transfer one or a few genes controlling a specific trait from one line into a second—usually elite—breeding line. The parent with the desired trait, called the donor parent, provides the desired trait and may not perform as well as an elite variety in other areas. The elite line, called the recurrent parent, usually performs well in all other areas. Backcrossing involves making an initial cross between the donor and recurrent parents. The resultant F1 progeny have 50% of their genetic material from each parent (Fig. 1). F1 individuals are crossed to the recurrent parent to develop a backcross one (BC1) population. Individuals from the BC1 population are once again crossed to the recurrent parent. Each generation of backcrossing reduces the proportion of the donor parent present in the population by half (Fig. 1). This cycle of crossing backcross progeny to the recurrent parent continues until a new line that is identical to the recurrent parent, but with the desired gene or trait from the donor parent is created. By the BC4 generation, the lines are >96% identical to the recurrent parent. The backcrossing process can often be accelerated using marker-assisted backcrossing, also known as background selection.

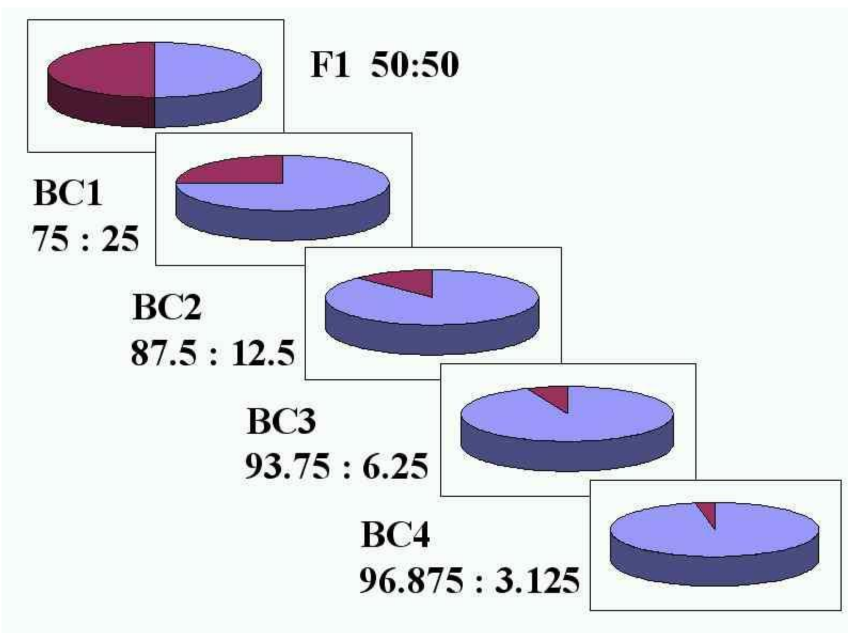

Figure 1: The contribution of the donor parent genome is reduced by half with each generation of backcrossing. Percentages of recurrent parent (light purple) are expressed as a ratio to percentages of donor parent (dark red-purple). Image credit: David Francis, The Ohio State University.

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Backcross-Dominant gene transfer:
Let the variety X is well adapted and high yielding.

Variety Y is resistant to a specific disease; which is governed by a dominant gene. We wish to transfer this dominant gene form variety Y to variety X.
So, variety X – recurrent parent (♀) Variety Y – donor parent (♂)

The various steps in backcrossing are as follows-

Hybridization – The two varieties X and Y are crossed. Generally recipient / recurrent variety is used as female parent.

F1 generation – Selection for disease resistance is not performed. Plants from F1 seed are back crossed with recipient variety X and seeds are collected to raise BC1 generation.

First backcross generation (BC1) – Selection is done for disease resistance and selected ones are back crossed with recurrent parent X.

Second to fifth backcross generation (BC2 to BC5) – Segregation for disease resistance occurs in every back cross generation. Plants are selected on the basis of similarity with recurrent parent and resistance to disease. Selected ones are back crossed with recurrent parent X.

Sixth backcross generation (BC6) – Disease resistant plants are selected. They are self pollinated and harvested separately.

BC6 F2 generation – Individual plant progenies are grown from seeds of BC6 generation. Plants are selected on the basis of similarity with recurrent parent and at the same time resistance to disease. They are harvested separately.

BC6 F3 generation – Individual plant progenies are grown from seeds of above cross. As done in above step, plants are selected on the basis of similarity with recurrent parent and resistance to disease but harvested in bulk.

Yield trials – Replicated yield trials are conducted with recurrent parent as a check. The newly constituted variety should be similar to variety X for most of the important characteristics with resistant to disease. Seeds are multiplied for distribution.

Backcross -Recessive gene transfer:
Let, variety X is well adapted and high yielding variety.
Variety Y is another variety resistant to a specific disease; which is governed by a recessive gene. We wish to transfer this recessive gene form variety Y to variety X.

So, variety X – recurrent parent (♀) Variety Y – donor parent (♂)

When the desired character i.e. disease resistance is governed by a recessive gene, back crosses cannot be performed in continuation as in dominant gene transfer method. After first back cross and then after every two subsequent back crosses F2 must be raised to test rust resistance. Only F2 is tested for resistance as all F1 and back cross progenies are heterozygous and susceptible to disease.

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The various steps for this backcross breeding are as follows-

Hybridization – The two varieties X and Y are crossed. Generally recipient / recurrent variety is used as female parent.

F1 generation – F1 plants are back crossed with the variety X.

BC1 generation –As disease resistance is controlled by recessive gene all the plants will be susceptible to disease, so disease resistance is not tested for this generation. Plants raised from seeds of above cross are selfed.

BC1 F2 generation – Test for disease resistance is conducted. Resistant plants which are similar in plant characteristic to recurrent parent are selected and back crossed with recurrent parent.

BC2 generation – Plants are grown from seeds of above cross, plants those are similar in plant characteristic to recurrent parent are selected and backcrossed with recurrent parent. Resistance test is not conducted.

BC3 generation – Plants are selfed to grow F2. Resistance test is not conducted for the sake of selection; it is done on the basis of resemblance to variety.

BC3 F2 generation – Selection for resistance is conducted and selected plants are back crossed with variety X.

BC4 generation – Back cross of plants selected above with recurrent parent. Disease resistance test is not conducted.

BC5 generation – Plants are selfed to raise F2. Disease resistance test is not conducted in this generation.

BC5 F2 generation – Disease resistant plants similar in plant characteristics to recurrent variety are selected. Selfed and seeds are harvested separately.

BC5 F3 generation – Individual plant progenies are grown. Selection is done for disease resistance and resemblance to variety X. Seeds of selected plants are bulked to constitute the new variety.

Yield trials – Replicated yield trials are conducted with variety X as a check. The newly constituted variety should be similar to variety X for most of the important characteristics. Seeds are multiplied for distribution.

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From Breeding 3.0 to Breeding 4.0

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Meniari Taku*[1], Suresh Yadav[2] and Nikki Kumari[3]
[1, 2, 3] Ph.D Scholar, Division of Genetics, ICAR-IARI, New Delhi

INTRODUCTION

Based on the techniques involved, plant breeding is split into four major stages. Each of these stages builds upon earlier ones by integrating established techniques with new technologies to increase breeding efficiency. Breeding 1.0 began 10-12 thousand years ago, where phenotype-based selection by local, independent farmers eventually resulted in the dramatic phenotypic changes seen in modern crops. Breeding 2.0 began in the late 19th and early 20th centuries when inbreeding depression was recognized, Mendelian genetics was (re)discovered, and quantitative genetics theory was established. Many advances in plant breeding during this time were in the science of breeding itself, including replicated field trials, controlled crossings, statistical analyses, formal experimental designs, hybrid breeding and pedigree-based estimates of breeding values. Roughly 30 years ago we entered Breeding 3.0 when molecular markers and genomic data began to complement phenotypic data. This stage started with marker-assisted backcrossing and pedigree confirmation, then moved to dissecting complex traits with linkage mapping. The introduction of high-throughput genotyping then expanded the quantitative genetics tool kit to dissect variation in natural populations (genome-wide association) and to select on genome estimated breeding values (genomic selection). We are now on the cusp of Breeding 4.0, a new level of breeding where functional genetic variants can be rationally combined both faster and better than ever before. This level of breeding is catalyzed by major technological advances in genetics and information systems. For example, genome resequencing studies can now cost less than a replicated yield trial, and genome editing is expected to enable parallel, precise modifications to many sites per generation. High-throughput phenotyping can measure numerous traits with unprecedented spatiotemporal resolution, and machine learning approaches permit the processing and interpretation of agronomic data at a level far beyond what humans can assimilate. Within each of these major technological phases, we see a pattern that we would now call a shift from monogenic to polygenic focus. While it is tempting to believe this pattern is the product of greater understanding, it is most likely the product of how adaptation proceeds, as suggested by the Fisher–Orr geometric model.

Moving to breeding 4.0

Due to ascertainment bias, genetic markers in Breeding 3 generally do not assay the whole pool of DNA polymorphisms in any given population. Furthermore, utilizing marker information typically implies estimating effects on many more loci (p genotypic variables) than there are observations at the genotype level (n plant genotypes, i.e., instances with distinct genetics): $n \ll p$. As a result, model parameters cannot be solved without simplifying assumptions. In models based on few markers, omitted marker information results in models that fail to account for the confounding effects of loci. The defining goal of Breeding 4 is to alleviate the issues of ascertainment bias and high dimensionality ($n \ll p$) in order to make reliable inferences about numerous effects of loci. The use of whole-genome or haplotype sequence data, will allow scientists to directly query the effects of observed loci, instead of estimating them indirectly through linked genetic markers. Furthermore, analyses involving higher n and/or lower p will permit more reliable inference of causal loci. This new framework will make use of sequence or image data and will therefore benefit from innovative machine learning approaches, different from the linear regression models typically used in Breeding 3.

A species could have 50 million common variable sites in the genome, most of them probably do not matter very much. There is a need to reduce this sea of variation to a few tens of thousands of high-probability functional

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sites. The types of data that are most useful for this filtering are; genetic mapping of complex target traits, genomic annotation, mapping of intermediate phenotypes - for example, RNA transcripts or metabolite abundance and related approaches such as chromatin profiling and proteomics could dramatically improve our ability to identify functional variants. The integration of these data requires characterizing global germplasm resources both genetically and phenotypically, developing informatics tools to share this information, and use of machine learning approaches. High-throughput phenotyping on simpler component traits (morphological and physiological traits) can be used to produce data on more genotypes, or endophenotypes (intermediate molecular traits such as gene expression levels or metabolic activity) can be used to provide many phenotypes per genotype. In Breeding 4, using simpler endophenotypes or component traits as phenotypes should therefore reduce the required model complexity. In Breeding 4, neural networks such as convolutional and recurrent neural networks (CNNs and RNNs, respectively) may be particularly appropriate, not only because they can capture nonlinear relationships to their output but also because they are designed to use sequence or image data as inputs. The direct genome editing in breeding 4 will almost certainly replace crosses as the most efficient way to tailor genetic variation into optimal combinations and will allow the development of cultivars with fewer deleterious mutations, both in low-recombination regions where genetic burden has accumulated due to low crossover rate and genetic hitchhiking, and in high-recombination regions where they are difficult to purge via recombination due to their close proximity to beneficial alleles. Of course, such edited crops would probably need to overcome consumer resistance to engineered foods, but that is an entirely different aspect to global food security.

CONCLUSION

Breeding has always been a numbers game, so we do not need to identify every variant with 100% accuracy. Even if we are only right 10% of the time, it may be enough to push crop breeding faster and more cost-effectively than we could otherwise. The hunt for these variants is already underway in many labs around the world. Integrating all this work into breeding pipelines will be key to providing an adequate, nutritious, and sustainable food supply for the entire globe throughout the twenty-first century.

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Cytosine base editors (BE1, BE2, BE3, BE4) for plant genome editing

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Nikki Kumari* and Meniari Taku
Division of Genetics, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION

A key characteristic of the CRISPR/CAS 9 gene editing is the creation of DNA double strand breaks at target loci, which can be used to introduce a variety of genomic modifications by one of two main DNA repair pathways: Nonhomologous end joining (NHEJ) and homology- directed repair (HDR). NHEJ competes with the preferred HDR-dependent genome editing and creates high frequency of indels and offsite alternations during genome editing. In actual practice selection needs to be exercised to obtain desired product, which is generally available at a frequency of not more than 5%. Requirement of specific PAM sequences and in absence of this PAM sequence notable to edit DNA. These limitations have highlighted the need for alternative approaches which can result in stable and precise genome editing in crops.

Cytosine base editing system

Cytosine base editor is a form of novel genome editing that enables direct, irreversible conversion of C to T or G to A substitutions in eukaryotic genomes without the requirement of DSBs, HDR processes, or donor DNA templates. Cytidine deaminase enzyme removes an amino group from cytosine converting it to uracil, resulting in a U-G mismatch which gets resolved via DNA repair pathways to form U-A base pairs. Subsequently, a T gets incorporated in the newly synthesized strand forming T-A base pairs. This results in C-G to T-A conversion in a programmable manner. The first-generation base editor (BE1) was developed by David Liu and co-workers of Harvard University, USA, in 2016. It was composed of a cytidine deaminase enzyme APOBEC1 (from rats) linked to a dCas9 by a 16 amino acid XTEN linker. The apolipoprotein B mRNA editing enzymes, catalytic polypeptide-like (APOBEC) family are a group of naturally occurring cytidine deaminases in vertebrates which protect them from invading viruses. Thus the original BEs consisted of the following two components: (i) a disabled Cas9 (dCas9) fused to a cytidine deaminase; (ii) a sgRNA for delivery of dCas9 with associated deaminase to the target locus carrying C within a window of 4–8 nucleotides and associated with a downstream PAM (protospacer adjacent motif) sequence available ~18–20 base pairs away.

Improvement of CBEs

In order to improve in vivo editing efficiency, BE2 were developed, which carried a gene encoding uracil glycosylase inhibitor (UGI) fused with the gene encoding dCas9, so that the enzyme UNG is inhibited and is not able to excise U from the U : G base pair, which is intended to be converted to T : A during DNA replication. The next stage for improvement of BEs was achieved by converting dCas9 to a nickase (then designated as nCas9) through replacement of either amino acid aspartate (D) by alanine (A) at position 10 (D10A) or replacement of amino acid histidine (H) by alanine at position 840 (H840A) and called as third generation BEs (BE3). Large number of BE3 variants (Including those for Non-Canonical PAM) developed which work on different PAM sequence and help to overcome the problem of CRISPR/Cas 9 system (Komor *et al*.2016).

Further expand and increase the base editing efficiency 4^{th} generation base editors BE4 developed by linking rAPOBEC 1 to Cas 9 D10A through a 32 amino acid linker and fusing two UGI molecules to both C and N terminal of Cas9 nickase by 9 amino acid linkers. Additional improvement in BE4 was achieved through fusion of Gam protein derived from Phage Mu. The Gam protein fusion products in the form of BE3-Gam and BE4-Gam vectors help in

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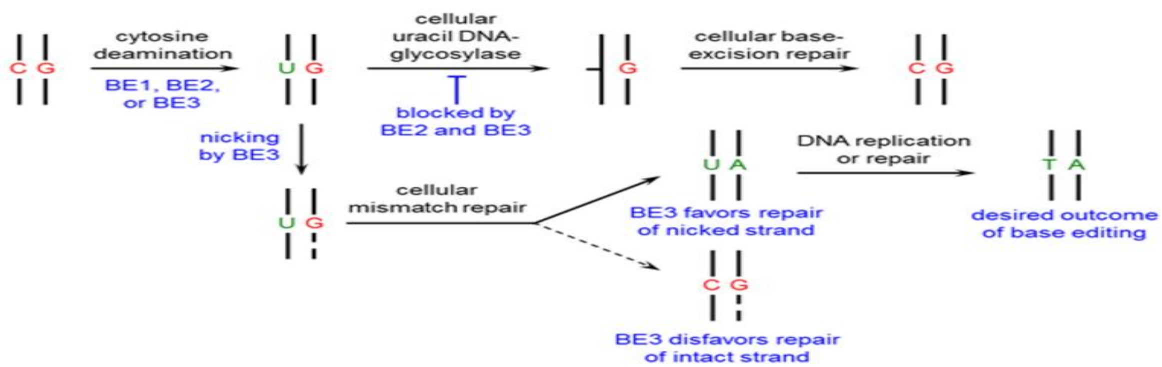
binding with DSBs leading to reduction in the frequency of indels and an improvement in product purity. Thus, fusion of Mu Gam protein to BE3 and BE4 gave one of the best base editors for conversion of C: G to T: A.

How It Work…….

Cellular response to cytosine base editing: Uracil DNA glycosylase mediated excision of uracil generated in genomic DNA is inhibited by BE2, BE3, BE4. BE3, BE4 are designed to nick the non-edited strand (containing the G of the original C:G target base pair), stimulating cellular DNA repair of that strand to replace the G with in A, completing the conversion of original C:G to U:A or follow DNA replication or repairs to a T:A base pair.



CONCLUSION

CBE is an efficient genome-editing approach which enables nucleotide substitutions in a programmable manner without the requirement of a DSB or donor template. Narrowing down catalytic window and adopting Cas9 variants to improve CBE base editors and expand the scope of base editing in crop plants. The highly precise base editors can be widely used in model plants and crops for precision breeding.

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DNA Adenine Base Editors (ABE)

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Nikki Kumari* and Meniari Taku
Division of Genetics, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION

After CBE was produced in 2016 and adenine base editors were more difficult to be produced because no DNA adenine deaminase was available anywhere in the living system, therefore it was more difficult to produce DNA adenine base editors. But RNA deaminase available that act on tRNA and convert adenine into inosine form, therefore this RNA deaminase utilizes in order to develop DNA deaminase. DNA adenine deaminase was developed in lab and this was first example, where new enzyme was developed in lab from pre-existing enzyme.

Finally, in 2017, David Liu and group developed ABEs by using *Escherichia coli* TadA (*E. coli* TadA) through extensive protein engineering and directed evolution. *E. coli* TadA is a tRNA adenine deaminase that converts adenine to inosine in tRNA. It also shares homology with the APOBEC enzyme.

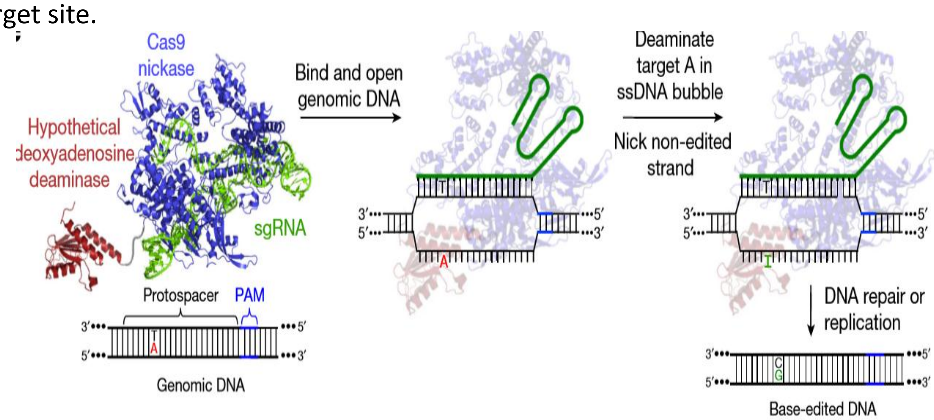
Adenine base editors

The deamination of adenine by DNA adenine deaminase give inosine, which is treated as guanine. ABEs that mediate the conversion of A: T to G:C in genomic DNA without DNA cleavage. The first- generation ABEs were developed by fusing a TadA with a catalytically impaired CRISPR/Cas9 mutant (Gaudelli *et al.*, 2017). Several generations of ABEs were developed, ABE7.7, ABE7.8, and ABE7.9 are considered to be the most active ABEs, with high level of editing efficiency.

Among series of ABEs, seventh-generation ABEs (ABE7.10) were recommended for conversion of A: T to G:C in a wide range of targets with high efficiency in term of low off-target editing and frequency of indels produced during editing that result to increase in product purity. ABEs introduce point mutations and enable the direct, programmable introduction of all four transitions (C to T, A to G, T to C and G to A) mutations without double-stranded DNA cleavage, this greatly expanded the scope of base editing.

ABE-mediated A•T to G•C base editing strategy

ABEs contain a hypothetical deoxyadenosine deaminase, which is not known to exist in nature, and a catalytically impaired Cas9. They bind target DNA in a guide RNA-programmed manner, exposing a small bubble of single-stranded DNA. The hypothetical deoxyadenosine deaminase domain catalyses conversion of adenine to inosine within this bubble. Following DNA repair or replication, the original A•T base pair is replaced with a G•C base pair at the target site.



ABEs for plant improvement

ABE was initially developed for human health care because there were a large number of diseases about two-third disease due to point mutation also called SNP and it was found that with the help of BE we can deal with almost 70% of human genetic diseases. Later on, plant base editor developed and used successfully in different crops for base editing. ABEs used in mammalian cells not work on plant system so need to codon optimization to develop an adenine base editor that efficiently create point mutations in plant system.

ABE-P1 (ABE plant version 1), the modified version of ABE7-10, was used for precise A.T to G.C conversion in rice plants (Hua *et al*., 2018). The editing efficiency of ABE-P1 was tested in rice by targeting IPA1 (OsSPL14), an important gene for plant architecture in rice for the base editing. Previous reports say that a point mutation in the OsmiR156 binding site of OsSPL14 perturbs OsmiR156-mediated cleavage of OsSPL14 transcripts, resulting in rice plants with an ideal architecture and enhanced grain yield (Jiao *et al.,* 2010). The plant ABE system was further used to develop herbicide resistance in rice (Li *et al*., 2018). A to G conversion in rice has been facilitated by a fluorescence tracking ABE developed by using E. coli TadA variants and Cas9 variants (Yan *et al.,* 2018).

CONCLUSION

- New ABE systems developed with Cas9 variants can be used as valuable tools for precise genome engineering in crops.
- Plant ABE systems combined with the modified single-guide RNA variants have the ability to expand the application of CRISPR-Cas9 tools as well as advance precise molecular crop breeding.
- ABEs is a novel editing approach which has the potential to modify crops precisely and accelerate crop improvement in the future.

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Biology and Management of invasive Fall Armyworm, *Spodoptera frugiperda* (J. E. Smith) on Maize in India

Article id: 23341

Sucharu Singh*[1], Shalendra Pratap Singh[2]
[1,2]Department of Entomology, CSA University of Agriculture and Technology, Kanpur-208002 (U.P.).

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal crop widely grown for food and also as livestock feed. Maize ranks with wheat and rice as one of the world's chief grain crop. Maize is a fully domesticated plant which has existed with man and evolved since ancient times. It has been referred as the "Queen of cereals" due to its highest yield potential among all the cereals (Ali et al.,2014)[1].FAW occurs in several countries such as Brazil, Argentina and the USA (Prowell *et. al*., 2004)[7] , causing economic losses in a variety of crops such as maize, soyabean, cotton and beans (Pogue,2002; Bueno *et al.,*2010)[2,5].The occurrence of this new invasive pest was reported for the first time from India by Sharanabasappa and Kalleshwaraswamy (2018)[8] .

Biology of FAW

Eggs are usually laid on the upper surface of leaves but occasionally may be deposited on other parts of the host plants. The number of eggs per mass varies from 100 to 200 (Prasanna *et al.,* 2018)[6]. The eggs were dorso-ventrally flattened initially pale green in colour. On the egg mass female covered a layer of scales and this gave moldy appearance. Black tubercles were found dorsally on the body which bears spines. The frons had a white inverted "Y" line. Each larva passed through six distinct instars over a period of 14 -19 days. The larval period tends to be about 14 – 30 days has been reported (Pitre and Hogg, 1983)[4].During the prepupal period the full-grown larva stopped feeding, turned greenish and the bright brown colour. Duration of the pupal period was about 9 to 12 days. Greyish brown male adults; forewings grey and brown shaded with oval or oblique orbital spots, triangular white patch near apical margins of the forewing. In female adults, forewings lack distinct markings with uniform greyish brown mottled colouration (Sharanabasappa *et al.,* 2018 & Shylesha AN *et al.,* 2018)[9,10]. The fall armyworm's life cycle is completed within 30 days during summer, and 60 days during the spring and autumn seasons; during the winter.


Eggs


Larva


Pupa


Adult

Management strategies of Fall Armyworm

(Government of India Ministry of Agriculture & Farmers Welfare Department of Agriculture)[3]

Cultural Measures

1. Intercropping of maize with suitable pulse crops of particular region. (e.g. Maize + pigeon pea/black gram /green gram).

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2. Erection of bird perches @ 10/acre during early stage of the crop (up to 30 days).
3. Sowing of 3-4 rows of trap crops (e.g. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows symptom of FAW damage.

Mechanical control:
1. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosine water.
2. Application of dry sand in to the whorl of affected maize plants soon after observation of FAW incidence in the field.
3. Application of Sand + lime in 9:1 ration in whorls in first thirty days of sowing.

Bio Control:
1. Augmentative release of egg parasitoid *Trichogramma pretiosum* or *Telenomus remus* @ 50,000 per acre at weekly intervals or based on trap catch of 3 moths/trap.
2. Bio-pesticides: If infestation level is at 5% damage in seedling to early whorl stage and 10% ear damage, then use entomopathogenic fungi and bacteria *Metarhizium anisopliae,Metarhizium rileyi (Nomuraea rileyi),Beauveria bassiana,Verticilium lecani*(1×10^8cfu/g) @ 5g/litre whorl application. Repeat after 10 days if required then use *Bacillus thuringiensis* v. *kurstaki* formulations @ 2g/l (or) 400g/acre respectively.

Chemical Control:
1. **Seed treatment:** Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml/kg of seed will be effective for 15-20 days.

2. **Seedling to early whorl stage:** To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE / Azadirachtin 1500ppm @ 5ml/l of water.

3. **Mid whorl to late whorl stage:** To manage 2nd and 3rd instars larvae having more than 10% foliar damage the following chemicals may be used upto early tasselling stage: Spinetoram 11.7% SC or Chlorantraniliprole 18.5% SC or Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC.

4. **Poison baiting:** Poison baiting is recommended for late instar larvae. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 litres of water for 24 hours to ferment. Add 100g Thiodicarb just half an hour before application in the field. The bait should be applied into the whorl of the plants.

5. **8 weeks after emergence to tasseling and post tasseling:**
Bio- pesticides as recommended above to be applied. Hand picking of the larvae is advisable. All the sprays should be directed towards whorl and either in the early hours of the day or in the evening time.

CONCLUSION

A pest is any living organism that is invasive or troublesome to crops, animals, human beings and livestock. Therefore pest populations must be kept below the economic injury level where economic damages occur. Management does not imply pest eradication. It implies finding efficient and cost effective tactics that minimize environmental damage.

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Farm Ponds: Purpose and Construction

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Bhagwat Saran
Research Scholar, Department of Soil & Water Conservation Engineering, College of Technology, Govind Ballabh Pant University of Agricultural and Technology, Pantnagar, India.

INTRODUCTION

Farm ponds are small tanks or reservoir used for storing runoff generated by the catchment. It is used for water harvesting structures, supply of water for irrigation, cattle feed and fish production. Farm Pond is a structure with specified shape and sizes with proper inlet and outlet for collecting the surface runoff flowing from the catchment area. It is constructed at the lowest elevation of the farm/catchment area. Sometime; it can be also used for ground water recharge, but structures require very high storage capacity and high infiltration rate. Purpose of farm pond is to meeting the crop water requirement of growing season, meeting water requirement during the critical stages of crop growth. Surface area of farm ponds are open, evaporation is the major problem in arid and semi-arid areas. So the depth of pond is about more than 5 metres and surface area will be less, more effective for reduction evaporation losses.

Purpose of Farm Ponds

- Farm ponds are multipurpose structure used for wild life conservation, boating, fishing, swimming etc.
- It is also used for drinking water for the livestock.
- It can also use for fish farming.
- It is also used for crop irrigation during non-rainy season.
- Water harvest in to the pond during rainy season and use in dry season.
- Farm ponds are also used for ground water recharge of the farm area.

Site Selection of Farm ponds

Site selection is an important parameter for designing of farm ponds. It is based on cost of construction and utilization of water. The site selection keeping in view of the following considerations:

- Minimum seepage losses.
- Largest storage volume with minimum earth filling.
- Avoided the large area of shallow water, causes of excessive evaporation losses.
- The pond should be located as near as possible to the area where the water will be used.
- If the ponds are constructed for livestock, they should be constructed at such point from where the transportation distance of water is more.

Classification of Farm Ponds

Depending upon the source of water availability, the farm ponds classified in four major groups, shown in fig. 1;

Embankment type ponds are partially excavated and an embankment is constructed to retain the water. It is also called surface water ponds or watershed ponds. Off-stream storage ponds are constructed by the

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side of stream which flow only seasonally. Spring type ponds are those, where spring is a source of farm water supply to the structure. Dugout ponds are excavated at the site and the soil obtained by excavations formed is formed as embankment around the pond. Dugout ponds to be used for irrigation by the pumping water while the embankment type ponds take water through gravity outlet.

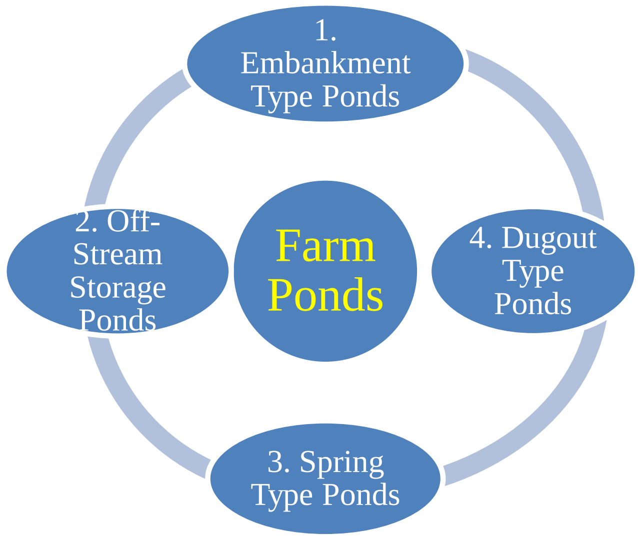

Fig. 1: Types of Farm Pond

Design of Farm pond

Farm ponds consists large number of parameters for designing. Site of farm pond surveyed for estimating earth work and design of spillways. The contour map of the site is also prepared to determine the pond capacity. Design of farm pond consists of following parameters;

1. Location of farm ponds

Site selection is one of the important factors that determine the utility of the pond. Site selection of farm ponds depends on soil condition, topography, drainage condition and rainfall. The site selected should have sufficient water supply around the year for filling pond. Lowest elevation site can be selected for more water collection but gravity flow ponds are ideal for higher elevation area. The site may be easily accessible by road or any form of transport to reach the market and, the accessibility of inputs (feed, seed, fertilizer and the construction material) should also be available nearby the pond. The pond site should be free from any type of pollution, industrial waste, domestic waste supply and any other harmful materials, because they mixed with water and degraded the water quality.

2. Capacity of farm ponds

The capacity of farm pond depends on the purpose for which water is stored and the amount of inflow. The storage capacity affected due to the losses of seepage and percolation. The capacity of farm ponds highly depends upon the size of catchment. The farm pond should be designed of capacity to meet the sufficient demand of the crops.

3. Embankment design

Hydrologic data, climatic data, geologic data etc. are used for design of embankment. To check the seepage flow from the foundation of the earthen dam, a core wall of impervious material is provided. Side slope depends upon dam height; foundation material etc., in most of the cases side slope varies from 3:1 to 2:1. Normally top width of embankment up to 5 m height and minimum top width 205 m recommended.

4. Design of spillways

Two types of spillways used in farm ponds; first one mechanical spillway and second is emergency spillway. Mechanical spillways are used for safely disposing the water from farm ponds while emergency spillway is used to protect the embankment from overtopping due to unexpected increase of flow in to farm ponds. Emergency spillway is located in one side of farm pond.

5. Seepage control measurement

Black cotton/ vertisol/ laterite soils have more clay content so these soils do not require lining for the seepage losses. More number of materials available for lining of farm ponds, used according to suitability. Bricks and stone are used for hard lining of the farm ponds. Plastic is also a low cost material for lining. Due to lining of farm ponds, loss of water through percolation and seepage is reduced up to 95%, availability of water due to minimum losses for a longer period of time.

CONCLUSION

Farm pond is a suitable structure for water harvesting on the farm. It is very useful for irrigation of crops and water supply to the cattle's. The role of farm pond is very effective when, the rainfall is uneven and due to this flood and drought will occur. Farm pond stored water when excess rainfall and supply when the season is dry. It is very effective in arid and semi-arid areas. The farm ponds not only provide water for irrigation of crops but also used for control of frost and air temperature during the growing of crops. Sometimes it may be used fire control on the farm.

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Role of insects in environment

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V. K. MISHRA, USHA AND M. SONIYA DEVI
College of Agriculture, Rani Lakshmi Bai Central Agricultural University, Jhansi-284003

INTRODUCTION

Insects represent a specific group of animals both in the variety of biological features and in their diverse functions in ecosystem .There are some 5 to 30 million insect species estimated in the world. insects are those that cause disease or compete for human agricultural products, but these insects represent only a small fraction of the world's insect population. In reality, most insects are *beneficial* to humans and the environment, not detrimental. Without insects, the environment could not function as it does, yet few of us have considered how these numerous and varied organisms actually affect our lives **(**Hevel, 2005). Insects play one of the most important roles in their ecosystems, which include many roles, such as soil turning and aeration, dung burial, pest control, pollination, and wildlife nutrition.

a. Soil turning and aeration: Insects play a key role in breaking down mulch, converting it into rich humus and improving the soil fertility, texture and structure. Example- Decomposition is a process that recycles nutrients back to the soil from formerly living organisms. The process can involve soil organisms breaking-down large pieces of organic matter into smaller ones which is done by many insect.

b. Plant-shredding insects: Plant-shredding arthropods break down dead plant matter to eat bacteria and/or fungi present on the matter. This shredding action helps to incorporate organic material into the soil. Most plant shredders are diplopods and crustaceans, but some insects, such as cockroaches, also shred dead plant matter.

c. Scavengers: Predacious arthropods feed on the live or dead bodies of other soil organisms. The digestion of the organisms breaks down the nutrients present in their bodies and adds to the organic matter of the soil.

d. Herbivorous insects: Herbivorous soil-dwelling arthropods eat the roots of plants, and include insects such as mole crickets and root maggots. In a healthy and balanced soil environment, herbivorous soil insects stimulate plant root growth while cycling and adding nutrients to the soil through their feces.

e. Fungus-eating insects: Fungus-eating arthropods keep fungal growth under control. Moreover, they cycle and release fungal growth nutrients through digestion and excretion of fecal matter. Silverfish are the most prevalent fungus-eating and soil-dwelling insects. These insects live near plant roots to take advantage of the fungus feeding ground that roots supply (Magallon and Sanderson, 2001).

f. Dung burial: Confining large mammals in small areas creates challenging waste-management problems. Fortunately, insects—especially beetles in the family Scarabaeidae (Ratcliffe 1970)—are very efficient at decomposing this waste.

g. Role in pest control

- **Insect predators:** Predators are mainly free-living species that directly consume a large number of prey during their whole lifetime.
- Ladybugs, and in particular their larvae which are active between May and July in the northern hemisphere, are voracious predators of aphids, and will also consume mites, scale insects and small caterpillars.
- The larvae of many hoverfly species principally feed upon greenfly, one larva devouring up to fifty a day, or 1000 in its lifetime. They also eat fruit tree spider mites and small caterpillars. Adults feed on nectar and pollen, which they require for egg production.
- **Parasitoid insects:** Parasitoids lay their eggs on or in the body of an insect host, which is then used as a food for developing larvae. The host is ultimately killed. Most insect parasitoids are wasps or flies, and usually have a very narrow host range.

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h. Role in pollination: Pollination is the process by which pollen is transferred in the reproduction of plants, thereby enabling fertilization and sexual reproduction. Most flowering plants require an animal to do the transportation. While other animals are included as pollinators, the majority of pollination is done by insects.

i. Relationship to humans

- Many insects have a parasitic relationship with humans such as the mosquito. These insects are known to spread diseases such as malaria and yellow fever and because of such, mosquitoes indirectly cause more deaths of humans than any other animal.
- Many insects are considered pests by humans. Insects commonly regarded as pests include those that are parasitic (mosquitoes, lice, bed bugs), transmit diseases (mosquitoes, flies), damage structures (termites), or destroy agricultural goods (locusts, weevils).
- Some of the more popular insects and arachnids eaten around the world include crickets, cicadas, grasshoppers, ants, various beetle grubs (such as mealworms), the larvae of the darkling beetle or rhinoceros beetle, various species of caterpillar (such as bamboo worms, mopani worms, silkworms and waxworms), scorpions and tarantulas.
- The value of commercially produced insect-derived products, such as honey, wax, silk, or shellac, and any value derived from the capture and consumption of insects themselves can also not be ignored.

j. Role in biological research: Insects play important roles in biological research. For example, because of its small size, short generation time and high fecundity, the common fruit fly *Drosophila melanogaster* is a model organism for studies in the genetics of higher eukaryotes. *D. melanogaster* has been an essential part of studies into principles like genetic linkage, interactions between genes, chromosomal genetics, development, behavior, and evolution.

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Current status of liquid hydroponics technique in smart agricultural research system

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Soumya Kumar Sahoo[1*], Selukash Parida[2] And Akankhya Guru[3]
[1]Department of Plant Physiology, COA, Indira Gandhi Krishi Vishwavidyalaya, Raipur
[2]Department of Plant Physiology, COA,Odisha University of Agriculture & Technology, Bhubaneswar
[3]Department of Plant Physiology, IAS, Banaras Hindu University, Varanasi

INTRODUCTION

The term 'Hydroponics' was derived from the Greek words '*hydro*' means water and '*ponos*' means labour. It is the technique of growing plants using mineral nutrients solution. In this technique, plants are growing in soil-less conditions and their roots are immersed in nutrients solution. Reports revealed that hydroponic activities linked from 4000 years back. However, plant biology research associated with hydroponic started from 1929. Then after commercial crop production via nutrient solution began by William Frederick Gericke from the University of California at Berkeley, and the other hydroponic systems developed subsequently. Now a days commercial cultivation via hydroponics is being conducted at a greater extent in agricultural and horticultural crop production, along with it has greater significance towards plant biology researches. Considering its efficiency, capability of modification and possibility of its development, the use of hydroponic systems cannot be unavoidable for plant biology researchers.

Advantages of conducting plant agricultural research in hydroponics

- Management of plant nutrients is very convenient.
- Nutrients can be directly available to plants.
- Easily controls its P^H and EC.
- Mutual elements interactions can be easily monitored.
- Less chance of soil-borne diseases or pests attack.
- Less water requirement than the soil culture.
- Roots are visible, and the root zone environment is easily monitored.
- Little or no pesticide is required.
- Plants can be grown in both on and off-seasons.
- Plants grow up to 50% faster than in soil.
- Higher number of plants can be grown in a small area.

Types of liquid hydroponics

- Nutrient film technique (NFT)
- Deep floating technique (DFT)
- Root Dipping Technique (RDT)
- Capillary Action Technique (CAT)

NFT	DFT	RDT	CAT
→True hydroponic system → 0.5mm of thin nutrient Solution film flow → Channel made From flexible sheet →Channel length 5-10 m. → Nutrient solution flow rate: 2-3 lit/min.	→ 2-3 cm of deep nutrient solution flows in 10cm Diameter PVC pipe. → Plastic pot contains plants and fitted in PVC pipes. → Bottoms of plants touch the nutrient solution that flows in pipes. → Root hanging.	→ Low growing method → Cost effective. → No water pump, cannels, and electricity is required. → Pot's bottom 2-3cm Submerged. → Non-metallic container → 2/3 filled.	→ Based on concept of capillary action. → Otherwise known as Wick system.

Role in agricultural research

Hydroponic techniques have been used in several aspects of plant biology researches such as plant nutrition, heavy metals toxicity, identification of elements deficiency, screening for abiotic stresses, screening for aluminium toxicity, root functions, root anatomy and in many more.

a) Plant nutrition:

- Soil-less methodology is using extensively from middle of twenty century in plant nutrition research. Numbers of research were conducted in hydroponics and the results of those experiments based on the nutrition solutions where the plants were grown are considered as soil. The proper condition in hydroponic solution is maintained by P^H, EC and presence or absence of some elements is monitoring nutrients uptake during the plant nutrition researches.
- Hydroponics provides suitable environments to detect the individual effects of elements on quantity and yield quality. (e.g: Many reports showed that influences of potassium on yield qualitative attributes sulfate in root zone are responsible for growth and elevation of micro and macro elements absorption.
- Tracing of nutrients in plants and comparison between plants on the basis of nutrient absorption has been studied since last decade by radiocesium in the hydroponics system.
- Hydroponics studies were conducted to study nutrient use efficiency, deficiency effects of micro and macronutrients and effects of interaction of different nutrients on crop plants.

b) Allelopathy in the rhizosphere:

- Effect of allelopathy studies need to identify chemical procedures, biologically active substances and the phytotoxic potential is quite difficult in field conditions.
- Hydroponics is a proper method to identify quantitative and qualitative determination of allelopathic materials and procedure of interaction between allelopathic materials with other chemical compound.
- The allelopathy compounds and screening the grain crops developed a fast and consistent bioassay method. The bioassay carried out in hydroponics culture, and a range of experiments with 2-(3H)-benzoxazolinone, an allelochemical of several grain crops, was carried out to define the basic protocol.

c) Abiotic stresses:

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- The use of hydroponics system for studying the abiotic stresses such as salinity and drought stresses is beneficial; help to understand abiotic tolerant mechanisms and identify abiotic stress-inducible genes in the tolerant plants.
- For screening of abiotic stresses tolerant plants, hydroponic methods provide suitable conditions to achieve proper data relevant to physiological and biochemical responses such as chlorophyll contents, and photosynthesis rate, stomatal conductance, transpiration rate, proline concentration, K/Na ratio, antioxidative enzymes activities etc.
- Effects of drought stress on rice genotypes in hydroponic method was more clearly observed.

d) Plant roots:

- Hydroponics is an ideal method for observing the root growth and development over time in different conditions.
- It is a convenient method to study the root morphology, anatomy, and root/shoot ratio, nutrient deficiencies, enzymatic activities, of the roots, root exudates, microorganisms activities in the rhizosphere and the effects of toxic elements on roots.
- It is an ideal method for observing root architecture and finding its relationship to plant productivity**.**

e) Heavy metal

- Hydroponics can be used to identify and characterize the mechanisms of tolerance to excess heavy metals in plants.
- It is the only way of eliminating mass transfer limitations and elucidating free metal ion and uptake and translocation of metal-chelate within the plant.
- In hydroponic and soil experiments, 'As' and 'Cd' showed synergetic and antagonistic effects on wheat root elongation.
- Hydroponically grown plants such as Indian mustard (*B. juncea* L.) and Sunflower (*H. annuus* L.) can extract the toxic metals like, Pb, Cu, Cr, Cd, Zn, and Ni, from aqueous solutions efficiently.

f) Aluminium toxicity:

- Although Aluminum (Al) is not an essential element, its low concentration can increase plant growth. 'Al' toxicity is one of the most common limiting factors for plants grown in acid soils. Excess 'Al' interrupts cell division in roots, increases the cell wall rigidity, fixes phosphorous in soils, reduces root respiration, interferes with uptake, transport and use of several essential elements such as Ca, Mg, K, Fe and P.
- Stress tolerance is genetically controlled, screening and selecting of Al tolerant genotypes under hydroponically, lead to improving tolerant cultivars to excess 'Al' because hydroponics provides easy access to root system, exact control over available nutrients and PH and non-destructive measurements of tolerance.

CONCLUSION

There are several advantages to conduct research related to agriculture in hydroponics as maintenance of P^H, EC, concentration of macro and microelements in hydroponics system is easy. So, it has greater importance to study plant nutrition, allelopathy effects, abiotic stresses, plant roots, heavy metal, aluminium toxicity through hydroponics technique. Furthermore, recently, NASA has planned to extend hydroponics research extensively in space, which will benefit current space exploration, as well as future, long-term colonization of Mars or the Moon.

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Soil Degradation: a global problem endangering sustainable development

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Manisha Apraj[1], Roshan Jadhav[2]
[1]Ph. D. Scholar, Department of soil science and agricultural chemistry
[2]Ph. D. Scholar, Department of plant physiology
PGI, MPKV, Rahuri, Dist- Ahmednagar (413 722)

INTRODUCTION:-

Soil degradation in India is estimated to be occurring on 147 million hectares (Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity, and 7 Mha from a combination of factors. This is extremely serious because India supports 18% of the world's human population and 15% of the world's livestock population, but has only 2.4% of the world's land area. Despite its low proportional land area, India ranks second worldwide in farm output. Agriculture, forestry, and fisheries account for 17% of the gross domestic product and employs about 50% of the total workforce of the country.

Soil Degradation

Soil degradation, decline in its capacity to support functions and provide ecosystem services, is caused by erosion, salinization, elemental imbalance, acidification, depletion of soil reduction in soil biodiversity and structure and tilth. Land degradation is not being adequately addressed, but is of vital importance to raise awareness so that future land management decisions can lead to more sustainable and resilient agricultural systems. Of India's total geographical area (328.7 Mha), 304.9 Mha comprise the reporting area with 264.5 Mha being used for agriculture, forestry, pasture and other biomass production. The severity and extent of soil degradation in the country has been previously assessed by many agencies .According to the National Bureau of Soil Survey and Land Use Planning ~146.8 Mha is degraded. Water erosion is the most serious degradation problem in India. Based on first approximation analysis of existing soil loss data, the average soil erosion rate was ~16.4 ton $ha^{-1}year^{-1}$ .Nearly 29% of total eroded soil is permanently lost to the sea, while 61% is simply transferred from one place to another and the remaining 10% is deposited in reservoirs

Extent of land degradation in India, as assessed by different organizations.

Organizations	Assessment Year	Degraded Area (Mha)
National Commission on Agriculture	1976	148.1
Ministry of Agriculture-Soil and Water Conservation Division	1978	175.0
Department of Environment	1980	95.0
National Wasteland Development Board	1985	123.0
Society for Promotion of Wastelands Development	1984	129.6
National Remote Sensing Agency	1985	53.3
Ministry of Agriculture	1985	173.6
Ministry of Agriculture	1994	107.4
NBSS&LUP	1994	187.7
NBSS&LUP (revised)	2004	146.8

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Causes of Soil Degradation

Physical Factors

There are several physical factors contributing to soil degradation distinguished by the manners in which they change the natural composition and structure of the soil. Rainfall, surface runoff, floods, wind erosion, tillage, and mass movements result in the loss of fertile top spoil thereby declining soil quality. All these physical factors produces different types of soil erosion (mainly water and wind erosion) and soil detachment actions, and their resultant physical forces eventually changes the composition and structure of the soil by wearing away the soil's top layer as well as organic matter. In the long-term, the physical forces and weathering processes lead to the decline in soil fertility and adverse changes in the soil's composition/structure.

Biological Factors

Biological factors refer to the human and plant activities that tend to reduce the quality of soil. Some bacteria and fungi overgrowth in an area can highly impact the microbial activity of the soil through bio-chemical reactions, which reduces crop yield and the suitability of soil productivity capacity. Human activities such as poor farming practices may also deplete soil nutrients thus diminishing soil fertility. The biological factors affect mainly lessens the microbial activity of the soil.

Chemical Factors

The reduction of soil nutrients because of alkalinity or acidity or water logging are all categorized under the chemical components of soil degradation. In the broadest sense, it comprises alterations in the soil's chemical property that determine nutrient availability. It is mainly caused by salt buildup and leaching of nutrients which corrupt the quality of soil by creating undesirable changes in the essential soil chemical ingredients. These chemical factors normally bring forth irreversible loss of soil nutrients and productivity capacity such as the hardening of iron and aluminum rich clay soils into hardpans.

Deforestation

Deforestation causes soil degradation on the account of exposing soil minerals by removing trees and crop cover, which support the availability of humus and litter layers on the surface of the soil. Vegetation cover primarily promotes thee binding of the soil together and soil formation, hence when it is removed it considerably affects the capabilities of the soil such as aeration, water holding capacity, and biological activity.

When trees are removed by logging, infiltration rates become elevated and the soil remains bare and exposed to erosion and the buildup of toxicities. Some of the contributing activities include logging and slash and burn techniques used by individuals who invade forest areas for farming, rendering the soils unproductive and less fertile in the end.

Misuse or excess use of fertilizers

The excessive use and the misuse of pesticides and chemical fertilizers kill organisms that assist in binding the soil together.The complex forms of the fertilizer's chemicals are also responsible for denaturing essential soil minerals, giving rise to nutrient losses from the soil. Therefore, the misuse or excessive use of fertilizers increases the rate of soil degradation by destroying the soil's biological activity and builds up of toxicities through incorrect fertilizer use.

Industrial and Mining activities

Soil is chiefly polluted by industrial and mining activities. As an example, mining destroys crop cover and releases a myriad of toxic chemicals such as mercury into the soil thereby poisoning it and rendering it unproductive for any other purpose. Industrial activities, on the other hand, release toxic effluents and material wastes into the atmosphere, land, rivers, and ground water that eventually pollute the soil and as such, it impacts on soil quality

Improper cultivation practices

There are certain agricultural practices that are environmentally unsustainable and at the same time, they are the single biggest contributor to the worldwide increase in soil quality decline. The tillage on agricultural lands is

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one of the main factors since it breaks up soil into finer particles, which increase erosion rates. The soil quality decline is exuberated more and more as a result of the mechanization of agriculture that gives room for deep plowing, reduction of plant cover, and the formation of the hardpan. Other improper cultivation activities such as farming on steep slope and mono-cropping, row-cropping and surface irrigation wear away the natural composition of the soil and its fertility, and prevent soil from regenerating.

Urbanization

Urbanization has major implications on the soil degradation process. Foremost of all, it denudates the soil's vegetation cover, compacts soil during construction, and alters the drainage pattern. Secondly, it covers the soil in an impermeable layer of concrete that amplifies the amount of surface runoff which results in more erosion of the top soil. Again, most of the runoff and sediments from urban areas are extremely polluted with oil, fuel, and other chemicals.

Overgrazing

The rates of soil erosion and the loss of soil nutrients as well as the top soil are highly contributed by overgrazing. Overgrazing destroys surface crop cover and breaks down soil particles, increasing the rates of soil erosion. As a result, soil quality and agricultural productivity is greatly affected.

- **Major Threats:-**

Soil Erosion

In general, soil erosion is more severe in mountainous than in undulating and plain areas. Inappropriate soil management, unsuited to the location like tilling along the slope, lack of crop cover during heavy rainfall, etc. is responsible for accelerated soil erosion with consequent loss of land productivity. Soil erosion by water is one of the most serious degradation in the Indian context.The land degradation due to wind erosion is limited to arid and semiarid regions of India, including the states of Rajasthan, Haryana, Gujarat and Punjab. Removal of natural vegetative cover resulting from excessive grazing and the extension of agriculture to the marginal areas is the major human-induced factors leading to accelerated wind erosion.NBSS & LUP and the Central Soil Water Conservation Research and Training Institute (CSWCRTI) have jointly initiated the preparation of soil erosion maps of different states using the components of Universal Soil Loss Equation obtained from field data available in soil resource maps generated by NBSS.

Salinization and Alkalization

The expansion of irrigation has been one of the key strategies in achieving self-sufficiency in food production. The net irrigated area in India has increased from about 22 M ha in 1950 to about more than 51 M ha at present. In most of the expansion, the area is increased under canal irrigation that leads to rise in groundwater Table resulting in the soil deterioration through accumulation of salts. These soils contain excessive amount of either soluble salts or exchangeable sodium or both affecting crop yields and crop production certain states like Rajasthan and Haryana are endowed with 84 and 62% of poor quality groundwater, respectively. Continuous use of such waters for irrigation to agricultural crops is bound to increase the problem of salinity and sodicity in India.

Acidity

The largest areas covered by acid soils in India belong to laterites and various latosolic soils e. g. Ferruginous red soils, ferruginous gravelly red soils, mixed red and black, or red and yellow soils. It is reported that about 6.98 M ha area is affected by acid soils; which is about 9.4% of TGA. Acid soils develop in humid and per-humid areas pertaining to states of Assam, other North east area, West Bengal, Bihar, Odisha, Andhra Pradesh, Kerala, Madhya Pradesh, Karnataka, Maharashtra and Tamil Nadu. These soils formed due to excessive leaching of cations with high rainfall, resulting in lowering of pH and loss of soil fertility. Acid soils pose typical water management problems, which are mostly associated with physical and chemical properties of soils. Kaolinite dominated light textured acid soils have very high saturated hydraulic conductivity leading to heavy percolation losses.

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Soil Organic Carbon Losses

Alfisols, Ultisols and Oxisols are prone to chemical deterioration owing to nutrient depletion due to pedogenic processes for soil development. The base saturation of these soils is very less specially in Ultisols and Oxisols as compare to Alfisols. In India, nearly 3.7 M ha is deteriorated due to depletion of organic matter Removal or in-situ burning of crop residues, no or least addition of organic manures, and intensive cultivation are the major reasons for the depletion of soil organic carbon.

Nutrient Imbalance

Balanced nutrient supply is essential for achieving high crop yields, but excessive and/or imbalanced nutrient inputs may pose risk pressure on the environment, human health and ecosystems. Nutrient losses could occur in many ways, i.e., via emission to the air as NH_3, N_2O, NO, and N_2, and discharge to the water through runoff, leaching and erosion. After 1980s, fertilizer was more widely used than manure in agriculturally developed states such as Punjab, Haryana and Orissa. The wide use of fertilizer and booming developed of the livestock production contributed to the vast N losses to the environment. The nutrient imbalance in soils could have much impact on crop production and environmental protection.

Pollution/Contamination by Toxic Substances

Both geogenic and anthropogenic factors cause pollution/contamination of soil and water resources. However, their impact varies with rainfall pattern, and depth and geology of aquifer.

Applications of sewage sludge to agricultural soils, and irrigation of field crops with sewage water and untreated industrial effluents alone, or in combination with tube well /canal water, are common practices, especially in the vicinity of large cities, as these are considered reusable sources of essential plant nutrients and organic C. Large variations in the composition of sewage waters of industrial and non-industrial cities of Punjab have been reported. In general, Pb, Cd and Nickel (Ni) were in higher Concentration in effluents of industries manufacturing metallic products as compared with textile and woolen industries.

Soil Sealing and Capping

Drastic and often irreversible land use changes such as the conversion of forest to agro-industrial land, extractive mining activities, as well as extensive horizontal expansion of cities have been resulting in the soil sealing and capping.

➢ Sustainable Soil Management

Five Basic Principles:

- Maintain Soil Livestock: They recycle nutrients and many other benefits!
- Cover the soil (Mulching): You may loose nutrients due to erosion and temperature extremes.
- Minimum or No Tillage: It speeds the organic matter decomposition Also, Moldboard plough destroy the soil population beside speeding humus decomposition.
- Maintain Nitrogen in Soil: Higher nitrogen (N) in soil means higher decomposition of organic matters and vice versa. Also, Low N starves plant.
- OM degradation should be less than its addition to maintain the soil fertility.

Methods of soil conservation

Contour Barriers: Stones, grass, soil are used to build barriers along contours. Trenches are made in front of the barriers to collect water.

Rock Dam: Rocks are piled up to slow down the flow of water. This prevents gullies and further soil loss.

Mulching: The bare ground between plants is covered with a layer of organic matter like straw. This helps to retain soil moisture.

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Terrace Farming: This is a process in which hill slopes are used as cultivable land. The farmer cuts terraces into slopes to create flat areas to grow crops because flat land is scarce in hilly regions.

Intercropping: Different crops are grown in alternate rows and are sown at different times to protect the soil from rain wash.

Crop Rotation: This is a cropping practice in which different crops are grown in systematic succession. Crop rotation involves growing of such crops in succession so as to add nutrients to the soil.

Contour Ploughing: This is a cropping method in which the farmer ploughs the land along a slope rather than up and down the slope. It reduces erosion.

Shelter Belts: In the coastal and dry regions, rows of trees are planted to check the wind movement to protect soil cover.

Prevention of Overgrazing: Animals like sheep and goats must be checked. Fodder should be raised as a crop. The free movement of the animals in the fields should be avoided.

Afforestation: Another very effective method to conserve soil. It means, planting of trees on a large scale. Large number of trees reduces wind speed and free flow of water. Thus, this method stops soil from being carried away and helps in conserving the soil to a great extent.

CONCLUSION

Appropriate mitigation strategies of the nearly 147 Mha of existing degraded land of India are of the utmost importance. With changing climate, land degradation is expected to only increase due to high intensity storms, extensive dry spells, and denudation of forest cover. Combating further land degradation and investing in soil conservation is a major task involving promotion of sustainable development and nature conservation. Sustainable agricultural intensification using innovative farming practices have tremendous potential of increasing productivity and conserving natural resources, particularly by sequestering SOC (both labile and recalcitrant) and improving soil quality. Novel Conservation Agriculture practices include: mulching, growing of cover crops, strip cropping, use of organic manure and soil conditioner etc. Improved grazing practices, irrigation management, control on industrial and municipal wastes, control and management on mining are a few other solutions for preventing land degradation. Finally, another critical challenge is controlling fragmentation of land holdings. This could be achieved by providing security of land rights and land tenure and encouraging the efficient use of marginal lands.

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Processing of Ginger Oil; Problems and Economic Prospects

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Suddhasuchi Das
Department of Plantation Spices Medicinal and Aromatic Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, INDIA

Ginger (*Zingiber officinale Rosc.*) is a commonly used spice, all over the world. It is also a remarkable plant with a very high amount of herbal, healing and medicinal benefits that can be used in all of our lives; the root and its essential oil are also used as preservative and flavouring agent. It aids digestion of food items such as meat, poultry and it can be added while cooking meat as it softens the meat. Processing of the crop to different forms plays an important role in the application of ginger for both local and internal purposes. This paper reviews the varieties; white type used in internal trade and yellow type that is mainly produced for Export trade. Products of Ginger, benefits of using ginger oil in order to improve the living standard of people and uses. The problems associated with the processing as well as economic importance of the oil are also reviewed.

1. INTRODUCTION:

Ginger (*Zingiber officinale Rosc.*) is a perennial herb and grows to about 3 - 4 feet high with a thick spreading tuberous rhizome. It is made up of stalk with narrow spear-shaped leaves and white or yellow flowers growing directly from the root. Ginger became familiar as one of the world's favourite spices next to pepper. This root can be widely used as herb, condiment, spice, home remedy and medical agent. Ginger snap cookies and gingerbread are also food in many homes, not only for children but also for parents. Ginger is regularly in everyday cooking due to the fantastic amount of herbal, healing and medicinal qualities that can be beneficial in all of our lives.

Oil from this crop is usually obtained from the root of ginger. The peculiar hot taste and pungent taste of ginger can be attributed to the presence of an acrid compound called Gingerol. Most of the health benefits of ginger are due to this Gingerol.

2. Products from Ginger:

Primary products:

- *Fresh ginger:*

Fresh ginger can be used directly due to its outstanding flavor as it contains the full note of the spice compared to other products from it. Fresh rhizomes with low fibre content but rich in aroma, pungency, fat and protein are preferred for green ginger purposes.

- *Dried ginger:*

Dry ginger obtained by drying of fresh ginger comes in the spice trade for the preparation of ground ginger and extraction of oleoresin and oil. It is available in a number of physical forms. It can be peeled or unpeeled and sometimes partially peeled. (Oliver, *et al*, 2008). Chinese dried ginger has more export potential than Indian ginger because of its bright color and more fibrous characteristics (Plotto, 2011).

Secondary products:

- *Ginger powder*:

Ginger powder is made by pulverizing dry ginger in a mesh size of 50 to 60. Grinding of Ginger releases the flavour, improves the texture of the powder and readily dispensable in the matrix.

- *Ginger oils*:

Ginger oil is produced commercially by steam distillation of freshly ground dry ginger. The yield of oil varies from 1.5 to 3.0% with an average of 2.0%. The oil obtained is a green or yellow mobile liquid which becomes viscous on ageing (Purseglove *et al*., 1981). The most suitable material for oil distillation is coated African ginger, followed by Nigerian splits and Cochin ginger. Ginger oil can also be recovered by steam distilling fresh ginger peelings and the yield is 1.5 to 2.8%. Ginger oil benefits include its therapeutic effects and it is used as an analgesic, expectorant, carminative, stimulant, anti-emetic, antiseptic, antispasmodic, bactericidal, laxative, tonic, etc.(Purseglove *et al*., 1981) .

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3. Processing of Ginger oil:

Ginger oil can be produced from fresh or dried rhizomes. Oil from the dried rhizomes will contain fewer of the low boiling point volatile compounds (the compounds that give ginger its flavour and aroma) as these will have evaporated during the drying process. The best ginger oil is obtained from whole rhizomes that are unpeeled. Ginger oil is obtained using a process of steam distillation. The dried rhizomes are ground to a coarse powder and loaded into a still. Steam is passed through the powder, which extracts the volatile oil components. The steam is then condensed with cold water. As the steam condenses, the oils separate out of the steam water and can be collected. In India the material is re-distilled to get the maximum yield of oil. The yield of oil from dried ginger rhizomes is between 1.5 to 3.0%. The remaining rhizome powder contains about 50% starch and can be used for animal feed. It is sometimes dried and ground to make an inferior spice.

4. Beneficial Effects of Ginger Oil:

The following are some of the benefits of ginger oil.

- ***Antimicrobial properties:***

Ginger oil has been reported to possess antimicrobial effects and studies by, Natta and co workers (2008) have shown that the essential oil of ginger extracted by hydrodistillation possess high antibacterial effects on food pathogens.

- ***Stomach:***

Ginger root and ginger oil is often used for stomach upsets. It is one of the best remedies for indigestion, stomach ache, diarrhoea, flatulence and other stomach and bowel related problems. Ginger and the products can be added to various food preparations.

- ***Food poisoning:***

Ginger is antiseptic and carminative in nature. As a result of this fact, it can be used for treating food poisoning, intestinal infections and bacterial dysentery.

- ***Nausea and Vomiting:***

From previous study, ginger root and its oil are effective against nausea, motion sickness and vomiting. Usage of ginger may result in reduction in pregnancy related vomiting in women.

- ***Heart:***

It is strongly believed that ginger boosts and strengthens the heart. Ginger oil is useful as a measure to prevent and cure heart diseases. Preliminary research has indicated that ginger may be helpful in reduction of cholesterol levels and prevention of blood clotting which might lead to stroke.

- ***Respiratory:***

It is effective in various respiratory problems such as cold, cough, flu, asthma, bronchitis, breathlessness and also good expectorant. Ginger is very effective in removing mucus from the throats and lungs and hence it is generally added with tea and honey for treatment of respiratory problems.

5. Economic Prospects of Processing and Uses of Ginger Oil

Spices are high value and export oriented commodity crops, which play an important role in agricultural economy. The freshly harvested ginger is used for consumption as green ginger and some sold at very low prices. (Yadav *et al* 2010). Sometimes the farmers are not able to sell their produce since there is no local market big enough to absorb and handle green ginger in large quantities. Therefore, it is essential to convert a part of produce into low volume high value ginger oil to make the crop remunerative. Therefore there is the need to improve on the processing technologies so as to achieve the following economic merits;

- Source of Revenue: Due to the benefits of using ginger oil, the product will command good price when accepted, properly processed and packaged in different countries.
- Employment opportunity: The processing will encourage the establishment of industries to create employment for the populace.
- Land Tenure System: Provision of large arable area of land for the cultivation of this crop will result into achieving large output which implies large economic returns.

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- Mechanization: Processing of this crop will enhance the use of improved technologies as related to the products from Ginger.

6. Challenges of the Processing of Ginger:

Oil Processing of Ginger into Essential Oil, play an important role in improving the economy of a country and also enhancing the standard of living of the people. Traditionally, ginger is processed under primitive conditions, which result into low yield and poor hygiene.

Therefore challenges posed from the processing of the oil arise from;

- Lack of contiguous parcels of arable land: The difficulties of acquiring contiguous parcels of land ranging from 2–5 Hectares to enable the farmer family to rely on this source of income and focus meaningfully on it without distractions.
- Appropriate Harvesting Time: Correct harvesting is very important. The essential oil content varies considerably during the development of the plant and even the time of day. If the plant is harvested at the wrong time, the oil yield or its quality can be severely reduce.
- Post Harvest Losses: Post – harvest losses of ginger are caused by pests, environmental factors, production and harvesting practices. Loss refers to the disappearance of food measured quantitatively, qualitatively and nutritionally. Quantitative loss involves the reduction in weight through water loss and loss of dry matter by respiration. Qualitative loss is frequently described by comparison with locally accepted quality standards and is often difficult to assess as it is based subjectively. Nutritional loss includes decline in vitamins, carbohydrates, proteins and lipids. In ginger, the main sources of deterioration are weight loss, sprouting, rotting and discoloration in commercial ginger.
- Lack of supports from the Government: If government funding is provided as a matter of policy to encourage ginger farming, available human and material resources will surely support the growth and development of this crop.
- The attitude of consumers at our local market level: If the consumers have the understanding of the benefits of ginger as an herb with healing qualities, the scale of operation may then gradually move from the peasantry level to a medium level where it should be. vi. Absence of credits to support the farmers: The government should grant to ginger farmers the revenue to go into the production of this beneficial crop. (Godfrey 2008).

CONCLUSION:

Ginger botanically known as *Zingiber officinale Rosc.* is one the of the world's favourite spice. The refreshing pleasant aroma, biting taste and carminative property of ginger make it an Indispensable ingredient of food processing throughout the world. To enhance the processing and uses of ginger, it is therefore important to look for a mechanical means of processing the ginger into essential oil and make the crop remunerative.

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ICTs: A Step towards Modern Agriculture in India

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Archit Singh*, Tejbal Singh, Priyanshu Singh
Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi-221005 (U.P.), India

Information and communications technology (ICT) refers to the technologies that provide access to information through telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage, and audio-visual systems, that enable users to access, store, transmit, and manipulate information. Information and communication technology in agriculture (ICT in agriculture), also known as e-agriculture, focuses on the enhancement of agricultural and rural development through improved information and communication processes. ICTs are most natural allies to facilitate the outreach of Agricultural Extension system in the country. Despite large, well-educated, well-trained and well-organized Agricultural extension manpower, around 60% of farmers in the country still remain un-reached, not served by any extension agency or functionary. Information is vital to tackle climate change effects for this reason; a shift is needed in the agriculture sector to disseminate appropriate knowledge at the right time to the ones. ICT in agriculture is an emerging fields focusing on the enhancement of agriculture, rural development and food security. The advancement in ICT can be utilised for providing accurate, timely, relevant information and services to the farmers, thereby facilitating an environment for more remunerative agriculture.

Need of ICTs in agriculture in India:

- Lack of awareness about modern technologies & market prices
- Inability to compete with modern farmers
- There is a gap between traditional & modern technology
- Many Farmers are not educated in India
- Cut off from cites & information
- Lack of extension facilities
- The continued increase in globalization and integration of food markets has intensified competition and efficacy in the agriculture sector, and has brought unique opportunities to include more small holders into supply chains.
- Agriculture faces a range of modern and serious challenges, particularly in developing countries exposed to price shocks, climate change, and continued deficiencies in infrastructure in rural areas.

Advantage of ICTs in Agriculture:

- Up-to-date market information on prices for commodities, inputs and consumer trends.
- Strengthen capacities and better representation of their constituencies when negotiating input and output prices, land claims, resource rights and infrastructure projects.
- Reduce social isolation, widen the perspective of local communities in terms of national or global developments, open up new business opportunities and allow easier

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Contact with friends and relatives.

- Increasing efficiency, productivity and sustainability of small scale farms through accurate information dissemination.
- Quick accomplishment of work.
- Information about pest and disease control, especially early warning systems, new varieties, new ways to optimize production and regulations for quality control.
- Better of markets resulting from informed decisions about future crops and commodities and best time and place to sell and buy goods.

Strengthen and empower farming community through ICTs in Agriculture:

ICTs can help for strengthening farming communities through wide networking and collaborations with various institutes, NGO's and private sectors. Further, farmers may enhance their own capacities through updated information and wide exposure to scientific, farming and trade community.

ICT Initiatives taken for Agriculture in India:

Some of the **successful ICT applications or** e-Agriculture initiatives are taken for Information Dissemination in India is indicated below.

e-NAM:

National Agriculture Market (eNAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. To promote uniformity in agriculture marketing by streamlining of procedures across the integrated markets, removing information asymmetry between buyers and sellers and promoting real time price discovery based on actual demand and supply. The eNAM is linked with 585 markets (APMCs) in 16 states and 2 union territories, with over 45 lakh farmer membership in 15 states.

eSagu:

The eSagu system was developed in 2004. eSagu provides customized solution to the farmers' problems and advice them from sowing to harvesting. Farmers send their farm condition in the form of digital photographs and videos, which were analyzed by the agricultural scientists and experts. After that, they suggest the right things to do to the farmers even small and marginal farmers are also getting advantage by this.

Warana:

The Warana "Wired Village" project was instigated in 1998 by the Prime Minister's Office Information Technology (IT) Task Force with the objective of providing agricultural information and services to farmers for increasing productivity. The information is transmitted to the farmers in local language about prices of agricultural outputs, employment schemes from the government of Maharashtra and educational opportunities.

IKSL:

IFFCO KISAN SANCHAR LTD (IFFCO Kisan) was started in 2012. It delivers relevant information and custom-made solutions to the concerned farmers through voice messages on mobile phones. The farmers can also communicate directly to the agricultural experts on explicit themes via 'phone-in' programmes.

Agmarknet:

Agricultural Marketing Information Network (AGMARKNET) was commenced in March, 2000 by Ministry of Agriculture, Government of India with the aim of empowering decision-making ability of the farmers regarding selling of their produce. This portal was developed to pace up the agricultural marketing system through broadcasting information about influx of agricultural commodities in the market and their prices to producers, consumers, traders, and policy makers transparently and quickly.

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Digital Mandi:

Digital Mandi is an electronic trading platform for facilitating farmers and traders to sell and procure agricultural produce beyond the geographical and temporal limitations effortlessly. Various financial institutions also participate in online trading of agricultural output to remove cash crisis.

eArik:

The eArik project was initiated in 2007 and it aims to disseminate climate smart agricultural practices and to achieve food security. It is an integrated platform to enhance the accessibility of agricultural information and technology in north-eastern India. It delivers agricultural specialist advice on crop cultivation, crop management and marketing. Farmers can also obtain information direct from the portal but field workers help farmers to access ICT based information or to consult with other agricultural experts.

Akashganaga (Meaning the Milky Way):

This ICT project makes possible the milk collection, fat testing, and payment timely and user friendly manner. It augments the income generation of dairy farmers through incorporation of advanced technology.

aAQUA (Almost All Questions Answered) :

aAQUA is a multilingual online system that facilitates farmers by advising them, solving their problems and answering their questions related to agriculture. Farmers have to register on aAQUA platform online or telephonically. After that, they can post their queries on the portal, for which they get answers shortly.

Fisher Friend Mobile Advisory KCC:

The Fisher Friend Programme (FFP) of M S Swaminathan Research Foundation was launched in 2009 to protect fisher folk from occupational hazards and to empower their livelihoods. The relevant information on wave height, wind speed and director, potential fishing zones, relevant news, government schemes and market price is provided to fishermen in local language. The FFP covers marginalized coastal communities in Tamil Nadu, Puducherry, Andhra Pradesh, Kerala, and Odisha, and is operational in English, Tamil, Telugu, Malayalam, Odiya languages.

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Reuters Market Light:

Reuters Market Light (RML) was initiated in October, 2007 to deliver customized information to the registered farmers via mobile-SMS. It disseminates information in eight local languages in 13 states.

e-choupal:

Indian Tobacco Company (ITC's) Agri Business Division, one of India's largest exporters of agricultural commodities, has conceived e-Choupal as a more efficient supply chain aimed at delivering value to its customers around the world on a sustainable basis. ITC's e-choupal is a unique example of using ITC's for agricultural development; e-choupal has already become the largest initiative among all internet based interventions in rural India.

SMS Portal/mKisan Portal:

SMS Portal for farmers was inaugurated on Jul 16, 2013 by the Hon'ble President of India. Till date, more than 152 crore SMSs have been sent to farmers by different departments/organizations of the Government of India and State Governments in agriculture and allied sector. So far, these messages have consisted primarily of advisories to farmers based on his / her location & selection of crops or practices in agriculture and allied sector.

This portal is designed aiming to serve farmers in three ways –

1. To disseminate information about diverse agricultural activities,
2. To provide seasonal advisories and
3. To provide various services directly to farmers through SMSs in their local languages.

Mahindara Kisan Mitra:

This portal provides information to the farmers on price of commodities, weather forecast, crop advisories, loans, insurance, cold storage and warehouses along with success stories of progressive farmers.

Agrisnet:

Agrisnet is a comprehensive web portal to broadcast relevant information to farmers, which was initiated and funded by the Ministry of Agriculture, Government of India. The AGRISNET serves farming community by disseminating information and providing services through use of Information & Communication Technology (ICT). It has following goals-

- Providing information to the farmers on quality of the inputs and its availability
- Disseminating information of various government schemes and recommending fertilizers after soil testing
- Providing information on latest technologies for increasing productivity in agriculture.

Digital green:

Digital Green is an international organization, which works with the participatory approach by engaging rural community to improve their livelihood using digital platform. Interactive and self explanatory videos are prepared for farmers by progressive farmers with the assistance of experts. These videos are shown to the farmers at individual level or in groups. The videos are prepared concentrating the requirements and welfare of the rural masses.

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Kisan Call Centers (KCCs):

KCCs were commenced on January 21, 2004 by the Department of Agricultural and Co-operation with the main intend of endowing extension services to the farming community in the local languages. The queries of farmers are tackled by agricultural graduates on help line, toll free number in their local language. The agricultural scientists also visit the field in person to get an idea about complex agricultural problems to resolve them.

Village Knowledge Centers (VKCs):

Village knowledge centers of MS Swaminathan research foundation, initiated in 1998 in Pondichery as a gateway of technical information related to agricultural inputs, price of outputs, crop rotation, use of fertilizers and pesticides. Information is disseminated through public address system.

Agronxt:

AgroNxt platform is multitasking platform for the farmers where farmers can get inputs, agriculture advice, weather condition etc. AgroNxt thrives to contribute to agriculture industry by delivering farmers usable, reliable and timely information that maximizes farm profitability. It assists upholding the agricultural productivity and sustainability.

Limitations of ICTs in Agriculture in India

- Illiteracy/ low level of literacy of farmers
- Digital illiteracy of farmers
- Poverty
- Poor infrastructure such as internet connectivity etc
- Non ownership of computers, tablets and other digital device
- Lack of awareness of farmers
- Lack of satisfaction with use of ICTs
- Several farming related issues unaddressed by ICTs
- Lack of access to markets and prices
- Challenges need to be addressed

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Oilseed Economy of India: Concerns and Issues

Article id: 23348

Sujatha K.
PhD Scholar, Department of Agricultural Statistics, BCKV, Mohanpur, West Bengal

INTRODUCTION

Vegetable oil is the prime source of fatty acids, which are essential for human nutrition. In India, there are nine oilseeds crop cultivated, out of which seven are of edible oils (rapeseed & mustard, groundnut, soybean, sunflower, sesame, safflower and niger) and two are of non-edible oils (castor and linseed). Among these nine oilseeds, soybean, groundnut and rapeseed & mustard are the main contributors in oilseed and vegetable oil production. Oilseeds are second only to food grains in terms of acreage, production and economic value within the segment of field crops. India has already attained self-sufficiency in food grains production, it has become surplus in rice and wheat with mounting food stocks, but it is facing severe shortages of oilseeds (Govindaraj *et al*., 2016). Oilseed crops are cultivated on poor and marginal soils primarily under the rain fed situation. This has resulted in the poor realization of genetic potential of improved varieties/hybrids. The rising demand and stagnant domestic vegetable oil supply will push the country's vegetable oil imports to over 25 million tonnes by 2030, from 15.5 million tonnes in 2017 (thehindubusinessline.com).

Indian Scenario of oilseeds

The oilseeds scenario in the country had undergone a deep change in the last fifteen years. In the 1980's India attained self-sufficiency with its production through "Yellow revolution" but could not be sustained beyond a short period and changed from not importer to a net exporter status during the early 1990s but again, it has come back to net importer status and importing more than 40 per cent of its annual edible oil needs. There is a large abyss between production and demand of edible oilseeds, leading to a growing need on import day by day. Growing population, economic growth, rising disposable income, urbanisation, changing food habits and deeper penetration of processed foods are the key drivers of India's vegetable oil consumption growth. Since the domestic oilseed production growth can't keep up with rising demand, the current demand for vegetable oil in India is met through domestic sources and imports.

India is one of the largest producers of oilseed in the world and grasps 4th position after the USA, China and Brazil. However, it is the 3rd largest consumer of edible oils. In case of imports, India stands in second-largest importer (9% of the total of the world) of edible oilseeds after China and plays a crucial role in the world trade of edible oils (DVVOF, 2017). India ranks first in the production of most of the minor oilseeds (castor, niger, safflower and sesame) and in the case of production of major oilseeds, India ranks second in the groundnut production, third in rapeseed-mustard and fifth in soybean (Sarada *et al*., 2015).

India holds a premier place in global oilseeds scenario with 12-15 per cent of the area, 6-7 per cent of vegetable oil production and 9-10 per cent of the total edible oil consumption and 13.6 per cent of vegetable oil imports (FAO, 2014). Despite having the largest area under oilseeds in the world, India currently imports about 58 per cent of total oil requirement. Domestic consumption of edible oils has increased

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significantly over the years and has touched the level of more than 23 million tonnes in 2015-16 and is likely to increase further with enhancement in income. The growth in production and consumption of domestic edible oils are not been able to keep pace.

Share of major oilseed in vegetable oil production in India

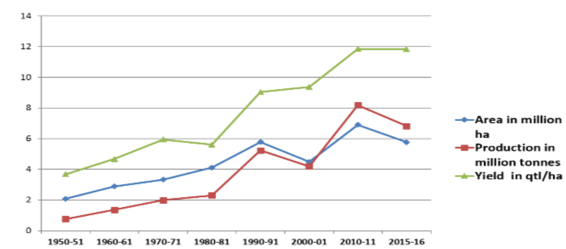
Nine oilseeds contribute more than 70 per cent of the domestic availability of vegetable oils. The remaining 30 per cent of the domestic consumption of oil are obtained from oil palm, rice bran, tree-borne oilseeds, coconut, cotton seed and solvent extracted oil which are the secondary source of vegetable oils. Among 09 oilseeds, soybean (39%), groundnut (24%) and rapeseed-mustard (24%) contribute more than 87 per cent of the total oilseeds production in the country. However, in terms of vegetable oil production mustard, soybean and groundnut contribute more than 31, 26 and 25 per cent respectively (nmoop.gov.in).

Table 1: Share of major oilseeds in oilseed and vegetable oil production

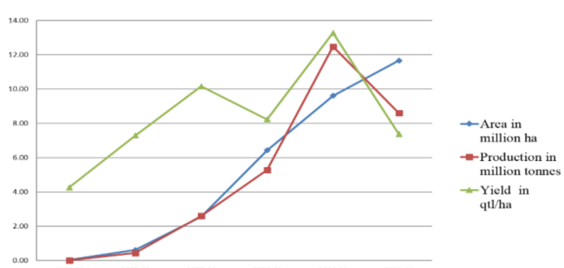
Oil bearing annual crops	Share in oilseeds production (%)	Share in vegetable oil (%)
Rapeseed & Mustard	24	31
Soybean	39	26
Groundnut	24	25
Others	13	18

Trends of Area, Production and Yield of Major Oilseeds

1. Rapeseed & Mustard: India occupies the third position both in area and production of rapeseed & mustard. The major producing states of rapeseed and mustard are Rajasthan, Haryana, Madhya Pradesh, Uttar Pradesh and West Bengal.

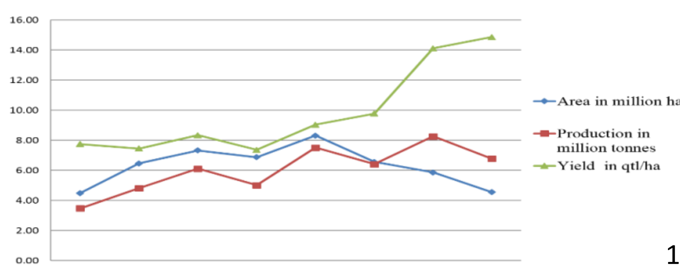


2. Soybean:



India occupies the fourth position in area and fifth position in the production of Soybean. Madhya Pradesh, Maharashtra, Rajasthan, Telangana, and Karnataka, are the major states which are producing Soybean in India.

3. Groundnut: India stands second in area and production of Groundnut after China in the world. In India, the cultivation of groundnut is mostly confined to Gujarat, Andhra Pradesh, Rajasthan, Tamil Nadu and Karnataka.



Constraints in oilseeds production

Oilseed crops are largely grown under rain fed condition (more than 70%) and are more prone to biotic and abiotic stresses. These crops are grown with minimum inputs due to high risk and poor resource base of farmers in rain fed areas. High seed rate and cost of seeds, non-availability of hybrids in case of major oilseeds like groundnut and soybean are other limitations in increasing the productivity of these crops. External price shock on account of the availability of cheaper imported oil is a major challenge in this sector. Such a complex scenario needs to be studied in depth to arrive at valid and useful conclusions which may enable effective policy interventions.

Conclusion and Recommendations

There have been variations in the growth behavior and trend of various oilseed crops over time. Hence given the competing demands on oil, increase in the production of oilseeds can be brought only through enhancing higher yield her hectare and by providing remunerative prices and assured market access. Buffer stock should be created by direct procurement from the farmers at Minimum support price which will not only reduce the dependency on import but also bring in self-reliance in the oilseed sector. Further, there is a need to strengthen the scope of research in the development of biotic and abiotic stress-tolerant varieties and bringing additional oilseed areas under irrigation, promotion of modern crop technology, better dry farming to re-energize the oil sector. Also, provide incentives to private sector participation in processing and value addition in oilseed crops, ensure availability of key physical (fertilizers, pesticides), financial (credit facilities, crop insurance) and technical inputs (extension services) in major crop ecological zones for oilseed crops and constraints for low capacity utilization should be addressed.

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Microbiological techniques to study soil microorganisms

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Sagar, R[1*]., Irfan, M. M[2]. and Vivek, M. S[3]
[1*]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, UAHS, Shivamogga
[2] Ph.D. Scholar, Department of Agronomy, UAHS, Shivamogga
[3] Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, UAS, Raichur

INTRODUCTION

There are a number of techniques to study soil microorganisms, they are

1. Determination of cell number: There are two methods

A. Non viable count method:

- **Breeds smear method or direct microscopic count:** The most obvious way to determine microbial numbers are through direct counting. In this method, a known volume of microbial suspension is spread uniformly over a glass slide within a specific area. The smear is then fixed, stained and examined under direct microscopic fields.
- **Hemo-cytometer method:** In this method of direct counting with a special counting chamber is used. The use of counting chambers is easy, inexpensive and relatively quick.
- **Electronic counter:** Larger microorganisms such as protozoa, algae and nonfilamentous yeasts can be directly counted with electronic counter.

Advantages:

1. It is a simple method, inexpensive and rapid.
2. Morphology of the cells can be studied under a microscope.

Dis-advantages:

1. It gives total cell count, which includes both viable and non-viable cells.
2. Accuracy also declines with very dense and very dilute suspension.

B. Viable count method:

The direct microscopic counts provide the bacteriologists with the total number of cells, both viable and nonviable in a population. In many instances, it is desirable to know the number of viable bacteria in a suspension.

- **Standard plate count method:** The plate count is based on the fact that each organism inoculated on agar medium grows and divides to form a colony of cells. The number of colonies, therefore, is the same as the number of viable cells inoculated.
- **Membrane filter count:** The viable count technique is not feasible for the enumeration of bacteria in samples that contain a very low concentration of cells such as water and air samples. In these situations, the samples are filtered through membrane filters (Nitrocellulose filters). The filter with minute pores traps the bacteria and the filter disc is then placed onto petri plate containing a suitable medium. The plates are incubated and then colonies are observed on the membrane surface. This method has a distinct advantage over standard plate count. A large volume of samples can be analyzed and various types of microorganisms can be detected by using selective media.

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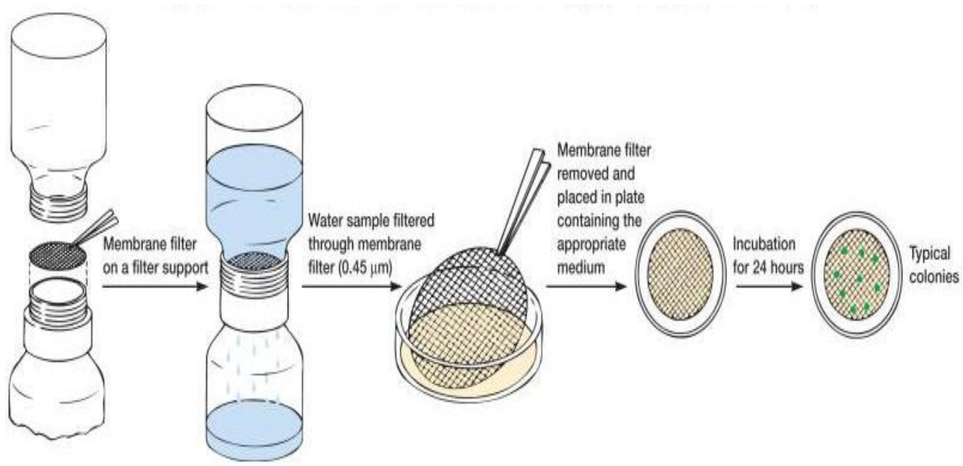

Fig. 2: Membrane filter count technique

- **Serial dilution method:** With both the spread plate and pour plate methods, it is important that the number of colonies developing on the plates not to be too large because some cells may fuse, leading to erroneous measurements. Therefore dilutions of the original suspension prior to plating on agar medium are necessary to reduce the number of cells per milliliter. In the dilution method, the original inoculum is subjected to successive serial dilutions, so that the concentration of the microbes gradually become less and less. When these dilutions are plated, colonies will appear discrete and far from one another.
- **Most probable number method:** This technique is used for estimating the number of viable bacterial counts in a liquid medium. Some microorganisms do not grow well on solid media, are more easily identified by growth in liquid media. The MPN method for liquid media provides an alternative to viable count for enumeration of microbes. The number of organisms in the original sample is determined by the use of standard MPN tables. This technique is used most often used to estimate the number of coliform bacteria in water samples.

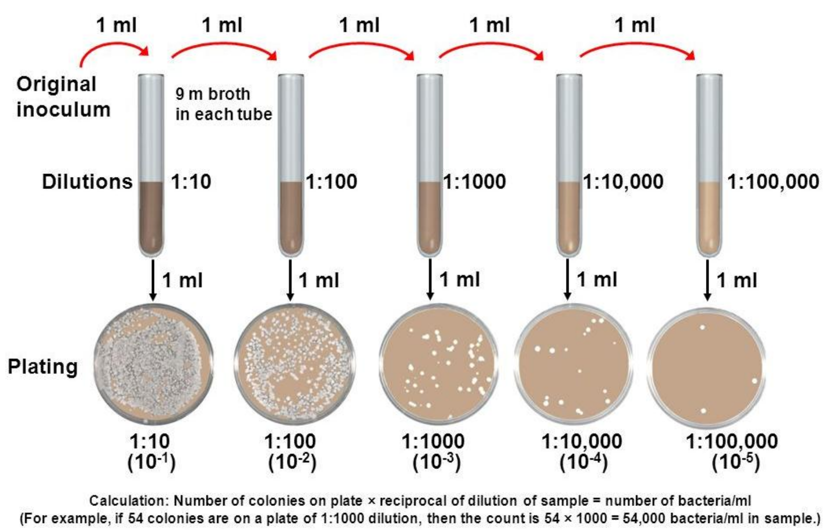

Fig. 3: Serial dilution technique

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2. Determination of cell mass: In this method, increased growth is determined by weight or mass of cells as because the cell mass is proportional to cell number. There are two methods.

A. Direct method:

Measurement of dry weight: This is the simplest and direct method of measuring the cell mass. A known volume of culture is centrifuged and the residue or the pellet is washed many times to remove all the extraneous matter. The residue is dried in oven and then weighed. This method can only be used with dense cell suspensions and commonly used in industrial work.

Measurement of cell nitrogen: The major chemical constituent of cell is protein and nitrogen is one constituent of protein. Therefore microbial growth can be measured in terms of quantity of nitrogen content. The cell suspension is centrifuged and then cell nitrogen is estimated by chemical analysis. An increase in the microbial population will be reflected in a higher total protein level.

B. Indirect method

Turbidometric method: This is the most widely used technique of measuring cell mass by observing the light scattering capacity of the sample. This is the rapid and quite useful method of obtaining an estimate of cell number or mass by use of turbidity measurements.

3. Determination of cell activity: Sophisticated methods have been developed in recent years to measure bacterial growth through changes in the cell activity. All living cells must synthesize macromolecules during growth. Increase in the amounts of these molecules as a function of growth can be monitored. Quantities of the above are determined by measuring the actual amount of these macromolecules through chemical analysis. The principle behind this is more number of cells produce a large quantity of metabolic products.

CONCLUSION

The principal way a microbiologist studies microorganism is by observing them through a microscope, either a compound light or electron. In order to grow microbes out of their natural habitats and in pure form in the laboratory, certain nutrients are required. The most widely used media is agar and technique is serial dilution technique.

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Reusage of untreated packaging wood material -a serious cause for entry of Invasive alien species

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B. L. Manisha [1*] and Bolli Venu babu [2]
Ph.D. Scholar[1], S. V. Agricultural college, ANGRAU, Tirupati -517502 & Ph.D. Scholar[2], ICAR-Indian Agricultural Research Institute (IARI), New Delhi – 110012 .

INTRODUCTION

Packaging wood is a circulating product, repeatedly used, repaired and often re-imported to the country of origin. According to intensive annual surveys for the possible occurrence of the pine wood nematode in many European countries , *B. xylophilus* was found nowhere in Europe except for a restricted area in Portugal but later the Chinese records of *B. xylophilus* in packaging wood from several European countries and possibly also from Brazil attributed to the circulation of contaminated wood material between different countries. Therefore, the presence or absence of this quarantine pest in packaging wood is not dependent on the recent origin of the wood. A serious threat of introducing *B. xylophilus* exists for every country that imports packaging wood contaminated with this serious forest pest, provided that a suitable vector (*Monochamus* spp.) is available, either already present in the importing country or imported with the same wood. The present study illustrate the danger of entry of invasive alien species due to the using of untreated packaging wood that is circulating in international trade.

Reasons for spread

Bursaphelenchus spp. are known for their impressive longevity in dead wood. They survive in wooden package for months or even years, survive the repeated use of packaging wood. That is even more surprising as most of the wooden packaging material, which contained *Bursaphelenchus* spp. were accompanied by heat treatment certificates. The fact of recording *B. xylophilus* in 40 (1.2%) of 3416 batches from eleven different countries or regions including six countries where the pine wood nematode is not known to occur, underlines the necessity of rigorous application of international agreements on the phytosanitary treatment of packaging wood in international trade. Furthermore, the effectiveness of the quarantine measures agreed upon should be investigated and their application should be controlled more strictly, because of the repeated interception of the pine wood nematode in imported packaging material accompanied by heat treatment certificate, the effectiveness of heat treatment procedures was investigated in China (Qi *et al.* 2005). The results of laboratory and factory tests revealed that the pine wood nematodes were not killed completely at a core temperature of 56 ^{0}C in wood for more than 4 h and at a core temperature of 60 ^{0}C in wood for 3.5 h (ISPM 15 approved measures of heat treatment: minimum core temperature of 56 ^{0}C for 30 min). However, when the core temperature of wood reached 65 ^{0}C for more than 0.5 h, the pinewood nematodes were completely killed.

Mode of spread:

When the beetles feed on the pine trees, wounds are created which are exploited by the nematodes and are a cause for the entry of nematodes, these nematodes thus entered feed on the plant cells causing a wilt in pine trees,where in they multiply till DL3 stage and enter into insect at DL4 stage to complete its life cycle ,when the beetles feed on new trees the nematodes are thus transmitted.

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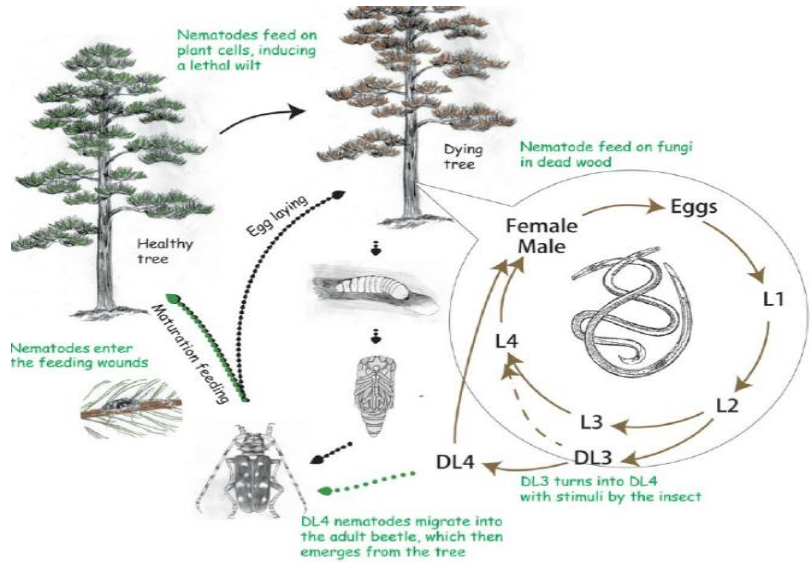

(a) (b) (c) (d)

Fig 1: (a)A batch of packaging wood imported from Taiwan showing bore holes and beetle larva;(b) both *Bursaphelenchus xylophilus* and larvae of *Monochamus alternatus* were isolated from the packed wood material,(c) pine wilt nematode.

Management:

ISPM 15: It has to be followed to curb the uncertain menace of beetles in wood

- A mark indicating that wood packaging material has been subjected to approved phytosanitary treatment in accordance with this standard comprises the following required components: -
- The symbol –
- A country code –
- A producer/treatment provider code –
- A treatment code using the appropriate abbreviation-
- Use of debarked wood

Heat treatment by subjecting to a temperature of 56 °C for a minimum duration of 30 minutes throughout the entire

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profile of the wood (including its core).

Example : Country code - (“XX”)

- Producer/treatment provider code – (“000”).
- Treatment code – Ethaneldinitrile instead of MB ,HT,DH

CONCLUSION

Reusage of unfinished raw wood without pre-treatment during export from different countries should be avoided as it will lead to the spread of unintentionally invaded pests which cannot be detected in the initial instance and may cause huge losses to both the timber industry as well pave a way for secondary infestations and act as vectors spreading several diseases.

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Milk associated microbial hazards

Article id: 23351

[1]Sonu K. S.* and [2]Basavaprabhu H. N.
Doctoral fellows
[1] Dairy Chemistry Division
[2] Dairy Microbiology Division
ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India

1. INTRODUCTION

Nutrition and health are the two important key elements in life for development and protection. However, the higher cost of a better quality diet is still not affordable for millions of people. Therefore, milk and their products have evolved as better alternatives to improve the nutritional status of an individual of all economic classes of a nation. Milk is a highly nutritious food that contains major (carbohydrates, proteins, and lipids) and minor (minerals and vitamins) nutrients that are regularly required to meet daily nutrient requirements. Milk is a major source of calcium, magnesium, selenium, riboflavin, vitamin B12, and pantothenic acid that fulfills the body's requirement of these nutrients. Hence, the consumption of milk and milk products throughout the lifetime is essential for healthy nutrition and development. Meanwhile, the consumption of dairy products is associated with a reduced risk of non-communicable diseases like osteoporosis, colorectal cancer, and Type 2 diabetes. Despite being a wholesome nutritional food, there is a growing concern of safety and quality issues in milk. Raw or under processed milk can lead to foodborne illness in humans. It is important to understand the hazards related to milk consumption in humans and how can these be controlled ensuring its safe consumption. The challenge to all food-safety policy-makers is to maintain a balance in the necessary control measures to bring desired human health outcomes while taking into account the diversity in milk production systems and products.

2. Food safety hazard

The food safety hazard is defined as any physical, chemical or biological agents present in the food or any other condition of foods that cause adverse health effects on human health upon consumption. The major hazard associated with milk and milk product is tabulated in the given below table.

Physical hazard	Biological hazard	Chemical hazard
Hair	Bacteria	Antibiotic residues
Stones	Fungi	Pesticide residues
Metal fragments	Virus	Aflatoxins
Jewelry	Cockroaches	Heavy metals
Bone fragments	Cat	Radionuclides
Glass pieces	Puppy	

3. Hygienic Practices and Measures for Dairy Personnel

I. Imparting Extensive Hygienic Training
II. Health Supervision

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III. Wounds and Injuries Care
IV. Washing of Hands
V. Personal Cleanliness
VI. Personal Behavior

4. Source of Microbial Contamination

I. Microorganisms
II. Environment
III. Water
IV. Packaging Material
V. Animal Hygiene and Animal Health
VI. Milking Equipments

5. Mechanism of Microbial Spoilage

The fermentation of milk and milk products is the main causative microbial spoilage factor in the dairy industry. Microbial fermentation is either normal or abnormal**.** Interaction between the microorganisms is responsible for the type of change that happens in the product. Such interaction types between organisms are discussed below.

5.1.Synergism

Mutual benefits of microorganisms with each other may capable to bring change in the product; otherwise, each individual alone is not able to bring such type of changes. For example, blue discoloration in milk by *Pseudomonas syncyanea* is associated with the *Lactococcus lactis* which creates an acidic environment by the production of lactic acid that favors the growth of *Pseudomonas syncyanea*

5.2. Metabiosis

In this type of association, the metabolic end products of one microorganism are utilized by the other microorganism as its energy source to bring changes in the product. For example, in the process of Swiss cheese-making, lactic acid bacteria produce lactic acid, which is later utilized by the propionic acid bacteria to produce propionic acid that gives characteristic flavor to Swiss cheese.

5.3.Antibiosis

The growth of one organism inhibits or suppresses the growth of the second organism. For example, the production of lactic acid by lactic acid bacteria causes inhibition of the proteolytic organisms

6. Milk-Borne Diseases and their classifications

Milk is a rich consortium of nutrients, provide a suitable microenvironment for the growth of numerous spoilage and pathogenic organisms. The variety of microorganisms *(Lactobacillus*, *Streptococcus*, *Staphylococcus*, and *Micrococcus*spp.) comprised of milk and milk products are an important source to cause foodborne illness*. Listeria monocytogenes*, Campylobacter spp. *E. coli*, *Salmonella* spp. *Yersinia enterolitica*, and *S. aureus* were the major organisms associated with milk-borne diseases to humans, which causes typhoid fever, diphtheria, and scarlet fever. Also, tuberculosis and brucellosis are the two important zoonotic diseases that are transmitted from animals to humans through milk. Salmonella Poisoning

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(Salmonellosis), Staphylococcal Poisoning and travelers diarrhea caused by *E. coli* are also important milk-borne causing illnesses.

6.1 Milk Borne Infections

6.1.1 Salmonella poisoning: Consumption of milk and milk product contaminated with Salmonella leads to Salmonella poisoning

6.1.2 Bacillary dysentery (Shigellosis):*Shigella dysenteriae, Shigella sonnei,* and *Shigella flexneri* are the causative organisms.

6.1.3 Streptococcal infection: *Streptococcus pyogenes* and *Streptococcus agalactiae* are the causative organisms

6.2 Milk Borne Intoxications

6.2.1 Staphylococcal poisoning: Milk contaminated with *Staphylococcus aureus* is the causative factor for these type of poisoning

6.2.2 Botulism: Severe among all types of poisoning, as it affects the nervous system. Milk is rarely involved in causing this type of poisoning. *Clostridium botulinum* is the organism responsible for this type of poisoning.

6.2.3 *E.coli* poisoning: Enterotoxin producing *E.coli* is the causative organism

6.2.4.Cholera: It is a diarrheal disease caused by *Vibreo cholerae.* Although it is mainly a waterborne disease, milk may also involve in transmitting this type of disease.

6.2.5 Fungal intoxication: Aflatoxicosis is the major fungal intoxication caused usually by the molds like *Aspergillus flavus* and *Aspergillus parasiticus*

6.3 Milk borne toxi-infection

6.3.1 *Bacillus cereus* poisoning: Ingestion of milk contaminated with *Bacillus cereus* or its spores leads to this type of poisoning.

6.3.2 *Clostridium perfringens* poisoning: Milk contaminated with enterotoxin A and enterotoxin C producing *Clostridium perfringens* is the causative factor.

7. CONCLUSION

The safety of dairy products concerning foodborne disease is of great concern around the world especially in developing countries where the production of milk and milk products takes place under unsanitary conditions. Foodborne infections badly affect individual health and financial status, thus have an impact on the nation economy. Proper hygiene practices should be adopted throughout the production process to control the microbial load and to ensure the microbiological safety of the product.

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Lactic Acid Bacteria (LAB) Derived Antimicrobial Compounds

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[1]Basavaprabhu H. N.* and [2]Sonu K. S.
Ph.D. Scholars
[1]Dairy Microbiology Division
[2]Dairy Chemistry Division
ICAR-National Dairy Research Institute, Karnal-132002, Haryana

Antimicrobial or antagonistic ability

Antagonism is an "association between two organisms in which one benefits at the expense of other". However, the ability to inhibit the growth of pathogenic microflora by lactic acid bacteria (LAB) is a major criterion to baptizes as the potential bioprotective cultures. To exhibit strain-specific antagonistic behaviors against competitive microflora, LAB rely on synthesizing dynamic cellular metabolites of low molecular weight (<1000 KDa) and high molecular weight compounds (>1000 KDa) at the end of the log (primary mrtabolites) and early stationary (secondary metabolites) growth phase to establish hindrance towards co-existed microflora. The possible metabolites mediated mechanistic insights towards the antagonistic responses against a wide range of spoilage causing and pathoentic microbes have been described below

1. **Organic acids**: Diffusion of undissociated molecules of organic acids viz. lactic acid, formic acid, acetic acid at specific lower pH via bacterial cytoplasmic membrane modulate the normal physiology of bacterial cells by lowering the intracellular pH. Thus developed low pH will inhibit the substrate transport and the F_oF_1 ATPase (Castellano *et al*., 2017).

2. **Hydrogen peroxide and ethanol**: Both being the potential oxidative agents, hold the capacity to destabilize the structure and functionality cell surface proteome of bacteria.

3. **Reuterin (3-hydroxypropionaldehyde)**: A low molecular weight, water-soluble antimicrobial compound produced by *Lactobacillus reuteri*. The highly active aldehyde group of reuterin reactive with thiol groups and amines, and therefore reuterin might inactivate cellular proteins. Further, the dimeric form of reuterin, is structurally similar to a ribose sugar and interferes with the enzyme ribonucleotide reductase activity as a competitive inhibitor and therfore attenuate bacterial DNA synthesis. Besides, the dehydrated form of reuterin "acrolein" has also found to exhibit bacterial toxigenic effect (Schaefer *et al*., 2010). Reuterin has a broad-spectrum activity against Gram-positive and Gram-negative bacteria, yeast, fungi, protozoa and viruses (Oelschlaeger *et al*., 2010).

4. **Mycocins:** These are the killer toxins, chemically the glycoproteins, produced by certain genera of yeast like *Saccharomyces*, *Candida*, *Cryptococcus*, *Debaryomyces*, *Pichia*, *Kluyveromyces*, *Torulopsis*, *Williopsis*, and *Zygosaccharomyces*. Inhibits closely related yeasts by inhibiting the synthesis of DNA and also by inhibiting the synthesis β-1,3-glucan, a cell wall component. In the era of AMR, mycocins might be potential alternatives to inhibit drug-resistant molds (Rima *et al*., 2012).

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5. **Bacteriocins:** These are the ribosomally synthesized antimicrobial peptides produced by lactic acid bacteria active against other bacteria and against which the producer has a specific immunity mechanism (Cotter *et al.*, 2013). Class I bacteriocins like Nisin A, Nisin Z inhibits cell wall synthesis by targeting the lipid II molecule, a key peptidoglycan biosynthetic machinery. The bacteriocins like lactococcin A127 and microcin E492 (Class IIa) kills target bacteria through pore formation in the cell membrane.

6. **Carbon dioxide:** Besides creating an anaerobic environment, it has been reported to inactivate the enzyme decarboxylase and also to able to disrupt the cell membrane integrity (Mishra *et al*., 1996). The accumulation of CO_2 in the lipid bilayer of the cell membrane affects the functioning of permeability.

7. **Diacetyl (2, 3 butanediol)**: Interfere with the arginine utilization and inhibits both gram-positive and gram-negative pathogens by reacting with arginine binding protein (Mishra *et al*., 1996).

8. **Other low molecular weight antimicrobial agents:** Other molecules exhibiting antimicrobial action on both Gram's positive and Gram's negative pathogens includes acetaldehyde, Acetyl methyl carbinol (AMC), acetoin, free fatty acids, reutrcycline, antifungal compound like antifungal cyclic dipeptides [cyclo(L -Leu- L -Pro) and cyclo (L -Phe- L -Pro)], phenyllactic acid, propionate, 4-hydroxyphenyllactic acid and 3-hydroxy fatty acids, benzoic acid, methylhydantoin, and mevalonolactone (Suskovic *et al*., 2010; Bermudez-Brito *et al*., 2012).

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What is C Sequestration and Processes and Technological Options for C Sequestration in Agricultural, Industrial and Natural Ecosystems

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Payal A. Mahadule[1] and Reshma Sale[2]
[1,2]Department .of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. (413722)

Carbon sequestration is a significant worldwide wonder that assumes a significant job in keeping up a fair worldwide carbon cycle and maintainable yield creation. Carbon Sequestration is the situation of CO2 into a safe in such manner that it remains securely and not discharged back to the air. Sequestration implies something that is bolted away for safety's sake. The trapping of a chemical in the atmosphere or environment and its isolation in a natural or artificial storage area. The soil C sequestration is solely dependent on the balance between input and output of C in soil. The processes involved in C sequestration are given as-

(a) Abiotic Sequestration

Abiotic sequestration depends on physical and synthetic responses and building procedures without intercession of living creatures (for example plants, organisms). The abiotic methodology of C sequestration in maritime and geographical structures has gotten extensive consideration in light of the fact that hypothetically abiotic sequestration has a bigger sink limit than biotic sequestration. Fast advancement is being made in creating/testing advances for CO2 capture, transport and injection.

- **Oceanic Injection**

Injection of a pure CO_2 stream deep in the ocean. CO_2 is injected below 1000 m from a manifold lying at the ocean floor, and being lighter than water. The oceanic sink capacity for CO_2 sequestration is estimated at 5000–10 000 Pg C.

- **Geological Injection**

This includes capture, liquefaction, transport and injection of industrial CO_2 into profound topographical strata. The CO_2 might be infused in coal creases, old oil wells, stable stone strata or Saline springs are underground strata of extremely permeable dregs filled with brackish (saline) water. Industrial CO_2 can be pumped into the aquifer, where it is sequestered hydrodynamically and by responding with other broke down salts to frame carbonates.

- **Scrubbing and Mineral Carbonation**

Mineral carbonation is accomplished through mimicry of characteristic inorganic synthetic change of CO_2 It includes change of modern quality CO_2 outflows into $CaCO_3$, $MgCO_3$ and different minerals as topographically and thermodynamically stable mineral carbonates. It is a two-organize process: cleaning and mineral carbonation. Scouring, the procedure of synthetic ingestion of CO2 utilizing an amine or carbonate dissolvable, is the most broadly utilized strategy for carbon catch. The CO_2 is purified by going through an absorption segment containing amine dissolvable. Pure CO_2 gas, recovered by warming the CO_2-rich amine, is re-hastened through mineral carbonation.

(b) Biotic Sequestration

Biotic sequestration is based on managed intervention of higher plants and micro-organisms in removing CO2 from the atmosphere.

- **Oceanic Sequestration**

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There are several biological processes leading to C sequestration in the ocean through photosynthesis. Phytoplankton photosynthesis is one such mechanism, which fixes approximately 45 Pg C yr-1. Some of the particulate organic material formed by phytoplankton is deposited at the ocean floor and is thus sequestered.

- **Terrestrial Sequestration**

Transfer of environmental CO2 into biotic and pedologic C pools is called terrestrial C sequestration. Earthbound environments establish a significant C sink inferable from the photosynthesis and capacity of CO2 in live and dead natural issue. Attributable to its various auxiliary benefits (for example improved soil and water quality, reclamation of corrupted biological systems, expanded harvest yield), It offers numerous benefits even without the risk of worldwide environmental change. There are three head segments of earthbound C sequestration: woodlands, soils and wetlands.

- **Wetlands**

Wetlands and the related soils or histosols establish a huge pedologic pool assessed at around 450 Pg. Wetland soils may contain as much as multiple times more C than the related vegetation.

- **Secondary Carbonates**

Soil C sequestration may also occur in SIC as secondary carbonates, and leaching of bicarbonates into the ground water.

- **Biofuels**

Converting biomass-derived sugars to ethanol and plant-derived oils and fats into bio-diesel is a viable strategy to reduce use of fossil fuels and develop alternate/sustainable sources of energy.

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Seed bio-priming: an eco-friendly approach for the management of seed borne diseases

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Mukul Kumar[1], Bipul Kumar [2] and Manoj Kumar[3],
[1]Department of Plant Patholgy
Chandra Shekhar Azad University of Agriclture and technology
[2] Department of Extension Education
[3] Department of Entomology
Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur)

INTRODUCTION

Cereal grains are staple food of world and satisfy the hungers of people. More than 70% of the world's farmlands devoted to the cultivation of cereal grains. Single most important source of calories to a majority of the world population. It is a source of vitamins, minerals, carbohydrates, fats, oils and proteins. More than one and half of the total calories consumed by humans are cereal. The expected dramatic increase in human population and shortages in food supply make it a necessity to explore new strategies to improve crop yields and effectively manage seed borne diseases with more natural, environmental-friendly strategies. Given the nutritional and economic importance of grains, microbial seed-borne diseases are real danger to global food security.

Bio-priming

Seed bio-priming is a technique of seed treatment that integrates biological (Inoculation of seed with beneficial organism to protect seed) and physiological aspects (seed hydration) of disease control. It is an ecological approach using selected fungal antagonists against the seed and soil borne pathogen. (Harman and Taylor, 1988).

Bio-priming word is made up by two words “Bio” means “life” and “Priming” means “to prepare”. The concept was originally developed for the protection of sweet corn from *Pythium ultimum* seed decay (Callan *et al*., 1990). These biological control activities are exerted either directly through antagonism of soil-borne pathogens or indirectly by eliciting a plant-mediated resistance response. The mechanisms of biocontrol involve antibiosis, parasitism, competition for nutrients and space, cell wall degradation by lytic enzymes and induced disease resistance (Singh, 2013). It allows rapid seed colonization by beneficial organisms and more uniform coverage of the seed surface compared to other techniques. This is a pre-sowing treatment in which seed are prepared for the accepting challenges (biotic and abiotic) of natural environmental conditions with the germination. Basically it allows imbibing water, going through the first two stage of germination, but does not permit the radicle protrusion through seed coat. Primed seed can be dried to original moisture content and stored (normally to the short period) prior to sowing.

Seed-borne pathogen

Any infectious agent association with the seed, having the potential of causing a disease of a seedling or plant, is termed as seed borne pathogen. e.g. fungi, bacteria, nematode, virus *etc.*

Seed-borne diseases

It means the association of pathogen on or in the seeds (embryo/ endosperm) which consequently be able to transmit the pathogens through the seed which as a result, may lead to the development of a disease in the seedling or plant. e.g. loose smut of wheat, downy mildew *etc.*

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Transmission of seed borne pathogens

Externally seed-borne pathogens:

If a pathogen is located out side the functional part of the seed, it is externally seed borne such as bunt spores.

Internally seed borne pathogens:

If pathogen is located inside the functional part of the seed, it is internally seed borne such as loose smuts, anthracnose, and blights.

Seed contamination:

Seed contamination means transmitting pathogen on seed surface without an active relationship between seed and pathogen. e.g. downy mildew.

Major seed-borne diseases of cereals

Crops	Diseases	Pathogen
Wheat	Loose smut	*Ustilago nuda* var. *tritici* S
	Karnal bunt	*Tilletia indica* M
	Seedling blight	*Septoria nodorum* B
Rice	Blast	*Pyricularia oryzae* C
	False Smut	*Ustilaginoidea virens* T
	Brown leaf spot	*Bipolaris oryzae* S
	Sheath blight	*Rhizoctonia solani* K
	Bacterial leaf blight	*Xanthomonas oryzae* pv. *oryzae* S
Maize	Leaf blight	*Cochliobolus heterostrophus* D
	White streak	*Fusarium moniliforme* S
	Black bundle	*Cepholosporium maydis* S
	Downy mildew	*Pernosclerospora maydis* R
Pearl millet	Downy mildew	*Sclerospora graminicola* S
	Smut	*Tolyposporium penicillariae* B
	Ergot	*Claviceps fusiformis* L
Sorghum	Anthracnose	*Colletotrichum graminicola* W
	Grain smut	*Sphacelotheca sorghi* C
	Downy mildew	*Peronosclerospora sorghi* S
	Zonate leaf spot	*Gloeocercospora sorghi* D

Site of infection

Embryo infection: Embryo infection in loose smut of wheat By *Ustilago nuda* var. *tritici*
Endosperm infection: Endosperm infection in Maize by *Fusarium moniliforme*
Glume (Bract) infection: Glume infection in Rice *Bipolaris oryzae*

Seed priming phases

Phase I.- Imbibition	Phase II. Lag	Phase III. Germination

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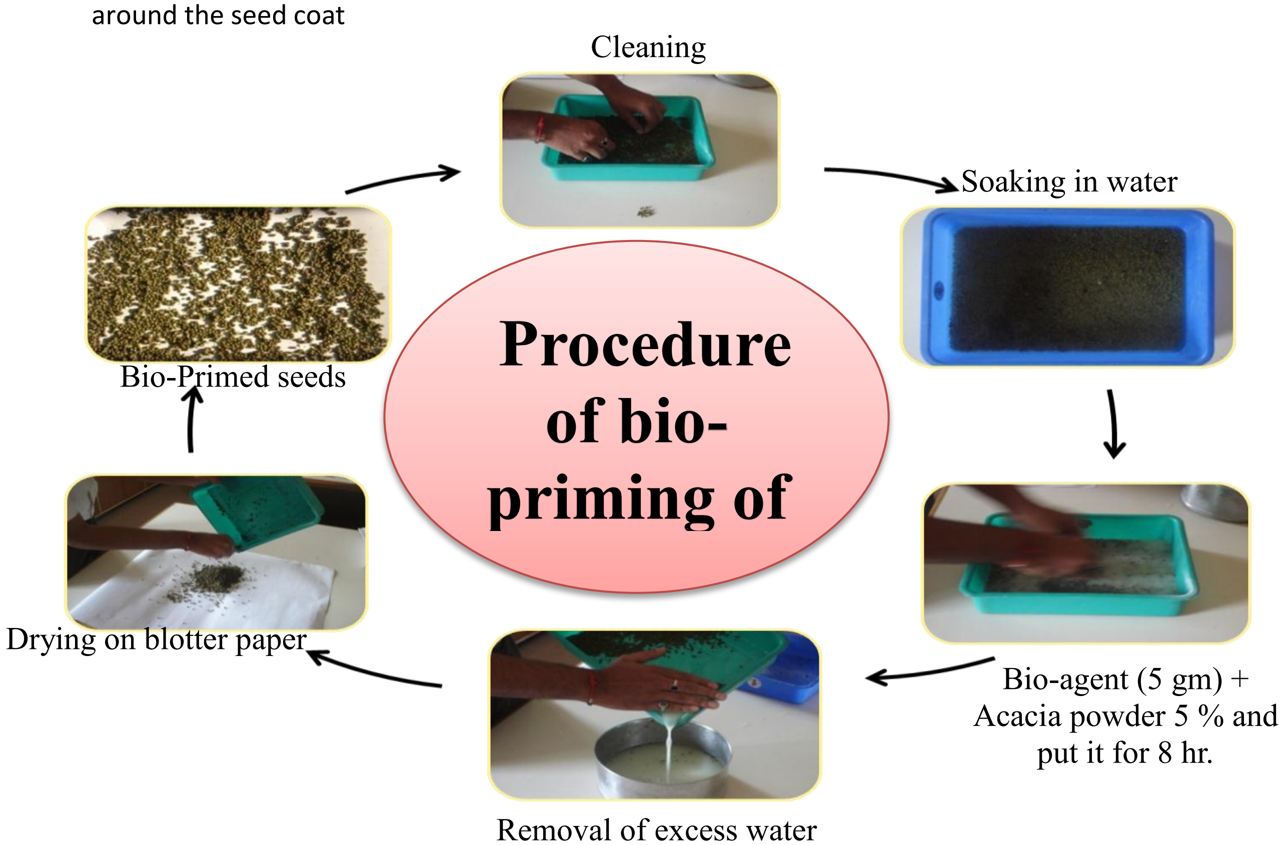
Advantage

- Addition of beneficial rhizosphere microorganisms in the priming process either as a method for efficient delivery to the crop rhizosphere or to manage pathogen.
- Useful in adverse soil conditions also and maintain the soil health also.
- It gives protection to seed against cold cause it increase the exudation of metabolites.
- To reduce seed rotting and increase germination percentage and quality parameters of plants.
- Restrict the transfer of seed borne disease.
- Decrease the use of hazardous chemicals and by this way cost of cultivation also decrease.
- It gives equal or superior control provided by the fungicidal seed treatment.
- Enhance efficacy, shelf life and consistent performance of biological control agents.

General Procedure

- Pre-soak the seeds in water for 12 hours.
- Mix the formulated product of bio-agent with the pre-soaked seeds at the rate of 10 g per kg seed.
- Put the treated seeds as a heap.
- Cover the heap with a moist jute sack to maintain high humidity.
- Incubate the seeds under high humidity for about 48 hours at approximately 25–32 °C.
- Bio-agent adhered to the seed grows on the seed surface under moist condition to form a protective layer all around the seed coat



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Losses due to seed borne diseases

- Brown spot of rice caused by the seed borne *Helmenthosporium oryzae* was responsible for Bengal Famine during 1942, due to these yield loss of 50-90%, resulting in death of 2 million people.
- Downy mildew of pearl millet caused by *Sclerospora graminicola* due to these about 27% yield loss observed in Rajasthan during 1962-64.
- Phytopathogen may result in a catastrophe as illustrated by the southern corn leaf blight caused by the fungus *Cochliobolus heterostrophus* epidemic of 1970–71 in the United States.
- Today, the rice blast fungus, *Pyricularia oryzae*, causes 10–30% crop losses annually. Moreover, the host range of this fungus extends to include other cereals such as wheat and finger millet where the infection may result in complete crop loss.

CONCLUSION

- As now a days our major concern is to protect environment for future generation by reducing the use of chemical fertlizers and pesticides in present day seed bio-priming provides a biggest solution to this as it provides or make availability of nutrient besides it has major role in crop protection from disease and pest. It makes the nutrient available in absorbable form.
- It makes the outer covering on seed coat and protect the seed from pathogen entry *i.e*., it doesn't allow the pathogen to penetrate the seed coat and thus entry of pathogen to endosperm and embryo.
- Efficacy of seed bio-priming with *Pseudomonas fluorescens* on PDI of the rice sheath blight disease under field conditions was determined and it was found that 41.33% redction in percent disease index. Suman *et al.* (2017)
- Effect of seed bio-priming with *Trichoderma harzianum* and foliar spray with fungicides on incidence of brown leaf spot and sheath blight of paddy under field conditions (Pooled analysis of three year) was analysed and found that there is 55% reduction in disease incidence Biswas *et al.* (2008)
- From foregoing discussion it can be concluded that bio-priming of seeds play an important role for the management of seed borne diseases of cereals.
- It can be used as a one of the component of biological management of plant diseases.
- It is economical, eco-friendly and provides protection to plants against seed borne diseases.
- Seed bio-priming with *Pseudomonas fluorescens*, *Trichoderma harzianum*, *Trichoderma viride, Gliocladium virens* and *Stachybotrys atra* and strains of them effectively manage seed-borne diseases *viz.,* downy mildew of pearl millet, sheath blight, blast, bacterial leaf blight, glume discoloration, brown spot of rice, loose smut and root rot of wheat, zonate leaf spot, anthracnose and head blight and grain mold of sorghum, ear rot and of maize *etc.* besides disease control, they were also reported to increase yield considerably.

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Role of new insecticides molecules in IPM

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Sucharu Singh*[1], Shalendra Pratap Singh[2]
[1,2]Department of Entomology, CSA University of Agriculture and Technology, Kanpur-208002 (U.P.).

INTRODUCTION: The new insecticides introduced in crop protection are quiet different in chemical structure over the existing groups and target alternate physiological and biochemical effect and diverse mode of action. Due to less toxicity it comes under the group IV which is green chemical origin. New group of insect control insecticides includes neonicotinoids, spinosyns, avermectins, oxadiazines, IGR's, fiproles, pyrroles, pyridine azomethine, ketoenols and benzenedicarboxamides. These plays an important role also in IPM because of high selectivity, low mammalian toxicity and bioefficacy. It replaces the older classes of insecticides which are very toxic to natural enemies, mammals and many insects show resistance due to this kind of insecticides. It helps to reduce the organophosphate and carbamates insecticides which are harmful for environment.

Role of new insecticides molecules

- High selectivity
- Low mammalian toxicity
- Less persistant in environment
- High efficacy at low doses
- Resurgence and outbreak of secondary pests can be reduce by these new insecticides molecules
- Greater specificity to target pests

Ideal qualities of an insecticides

- Kill the target insect effectively and quickly
- Be less toxic to natural enemies
- Be less toxic to honey bees, soil microorganisms
- Be less toxic to fishes and mammals
- Less hazardous and less toxic during handling
- Residues should be less
- Should not cause resurgence of the target insect
- Should not cause outbreak of secondary pest on a minor pest by killing the natural enemies
- Should be cost effective and safe to use
- Complex mode of action against which resistance development will take more time.

Classification of new insecticides of molecules

Insecticide group	Insecticide name	Trade name	Mode of action	Target pests	Manufacturing Company
1. Neo-Nicotinoids (a) Chloronicotinyl compounds	Imidacloprid 17.8% SL	Confidor	Acetylcholine receptor agonist(mimic)	Jassids, aphids, thrips	Bayer CropSciences
	Imidacloprid 70% WS	Gaucho	Acetylcholine receptor	Jassids, aphids, thrips	Bayer CropSciences

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			agonist(mimic)		
	Acetamiprid 20% SP	Pride	Acetylcholine receptor agonist(mimic)	Aphids, jassids, whitefly	Dow AgroSciences
(b) Thionicotinyl group	Thiamethoxam 25% WG Thiamethoxam 70% WG	Actara, Cruiser	Acetylcholine receptor agonist(mimic)	stem borers, hoppers, jassids, whiteflies	Syngenta Co Ltd.
(c) Furanicotinyl group	Dinotefuran 20%SG	Osheen Token	Acetylcholine receptor agonist(mimic)	hoppers, jassids , aphids	Biostad India Ltd.
(d) Pyridincarboxamides	Flonicamid 50% WG	Ulala	inhibition of oxidative phosphorylation	whiteflies, plant hoppers, plant bugs and mealy bugs	United Phosphorous Limited
2. Phenyl Pyrazoles	Fipronil 5% SC Fipronil 0.3%GR	Regent	Chloride channel modulator	stem borer, gall midge, DBM, thrips,	Bayer Crop Science
3. Pyridine azomethines	Pymetrozine 50WG	Chess, Fulfill	Chordotonal organ TRPV channel modulators	whiteflies, hoppers and aphids	Syngenta Co. Ltd.
4. Oxadiazine Group	Indoxacarb 14.5% SC Indoxacarb 15.8% EC	Avaunt Avanut EC.	Voltage-dependent sodium channel blocker	cotton bollworms, DBM, & pod borer complex.	E.I. DuPont Co.
5. Halogenated Pyrroles	Chlorfenapyr 10% SC	Intrepid	Oxidative phosphorylation disruption uncoupler	DBM, mites	BASF Company
6. Thiazolidine Group	Hexythiazox 5.45% EC	Maiden	Mite growth inhibitors	red spider and yellow mites	
7. Thiourea Derivatives	Diafenthiuron 50% WP	Pegasus, Polo	inhibition of oxidative phosphorylation	whiteflies, aphids, jassids, thrips	Syngenta Co Ltd.
8. Sulfite Ester Group	Propargite 57EC	Omite	inhibition of oxidative phosphorylation	red spider mite, pink mite, purple mite, scarlet mite	Dhanuka Agritech
9. Diamide Group	Flubendiamide 20% WG Flubendiamide 39.35% SC	Takumi Fame	Ryanodine Receptor modulators	stem borer, leaf folder, H.armigera	Rallis Company
	Chlorantraniliprole 18.5% SC	Coragen Ferterra	Ryanodine Receptor modulators	DBM, H. armigera, S. litura, stem borer	E.I. DuPont Co.

	Chlorantraniliprole 0.4%GR				
10. Quinazoline group	Fenazaquin 10% EC	Magister	inhibits mitochondrial electron transport chain	red spider mite, pink mite, purple mite, scarlet mite	E.I. DuPont Co.
11. Tetronic Acid Derivatives	Spiromesifen 22.9%SC	Oberon 240SC	Inhibitors of acetyl COA carboxylase	red spider mite, yellow mite	Bayer Crop Science
12. Insect Growth Regulators (a) Benzoyl Urea	Novaluron 10EC	Rimon , Signa	Chitin synthesis inhibitor	DBM, fruit borer,pod borer	Indofil Company
(b) Thiadiazines	Buprofezin 25%SC	Applaud	Chitin synthesis inhibitor	hoppers, Jassids and whitefly	Rallis Company
13. Pyridazinones Acaricide	Fenpyroximate	Mitigate	inhibits mitochondrial electron transport	red spider mites and two spotted mites.	
14.New Insecticides from Microorganisms Avermectins	Abamectin 1.9%EC	Vertimec	Chloride channel activator	sucking pests, dipterans, psyllidae, leaf miners and phytophagous mites.	Syngenta Co Ltd.
Avermectins	Emamectin benzoate 5% SG	Proclaim	Chloride channel activator	lepidopteran pests	Syngenta Co Ltd.
Spinosyns	Spinosad 45%SC Spinosad 2.5%SC	Tracer, Success	Nicotinic acetylcholine receptor agonist (mimic)	American bollworm, podborer,thrips,DBM	Dow Agro Sciences

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MILLETS: The nutri cereals

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Diksha Singh and Shikha
Ph.D. Scholar, Dept. Food and Nutrition, College of Home Science, G.B.P.U.A.& T., Pantnagar, U.S. Nagar, Uttarakhand- 263145

INTRODUCTION

Millets are traditional grains, grown and consumed in the Indian subcontinent from the past more than 5000 years. Millets are small - grained, annual, warm - weather cereals belonging to grass family. They are rain - fed, hardy grains which have low requirements of water and fertility when compared to other popular cereals. They are highly tolerant to drought and other extreme weather conditions.

Millets are nutri cereals comprising of sorghum, pearl millet, finger millet (Major millets) foxtail, little, kodo, proso and barnyard millet (minor millets). These are one of the oldest foods known to humanity. These are one of the several species of coarse cereal grasses in the family *Poaceae*, cultivated for their small edible seeds. Pseudo millets are so called because they are not part of the *Poaceae* botanical family, to which 'true' grains belong, however they are nutritionally similar and used in similar ways to 'true' grains.

Millets are highly nutritious, non-glutinous and non-acid forming foods. Millets have many nutraceutical and health promoting properties especially the high fibre content. Millets act as a probiotic feeding for micro - flora in our inner ecosystem. Millets hydrate our colon to keep us from being constipated. Niacin in millet can help lower cholesterol. Millets contain major and minor nutrients in good amount along with dietary fibre. Millets are gluten free and can be a substitute for wheat or gluten containing grains for celiac patients.

Global Distribution and Production of Millets

According to FAO statistics (2009), the world production of millets was 26.7 million metric tonnes from an area of 33.6 million hectare. Nearly a decade earlier (2002), the world production of millets was down to 23.3 million metric tons from an area of 33.3 million hectare. Africa was the largest producer of millet in 2009 (20.6 million metric tonnes), followed by Asia (12.4 million metric tonnes) and India (10.5 million metric tonnes). Relative to wheat, rice, maize and barley, sorghum ranks fifth in importance, in terms of both production and area planted, accounting for 5% of the world cereal production.

Global Production

The global production of pearl millets has come down from 32.8 million tonnes in 2010 to 28.4 million tonnes during 2014. Asia and Africa are the major contributors of worlds total
pearl millets production contributing more than 98%of the global production. The share of African countries in global millets production has come down from 49.22% in 2010 to 43.72% during 2014, whereas the contribution from Asian countries has increased to 52.25% from 48.72% during 2010. Sorghum (Sorghum bicolor (L.) Moench) is the fifth major cereal of the world after maize, paddy, wheat and barley as per FAO production data of 2016. The world sorghum production increased significantly during 2014 to 68.9 million tonnes from 60 million tonnes in 2010, after a drastic reduction in 2011 to 57 million tonnes.

Distribution of Millets in India

India is the top most producers of millets followed by Nigeria for the year 2000 and 2009. In India, eight millets species (Sorghum, Pearl millet, Finger millet, Foxtail millet, Kodo millet, Proso millet, Barnyard millet and Little millet) are commonly cultivated under rain fed conditions. Further, in each of the millet growing areas at least 4 to 5 species

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are cultivated either as primary or allied crop in combination with the pulses, oilseeds, spices and condiments. For instance, while pearl millet and sorghum are primary crop and allied crops respectively in the desert regions of Rajasthan, in the eastern parts of Rajasthan and Gujarat it is the opposite. Similarly, sorghum is sown as major crop in the Telangana, Andhra Pradesh, Maharashtra and parts of Central India, while it is considered as fodder crop in some of the Southern regions. Likewise, Finger millet is a primary crop in Tamil Nadu and Gujarat, while the same is a minor crop in Telangana. Hence, the spatial distribution of millets either as a primary crop or as allied crops largely depends on the growing habitat and the amount of rainfall the region receives. While sorghum predominates in areas receiving annual rainfall beyond 400 mm, pearl millet rivals it in areas with annual rainfall of 350 mm. Further, the small millets like finger millet, foxtail millet, barnyard millet, little millet and proso millet are found in most of the southern and central states in India especially wherever annual rainfall is below 350 mm, perhaps where no other cereal crop can grow under such moisture stress.

Table 1: Vernacular Names of Millets

English	Sorghum	Pearl Millet	Finger millet	Little millet	Kodo millet	Foxtail/ Italian millet	Barnyard millet	Proso millet
Hindi	Jowar	Bajra	Mandua	Kutki	Kodon	Kangni, Kakum	Sanwa, Jhangon	Baare
Kannada	Jola	Sajjai	Ragi	Same	Harka	Navane	Oodalu	Baragu
Tamil	Cholam	Kamboo	Kelvaragu	Samai	Varagu	Tenai	Kuthiravaali	Panivaragu
Telugu	Jonna	Sajjalu	Ragulu	Samalu	Arikelu, Arika	Korra	Udalu, Kodisama	Varigulu, Varagalu
Malayalam	Cholam	Kamboo	Moothari	Chama	Varagu	Thina	-	Panivaragu
Marathi	Jcwari	Bajri	Nachni	Sava	Kodra	Kang, Rala	Shamul	Vari
Gujarati	Juar	Bajri	Nagli, Bavto	Gajro, Kuri	Kodra	Kang	Sama	Cheno
Bengali	Juar	Bajra	Mandua	Kangani	Kodo	Kaon	Shamula	Cheena
Punjabi	-	Bajra	Mandhuka, Mandhal	Swank	Kodra	Kangni	Swank	Cheena

Nutritional composition of various types of millets

Millets are high in nutrition and dietary fibre. They serve as good source of protein, micronutrients and phytochemicals. The millets contain 7-12% protein, 2-5% fat, 65-75% carbohydrates and 15-20% dietary fibre. The essential amino acid profile of the millet protein is better than various cereals such as maize. Millets contain fewer cross-linked prolamins, which may be an additional factor contributing to higher digestibility of the millet proteins.
Similar to cereal proteins, the millet proteins are poor sources of lysine, but they complement well with lysine - rich vegetables (leguminous) and animal proteins which form nutritionally balanced composites of high biological value. Millets are more nutritious compared to fine cereals. Small millets are good source of phosphorous and iron.

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Millets contributes to antioxidant activity with phytates, polyphenols, tannins, anthocyanins, phytosterols and pinacosanols present in it having important role in aging and metabolic diseases. All millets possess high antioxidant acitivities.

Major Millets

Sorghum (Jowar)

- ✓ Major portion of sorghum protein is prolamin (kaffirin) which has a unique feature of lowering digestibility upon cooking which might be a health benefit for certain dietary groups.
- ✓ Sorghum proteins upon cooking are significantly less digestible than other cereal proteins, which might be a health benefit for certain dietary groups.
- ✓ It is rich in protein, fibre, thiamine, riboflavin, folic acid, and carotene.
- ✓ It is rich in potassium, phosphorus and calcium with sufficient amounts of iron, zinc and sodium.

Pearl Millet (Bajra)

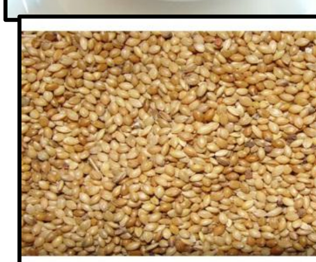
- ✓ Pearl millet contains considerably high proportion of proteins (12-16%) as well as lipids (4-6%).
- ✓ It contains 11.5% of dietary fiber. It increases transit time of food in the gut. Hence, reduce risk of inflammatory bowel disease.
- ✓ The niacin content in pearl millet is higher than all other cereals.
- ✓ It also contains folicate, magnesium, iron, copper, zinc and vitamins E and B-complex. It has high energy content compared to other millets.
- ✓ It is also rich in calcium and unsaturated fats which are good for health.

Finger Millet (Ragi)

- ✓ Finger millet is the richest source of calcium (300-350 mg/100g)
- ✓ Ragi has the highest mineral content.
- ✓ It contains lower levels of protein (6-8%) and fat (1.5-2%)
- ✓ Finger millet proteins are unique because of the sulphur rich amino acid contents.
- ✓ The grains have excellent malting properties and are widely known for its use as weaning foods.
- ✓ It has high antioxidant activity.

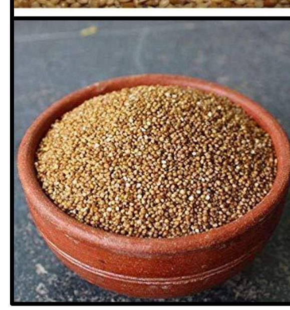
Minor Millets

Foxtail millet (Kakum)



- ✓ It is high in carbohydrates.
- ✓ It has double quantity of protein content compared to rice.
- ✓ It contains minerals such as copper & iron.
- ✓ It provides a host of nutrients, has a sweet nutty flavour and is considered to be one of the most digestible and non - allergic grains.

Kodo millets (Kodon)



- ✓ It has high protein content (11%), low fat (4.2%) and very high fibre content (14.3%).
- ✓ Kodo millet is rich in B vitamins especially niacin, pyridoxin and folic acid as well as

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the minerals such as calcium, iron, potassium, magnesium and zinc.
- ✓ It contains a high amount of lecithin and is an excellent for strengthening the nervous system.

Barnyard millet (Sanwa)
- ✓ It is the richest source of crude fiber and iron.
- ✓ Its grains possess other functional constituents i.e., Gamma amino butyric acid (GABA) and Beta - glucan, used as antioxidants and in reducing blood lipid levels.

Little millet (Kutki/Shavan)

- ✓ It is smaller than other millets.
- ✓ It is high in iron content.
- ✓ It has high antioxidant activities.
- ✓ It contains about 38% of dietary fiber.

Proso millet (Chenna/Barri)
- ✓ It contains the highest amount of proteins (12.5%).
- ✓ Health benefits of proso millet come from its unique properties. It has significant amounts of carbohydrate and fatty acids.
- ✓ It is cheaper source of manganese as compared to other conventional sources like spices and nuts.
- ✓ It contains high amounts of calcium which is essential for bone growth and maintenance.
- ✓ It reduces cholesterol levels and also reduce the risk of heart diseases.

Key Takeaways
- ➢ Most of millet crops are native of India and are group of small grained cereal food crops which are highly nutritious.
- ➢ Millets are popularly known as Nutri-cereals as they provide most of the nutrients required for normal functioning of human body.
- ➢ Millets are Gluten free and good for people who are gluten-intolerant.
- ➢ Prefer to buy Multi grain processed food products like Multigrain Atta, Multigrain Biscuits, multigrain Bread etc. having millets as one of the ingredient.
- ➢ Don't buy, if odour is unpleasant and taste is bitter or gritty. Avoid millets if living or dead insects are visible in the product.
- ➢ Prefer millets in packed form and certified under AGMARK.
- ➢ Check FSSAI license number on the package label.
- ➢ Always read the manufacturing/ packaging date and best before date before buying.
- ➢ Look for FSSAI Organic logo (Jaivik Bharat) on the pack while buying organic food products.

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Role of beekeeping in employment generation, increasing crop productivity and rural upliftment

Article id: 23357

Bipul Kumar[1], Manoj Kumar[2], Chandreshwar Prasad Rai[3] and Mukul Kumar[4]
[1]Department of Extension Education, DRPCAU, Pusa (Samastipur) Bihar
[2]Assistant Professor, Department of Entomology, DRPCAU, Pusa (Samastipur) Bihar
[3]Senior Technical Officer, Department of Entomology, SRI, Pusa (Samastipur) Bihar
[4]Ph.D. Research Scholar, Department of Plant Pathology, CSAUA&T, Kanpur

INTRODUCTION

Agriculture is the back bone of Indian economy contribute about 25 per cent of national income and remain a major sector that employs more than 60 per cent of labour force of rural India. Beekeeping is an agro-forest based industry providing basic employment, supplementary income and nutritious food to a large rural population besides, enhancing crop productivity through bee pollination. Beekeeping in India was being practiced with indigenous hive bee, Apis cerana indica Fab till 1960's. The strenuous efforts of Prof. A.S. Atwal and his associates at Nagrata succeeded in introducing, acclimatizing and establishing the exotic honeybee, Apis mellifera L. for the first time in the country during, mid sixties (Atwal, 1964 and Atwal and Goyal, 1973). It was spread to the other states, however, restricted till 1986 when the Indian council of Agricultural Research, New Delhi allowed its extension to other parts of the country. Subsequently, it was introduced in Bihar during 1987-88 at R.A.U., Pusa (Bihar).

Bihar has 8.29 crore population which is mainly dependent upon agriculture. Of these about 70 per cent population is engaged in agriculture, but majority of them are land less or marginal to small farmers. Bihar is enriched with highly diversified, abundant bee flora and favourable ecological conditions, which considered to be paradise of honeybees. After division of the state, all the hopes are centred with agriculture and allied activities, which need investment, infrastructure and human resources development. Beekeeping is such an enterprise, which will certainly assist,increasing employment, per capita income and quality and quantity of the agricultural produce.The beekeeping involves a number of steps starting from fabrication of bee boxes and other bee equipments for the harvesting of bee hive products, their processing, packing and marketing. The enterprise involves persons, viz., carpenters,black smith, farmers, transporters, beekeepers, salesmen, technicians, extension workers, scientists etc. Thus, there are high avenues for generation of employment for rural mass. By promoting this enterprise the problem of unemployment among rural mass can be reduced upto a level 5 per cent. Role of bee pollination in clop yield is a well established fact. This will certainly increase awareness among farmers, orchard owner about the significance of bee pollination. It has been estimated that in different crops, there is an increase in yield up to 40-60 per cent with improved quality of agricultural produce. Thus, it will lead to an enormous increase of agricultural produce.

Employment Generation

As in case of all other industries beekeeping too causes multipronged employment generation. The added advantage is that it basically creates employment through small and rural scale enterprises. Beekeeping has the potential for 5 tier activities as follows:

A. Production from Beehive

1. Honey
2. Wax
3. Pollen
4. Royal jelly
5. Bee venom

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6. Propolis

B. Multiplication

7. Queen bee production
8. Package bee production

C. Fabrication and construction

9. Hives
10. Honey extractor
11. Wax comb foundation
12. Hive stand
13. Honey processing plant
14. Manufacture of packages material for honey and other products

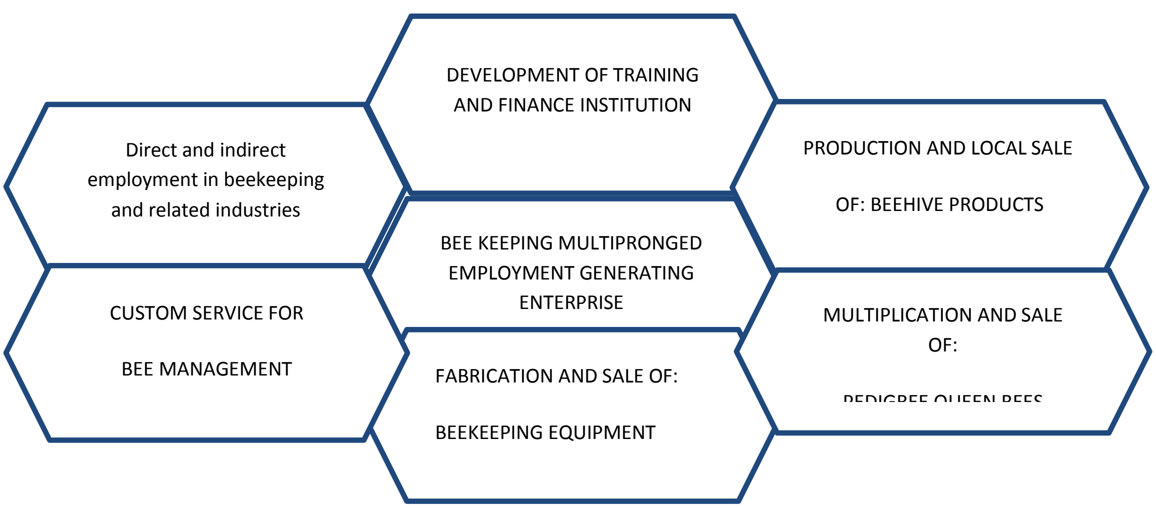
D. Processing

16. Honey
17. Wax
18. Processing of value added products honey

E. Service

19. Pollination activities
20. Bee colony migration and transport
21. Consultancy services to small beekeepers direct or through cooperatives
22. Transport of produce and manufactured equipments

All these beekeeping related activities have potential for the dcvelopment of rural industries and job generation to rural masses. To maintain 10,000 bee colonies of A.mellifera the estimated requirement of bee appliances and man days generated to manufacture them. Total man-day of 58,500 are needed to manufacture the above appliances for 10,000 bee colonies. If we take the projection of NCA of 6 million bee colonies, the man-days needed to manufacture the appliances shall be 35.1 million i.e. one full year job for 1,17,000 persons. Some of these appliances shall have to be replaced every five years and some at 10 years. If we take thumb rule of 7 years i.e. a replacement rate of about 15 per cent per year, full time job for 16,950 persons per year only for the fabrication of these appliances will be ensured, keeping a side all other activities including the processing and transport etc. All these jobs, except the honey processing units, shall be created at the village level to be handled by village artisans, the carpenters, black smiths, tailors etc.



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Beekeeping: A multipronged employment generating enterprise

At 6 million bee colonies the jobs so created shall be for 9,45,000 persons earning Rs.283.50 million. This employment generation potential is only for the main activities. The honey production from rock bee, *Apis dorsata* creates additional jobs for the rural falk. If this activities is organized through cooperative societies with awareness of wild bee fauna the production per hectare from forest as well as employment is liable to go up.

Contribution to Agriculture

Honeybees external association with plants and thereby increased production of crops through pollination is now a well proved fact. In India over 80 per cent oilseeds, pulses, fodder seeds, vegetables, fruits and commercial crops are benefited by bees.The report of National commission on Agriculture has summarized the potential enhancement in the yield levels of various crop. The report also estimated that crops benefited directly by bee pollination are grown an area of 50.7 million hectares. An estimation of increase in total production of only 12 most benefited crops in India, if provided with optimum level of pollination with a total number of 73.75 million bee colonies comes about Rs.29,967 million (Dogra and Gupta, 1993). NCA projected a requirement of bee colonies for crop production at 150 million and targeted at only 6 million bee colonies by 2000 AD to cover an area of 2 million hectare and advocated for conservation of natural bee fauna (Anonymous, 1976). If we orient ourselves to beekeeping and develop it as input for crop production.

Rural upliftment

Production and employment are the basic factors to bring upliftment and prosperity, Being a very practical visionary, Gandhijee not only highlighted the importance of rural industries for the economic betterment of masses but also started many rural industrial programmes including beekeeping at his Asharam, Pt.Ram Sharma Acharya, the exponent of `YUG N1RMAN YOJANA' and devoted GAYATRI said empty stomach can not be a devotee to concentrate at prayer of God. One has to perform his first DHARMA of fulfilling the need of protecting the body and then can develop rituals of soul. He established a number of village and small scale industries with maximum human involvement at his SHANTI KUNJ Asharam.

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Integrated disease management of seed-borne plant diseases

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M. Divya*, Pravallika Sree Rayanoothala
Department of Plant Pathology
BCKV, Mohanpur, Nadia

1. INTRODUCTION:

Seed is the basic input in crop production. Seed borne diseases are caused by micro-organisms infecting seeds. Seeds are attacked by various fungi, bacteria and viruses at various stages *viz.,* in the field, during processing, at the time of transportation, and during storage. Infection may be either internal or external seed borne. The effects of seed infection are reduction of germination percentage and market value. Infection induces the secretion of toxic chemicals like aflatoxin, rubra toxin, ochre toxin, patulin *etc.*

To obtain a perspective of seed borne diseases, microorganisms can be considered under four classes.
1. Pathogens for which the seed is the main source of inoculums. Eg., *Lettuce Mosaic Virus*
2. Pathogens in which the seed borne phase of the disease is of minor significance as a source of inoculum
3. Seed borne microorganisms consists of those that have never been shown to cause disease as a result of their presence on seeds. This is the largest group. Eg., *Helminthosporium*, *Alternaria*
4. Microorganisms that can infect the seed either in the field or in storage and reduce yield and seed quality Eg., Field fungi - *Diplodia, Fusarium*, *Cladosporium*, etc.
Storage fungi - *Aspergillus* and *Penicillium*

1.1 Important seed- borne fungal, bacterial, viral and viroid diseases of major crops

Crops	Diseases	Pathogen
Wheat	Loose smut Karnal smut Flag smut	*Ustilago segetum var. tritci* *Neovossia indica* *Urocystis agropyri*
Chickpea	Ascochyta blight Wilt	*Ascochyta rabiei* *Fusarium oxysporum f.sp.ciceri*
Crucifers	Grey and black leaf Spot	*Alternaria brassicae* *A. brassicicola*
Rice	Bunt False Smut Stackburn	*N. horridae* *Ustilaginoidea virens* *Trichoconiella padwickii*
Maize	Southern leaf blight	*Dreschleria maydis*
Sorghum	Anthracnose Kernel or grain smut Downy mildew	*C. graminicola* *Sphacelotheca sorghi* *Peronosclerospora sorghi*
Soybean	Anthracnose Pod & stem blight Purple seed stain	*C. dematium* *Phomopsis sojae* *Cercospora kikuchii*

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Onion	Downy mildew Purple blotch Stemphylium Blight	*Peronospora destructor* *A. porri* *Stemphylium vesicarium*
Tomato	Buck eye rot Damping off Early Blight	*Phytophthora parasitica* *Pythium aphanidermatum* *A. solani*
Bacterial diseases	Black rot in crucifers Bacterial Canker in tomato	*Xanthomonas campestris pv. campestris* *Clavibacter michiganense* sub sp. *michiganense*
Viral diseases	-	Bean common mosaic, Cowpea mosaic virus, Tobacco mosaic virus, Tomato ring spot virus.
Viroid diseases	-	Potato spindle tuber viroid (PSTVd) Tomato apical stunt viroid

2. Integrated Disease Management (IDM): IDM is the integration of all available management strategies like cultural, biological and chemical with resistance. IDM is currently implemented for plant disease control to reduce the use of fungicides, to enforce ecofriendly, low cost and effective disease management.

2.1 Avoidance:

Methods	Favourable conditions	Feasible solutions
Proper selection of the geographical area	Bajra smut (*Tolyposporium penicillariae*) and ergot disease (*Claviceps fusiformis*) incidence are more severe in wet areas than in dry areas.	When Bajra is grown under dry areas there will decrease in the disease incidence.
Time of sowing	By adjusting the sowing time of the crop, susceptible stage of the crop is made not to coincide with the favourable environmental conditions of the pathogen	Early sowing of wheat reduces the incidence of Karnal bunt
Selection of seed and planting material	In Shimla hills, potato is not effected by viral or bacterial diseases.	Seed potato from such areas is selected for planting in southern states of India. The other examples are Potato wart, loose smut of wheat, Bunchy top and Panama disease of banana

2.2 Exclusion: Plant quarantine is legislative regulation on the movement of living plants, living plant parts or plant products between political boundaries or with in political territories to prevent the spread of the disease. Eg., In Kerala, Assam, Bihar, Orissa and West Bengal bunchy top is an established disease. Movement or transport of any part of the banana excluding the fruits is prohibited.

<u>Banana mosaic:</u> Movement of banana is prohibited from Maharashtra and Gujarat to any Indian state. <u>Potato wart:</u> Movement of potatoes from Darjeeling in West Bengal is prohibited to any other Indian state

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2.3 Cultural methods:

S.No	Methods	Remarks	Examples
1)	Rouging	Removal or destruction of infected plants or plant parts from the field at an early stage. Rouging prevents spread of the disease to the healthy plants and ensures production of healthy seed.	Loose smut of wheat
2)	Crop rotation	Crop rotation with non - host crops	Karnal bunt of wheat

2.4 PHYSICAL METHODS:

2.4.1 Mechanical separation: Healthy seed contaminated with ergot of rye, ergot of bajra, false smut of rice, ear cockle of wheat can be separated mechanically because the pathogen causes alteration in size and weight of the seed.

2.4.2 Steeping in brine solution: The diseased grains are removed by steeping the seed in 12-20% brine solution and the diseased grains float due to their light weight. Eg., Ergot of rye and Ear cockle of wheat

2.4.3 Solar heat treatment: It is a safe and convenient method than hot water treatment. Seed is presoaked in water for 4-5 hours in the shade or in a room and then dried on ground or concrete floor in a thin layer in sun for 1 hour usually at noon. Eg., Loose smut of wheat

2.4.4 Dry heat treatment: Eg. TMV from infected tomato was successfully eliminated by subjecting the dried infected seeds to temperatures of 70^{o}C for three days or 80^{o}C for one day

2.4.5 Steam –air treatment:

Crop	Temperature	Against causal organism	Reduced infection from
Pea	55^{o}C/40 min	*A. pisi*	Reduced infection from 41-6%
Tomato	56^{o}C/30 min	*C. michiganensis* subsp *michiganensis*	97-0%
Cabbage	56^{o}C/30 min	*A. brassicae*	14.5-0%

2.4.6 Hot water treatment: Hot water aims at destroying the infection in the seed without harming the embryo.

Crop	Against causal organism	Temperature
Wheat	*U. nuda tritici*	52^{o}C/10 min
Pepper	*X. campestris* pv. *vesicatoria*	50^{o}C/25 min
Tomato	*C. michiganensis* pv *michiganensis*	51.7^{o}C/20 min
Cauliflower	*X. campestris* pv *campestris*	50^{o}C/20 min

2.4.7 Irradiation: Gamma irradiation has been used for the inactivation of seed-transmitted viruses. Eg. Inactivation of *Necrotic ring spot* and *Prune dwarf viruses* in Prunus seeds after irradiation. Cowpea banding mosaic virus (CpBMV) can be inactivated at higher doses (30 & 40 kR), but viability of seeds was severely affected and a majority of seedlings died early due to lethal mutation induced by gamma rays. Treating infected seed with effective chemical inhibitors like thiouracil, followed by gamma irradiation may yield better results in curing infected seeds.

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2.4.8 Biological treatment:

1. *Trichoderma viride*– Loose smut of wheat
2. *Trichoderma* and *Gliocladium* – Karnal bunt

2.4.9 Chemical treatment:

1. For externally seed-borne diseases, seed is treated with contact fungicide. Eg. *T. caries* (wheat bunt) – contact fungicides
2. For Internally seed-borne, *U. nuda tritici* (Loose smut) – systemic fungicides. Eg. seed treatment (carboxin-0.2%) – loose smut, bunt

3. CONCLUSION: Integrated disease management (IDM) is a collaborative approach of using all available management strategies to reduce the disease below threshold level. It not only reduces the usage of chemicals but also endorse the integration of cultural, biological and mechanical practices which enhances the potential protection of the environment. Finally, IDM controls the disease in a greater way when compared to the other individual disease management strategies.

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Study of Pathogenesis and Intra cellular Movement of Prune Dwarf Virus by Ultrastructural Analysis

Article id: 23359

Vanama Sowmya[*], Lopamudra Behera
Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh -221005

INTRODUCTION:

The Bromoviridae are a large family of plant RNA viruses which include many economically important pathogens of monocots and dicots. The family contains 6 genera, with one of most interesting being the genus Ilarvirus. Amongst the Ilarviruses, an important species is Prune dwarf virus (PDV). This viral pathogen infects a whole range of hosts from plum, sweet cherry, and peach to various test plants. The genome of PDV, like other Ilarviruses, is multipartite and consists of 3 viral RNA (vRNA) molecules: RNA1, RNA2 and RNA3. RNA1 and RNA2 encode two replication proteins, the ―replicase (P1 protein) and RNA-dependent RNA polymerase (RdRp, P2 protein), respectively. Both P1 and P2 are required for replication of vRNAs and build replication complexes during viral infection. RNA3 encodes two proteins, the movement protein (MP) and coat protein (CP). PDV-MP is involved in cell-to-cell transport. Apart from forming the viral capsid, PDV-CP is needed for genome activation, and possibly also for cell-to-cell transport. Our previous microscopic and bioinformatics studies showed that PDV infection induces changes in cell membranes and its cell-tocell transport, likely similar to Alfalfa mosaic virus (AMV). This study focuses on sequential ultrastructural changes in cell organelles and PDV-induced structures in cucumber plants. Moreover, the study shows the potential mechanism of PDV intercellular transport based on both microscopic and bio-informatic analyses. Our observations reveal changes in chloroplasts, mitochondria and endomembranes, as well as in the cell wall and plasmodesmata, the latter carrying tubular structures for virus translocation.

Morphological alternations of infection caused by *Prune dwarf virus (*PDV) on cucumber

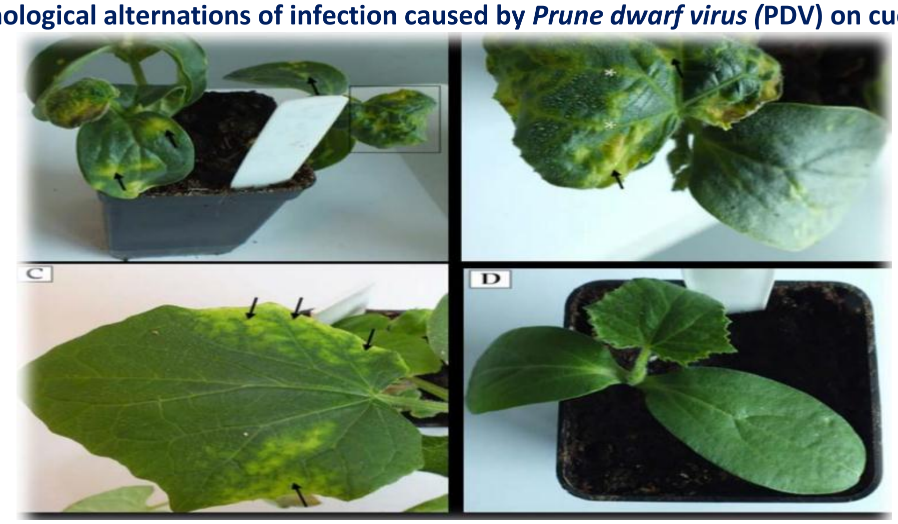

Fig: Chlorotic spots (arrow) on the cotyledons and leaves of cucumber infected by PDV (14 dpi). The black frame area is enlarged in (B); (B) Enlarged deformed leaf with chlorotic spots (arrow) and yellowing veins (*); (C) Yellowing of leaf blades along the edges (arrow) at 14 dpi; (D)Mock inoculated cucumber plants without symptoms

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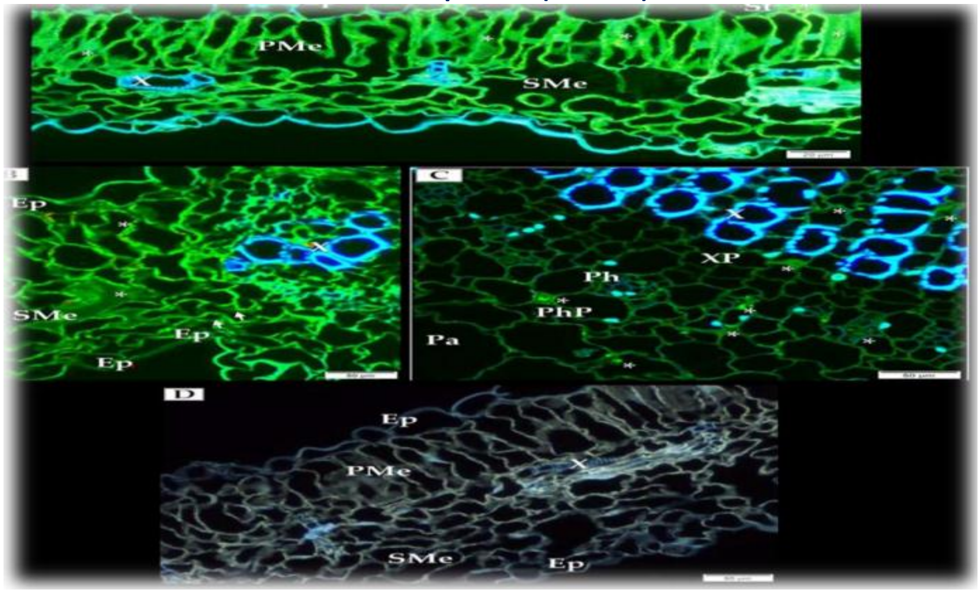
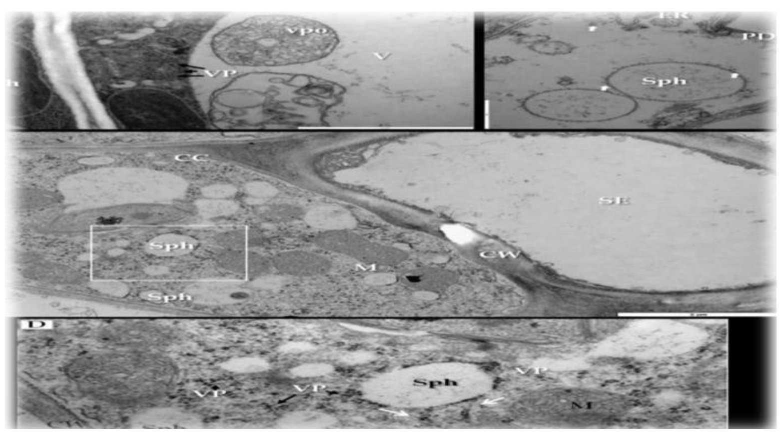
Immunofluorescence localization of PDV-coat protein (PDV-CP) in the infected cucumber leaf tissue.



(a)Localization of the epitopes of PDV-CP (green fluorescence, marked with *) in stomata and palisade mesophyll cells (14 dpi), (b)PDV-CP epitope (*) inside spongy mesophyll (14 dpi). Deformations of cell wall in spongy mesophyll cell are marked with white arrows, (c)Cross section of cucumber leaf through main vein with presence of CP (*) in xylem and phloem parenchyma (14 dpi),(d)Section of mock-inoculated leaf without PDV-CP

Membranous structures induced by PDV infection:

Fig: (**A**) Fragment of palisade mesophyll cell from PDV infected cucumber with viral particles (VP, black arrow) in cytoplasm and vesicle pockets inside vacuole, (**B**) Mesophyll cell with spherules carrying viral particles on the surface (white arrow), (**C**) Section through a phloem cell with companion cell and sieve tube, showing various numbers of membranous structures and spherules.The white frame area is enlarged in (**D**) A fragment of companion cell with viral particles present, arranged in line (white arrow) connected to the spherule, Viral particles in cytoplasm (black arrow).



Changes in cell wall structure and plasmalemma in phloem cells of PDV infected cucumber leaves:

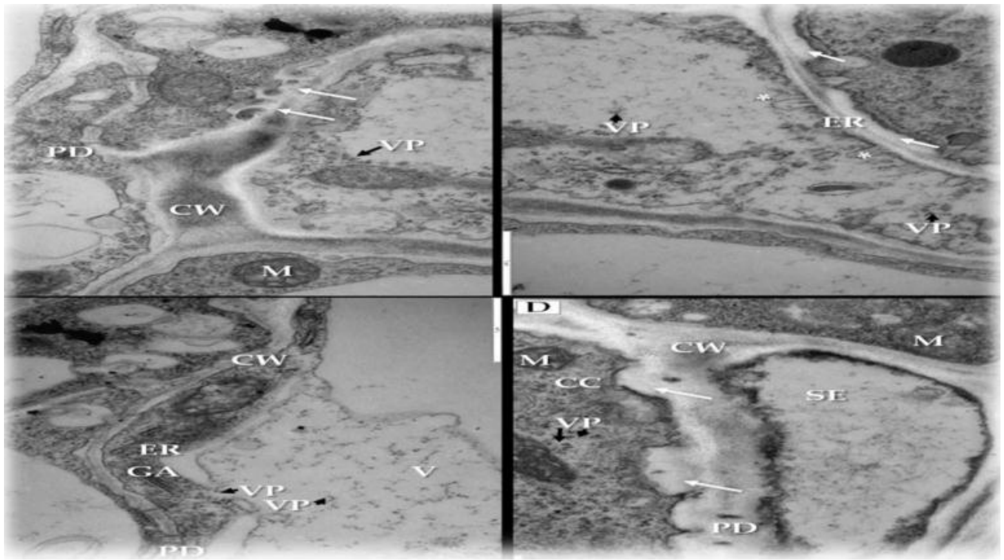


Fig: (A) Fragment of phloem parenchyma with cell-wall invaginations (white arrow). Viral particles (VP, black arrow) in phloem parenchyma cell, (B) Fragments of phloem parenchyma cells with irregular cell wall (white arrow) and plasmalemma invaginations (*) and with viral particles (C) Presence of viral particles (VP, black arrow) inside the vacuole with the vacuolar lumen having connections to the cytoplasm of parenchyma cell, (D) An irregular and thicker cell wall (white arrow) between companion cell with viral particles (VP, black arrow) and sieve tube.

CONCLUSION:

TEM ultrastructural analyses show the involvement of specific organelles including vacuole, ER, chloroplasts, and mitochondria in the PDV-infected cucumber tissue and the immunolocalization of CP and MP PDV proteins in order to better understand the pathogenesis and cell-to-cell transport of this virus.

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BioClay: An alternative strategy to transgenic RNAi against plant viruses

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Bichhinna Maitri Rout[1], Nikki Kumari[2]
[1]Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi
[2]Division of Genetics, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION

Globally, plant viruses have a tremendous impact in food production and quality, being responsible for loses in several crops, fruits, and vegetables.The contribution of plant pests and pathogens towards global crop yield losses are estimated to be 30–40% per year creates a major concern for global food security. Global warming contributes a big threat to the movement of disease-causing agents into new territories. RNAi is an indispensable mechanism in reducing the virus incidence in plants but its transformative approach is not suitable in all plants. A major limitation in the practical application of naked dsRNA to control viruses is that RNAs face a hostile environment where it is rapidly degraded with not only low uptake into plants, but also the short virus protection window of few days postspray. BioClay is emerging as an effective tool in alleviating these losses in an ecofriendly manner, negating conventional transgenic approaches. It is an alternative strategy to RNAi mechanism which involves the use of layered double hydroxide (LDH) clay nanosheets for topical delivery of RNAi for protection against plant viruses.

RNAi mechanism:

Plants have systemic RNAi that move siRNA molecules between neighbouring cells via plasmodesmata or through the phloem. RNAi, a conserved eukaryotic mechanism , plays a crucial role in regulation of expression of endogenous gene, silencing of transposable elements and antiviral defence. It is a double stranded RNA (dsRNA) mediated gene silencing. It is a sequence-dependent mode of action that involves the blocking of the expression of specific target genes by destroying the corresponding mRNA molecules affecting only the translation process. DICER LIKE (DCL) enzymes, a ribonuclease III enzyme, plays a key role in stepwise processing of dsRNA into single stranded small interfering (si)RNAs and is a main conserved feature of RNAi in plants. Subsequently, the siRNAs are then incorporated into a RNA-induced silencing complex, ensuring that it specifically degrades any RNA sharing sequence similarity with the inducing dsRNA. The cleavage of cognate RNA takes place near the middle of the region bound by the siRNA strand.

Pooggin (2017) reported that RNAi can be induced against viruses by expression in transgenic plants of constructs expressing dsRNA of various lengths ranging from shorter sizes of 50–150 base pairs (bp) and larger sizes of up to 2.5 kb. Many RNAi-inducing constructs have been designed against potyviruses such as: 1,048 bp targeted to the CP coding region of plum pox virus (Montes *et al*., 2014), a 302 bp construct targeting the P3 coding region of soybean mosaic virus (Yang *et al*., 2018), a 423 bp targeting the CP coding region of sorghum mosaic virus (Guo *et al*., 2015), an 899 bp hybrid construct targeted to 462 nucleotides (nt) of the CP coding region of cowpea aphid-borne mosaic virus, and a 415 nt construct targeting the proteinase cofactor coding region of cowpea severe mosaic virus (a comovirus) (Cruz and Aragão, 2013). The main characteristic features of RNAi are:

- Invaluable tool for functional analysis of gene knockdown-phenocopies
- siRNA more effective and sensitive at lower concentration
- High specificity
- Can be labelled
- Eliminates the hypothetical hazards associated with the presence of novel or foreign proteins in crop plants

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BioClay:

BioClay is an agriculturally nanotechnology innovation that could help reduce crop losses to pests and pathogens, without the toxic environmental impacts of current chemical sprays. It involves a spray of nano-sized degradable clay used to release double–stranded RNA, that protects the plants from specific disease-causing pathogens (Mitter *et al*., 2017). This strategy reduces the use of pesticides without altering the genome of plants. A single spray of BioClay protects the plant and then degrades, reducing the risk to the environment or human health.

BioClay uses the sequence from virus itself. The dsDNA can be loaded on designer, non-toxic, degradable, layered double hydroide (LDH) clay nanosheets. Once loaded on LDH, the dsRNA does not wash off, shows sustained release and can be detected on sprayed leaves even 30 days after application. The positively charged clay nanoparticles bind with the negatively charged RNAs and act as a dsRNA carrier for prolonged and effective protection against plant viruses. It also protects the dsRNA from degradation by nucleases, provides prolonged stability and also facilitates slow release of dsRNA on the plant surface. LDH materials are hexagonal with the average particle size from 80 to 300 nm and occur naturally as a result of precipitation in saline water bodies or through the weathering of basalts and can be completely degraded over a period of time. Atmospheric CO_2 and moisture can slowly breakdown LDH into a biocompatible residue and releases the loaded biomolecules. LDH degrades because of the formation of carbonic acid from CO_2 and water present on the leaf surface.

LDH nanosheets are a family of inorganic layered materials, with a general formulation expressed as:

$$[(M_{(1-x)}{}^{2+}M_x{}^{3+}(OH)_2)^{x+}.(A_{x/m}{}^{m-}.\ nH_2O)^{x-}]$$

In addition to this, topical spray of BioClay provides RNAi based systemic protection to sprayed and newly emerged unsprayed leaves against targeted viruses even when challenged 20 days after a single spray (Mitter *et al*., 2017).

CONCLUSION:

BioClay is emerging as an appealing alternative to genetically modified crops. It can provide effective protection against the most common and important mode of virus transmission encountered under field conditions and has the capacity to change the way we protect plants with the potential of reducing pesticide usage.

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Milk: A Consortium of Bioactive Components

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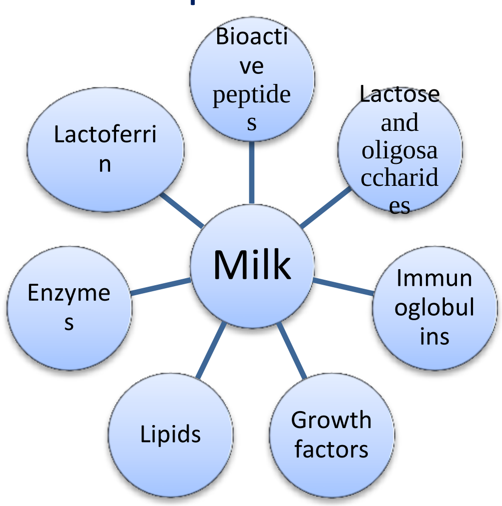
[1]Sonu K. S.* and [2]Basavaprabhu H. N.
Doctoral fellows
[1]Dairy Chemistry Division
[2]Dairy Microbiology Division
ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India

Functional foods and bioactive components are gaining popularity worldwide for their well-known health attributes. The relationship between diet and health plays a prominent role in the prevention of various diseases. Milk and milk products are considered to be one of the main sources for bioactive components since it contains various macro and micronutrients of high nutritional and therapeutic significance. Casein, whey proteins, lactoferrin, enzymes, lipids, vitamins, and growth factors are the milk constituents for the bioactive component's source.

1.0. INTRODUCTION

Milk is the first food for human life. It contains various macro compounds and micro compounds that are required by the individual for their growth and maintenance of life. Milk is considered as nature's most complete food. In this modern era, people are not only considered food for its nutritional point, but also therapeutic attributes. Food with therapeutic properties beyond their nutrition is exploited largely to overcome the various lifestyle disorders. Hence, functional foods emerged as a new approach to improve human nutrition and health status. Bioactive components are defined as those compounds either naturally present in food or formed and /or formulated in the processing of foods that may have a physiological and biochemical function when they consumed by the host. Milk and milk products are largely exploited for their bioactive compounds to design functional foods as well as pharmacological applications. Growth factors (epidermal growth factor, neuronal growth factors, vascular endothelial growth factors, erythropoietin, growth-regulating factors) and immune-related factors (immune cells, cytokines, chemokines) are some of the bioactive components present primarily in milk (Giacometti and Buretic - Tomljanovic, 2017; Ballard and Morrow, 2013). **Figure 1** represents the overview of milk-derived bioactive components.

Figure 1: Bioactive components of milk



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2.0. Bioactive Components of Milk

2.1. Bioactive peptides

Bioactive peptides (BP) are defined as the peptide sequences encrypted within the parent protein molecule and exert health benefits beyond their nutrition once they get hydrolyzed from parent protein (Chakrabarti *et al.,* 2018). BP usually contains 3-20 amino acids per molecule. Generally, bioactive peptides can be produced by three main ways: by enzymatic hydrolysis with digestive enzymes; by fermentation of milk with proteolytic starter cultures; and by proteolysis with enzymes derived from microorganisms or plants. BP have reported having many biological effects like hypocholesterolemic, antioxidative, antithrombotic, antimicrobial, immunomodulatory, mineral binding, antihypertensive, antimicrobial and opioid antagonist/agonist (Biadala and Konieczny, 2018; Park and Nam, 2015). Many BP derived from milk and milk products exert one or more above mentioned biological activities

2.2. Bioactive lipids

Milk lipids exert various biological functions like intracellular signaling, maintaining the structural integrity of membranes, thermogenesis, etc., beyond its high energy value**.** Lipids also play an important role in pathology and prevention of numerous diseases like cardiovascular, neurological diseases, obesity, and metabolic syndrome, such as obesity and thus lipids have appeared as a component of nutraceutical products (Kumar *et al.,* 2018). Fatty acid namely conjugated linoleic acid (Rumenic acid) has reported having various biological functions like immunomodulatory, antidiabetic, anticancer, and anti-atherogenic activities (Hayam *et al.,* 2014). Milk fat globular membrane components have also been reported to exert health benefits like immunomodulatory, anticancer, and antiobesity activity (LisakJakopovic *et al.,* 2019).

2.3. Growth factors

The presence of growth factors is first demonstrated in human colostrum and milk (Pouliot and Gauthier, 2006). Growth factors present in milk are betacellulin (BTC), the epidermal growth factor (EGF), the fibroblast growth factor 1 and 2 (FGF1 and FGF2), the insulin-like growth factor I and II (IGF-I and IGF-II), the transforming growth factor β1 and β2 (TGF-β1 and TGF-β2) and the platelet-derived growth factor (PDGF). In general, growth factors are the polypeptides and their molecular masses range between 6 to 30 kDa with amino acid residues varying from 53 (EFG) to about 425 (TGF-β2), respectively. TGF-β growth factors play a critical role in embryo development, bone and cartilage formation, tissue repair, and immune system regulation (Gauthier *et al.,* 2006). EGF and BTC stimulate the proliferation of cells (epidermal, epithelial, and embryonic cells) as well as inhibit the secretion of gastric acid, promote wound healing and bone resorption. IGF stimulates the proliferation of many cell types and regulates some metabolic functions like glucose uptake and synthesis of glycogen (Pouliot and Gauthier, 2006).

2.4. Lactoferrin

Lactoferrin is an iron-binding globular glycoprotein that belongs to the whey protein group of milk proteins. It is reported to exhibit various biological functions like antimicrobial, immunomodulatory, anticancer, antidiabetic, and mineral binding activities (Liu *et al.,* 2019).

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CONCLUSION

Milk and milk products are promising sources for the various biologically active components. Bioactive components of milk origin owe a high capability for enhancing various biological functions in the human body that results in a positive impact on human health and might replace conventional pharmaceutical therapy in the future. Thus, consumption of milk and milk products not only meet the nutritional demand of the body but also improve the health status of the individuals.

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Cell wall structure and cell wall hydrolyzing enzymes

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Mainak Barman
Department of Plant Breeding and Genetics,
Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India

Meaning and discovery of cell:

The word "CELL" has arrived from a Latin word "*cella*" which means "small room". Cells were discovered by Robert Hooke in 1665

What is cell?

Cell is the basic structural, functional, and biological unit of all known living organisms. It is the smallest unit of life which are capable of performing life functions. Cells are often called the "**building blocks of life**". Cells may be of spherical, rod-shaped, cylindrical, hexagonal-cylindrical or of irregular shape

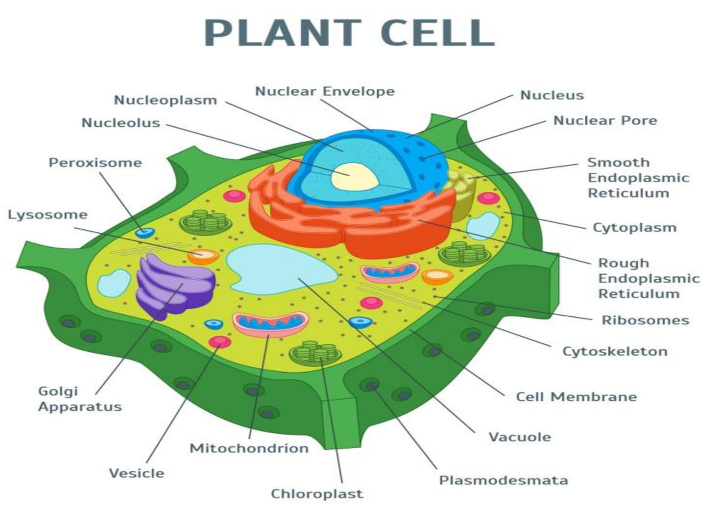

Figure 1: Plant cell structure

What is cell wall?

Plant cells are surrounded by a non-living and rigid coat, which is referred to as CELL WALL. It is a protective layer surrounding the cell on the outside of the plasma membrane It is found only in plant cells**.** Plant cell walls are heterogeneous structures in nature which composed of polysaccharides, proteins, and aromatic polymers. The composition and structure of the cell wall differ significantly among different plant lineages however; they share basic principles in their structural components like containing cellulose microfibrils embedded in a matrix of pectin, hemicellulose, lignin, and structural proteins. In addition to the different physical complexity of the plant cell wall, its structure variably changes as the plant grows and develops which differ at different phase. *For example*, in both the monocot and dicot species, during the maturation of the cell wall from a primary to secondary wall, the amount of pectin, xyloglucan and structural proteins decreases, whereas the amount of xylan and lignin increases.

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Structure of cell wall:

The cell wall of a differentiated cell has the following distinct parts:

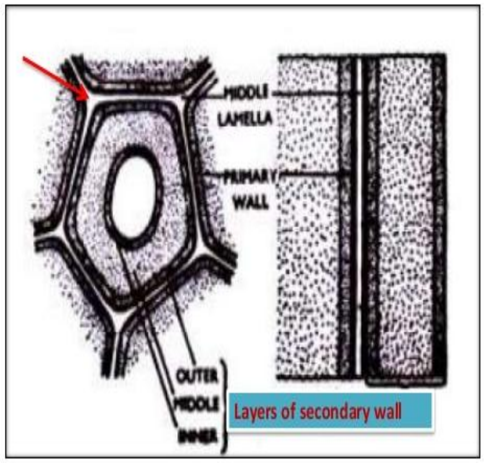

Figure 2: Structure of cell wall

Middle lamella:

In plants, the walls of contiguous (immediate neighbour) are joined by MIDDLE LAMMELLA. This is composed mainly of pectin, occurring most likely in the form of *Calcium & Magnesium salts.* Cellulose is characteristically absent in Middle Lamella.

Primary cell wall:

Primary cell wall is deposited after the formation of middle lamella, and lies between middle lamella and plasma lemma. Its main constituents are hemicellulose(53%) and cellulose (30%) ; in addition, pectin(5%) , protein (5%) and lipid (7%). Cellulose molecules are like fibers ; each molecule is made up of upto 3000 glucose molecules. Several cellulose molecules associate to form a cellulose microfibril(Upto 2000 molecules in a single microfibril). Cellulose microfibrils are the units of cell wall structural organization

Secondary cell wall:

Secondary cell wall is the last to be deposited and lies between PRIMARY CELL WALL and PLASMA LEMMA. In a cell, it is the innermost layer of cell wall. It is composed mainly of Cellulose, but in many tissues it contains lignin, suberin and in some cases Cutin. In secondary walls, Cellulose microfibrils are relatively more clearly packed and they are arranged more or less parallel to each other. Several microfibrils associate to form a macrofibril, which is the structural unit of Secondary cell walls.

Functions of plant cell wall:

The major role of the cell wall is to form a framework for the cell to prevent over expansion. The functions of the cell wall include:

(1) Support: The cell wall provides mechanical strength and support. It also controls the direction of cell growth.
(2) Withstand turgor pressure: Turgor pressure is the force exerted against the cell wall as the contents of the cell push the plasma membrane against the cell wall. This pressure helps a plant to remain rigid and erect, but can also cause a cell to rupture.
(3) Regulate growth: The cell wall sends signals for the cell to enter the cell cyclein order to divide and grow.

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(4) Regulate diffusion: The cell wall is porous allowing some substances, including proteins, to pass into the cell while keeping other substances out.
(5) Communication: Cells communicate with one another via plasmodesmata (pores or channels between plant cell walls that allow molecules and communication signals to pass between individual plant cells).
(6) Protection: The cell wall provides a barrier to protect against plant viruses and other pathogens. It also helps to prevent water loss.
(7) Storage: The cell wall stores carbohydrates for use in plant growth, especially in seeds.

Table 1: Major cell wall degrading enzymes used in protoplast isolation

Type	Commercial name	Source
Cellulase	Onozuka RS Cellulase R-10 Meicelase-P	*Trichoderma viridae* *T. viridae* *T, viridae*
Hemi-cellulase	Hemicellulase Rhozyme HP-150	*Aspergillus niger* *A. niger*
Pectinase	Macerozyme R-10 Pectinase Pectolyase Y-23	*Rhizopus* sp. *Aspergillus niger* *Aspergillus japonicus*

The enzymes which hydrolyzes the cell wall are classified as :-

Cellulose-degrading enzymes:
The primary role of these enzymes is to degrade the cellulose structure by hydrolysis process which mainly involves the synergistic action of two cellulases namely exo and endocellulases followed by a β-glucosidase that hydrolyzes the soluble cellodextrin oligomers to glucose. Fungi degrade the cellulose by discrete noncomplexed cellulases and complexed cellulases.

Hemicellulose-degrading enzymes:
The plant cell wall which contains hemicellulose described as the noncellulosic polysaccharides that comprise xyloglucans, xylans, and galactomannan. Fungi use both specific and nonspecific groups of endo-Beta-(1,4)-glucanases for thorough hydrolysis of the backbone chain of xyloglucan. The specific and effective xyloglucanases completely lack or have very low activities toward Beta-glucan and carboxymethyl-cellulose of the plant. Fungal endo-1,4-Beta-xylanases cleave the glycosidic bonds of backbone chain of xylan. Other important mannan-degrading enzymes comprise β-mannanase and β-mannosidase in which Beta-mannosidase contains enzymes with Beta-1,3-xylanase activity, whereas these enzymes belonging to this family characterized from fungi viz., Penicillium chrysogenum and Aspergillus spp. where exclusively Beta-mannanases play major role in degradation of plant galactomannan.

Pectin-degrading enzymes:
Pectin lyases and Pectate lyases effectively cleave building block of pectin (sugar acid) by hydrolysis and a nonhydrolytic reaction. Fungi like *Rhizopus oryzae, Aspergillus niger* and few phytopathogenic fungi used in food and feed industries which effectively use polygalacturonidases comprises endo- and exoacting enzymes for degradation of pectin of the plant. Fungal polysaccharide lyases cleave uronic acid-containing polysaccharide chains to generate an unsaturated hexenuronic acid residue and a new reducing end of the plant cell wall. Fungal pectin lyases and pectate lyases also target the homogalacturonan backbone of pectin of the plant.

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Climate smart plant breeding

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Smrutishree Sahoo[1], Sanjay Kumar Sanadya[2]
[1]Ph.D. Scholar (GPB), GBPUAT, UTTARAKHAND -263145,
[2] Ph.D. Scholar (GPB), CSK HPKV-176062

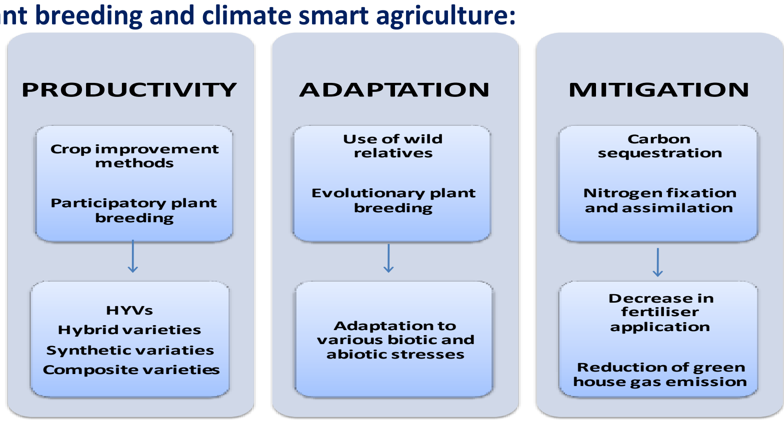
Climate change is not a new phenomenon, starting from decrease in CO_2 content before 350 million years to till date pushing the hunger worldwide. The main challenges from climate change to agriculture and food production are the increased frequency and severity of abiotic stresses, and higher infestation of insects and diseases. It has been observed that an increase of 1^0C of seasonal temperatures diminishing yield ranging from 7.4% in maize to 3.1% in soybean (Zhao *et al.,* 2017). Indian Council of Agricultural Research (ICAR) initiated a project titled "National Initiative on Climate Resilient Agriculture (NICRA)" in 2010-11 to combat these challenges. Climate resilient agriculture has an important place in order to fight the changing climatic events, relied on three pillars i.e., productivity, adaptation, and mitigation. According to the need of present context, considering the role of plant breeding, it has evolved itself from improving a single trait to bring out wholesome varieties which can stand out multiple stresses. Cutting edge plant breeding depends on the accessibility to large germplasm collections and populations with desirable traits, proficient technologies, big data management tools, and combined classical plant breeding, biotechnology and molecular breeding activities.

How plant breeding acts smart?

-Plant breeders acquire knowledge of the physiological, morphological and molecular mechanisms that allow plants to respond stress due to climate change and its adaptation.

- Plant breeding also provides miscellaneous strategies to develop climate-resilient cultivars and expedite the rate of genetic gain.

Plant breeding and climate smart agriculture:



Breeder's Toolbox for Facing the Challenges Imposed by Climate Change

a) **Genetic Resources** in the form of wild species, wild relatives, and landraces are cornerstones for competitive plant breeding by residing several desirable traits which can be inrtogressed in to the cultivars.

b) **Conventional plant breeding methods** like mass selection, bulk method, pedigree selection, backcross breeding, recurrent selection and several others have played wonderful roles in crop improvement. However, the demand for the resiliency can't alone be fulfilled by the conventional methods hence, plant breeding includes the biotechnological tools to be more efficient.

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c) Front line technologies for plant breeding

i) Marker-Assisted Selection: It is the application of molecular markers (RFLPs, RAPDs, SSRs, SNPs etc.), in combination with linkage maps to alter and improve plant traits on the basis of genotypic assays. This includes several modern breeding strategies like marker-assisted selection (MAS), marker-assisted backcrossing (MABC), and marker-assisted recurrent selection (MARS). QTL mapping is the identification of DNA molecular markers (such as SSRs, SNPs) for the quantitative traits that correlate with a given trait in a segregant (mapping) population, thus allowing the positioning of QTLs within linkage maps. Genome-wide association study (GWAS) involves rapid scanning several up to 5 million markers (SNPs) across the complete sets of DNA.

ii) Genomic Selection: Genomic selection (GS) facilitate the selection of superior genotypes, shortening the breeding cycle, and reduce the cost of breeding line development. It includes two population, firstly, a training population (TP) and secondly, a breeding population (BP). Training population which is a representative of breeding population is subjected to genotyping and phenotyping for the traits of interest. Then, a GS prediction model linking genome-wide marker data to phenotypes is built to be used on the BP, which is only genotyped but undetermined phenotype to get information on their genomic estimated breeding value (GEBV). This allows the selection on marker data that excludes costly phenotyping and saves time.

iii) Speed breeding: A very new technique in order to expedite the genetic gain. This has the components of extended photoperiods, controlled temperature, fully enclosed growth rooms or glasshouses, rapid generation cycling. Four to seven generations per year can be achieved in six crop species including wheat, durum wheat (*Triticum turgidum*), barley (*Hordeum vulgare*), chickpea (*Cicer arietinum*), pea (*Pisum sativum*), and canola (*Brassica napus).*

iv) Combining participation and evolution: participatory– evolutionary plant breeding: In Participatory Plant Breeding, farmers are actively involved in the breeding process, selecting desirable variation and early- generation material. Evolutionary breeding involves creation of genetic diversity with repeated sowing and harvesting of the population in one or more agronomic environment without active selection of individual plants, and use of the seed as food or feed, or use of the seed as a basis for further breeding (Döring *et al.,* 2011). EPB combines the both to develop high-yielding, stress resistance variety with high degree of genetic variation to allow for adaptability to fluctuations in environmental condition.

Achievements of plant breeding:

As yield being a quantitative trait, it is challenging for breeders to take care of climate resiliency along with the yield. However, the breeders have succeeded in releasing several varieties which are well adapted to several stresses and productive too. Only few of them are given below.

PPB Varieties: The three white maize varieties were developed from the PPB programme (called 'PPB varieties', i.e. GDRM-185, GDRM-186, and GDRM-187 (Witcombe *et al.,* 2003)**.** GDRM-187 was bred as an extra-early maturity maize variety. This variety matures seven days earlier than the earliest local varieties. It produces fewer barren plants and larger cobs, which, unlike local varieties, are filled to the tip.

SWARNA SUB-1: 'FR13A' was a pure line selection released in fourties in Orissa, India, from the local variety Dhullaputia. Using FR13A, submergence tolerant line 'IR' was developed and crossed with a susceptible Japonica line 'PI543851'. Major QTL was mapped to chromosome 9, designated as *Sub1* was incorporated into existing popular varieties like 'Swarna', 'IR 64', 'BPT5204' etc. (Neeraja *et al.* 2007). The resulting Swarna-Sub1 and Sambha Mahsuri-Sub1, are already released in India in 2009 for the commercial cultivation. Varieties carrying the *sub1* gene developed through this process had the same agronomic, yield and quality traits as their non-Sub1 counterparts when grown under non-flooded conditions, but showed yield advantages of 1 to more than 3t ha^{-1} after complete submergence for various durations in naturally flooded fields.

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CR DHAN 801 AND CR DHAN 802: Two most recent climate smart varieties CR Dhan 801 and CR Dhan 802 are notified in 2019 by NRRI, Cuttack with in-built drought and submergence stresses tolerance are unique. Submergence tolerance quantitative trait loci (QTL), *Sub1* and drought yield QTLs, *qDTY1.1, qDTY2.1*, and *qDTY3.1* are stacked in the background of Swarna variety through marker-assisted backcross breeding. CR Dhan 801 gives 6.3t/ha under normal condition while 4 t/ha in submergence and 2.9 t/ha in drought condition. CR Dhan 802 (SUBHAS-IET 26673) gives 6.6t/ha under normal condition while 4.3 t/ha in submergence and 2.3 t/ha in drought condition.

Sahbhagi Dhan (IR74371-70-1-1): It is a conventionally bred, drought-tolerant rice variety identified in 2009 by the Central Variety release Committee (CVRC) and released for cultivation in India, in 2010. Under normal conditions, Sahbhagi Dhan produces 4-5 tonnes per hectare, whereas other varieties yield about 2.5 tonnes; under severe drought conditions, it produces 1–2 tonnes per hectare, while other high-yielding varieties produce nothing at all. It is an early maturing variety that is ready after 105 days, as compared to the usual 120–150 days.

HHB 67 improved: HHB 67 was rapidly and widely adopted by farmers during the early 1990s, but consequently shows highly susceptibility to downy mildew. Marker-assisted backcrossing with elite donor parent ICMP 451 was used as donor of DM resistance to male parent H 77/833-2. Marker-assisted selection (MAS) used restriction fragment length polymorphism. As the resistance was slow, additional DM resistance genes were backcrossed into female parent 843A/B from donor ICML 22 using conventional progeny-based greenhouse screening of pot-grown seedlings by HAU, Hisar. Conventional backcross transfer of DM resistance to improve 843A/B took nearly nine years (1991-1999), while marker-assisted backcross transfer to improve H77/833-2 was completed in just over three (1997-2000). . Its state release as HHB 67 Improved was approved by the Central Plant Variety Release Committee in June 2005. Towards mitigation**,** plant breeding through genetic engineering approaches for enhancing photosynthesis. The difference in leaf anatomy C_4 plants is able to sequester carbon dioxide through photosynthesis. Since 2009, the consortium of scientists uses multiple approaches to introduce C_4 photosynthesis mechanism in to C_3 rice. A bright prospect of non leguminous plants (rice, wheat and maize) is being enabled to fix nitrogen in the soil. Another strategy is planting crops having higher nitrogen use efficiency.

CONCLUSION: Climate resiliency in agriculture and food production is a dire need for the present increasing populous world. Plant breeding for climate resiliency lays foundation on the analysis and interpretation of classical plant breeding along with big “omics” data and new plant breeding technologies. However, it is expected to give fruitful results in the near future. Through different improved varieties plant breeding efforts for productivity, crop adaptation as well as for mitigation. Plant breeders have shifted their targets from one particular trait to the multiple traits which a crop plant needs to combat the upcoming climate changes. The breeders need to expand their visions, skills enough to allow starting thinking of breeding with different tools than that in the past, will reduce the breeding cycle in a cost-effective manner.

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A Reverse Genetics method: TILLING

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Sanjay Kumar Sanadya[1] and Smrutishree Sahoo[2]
[1]PhD Scholar, Department of Genetics & Plant Breeding, CSK HPKV, Palampur 176 062; [2]PhD Scholar, Department of Genetics & Plant Breeding, GBPUAT, Pantnagar 263 145

INTRODUCTION

Reverse genetics is highly desirable in the modern genomics era; however, the most powerful methods are generally restricted to a few model organisms. Since in TILLING method no recombinant exogenous DNA is introduced into the plant, so that mutagenesis is considered as non-transgenic. A method for reverse genetics called T*arget* I*nduced* L*ocal* L*esions* IN G*enomes* (TILLING) has been developed as a method for inducing mutations and identifying novel genetic variation and has been demonstrated in the model plant, *Arabidopsis thaliana*. McCallum first time introduced the term TILLING in year 2000, using the model plant *Arabidopsis thaliana* and elaborated in subsequent studies. Parallel processing of sequencing libraries aided by unique tracer sequences and barcodes allowing flexibility in the number, pooling arrangement of targeted genes, species and pooling scheme. Sequence reads were processed and aligned to the reference to identify possible single-nucleotide changes, which then evaluated for frequency, sequencing quality, intersection pattern in pools and statistical relevance.

Steps used in TILLING method

1. Mutagenesis

It is the application of physical or chemical mutagens or spontaneously into plant materials to create variability. Commonly used chemical mutagens include EMS, sodium azide, MNU, MMS, hydrogen fluoride and hydroxylamine. Physical mutagens such as gamma-ray, x-ray and fast neutrons are also used but rarely because of these break the DNA at random site and rarely detect the point mutation. Among all the mutagens EMS is widely used in developing TILLING populations which creates G:C to A:T transitions in the genome, due to the alkylation of G nucleotide residues which then pairs with T instead of C. In *Arabidopsis*, wheat and maize about 99 % of EMS induced point mutations are transitions, however, in rice and barley mutagens such as NaN_3 and MNU were more efficient in introduced point mutation. Before embarking on large-scale mutagenesis, pilot studies should be made to determine the right mutagen, optimum concentration and handling procedures. In general, the optimum concentration of the mutagen is lower in diploid species than in polyploids due to complementation of essential genes by homoeologous copies. In most crop plants, the seeds are used for mutagenesis except for maize, where the mutagenized pollen grains then followed by transferred to the normal female parent.

2. Development of non-chimeric population

The first generation of mutagenized seeds (M_1 population) is typically chimeric due to the multicellular stage of embryos in seeds. Hence, M_1 plants are self-pollinated to establish the subsequent M_2 populations. In this population, the mutations do not segregate within cells of an individual plant and therefore the induced changes are considered stable and heritable. Tissue samples are collected from individual M_2 plants for DNA isolation and M_3 seeds are harvested and stored for subsequent studies.

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Figure 1a: The first step is mutagenesis then advanced up to M_2 generation as non-chimeric population, assembling the DNA of individual M_2 plants into pools and plates for efficient screening.

3a. DNA extraction, Sampling and Pooling

Tissues from individual M_2 lines used for the DNA isolation using simple-scale methods. After that, the quality and quantity of the DNA needs to checked. The quality of DNA can easily observe on an agarose gel and quantity can estimate by comparing it to DNA markers of known concentration. Once the concentration of each sample estimated, later use as template in the PCR reaction. One can either pool one wildtype and one mutant DNA, however, most often individual mutant plants are pooled together. Since only one plant of the pool is likely to carry a mutation in the target sequence it ensures that wildtype and mutant sequences are represented in a pool, while simultaneously screening in a time and cost efficient manner. The dimension refers to the way of pooling as each sample is either represented once on a plate or at two different unique positions. The advantage of direct single candidate detection and avoidance of false positives often justifies the additional effort of that particular pooling scheme.

3b. PCR Amplification and heteroduplex formation

TILLING is used to screen for mutations in specific genes that are expected or known to correspond to the trait of interest. With an established TILLING population, virtually any gene can be targeted, however, some prerequisites have to be met. Primer Design Designing the right primer pair is crucial and sometimes a challenge in TILLING projects. Primers need to be specific to amplify only the gene of interest and the appropriate gene region. Multiple amplifications reduce the detection efficiency. Primer specificity is especially important for members of multi-gene families or in polyploidy species where multiple homoeologues are present. This commonly achieved by using copy-specific primers. In polyploid species, specificity can achieve by designing primers in more divergent regions, particularly in the introns or in the 5′ and 3′ UTR region. Depending on the detection method, the length of the amplified products can range from 0.3 to a maximum of ~3 kb. To ensure that the appropriate gene region is amplified by PCR, the CODDLE (Codons Optimized to Detect Deleterious LEsions) software can be used. Hence it is useful for providing an allelic series of mutations.

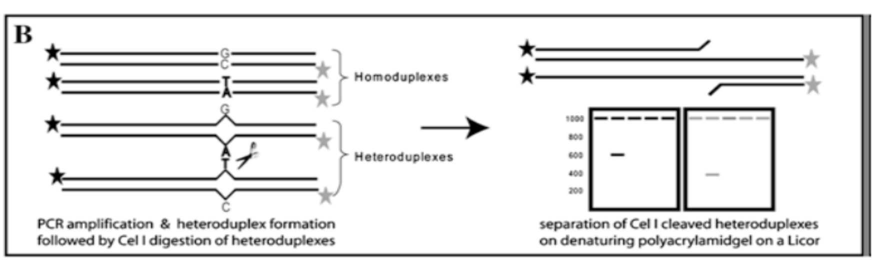

Figure 1b. The mutation screening step involves cleaving of PCR products followed by resolution on gel-based systems, such as LI-COR.

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To assure the specificity and to maximise the yield of PCR products for the subsequent steps, most TILLING projects use touchdown PCR protocols. Non-specific amplification can lead to additional heteroduplex formation, reducing the detection frequency and resulting in cleaved products even in control samples. Copy-specific primers deduced from unique gene regions overcome this problem and allow a normal PCR protocol to be used, resulting in an appropriate amount of the specific PCR product for mutation detection. The PCR amplification is followed by the heteroduplex formation step where the PCR amplified products are first denatured and then allowed to slowly cool, which facilitates the formation of heteroduplex molecules. This is usually introduced as an additional step at the end of the PCR program.

4a. Mutation Detection

Initially, the detection of single base pair differences was done using denaturing HPLC, whereas nowadays single-strand cleaving endonucleases are used to detect mismatches in heteroduplexes. Several single-strand specific nucleases, members of the S1 nuclease family (e.g. CELI or mung bean nuclease), recognize and cleave the mismatches formed in heteroduplexes. CEL I is the most commonly used and preferred enzyme for mutation detection in TILLING projects. CEL I cleaves to the 3′ side of mismatches in heteroduplexes while leaving homoduplexes intact. Thereby, CEL I cleaves each strand of the heteroduplex at the site of the mismatch that produces two complementary fragments. Recently, other endonucleases such as *Brassica* petiole extract (BPE) and ENDO1, which is extracted from *A. thaliana* have been identified. Mutation detection after cleavage of heteroduplexes can do using different methods. The most commonly used method is through a denaturing polyacrylamide gel run on a LI-COR DNA analyser. For this approach, PCR products are amplified using infra-red dye (IRD) labelled primers. After PCR amplification and endonuclease digestion, products are purified using either Sephadex® purification or ethanol precipitation. In addition to the above mentioned methods, Next Generation Sequencing (NGS) platforms have recently been implemented to detect mutations in TILLING populations.

4b. Confirmation by Sequencing

Mutations detected by gel-based TILLING methods need to be confirmed by sequencing. If the LI-COR is used, the detected mutation pinpoints directly to the location of the polymorphism and makes confirmation by sequencing quite efficient. The labelled primers on the LI-COR provide a directionality (5′ or 3′ end), which allows the sequencing reaction to target the specific site. On the other hand, the alternative screening methods, which use unlabelled primers, do not provide an exact position of the mutation. Since the size of the fragments on the gels indicates only a putative but not exact location, sequencing should be carried out in order to pinpoint the mutation. In addition, the longer fragments (~2-3 kb) that can be amplified, imply that sometimes an additional sequencing primer within the amplicon might be needed to reveal the mutation. Mutations are randomly induced and can target every gene. The advantage of the chemical mutagenesis in TILLING is that it creates an allelic series of mutations. These include nonsense mutations, missense mutations, silent mutations and splice junction mutations.

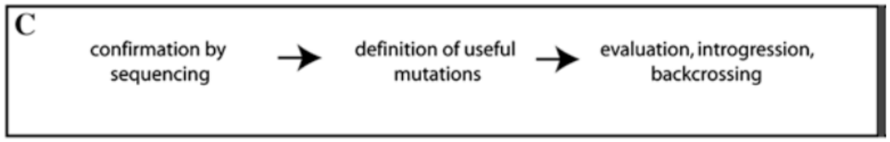

Figure 1c. The last step involves the confirmation of the putative SNP through direct sequencing, characterizing SNPs based on their predicted effect on protein function (using PARSESNP and SIFT), and the subsequent phenotypic characterization and deployment into breeding programs.

Mutations in the coding region of the gene might alter plant metabolism or the effective level of a gene product that might be useful for breeding. To investigate whether the detected mutations have an influence on the protein, web-based software, namely PARSESNP and SIFT can be used. PARSESNP reveals the changes in the nucleotide and amino-acid sequences and documents any restriction endonuclease site that has been altered. SIFT uses alignments between closely related sequences to predict whether the amino acid change is expected to have deleterious effects on the protein.

Estimation of Mutation Frequency

$$\text{Mutation frequency of a population} = \frac{\text{The total number of base pairs screened}}{\text{The total number of mutations scored}}$$

According to Weil (2009), a mutation rate of 1/500 kb or less is considered feasible in TILLING. Higher mutation frequencies imply that the number of individuals to be screened in order to obtain a certain number of mutations is too large to make TILLING a practical endeavour.

CONCLUSION

TILLING is widely adopted in many crop plants, including *Arabidopsis,* maize, wheat and rice. The technique is widely used for plant functional genomics and can also use in "pre-breeding", which is the discovery or generation of genetic variation of potential benefit to commercial and public plant breeding programs that release crop cultivars to farmers. TILLING is high-throughput mutation detection systems that exploit non-transgenic allelic variation. The technique has proven highly efficient in obtaining desirable mutant lines. Consequently, there is also growing interest in applying the technique in orphan crops that lack well-developed genetic tools. Once mutations of interest have been obtained the major challenge of shifting these mutations into breeding lines or varieties with advanced agronomic performance for resource poor farmers remains. It is only at this point, that TILLING will be delivering on the promise of improving food security.

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Effect of environmental factors on disease development

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Pravallika sree Rayanoothala* and M. Divya
Research scholar, Department of plant pathology
Bidhan Chandra krishiviswavidyalaya, Mohanpur, Nadia

1. INTRODUCTION:

The development of disease mainly depends on the combination of three factors, susceptible plant, infective pathogen and favourable environmental conditions. Although the first two factors remain unchanged for some period of time, the environmental conditions may change more or less suddenly to various degrees which influences the development of diseases or the initiation of the diseases. Therefore it is essential to know about the degree of deviation of environmental factors that influences either susceptibility of host or the virulence of the pathogen or more than one factors that aggravates the disease development.

1.1 Effect of temperature:

a) Each pathogen has an optimum temperature for its growth.
b) Different growth stages of fungus, such as the production of spores, their germination and the growth of the mycelium may require different optimum temperature.
c) Storage temperatures are manipulated for certain fruits, vegetables and nursery stock to control fungi and bacteria that causes decay, provided the temperature does not change quality of products.
d) In temperate regions, low temperature during late fall, winter or early spring are not congenial for the development of pathogen, but as the temperature rises, these pathogens become active and when other conditions are favourable they can cause infection and thus disease.
e) Pathogen differs in their choice for higher or lower temperature. For example, the fungi namely *Typhula* and *Fusarium* causing snow mould of cereals and turf grasses, late blight pathogen *Phytophthora infestans* are more serious in cold regions whereas fungus like *Colletotrichum*, *Ralstonia* are favoured by higher temperature.
f) Rapid disease development occurs when temperature is optimum for pathogen development and is below or above the optimum for host development.
g) For stem rust of wheat (*Puccinia graminis tritici*) the temperature required to complete the infection cycle is 22 days at 5°C, 15 days at 10°C and 5-6 days at 23°C.
h) Effects of temperature may mask symptoms of certain viral and mycoplasmal diseases and making them more difficult to detect.

1.2 Effect of moisture

Moisture influences the initiation and development of infectious plant diseases. It may exist as rain or irrigation water on plant surface or around the roots, as relative humidity in the air and as dew. Moisture is essential not only for the germination of fungal spores and penetration of the host by germ tube but also for the activation of bacterial, fungal and nematode pathogens before they can infect the plant. Moisture in the form of splashing rain and running water also plays an important role in the distribution and spread of many pathogens on the same plant and on other plants. Moisture also increases the succulence of host plants and thus their susceptibility to certain pathogens, which affects the extent and severity of disease.

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Examples:

1. Late blight of potato, apple scab, downy mildew of grapes and fire blight are found or are severe only in areas with high rainfall or high relative humidity during the growing season.
2. In apple scab, continuous wetting of the leaves, fruits etc. for at least 9 hours is required for primary infection to take place even at optimum range (18 to 23°C) of temperature. At lower temperature the minimum wetting period required is higher.
3. In powdery mildews, spore germination and infection are actually lower in the presence of free moisture on the plant surface than they are in its absence.
4. Rhizopus soft rot of sweet potato (*Rhizopus stolonifer*) is an example of storage disease that does not develop if relative humidity is maintained at 85-90 %, even if the storage temperature is optimum for the growth of the pathogen. Moisture is generally needed for fungal spore germination, the multiplication and penetration of bacteria and the initiation of infection e.g., germination of powdery mildew spores occurs at 90-95 % relative humidity.

1.3 Effect of soil moisture

Soil moisture influences the initiation and development of infectious plant diseases. High soil moisture levels favours development of destructive water mould fungi, such as species of Aphanomyces, Pythium and Phytophthora. Overwintering by decreasing oxygen and raising carbon-dioxide levels in the soil makes roots more susceptible to root rotting organisms. Diseases such as take all of cereals (*Gaeumannomyces graminis*), charcoal rot of corn, sorghum and soyabean (*Macrophomina phaseolina*), common scab of potato (*Streptomyces scabies*) and onion white rot (*Sclerotium cepivorum*) are most severe under low moisture levels.

1.4 Effect of wind

Most plant epidemic diseases that occurs and spread in large areas are caused by microorganisms that are spread either directly by wind or indirectly by insects which can disseminate long distances with the wind. Uredospores and many conidia are transported to many kilometers by wind. Wind becomes more important when it is accompanied by rain. Wind blown rain splashes can help in spread of bacteria from the infected tissues.

1.5 Effect of light

Light intensity and duration may either increase or decrease the susceptibility of plants to infection and severity of disease. Light mainly cause production of etiolated plants due to reduced light intensity which in turn increases the susceptibility of plants to non-obligate parasites but decreases the susceptibility of plants to obligate parasites. It also enhances the plants' susceptibility to viral infections.

1.6 Effect of soil pH

Soil pH is a measure of acidity or alkalinity and it markedly influences occurrence of soil borne pathogens. Growth of potato scab (*Streptomyces scabies*) pathogen is suppressed at a pH of 5.2 or slightly below but is more severe at a pH 5.2 to 8.0 or above. Club root of crucifers caused by *Plasmodiophora brassicae* is most severe at a pH of 5.7, whereas its development drops sharply between 5.7 and 6.2 and is completely checked at pH 7.8.

1.7 Effect of soil type

Certain pathogens are favored by loam soils and others by clay soils. Fusarium wilt disease which attacks a wide range of cultivated plants causes more damage in lighter and higher soils. Nematodes are also most damaging in lighter soils that warm up quickly.

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1.8 Effect of host-plant nutrition

1. Nutrition affects the rate of growth and the state of readiness of plants to defend them against pathogenic attack.
2. Nitrogen abundance results in the production of young, succulent growth, a prolonged vegetative period and delayed maturity of the plants. These effects make the plant more susceptible to pathogens that normally attack such tissues and for longer periods. In contrast, plants suffering from a lack of nitrogen are weaker, slow growing and faster aging. Such plants are susceptible to pathogens that are best able to attack weak, slow-growing plants.
3. Large amounts of nitrogen increases the susceptibility of pear to fire blight (*Erwinia amylovora*), wheat rust (*Puccinia*) and powdery mildew (*Erysiphe*).
4. Reduced availability of nitrogen may increase the susceptibility of tomato to Fusarium wilt and *Alternaria solani*, of sugar-beets to *Sclerotium rolfsii* and of most seedlings to Pythium damping-off.
5. Severity of the disease caused by Fusarium spp., *Plasmodiophora brassicae* and *Sclerotium rolfsii* increases when an ammonium fertilizer is applied whereas the severity of diseases caused by *Streptomyces scabies* and *Gaeumannomyces graminis* increase when nitrate form of fertilizers are applied.
6. Phosphorus has been shown to reduce the severity of potato scab but to increase the severity of cucumber mosaic virus on spinach and Septoria infection of wheat leaves and glumes.
7. Phosphorus seems to increase resistance either by improving the balance of nutrients in the plant or by accelerating the maturity of the crop and allowing it to escape infection by pathogens that prefer younger tissues.
8. Potassium has also been shown to reduce the severity of numerous diseases including stem rust of wheat and early blight of tomato, whereas high amounts of potassium increase the severity of rice blast and root knot.
9. Calcium reduces the severity of several diseases caused by root and stem pathogens such as Rhizoctonia, Sclerotium, Botrytis and Fusarium oxysporum, but it increases the severity of common scab of potato (Streptomyces scabies).
10. The effect of calcium on disease resistance seems to result from its effect on the composition of cell walls and their resistance to penetration by pathogens.

1.9 Effect of pollutants

Ozone may affect a pathogen and sometimes the disease it causes. For example in wheat rust fungus, ozone reduces the growth of uredia. Ozone increases the infection of potato leaves by Botrytis.

2. CONCLUSION: In general, plants receiving a balanced nutrition, in which all required elements are supplied in appropriate amounts, are more capable of protecting them from new infections and of limiting existing infections than plants to which one or more nutrients are supplied in excessive or deficient amounts.

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Agro-Production Technology for Soybean (*Glycine max* L.)

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Vikram Bharati[1], Kumar N Lamani[2], Manoj Kumar[3] and Chandreshwar Prasad Rai[4]
[1]Assistant Professor, Department of Agronomy, Tirhut College of Agriculture, Dholi
[2]M.Sc.(Ag.) Scholar, Department of Agronomy, RPCAU, Pusa (Samastipur) Bihar
[3]Assistant Professor, Department of Entomology, RPCAU, Pusa (Samastipur) Bihar
[4]Senior Technical Officer, Department of Entomology, SRI, Pusa (Samastipur) Bihar

INTRODUCTION:

Attributable to high oil content and moderate fiber levels, many vitamins, minerals, and fatty acids (both saturated and unsaturated), oilseeds are energy dense foods. These oils and fats, in addition to being an important component of human diet, bear industrial significance which is necessary for the development of a large number of products such as soaps, hair oils, pharmaceuticals, textiles, paints and varnishes, etc. Oilcakes and meals obtained after oils have been extracted from these crops are important sources of animal feed and manure. With around 19 percent of the world's region accounting for about 2.7 percent of global growth, these field crops hold only next to cereals the second most important determinant of Indian agricultural economy. With less than 27 Mha of oilseed field cultivated at an average yield of 1095 kg / ha yielding 29 Mt, India occupies a significant position in the world as the world's leading oilseeds producing countries that have only the US, China and Brazil behind[1]. Oilseed crops have reached an annual growth rate of 2.44%, 5.47% and 2.96% respectively over the past decade (1999-2009).

Being a country rich in various agro-ecological resources, India has optimum conditions for the production of all nine annual oilseeds including seven edible oilseeds, that is to say. Groundnut, Rapeseed-Mustard, Sunflower, Sesame, Niger, Safflower, and Soybean, and Castor and linseed as uneditable oilseeds. In addition to these nine annual oilseeds, other small oilseeds of horticultural and forest origin, including coconut and oil palms, and other non-conventional sources such as rice bran, cotton seeds, maize seeds and tobacco seeds also provide significant oils. The country is the leading nation in Castor production contributing a massive 79.6 percent of global output and contributing significantly to the Groundnut (25.1 percent) holding the pride of being the second largest producer after China and Rapeseed-Mustard production contributing about 16 percent of global output, ranking third only behind China and Canada on the global stand Although the country is so rich in diversity, growing oilseed crops on poor and marginal soils, mainly in rain fed circumstances, has led to poor realization of its genetic potential. Because of this, although it covers 20.8 per cent of the global region of oilseed crops, the country produces only around 10 per cent of total production, which causes a gap between the demand and supply of these oils to be met annually through imports. Booming populations with higher incomes are likely to increase domestic consumption of edible oils even further. The nation is unable to satisfy the annual demand, which rises at a rate of 6%, with production that by just 2% per year.

Indian scenario:

Soybean is the oilseed crop in India. Soybean has become an important oilseed crop in India in a very short period with approximately 10-million ha area under its cultivation. India is divided into five agro-

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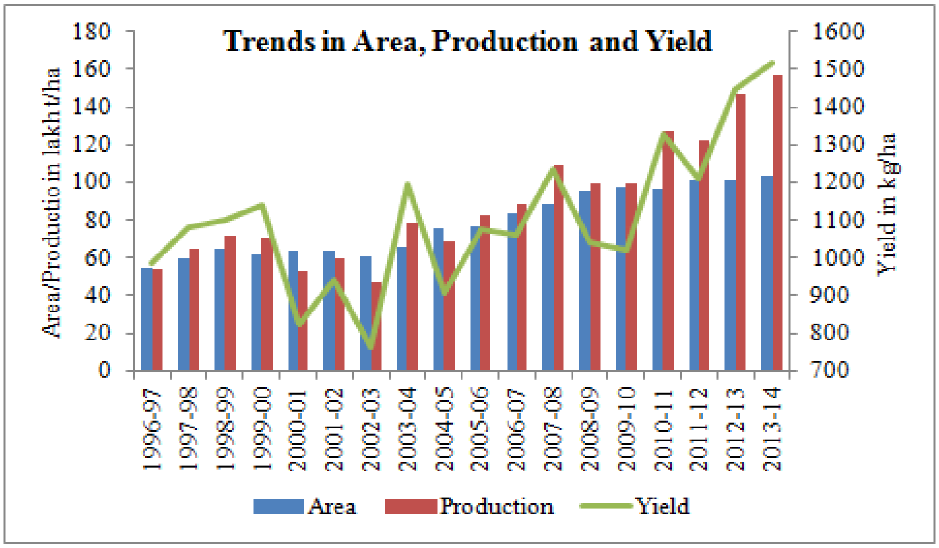
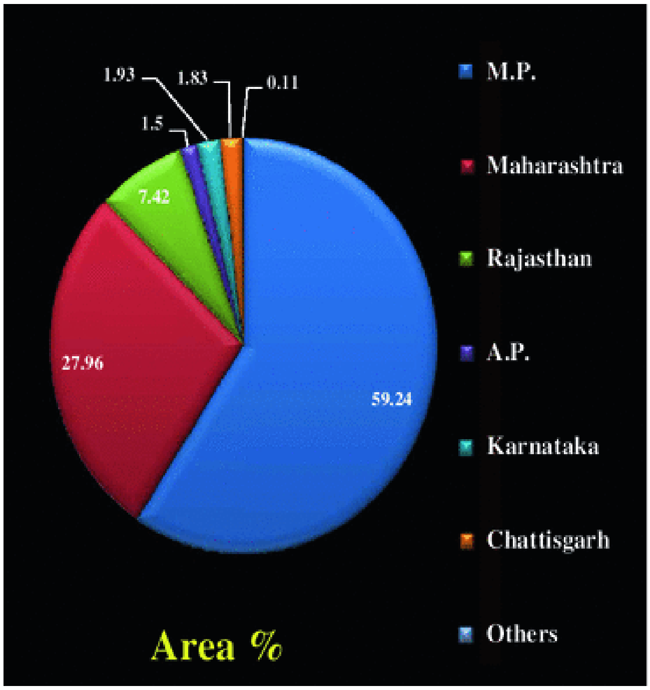
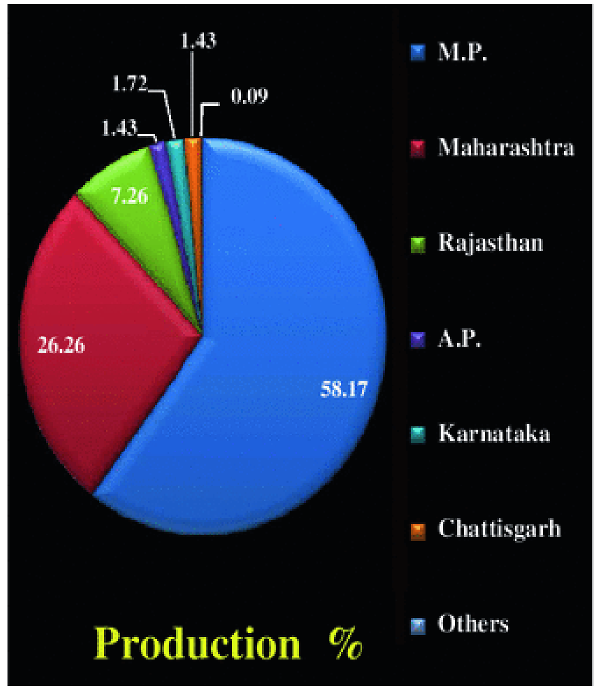
climatic zones for soybean cultivation. These are northern hill zone, northern plain zone, north eastern zone, central zone, and southern zone. There are specific varieties released for each zone which are suited to their agro-climatic conditions. There has been an unprecedented growth in soybean; area which was just 0.03 m ha in 1970 and has reached to 9.30 million ha in 2010. The mean national productivity has increased from 0.43 t/ha in 1970 to 1.36 t/ha in 2010.



Source: Ministry of Agriculture, GoI

The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, and Chhattisgarh. Owing to rapid expansion, in 2006–07 the crop surpassed area and the rest of the oilseed production. Soybean is now primarily grown in vertisols as a rainfed crop and associated soils with an average 900 mm rainfall in the crop season, which varies greatly across locations and years. The introduction of soybean in these areas has led to a change in the cropping method from rainy seasonal fallow to soybean followed by post-rainy seasonal wheat or chickpea fallow system (wheat / chickpea) followed by wheat or chickpea system (soybean–wheat / chickpea). This has led to an increase in crop intensity and a consequent increase in profitability per unit land area. The introduction of soybean has helped to improve the socio-economic conditions of large numbers of small and marginal farmers, possibly because it generates competitive returns for farmers even under minimal agricultural inputs, management practices and climatic adversities. In reality, soybean is one of the most resilient crops for the rainfed *kharif* season, as the crop has maintained its output despite the recent aberrant weather conditions. The region under soybean is located around 15 ° –25 ° N in a latitudinal belt comprising the states of Madhya Pradesh, Maharashtra, Rajasthan, Chhattisgarh, Andhra Pradesh and Karnataka. Together, these states contribute about 98 per cent of the country's total soybean output. Soybean has shown a rapid increase in area in southern parts of the country in recent years, especially in the states of Maharashtra, Andhra Pradesh and Karnataka. Since its inception, Madhya Pradesh has been a major contributor to the soybean area and output, currently contributing 59 percent of the area and production, led by Maharashtra with a 28 percent and 26 percent contribution in terms of the country's total area and production. The crop can be grown in most parts of India and states such as the northeastern states, Himachal Pradesh and Jharkhand have strong soybean potential





Edible oil Economy:

India holds the world's fifth-largest vegetable oil market. Oilseeds are the second largest agricultural commodity after cereals, comprising 14 per cent of the country's total cropped area. However, by importing nearly 50 per cent of its requirement, the country is meeting its edible oil demand. The per capita consumption of vegetable oil is growing quite rapidly due to population growth and an improved population economic status. Demand increased to about 12.6 kg / year compared to 4 kg / year in 1961, and the estimated 2015 and 2020 demand is 14.57 and 16.38 kg / year, respectively. The country will need between 18.3 and 21.8 million tons of edible oil to meet that demand. Soybean may play a crucial role in this scenario. This has the potential to become a major oil producing crop worldwide thanks to the advances in knowledge of lipid biochemistry and the possibilities of improving the quality and yield of edible oil in soybean. Soybean contributes 40 and 25 per cent to the country's total oilseeds and edible oil production and earns valuable foreign exchange through the export of soymeal. Current soybean processing industry crushing capacity is about 20 million t / annum, with an annual total soybean oil output of 12.0 million t. In terms of consumption patterns, 100 percent of soybean oil produced in the country is consumed domestically, and 8–10 percent of total soybean output is consumed for direct food purposes at home. Thirty-five percent of the total soymeal produced becomes domestic

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Important World Soy Markets:

- Chicago Mercantile Exchange, which acquired Chicago Board of Trade – the world's oldest soy futures market
- Dalian Commodity Exchange - trades the most liquid soybean contracts in the world
- Argentina and Brazil FOB determine the physical prices

India's Position in World Soy Industry:

Name of Products	Global	India	% Share
Soybean Production	230	9	4
Soybean Trade	75	0	0
Soy Oil Production	35	1.5	4
Soy Oil Imports	9	1	11
Soy Oil Exports	9	0	0
Soymeal Production	150	7	5
Soy Meal Exports	52	3.5	7

Constraints to Soybean Production:

Despite having made rapid stride for both coverage and total production, soybean still suffers on productivity front. There are a number of constraints, pertaining to climate, edaphic, production, and technology aspects as mentioned below that hinder higher productivity.

- Most of the area under soybean cultivation are a *rain fed.*
- Erratic behavior of *monsoon* affecting planting.
- Large spatial and temporal variability in rainfall.
- Soil moisture stress at critical growth stages, especially seed-filling stage.
- High-temperature stress at critical growth stages.
- Biotic interferences to crop growth.
- Limited mechanization.
- Poor adoption of improved production technology—low risk covering ability.
- Monocropping and poor varietal diversification increasing risk chances.
- Timely availability of quality inputs.
- Poor/inadequate technological information.
- Poor utilization in food chain owing to characteristics beany flavor of soybean.
- Road blocks in utilization as pulses because of hard-to-cook characteristics of soybean.
- Psychological stigmas and conventional food habits.
- Lack of awareness about health/nutritional benefits.

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Nutritional Security of Soybean:

The unique chemical composition of soybean seed, which includes the number of nutraceutical compounds such as isoflavons, tocopherol, and lecithin besides 20 % oil and 40 % protein, has made it one of the most valuable agronomic crops in the world. The food derived from soybeans generally provides the health benefits and is a cheaper source of high-quality protein. The crop has potential to eliminate protein malnutrition prevailing in poor sections of society in the country. The foreign exchange earned from export of soy meal is encouraging draining out of high-quality protein from the country which poor sector of society needs at an affordable price. The utilization of soybean for food uses in India is meager, and it needs work in terms of blending with other foods to make taste acceptable. The high-quality soybean protein should be included in daily diet of Indian masses to mitigate the widespread energy-protein malnutrition. The Government of India as well as private sector should take aggressive approach to increase the food use of soybean in the country.

Soybean Genetic Improvement:

To ease the availability of edible oil and pulses, the Government of India has been consistently making efforts to gear up research and development programs through TMO (1986) and TMOPM (1991) and 2004 onward through ISOPOM programs. The ICAR started the All India Coordinated Research Project on Soybean (AICRPS) in 1967. Eventually, ICAR established the National Research Centre for Soybean (now upgraded to Directorate of Soybean Research during XIth Plan) at Indore in Central India in 1987 when soybean covered only about 1.5 million hectares, nearly one-sixth of the present coverage by the crop. At present, soybean has surpassed groundnut and rapeseed/mustard in cultivable area and production, the two most important edible oilseeds among nine oilseeds grown in the country.

The soybean research in India is being pursued by Directorate of Soybean Research (DSR) and All India Coordinated Research Project on Soybean (AICRPS). The AICRPS is an integral part of the DSR with 8 main, 14 sub, and 16 voluntary centers, spread across the nation. The system is well equipped with human resource equipments and infrastructure to conduct quality research. Through their unified efforts and with support from soybean industry, nongovernmental organizations, and farmers, soybean is playing a pivotal role in oil economy of the country. The advancement in research component culminating to improved varieties and agro-ecological zone-specific production technologies and crop protection modules has been the driving force in motivating the other components of production system to function in harmony leading to unparallel growth of the crop and elevated socioeconomic status of small and marginal farmers.

Insect-Pests & Disease Management:

The major insect-pests of soybean are Semiloopers, Tobacco caterpillar, Gram pod borer, Bihar hairy caterpillar, Leaf folder, White fly, Jassids (Hoppers) and Thrips. The major diseases of soybean are Rust, Yellow mosaic, Soybean mosaic, Charcoal rot, Rhizoctonia root rot & aerial blight, Anthracnose and Powdery mildew. The IPM package for soybean includes:

- Deep summer ploughing
- Use of insect-tolerant varieties
- Phorate application at sowing

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- Installation of light trap
- Use of bird-perches
- Mechanical removal of infested plant parts
- spray of *Bt* based bio-pesticide, and
- Neem- based use of chemical insecticides

Soybean diseases can be a significant economic factor in India. On average, diseases reduce yields in India by an estimated 10 to 30%, although in individual fields and with certain diseases, losses may be much higher. The management of these diseases are primarily dependant on cultivars that are resistant to different diseases. Cultural management practices consists of planting high-quality, disease –free seed and using tillage practices that lead to rapid decomposition of crop residue. Narrow row widths and high plant populations should be avoided in fields.

Future challenges

Nevertheless, soybean productivity in India has increased from 426 kg / ha in 1970–71 to 1,264 kg / ha in 2017–18, which is still well below India's crop capacity. Therefore, India's low productivity and great climate and yield fluctuation are detrimental. Simulation studies conducted across India have shown that the crop's climate potential is 3,000–3,500 kg / ha, while the rain fed potential is 2,000–2,500 kg / ha compared with the national average of 1,200 kg / ha. The average rain fed potential of 2,000 kg/ha has also been demonstrated in large number of on-farm trials conducted over years across India. Several biotic, biotic, and socio economic factors, responsible for poor productivity of soybean in India, have been identified. However, the major cause of large yield gaps between rains fed yield potential and actual yields harvested by farmers is attributed to non-adoption of improved production technology by the farmers.

Despite having established non-adoption of technologies as the foremost reason for stagnation of soybean productivity, maintaining the focus on providing the upward thrust to soybean production and productivity in the country in next 20 years to come, the following multi-pronged strategies have been formulated.

- Improving productivity of soybean through development of new gene technologies.
- Enhancing and enriching the gene pool to broaden the selection pool along with gene flagging to assign the worth to our genetic wealth.
- Development of new varieties that would fit into futuristic crop management regimes and can harness the opportunities created by shift in weather patterns.
- Exploitation of heterotic vigor to create an opportunity window for development of hybrids for further increasing the yield potential.
- Exploitation of new biotechnological tools in exercising efficient selection in reduced time frame.
- Development of varieties with efficient extraction metabolism to assimilate ever limiting phosphorous and zinc availability.
- Breeding varieties that could cope with abiotic stresses like water deficit and excesses.
- Using zinc-finger nuclease technology, the trypsin inhibitor and other undesirable genes can be deleted or modified. A thaumatin gene for sweet protein gene and cloning of omega and hydroxyl

acids genes can make soybean the most valuable oil crop. There are no limitations of technology. Imagination and bold decisions to do are the scarce virtues holding soybean back.

CONCLUSION:

Soybean plays a vital role in total vegetable oil production across the globe. The diverse agro-ecological condition in the country is favorable for growing nine different oil seed crops and two non-edible oilseed crops. The oilseed accounts for 12% of the gross cropped area, 3% of the Gross National Product and 10% valve of all agricultural commodities. Production of soybean in India increased at an annual growth rate of 14.8% for 1970-71 to 2016-17 and 5.5% for 2000-01 to 2016-17. Its cultivation enhances the soil fertility by fixing atmospheric nitrogen at the rate of 40kg per hector. In our country Madhya Pradesh contributes higher in the total production of the soybean. There is a vast scope in soybean oil exploitation and varietal improvement for sustainable crop production.

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Useful apps for agricultural community

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Mukesh Kumar Mehla
Department of Soil and Water Engineering, College of Technology and Engineering, MPUAT, Udaipur, Rajasthan, India-313001

In today's modern age smartphone use and internet usage has been increasing day by day. There are several apps out there at google play store that offer different services to the farmers. Here are some useful apps that are available on Appstore, their objectives and functions which are developed for Indian farming community. Here, not every agriculture app that's available is listed, but a good list from selection is mentioned. Here we focus on apps required for Indian farming community in groups by scouting/identification, information and overall farm management. There are so many applications available on Play Store related to farming. But only few of them are truly useful and provide relevant information to farmers depending upon their needs. Some of such apps that can prove to be useful to farmers is given as under:

m-KISAN

This app has been designed by inhouse IT team of DAC with the help of C-DAC Pune. It enables the farmers and all other stakeholders to obtain advisories and information being sent by experts and government officials at different levels through m-kisan portal without any registration on the portal. All applications and services listed in other sections of m-Kisan Portal are accessible on any kind of mobile phone including basic feature phone. Even today, feature phones (as against smart phones) constitute maximum share of mobile phone in India. However, with increasing penetration of smart phones in India at affordable prices (likely to go down further with the introduction of Android One by Google), it has been considered necessary to create mobile apps. Android Operating System has the largest share among the smart phones in the country. Therefore, initially apps are being developed for Android and gradually other operating system such as Windows and iOS will also be worked upon. The apps are not only useful for remote location data entry where desktop, PCs are not available, but would also be available to farmers and all other stakeholders for extracting information from the web. The mobile apps to be listed on m-Kisan Portal are some good applications which are free of cost and do not have any royalty or Intellectual Property Right (IPR) issue. These applications are being developed through C-DAC, NIC, in-house in DAC and independent Android enthusiasts/private firms.

Plantix app

Plantix app identifies potential defects and nutrient deficiencies in soil by using images to detect plant diseases, pest damages and nutrient deficiencies affecting crops. This image recognition app identifies possible defects through images captured by smartphone camera. The farmer can communicate with other farmers through online community network to discuss plant health issues and access their local weather reports. It can diagnose as well as offers corresponding treatment measures against pathogen attack or remediation for nutrient deficiency. The users are also provided with soil restoration techniques. Analysis is

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conducted by software algorithms which correlate particular foliage patterns with certain soil defects, plant pests and diseases.

IFFCO Kisan App

It is one of the best apps for farmers. It was launched in 2015 and is managed by IFFCO Kisan, a subsidiary of Indian Farmers' Fertilizer Cooperative Ltd. It is a small android application in terms of memory with an easy interface to use. It provides agriculture alerts to farmers in 10 Indian languages. The farmers can easily take help of agriculture experts. Approximately 50 thousand users have downloaded this app.

Its aim is to help Indian farmers make informed decisions through customized information related to their needs. The user can access a variety of informative modules including agricultural advisory, weather, market prices, best practices tips related to agriculture, horticulture, animal husbandry; a buyer and seller platform, all agriculture related news and govt. schemes, agriculture information library in the form of text, imagery, audio and videos in the selected language at profiling stage. The app also offers helpline numbers to get in touch with Kisan Call Centre Services.

Kisan Suvidha

It is an omnibus mobile app developed to help farmers by quickly providing relevant information to them. With click of a button, they can get the information on weather of current day and next 5 days, dealers, market prices, agro advisories, plant protection, IPM Practices etc. Unique features like extreme weather alerts and market prices of commodity in nearest area and the maximum price in state as well as India have been added to empower farmers in the best possible manner. Launched by the PM Narendra Modi in 2016 to work towards empowerment of farmers and development of villages, the app design is neat and offers a user-friendly interface. It provides information on current weather and also the forecast for the next five days, market prices of commodities/crops in the nearest town, knowledge on fertilizers, seeds, machinery etc. The option to use the app in different languages makes it more widely accessible. Kisan Suvidha (Ministry of Agriculture): Farmer can get the information on weather of current day and next 5 days, dealers, market prices, agro advisories, plant protection, IPM Practices etc. Unique features like extreme weather alerts and market prices of commodity in nearest area and the maximum price in state as well as India.

AgriApp

It is an online farming market place bringing Kisan, farming input/output, government service on an online platform. It also provides chat option for farmers. Kisan can easily chat with an expert of agriculture using this app. This mobile application provides diversified videos of agriculture work. Approximately 0.1 million users downloaded this farming app. It provides complete information on Crop Production, Crop Protection and all relevant agriculture allied services. It also enables farmers to access all the information related to "High value, low product" category crops from varieties, soil/ climate, to harvesting and storage procedures. An option to chat with experts, video-based learning, the latest news, online markets for fertilizers, insecticides etc. are also available on this app.

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Pusa Krishi

This app was launched in 2016 by the Union Agriculture Minister and aims to help farmers to get information about technologies developed by Indian Agriculture Research Institute (IARI), which will help in increasing returns to farmers. The app also provides farmers with information related to new varieties of crops developed by Indian Council of Agriculture Research (ICAR), resource conserving cultivation practices as well as farm machinery and its implementation will help in increasing returns to farmers.

Kheti-badi

Kheti-Badi (खेती–बाड़ी) is a social initiative app which aims at promoting and supporting 'Organic Farming' to extenuate the excessive use of chemical fertilizers. It provides important information regarding issues/problems caused by genetically modified seeds, chemical pesticides and fertilizers in India. The app promotes farmers to shift their chemical farming into organic farming. This app is currently only available in four languages (Hindi, English, Marathi and Gujarati).

PhuleJal

The app is developed by Irrigation Water Requirement Advisory Service (IWRAS) to estimate Evapotranspiration (ET_r). The irrigation water requirement varies from crop to crop and also with time of cultivation, and region for a single crop due to variations in meteorological parameters. The basic information that is required for estimating the irrigation water requirement of the crops is based on parameters like temperature, humidity, sunshine hours, wind speed, etc. The weather data estimates the ET_r of crop and crop coefficient values.

JFarm Services

This app is from Tractors and Farm Equipment Limited (TAFE). JFarm Services is an initiative by TAFE to increase easy access to farm mechanization solutions through rental of tractors and farm equipment for small and large farms, localized weather forecast, latest mandi prices, agri-news alerts and advisory. Small and marginal farmers, who hold about 85% of the land holdings in India may not be able to afford ownership of tractors or implements. JFarm Services bridges this gap by connecting these farmers with tractor and equipment owners through its Farmer-2-Farmer platform. Farmers can explore and book nearby equipment through: JFarm Services Android App OR Toll-free helpline: 1800-4-200-100 / 1800-208-4242. This free app connects tractor owners and Custom Hiring Centres (CHCs) operated by tractors and equipment owners directly to farmers seeking farm mechanization solutions, thereby facilitating a fair and transparent rental process while focusing on quality, dependability and timely delivery. JFarm Services offers the farmers and renters a wide range of prospects for hiring and renting of farm equipment and connects them directly to negotiate and fulfill their respective requirements.

Bhuvan Hailstorm App

It is a mobile app that is developed especially for capturing the losses caused by hailstorm on farmer's fields. An Agriculture Officer goes to the affected field and captures the photograph of field with latitude and longitude, name of crop, date of sowing, date of harvesting and source of irrigation with mobile or

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tablet loaded with this mobile app. This captured data is automatically sent to Bhuvan Portal and analysis is done easily.

Pashu Poshan

NDDB has developed very handful android based software that can be operated on phones as well as tablets. The software is used to formulate balanced ration and to optimize the cost and expenditures of animal husbandry, i.e., cattle or buffalo, milk production, milk fat and feeding regime etc. The dairy farmers are recommended to add some quantity of mineral mixture along with locally available feed ingredients offered to their animals.

MNCFC

The android based application is developed by National Remote Sensing Centre, ISRO for crop assessment via satellite data under the project FASAL by Ministry of Agriculture. The application provides services for collecting field photographs (640 x 480 resolution), GPS coordinates and field information, such as crop cultivated, sowing date, soil type, etc. All data collected through this application reaches at ISRO's Bhuvan Server and can be very useful in creating a national geospatial database of crops.

CONCLUSION

There are many other apps like SmartCrop, Mandi Trades, Kisaan Market which serve as an e- market place for farmers to sell their produce and for customers to choose before buying the produce. Many state specific apps such as Farm-o-pedia for Gujarat, AgriSmart for Punjab, Krishi Suchak for Karnataka have narrowed down the user base and help to provide information regarding a specific area. All these handy mobile apps have proved helpful in reducing transportation, transactional waste, corruption and also provides easy access for resource sharing by farmers. These apps serve to boost overall agribusiness performance and lessen the negative environmental impacts of farming. This advancement of technology is working towards a positive significant change in the lives of farmers and the field of agriculture.

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IPM of emerging pests of Groundnut and Cotton

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Bhut, J. B.[1] and Repalle Naganna[2]
Assistant Research Scientist[1] Ph.D. Scholar[2]
Main Oilseeds Research Station
Junagadh Agricultural University, Junagadh

Definition of IPM:

Integrated Pest Management (IPM) is a strategy that, in the context of the associated environment and the population dynamics of the pest species, utilises all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economically unacceptable damage or loss (FAO).

IPM IN GROUNDNUT:

Groundnut (*Arachis hypogaea* Linnaeus*)* is an annual legume crop and belongs to family Leguminoceae. It is also known as peanut, earthnut, monkeynut and goobers. It is world's largest source of edible oil and ranks 13th among the food crops as well as 4th most important oilseed crop of the world (Ramanathan, 2001). It is grown in tropical and sub-tropical regions and in the continental part of temperate countries. The seed (kernels) contains up to 50 per cent of a non drying oil, 40-50 per cent fat, 20-50 per cent protein and 10-20 per cent carbohydrate (Mehta, 2002).

In India, groundnut is cultivated during *kharif, rabi* and *summer* season under various cropping systems. Rain fed groundnut cultivation coupled with attack by a variety of insect pests and diseases are the major reason for lower productivity. The crop is mainly attacked by 500 species of arthropod. Saurastra region of Gujarat is the belt of groundnut. The number of biotic and abiotic factors affect the groundnut production. Among them insect pests damage is major one. The inset cause damage to these crop are Aphid (*Aphis craccivora* Koch), Leaf miner (*Stomopteryx nertara* Meyrick), Stem borer (*Sphenoptera perotett* Cameron), White grub (*Holotrichia consanguinea* Blanchard), Bihar hairy cater pillar (*Spilosoma oblique* Walker), Red hairy caterpillar (*Amsacta albistriga* Butler), Leaf eating caterpillar (*Spodoptera litura* Fabricius), Pod borer (*Helicoverpa armigera* (Hubner) Hardwick), Jassid (*Empoasca kerri* Pruthi), Thrips (*Scritothrips dorsalis* Lindman), Jewel beetle (*Sphenoptera indica*), Termites (*Odontoterms obesus* Rambur) and Grasshopper (*Hieroglypus banian* Fabricius) reported by Atwal and Dhaliwal (2008). For management of insect pest farmers use number of insecticides which causes resistance and resurgence problems. Due to the climate change and changing in different cultural practices by farmers now a day's number of new insect pest causes heavy damage to this crop. In groundnut new emerging insect pest are wire worm, ear wing, leaf weevil, thrips and white grub.

Wire worm:

Wireworm is the common name for the larvae of **click beetles (Coleoptera: Family Elateridae)**. The adults do little or no damage; although there are some anecdotal reports that
they can damage certain crops (e.g., grapes and stone fruits) by feeding on flowers. However, larval wireworms are among the most destructive of soil insect pests. They are important pests of potatoes and other crops, including corn, cereals, carrots and groundnut. Wireworms can also damage germinating seeds, but transplants are generally less susceptible. Their importance as crop pests seems to be increasing (Parker and Howard, 2001).

Identification:

Adult click beetles are slender, hard-shelled beetles. They range from tan to dark brown and from about 8–20 mm long (1⁄3–¾ inch), depending on species. Click beetles get their name from their ability to snap a spine on their

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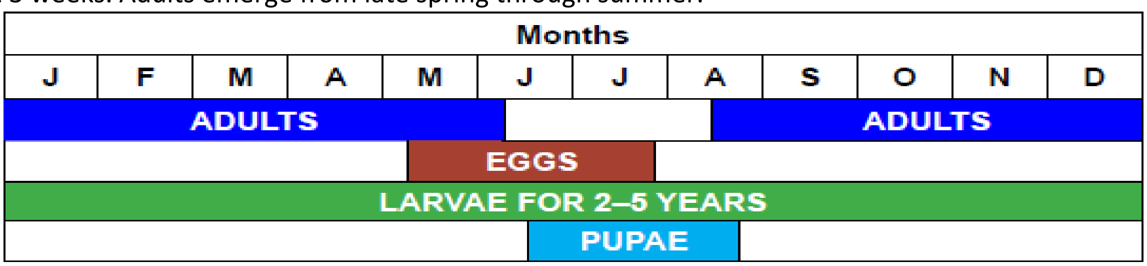
thorax, thus producing a sudden clicking sound and allowing them to jump in the air. All beetles in this family have this ability, which they use to avoid predation or to get back on their feet after falling on their back. After mating, each female lays an average of about 80 eggs in the soil, either singly or in small clusters. Eggs of most wireworms are white, spherical, and about 0.5 mm in diameter. Immediately after egg hatch, wireworm larvae are white; with age they darken to tan or reddish brown. Unlike the immature stages of most insects, wireworms have a hardened, shiny shell (exoskeleton) and very few hairs. They have three body regions: a fairly distinct head, a thorax with three pairs of legs, and a segmented abdomen with processes or prongs at the tail end. Depending on species, wireworm larvae range from about 2 mm long after hatching to 4 cm long or more at maturity (1⁄16–1½ inches).

Life cycle

Wireworm life cycle allows one to more effectively manage populations on the farm by taking advantage of the insect's more vulnerable stages. Wireworms overwinter in the soil as larvae or adults. Overwintering adults mate the following spring from mid-April to early June. Mating occurs in or on the soil, sometimes after short flights. Although adults can fly, they usually prefer to remain where they developed as larvae. Females lay eggs a few days after mating. They tend to prefer laying eggs in grassy areas. A female may lay from 50 to more than 350 eggs, singly or in small clusters, 2.5–15 cm (1–6 inches) deep in moist soil. After laying most of their eggs, some females emerge from the soil and make short flights to nearby fields, where they continue egg laying in newly colonized areas. Eggs usually hatch in 3–4 weeks under favorable conditions. Larvae can live 2–5 years in the soil, depending on species, feeding on seeds and belowground plant parts. Wireworms from the same clutch of eggs may develop to the beetle stage at different rates. Some larvae may spend up to several years in the soil and be found as deep as 0.3–1.5 m (1–5 feet) or down to the hard pan. Mature larvae pupate in the soil from spring through midsummer. The pupal stage lasts about 3 weeks. Adults emerge from late spring through summer.



Life cycle of wire worm (Berry, 1998)

Nature of damage:

It feeding on and destroying planted seeds, wireworms bore into roots and crown tissue and even tunnel up the stems of plants, depending on the crop attacked. Injury is most severe to seeds and seedlings and can result in stand loss. Root feeding causes wilting, stunting, and distortion of seedlings that usually kills the plant. In groundnut it make small circular hole on pod and after damage secondary fungal infection is found.

Earwig

Anisolabis stali Dohrn (Dermaptera: Labiduridae)

The Groundnut earwig *A. stali* is common in India and is known to occur in a few other Asian countries, Israel, Europe and the Americas. The adult is an elongated, wingless, dark brownish to black insect and measures 30- 35 mm in length. Earwigs can be easily recognized by their unique forked abdominal tip. The eggs (20-100) are laid in clusters on pods or in the soil. Their incubation period is 3-11 days. There are five nymhal instars, and the nymphal period lasts between 30-60 days. Both nymphs and adults bore into tender pods and feed on the kernels. They also feed on vegetative material, onion bulbs, cotton bolls, and sorghum stems. Adults survive as long as 250 days and one generation takes 56-101 days. In general these are not considered as economically important, however pod damage

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is relatively high in summer groundnut and heavier soils. Infested pods are prone to *A. flavus* infection. Also, it is important to note that earwigs are important predators of garden insects, including pests such as aphids.

Management

Monitoring and risk assessment:

Risk assessment is important for predicting the potential for wireworm damage. It can also support decisions to implement nonchemical management strategies, treat fields, or plant alternative crops.

Larval monitoring

Larval monitoring methods are time-consuming and laborious and often do not reflect field populations or damage potential. This is largely because of the aggregated and patchy distribution of these pests in fields (Salt and Hollick, 1946; Blackshaw and Vernon, 2006), their ability to injure some crops at very low population levels, and their vertical mobility within the soil profile. However, thorough and consistent scouting can help indicate whether a field is at low or high risk.

Soil samples

Historically, wireworms have been monitored by extracting and sifting through soil cores to locate larvae. Treatment thresholds based on numbers of larvae per sample have been developed (Robinson, 1976). Since the distribution of wireworms in a field tends to be patchy and unpredictable, large numbers of samples are required.

Bait traps

Baits have largely replaced random soil sampling since they are less labor intensive and may detect low wireworm populations that soil samples can miss. Wireworms are attracted to carbon dioxide (CO_2), and several baits that take advantage of this behavior have been tried. Baits are most effective when other crops or decaying crop residues are not present to release CO_2. Set bait traps in the spring when soil temperature exceeds 6–10°C (43–50°F) in the top 2 inches of soil. Generally the best sampling times are mid-April through May, when wireworms are feeding near the surface in response to adequate moisture and temperature.

Preparation of trap:

Make traps by presoaking cereal seeds overnight and burying them 15–20 cm (6–8 inches) deep in the ground. About 3 table spoons (or a film canister) each of spring wheat and corn or barley works well. Seeds can be placed directly in the soil, in a 9–10 cm (3½–4 inches) planting pot filled with vermiculite (with drainage holes or drilled holes), or in a porous bag. Cover the baited soil with black or clear plastic to warm the surrounding soil. Place at least 25 bait stations for 30 acres. More traps allow a better chance of detecting damaging populations. Flag bait stations in the field and leave them undisturbed for 10–14 days to allow wireworms to approach. Collect the bait and soil immediately around the bait (about 4–6 inches diameter) for sorting. Wireworms can be extracted from soil by hand sorting, by floating them off in a bucket of water, or by using Berlese funnels. Move the traps when resetting them in the same field (Ward and Keaster, 1977). Brunner *et al.* (2007) compared different baiting methods and found that baits in pots were the most effective.

Leaf weevil

Myllocerus undecimpustulatus Faust , *Myllocerus spp.* (Coleoptera: Curculionidae)
Cyrtozemia dispar Marshall

M. undecimpustulatus Faust, a species native to southern India and spread over southeast Asia, the Indian subcontinent, Africa, Asia (including China and Japan), Indonesia and Australia. This species is one among the most serious weevil pest in India and Pakistan, where they attack more than 20 crops. The adult measures 5 - 6.5 mm in length with broad snout. The larvae resemble small white grubs, and mature grubs measure 9.5 mm in length. The eggs are laid on the foliage close to the soil, in masses of 12-130 and are white in color. On hatching, the young grubs enter the ground and start feeding on the roots. The development from egg to adult ranges from 60-120 days. There are 6 larval instars. Larvae feed and pupate underground. A female lays about one thousand eggs during her 160 day

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life span. The range of larval hosts and the developmental biology is not clearly known, but looking at its distribution and host range it can be noted as potential pest. Gray (or ash) weevils eat on foliage of groundnut and wide a variety of hosts, notching or scalloping the edges of leaves.

Management:

- Crop rotation
- Deep ploughing in summer
- Spraying of insecticide *i.e.* Dichlorvos 76 EC 7-10 ml or Chlorpyrifos 20 EC 20 ml, Quinalphos 25 EC 20 ml or Cypermethrin 10 EC 10 ml in 10 liters of water for adult management.
- Soil drenching with Chlorpyrifos 20 EC, 4 lit/ha.

IPM IN COTTON

Cotton occupies 5% of the total cropped area distributed among three different agroclimatic zones in India, and consumes 55% pesticide share accounting for 40% of total production costs. This fact signifies the impact of insect pests and the increased agrochemical use in cotton production. Concern over human health and environmental consequences of agrochemicals besides pest resistance to pesticides has been a corner stone from the eighties. Despite the fact that IPM has been in practice for almost a decade and a half, except for realization of natural control operating in field, their conservation and augmentation, better cultural practices, use of resistant cultivars, established monitoring and scouting based economic threshold levels (ETLs) and alternate pest control techniques such as matting disruption through pheromones, use of botanicals and insect pathogens, there has been little reduction in pesticide use. The number of insect pest cause damage to the cotton crop among in Gujarat region pink bollworm and flower beetle are new emerging pest in cotton. It cause economically damage to this crop.

Flower chaffer beetle:

- *Oxycetonia versicolor* (Fabricius) Family: Scarabaeidae, Order: Coleoptera

Changing scenario of insect pest problems in agriculture as a consequence of green revolution technology has been well documented (Dhaliwal and Arora 2006). As a result, there has been a further shift in the status of several insect pests. The pest complexes have changed to the extent that some of the insects which had been known earlier to be sporadic, minor or non-injurious to these crops, have become serious pests in certain agroclimatic conditions today, whereas other insects which were never previously recorded on these crops are now becoming a matter of concern.

The flower chafer beetle *Oxycetonia versicolor* (Fabricius) [Order: Coleoptera; Family: Scarabaeidae; Subfamily: *Cetoniinae*; Genus: *Oxycetonia*; Species: *versicolor* (Fabricius); Synonymy: *Cetonia versicolor* Fabricius, 1775; *Gametis versicolor* Fabricius, 1775] was first reported from the Seychelles (as 'Glycyphana versicolor') by Fairmaire (1893). Besides Seychelles, the beetle has also been reported to be distributed in different parts of the world including Samoa, China, India, Sri Lanka, Chagos, Madagascar, Mascarenes and South Africa (Matot 2000). In India, the beetle was first reported from the Indore (Madhya Pradesh) region (Arrow 1910). In last two years this pest also causes heavy damage to cotton crop in Gujarat.

Host range:

Groundnut, okra (Fletcher 1917); Sawdust, grass compost, and other heaps of organic matter, brinjal (Ambethgar 2000), pigeonpea (Reed *et al.* 1989); pearl millet and rose (Kumar *et al.* 2009).

Identification:

The adults measure 7–15 mm in length and 5–7 mm in breadth. The two sexes are alike. Body is compact and oval, usually somewhat flattened, brilliantly colored and mostly red with black markings. The upper surface of the body is smooth with a metallic sheen and striking color patterns. The prothorax and elytra are brick red. A pair of black spots is present on the prothorax and lateral margins reveal a white border. The elytra bear various patterns of white spots. Front tibiae are tridentated and all the femora are fringed with yellow hairs.

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Nature of damage

The adult beetles feed on the flowers, with most of the damage occurring during August and September, coinciding with the peak flowering period of cotton. It feed irregularly on flower. Adult beetles devour the flowers and buds, thereby greatly reducing the number of pods that are set. Heavily infested plants can look shabby as a result of the feeding damage. The plants' appearance, however, improves due to continuous flowering of these crops. Flower chafers are day-flying beetles and principally pollen feeders. The grubs develop in organic matter in the soil and some infest roots.

Management

- Hand picking of beetles
- Avoid the inter cropping with alternative host of pest *i.e.* okra, brinjal and pigeon peas.
- Apply well decomposed manure.
- Spraying of insecticide *i.e.* Dichlorvos 76 EC 7-10 ml or Chlorpyrifos 20 EC 20 ml, Quinalphos 25 EC 20 ml or Cypermethrin 10 EC 10 ml in 10 liters of water for adult management.

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Herbicide resistance in weeds: a serious matter to concern.

Article id: 23370

Sirazuddin, Rajbeer singh and Rajnish Yadav

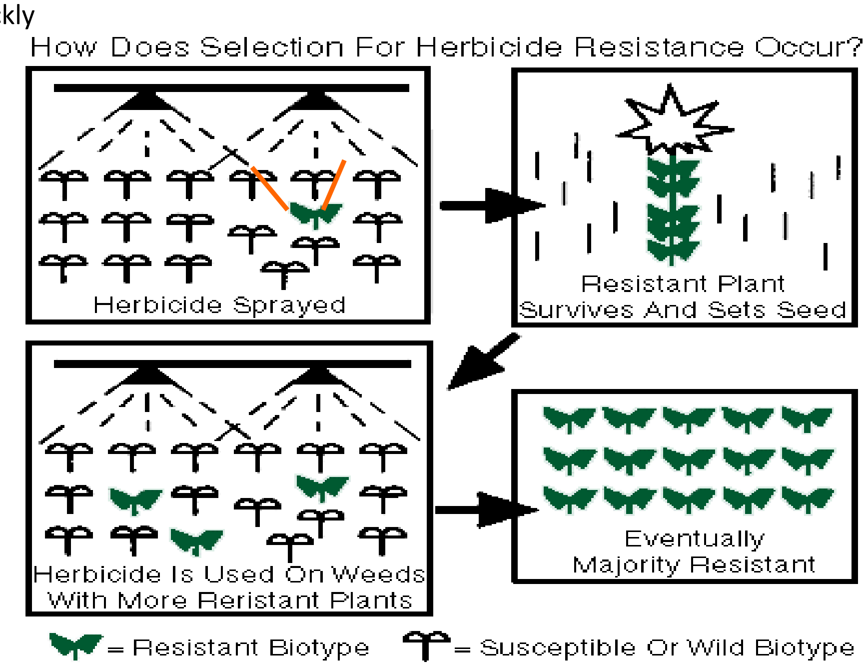
Herbicide resistance is the inherited ability of a biotype of a weed to survive an herbicide application to which the original population was susceptible. In simple terms, resistance refers to a situation where a given herbicide, applied at the recommended rate and time, once controlled a particular weed population but, after repeated use, that herbicide no longer controls that population. That population is said to be resistant (or resistance has developed in that population).

Types of herbicidal resistance

- **Cross resistance**: Weed biotype that has gained resistance to more than 1 herbicide with the same mode of action but same or different families.
- **Multiple resistance**: Weed biotype that has developed tolerance to more than one herbicide brought about by different selection pressures *(different modes of action).*

Conditions favoring herbicide resistance

- Repeated use of a specific herbicide or a combination of herbicides
- Weed populations with wide genetic diversity may develop resistance rapidly, especially for herbicides with a single mechanism of action
- Weed possessing characters like large plant numbers, prolific seed production, high rates of weed migration/spread, and diverse environmental conditions may contribute to high genetic diversity and develop resistance very quickly



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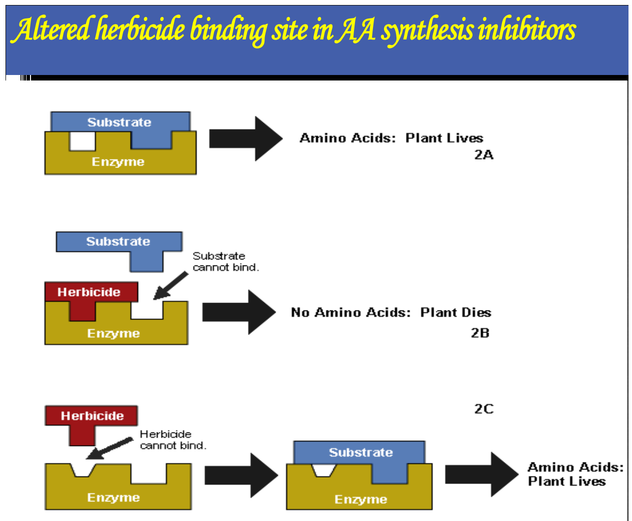
The four known mechanisms of resistance to herbicides are:

1. Altered target site

- An herbicide has a specific site (target site of action) where it acts to disrupt a particular plant process or function (mode of action). If this target site is somewhat altered, the herbicide no longer binds to the site of action and is unable to exert its phytotoxic effect. This is the most common mechanism of herbicide resistance.
- Where the herbicide has such little inhibitory effect on the site of action, plants may survive greater than 10 times the normal herbicide rate (considered high-level resistance).
- Mechanisms of action where high-level resistance is most often seen include ACCase, ALS, and photosystem II inhibitors.



2. Enhanced metabolism

- This type of resistance is **more complex** than altered site-of-action type resistance because it involves several plant processes.
- Plants with altered metabolism resistance can **degrade several unrelated herbicides of different modes of action** through multiple genes controlling metabolic processes.
- Plant injury may occur because plants cannot rapidly degrade absorbed herbicide, causing this mechanism to be considered low-level resistance.
- Increasing the herbicide rate to smaller plants may control more plants.

Examples:

- ✓ Ryegrass resistant to Acetyl coenzyme A carboxylase, Acetolactate synthase , and photosystem II inhibitors.
- ✓ Velvetleaf resistant to atrazine.
- ✓ In simazine resistance, the herbicide is acted upon by cytochrome P-450 monoxygenase enzyme and converted to herbicidally inactive de-ethyl simazine and di-de-ethyl simazine
- ✓ Simazine resistance in *Lolium rigidum*

3. Compartmentalization or sequestration

- Some plants are capable of restricting the movement of compounds (herbicides) within their cells or tissues to prevent the compounds from causing harmful effects. In this case, an herbicide be inactivated either through binding (such as to a plant sugar molecule) or removed from metabolically active regions of the cell to inactive regions, eg. cell wall, where it exerts no effect.

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- Nearly all plants with this type of resistance are injured shortly after the herbicide application because the herbicide cannot be moved away from the site of action fast enough and for a long enough time.
- Herbicide sequestration is considered low-level resistance because increasing rates applied to smaller plants increases mortality.
  Examples: Glyphosate-resistant biotypes of horseweed, ryegrass, common and giant ragweed.

4. Over-expression of the target protein

- If the target protein, on which the herbicide acts, can be produced in large quantities by the plant, then herbicide becomes insignificant.

Most Important Herbicide-Resistant Species

1.	Rigid Ryegrass	*Lolium rigidum*
2.	Wild Oat	*Avena fatua*
3.	Redroot Pigweed	*Amaranthus retroflexus*
4.	Common Lambsquarters	*Chenopodium album*
5.	Green Foxtail	*Setaria viridis*
6.	Barnyardgrass	*Echinochloa crus-galli*
7.	Goosegrass	*Eleusine indica*
8.	Kochia	*Kochia scoparia*
9.	Horseweed	*Conyza canadensis*
10.	Smooth Pigweed	*Amaranthus hybridus*

Ten important herbicide mode of actions as per WSSA

Mode of action	WSSA group	No of resistant species
Acetyl coenzyme A carboxylase	Group 1	44
Acetolactate synthase	Group 2	142
Shoot inhibitors	Group 3	
PGR	Group 4	12
PS-II	Group 5	31
PSP	Group 9	72
PS-I	Group 22	25
Glutamine Synthetase	Group 10	29
Protoporphyrinogen Oxidase	Group 14	2
Cellulose inhibitors	Group 20/29	6

How to prevent or delay herbicide resistance?

- Herbicide rotation
- Crop rotation
- Monitoring after herbicide application
- Non-chemical control techniques
- Short-residual herbicides
- Certified seed
- Clean equipment

Proactive Herbicide Resistance Management

- Early detection of resistance means management will be easier, and it increases the potential to avoid the spread of the resistant biotype. Unfortunately, because resistant plants and susceptible plants look alike, resistance often is not detected until the resistant biotype has spread to 30% or more of the field and perhaps to surrounding fields.
- Therefore, a proactive approach using diverse weed control tactics is the most effective way to manage herbicide resistance.
- The primary objective of proactive resistance management is to reduce selection pressure by:

1) Selecting and using herbicides correctly;
2) Recognizing weed characteristics that promote resistance; and,
3) Managing fields, farms, or sites wisely.

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Breeding for Pest Resistance in Vegetable Crops

Article id: 23371

Dinesh Nagar[1], Bichhinna Maitri Rout[2]
[1]Ph.D , Rajasthan Agricultural Research Institute, Durgapura, Jaipur
[2]Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION

Vegetable crops play an important role in human nutrition and health by providing minerals, micronutrients, vitamins, antioxidants, phytosterols and dietary fibre. Vegetable cultivation is a significant part of the agricultural economy of nations, especially in the developing world. At present, the control of the epidemic spread of diseases and pests mainly involves three strategies: first, husbandry techniques, such as crop rotation and avoiding the spread of infested soil and pathogen - contaminated plant materials , second, breeding of resistant crop cultivars and third, the application of agro- chemicals. Although conventional plant breeding has made a significant impact by improving the resistance of many crops to important diseases and pests, the time-consuming processes of making crosses and back-crosses, and the selection of the desired resistant progeny make it difficult to react adequately to the evolution of new virulent races of pests and diseases.

Important Insect-Pests of Vegetables

Potato: Potato tuber moth, Cutworms, White crops, Aphids and Jassids.
Tomato: Fruit borer, White fly, Jassids and leaf minor.
Brinjal: Shoot and fruit borer, Epilicana beetle, Leaf roller, Jassids, White fly, Aphids and Red spider mite.
Chilli: Thrips, mites and Aphids
Cole crops: Cabbage utter fly and Diamond Back Moth
Cucurbits: Fruit fly, Red Pumpkin beetle
Legumes: Pod borers, Stem fly and Aphids
Okra: Shoot and fruit borer Jassids and White fly.

Resistance

Resistance is the condition in the plant whereby pests and diseases either fail to enter the host. Whereas, Susceptibility in the plant is the condition of being a suitable host for a given parasite. The degree of resistance is negatively correlated with the rate of reproduction of pests and diseases. Thus, if there is poor and slow reproduction of pathogens and pests on a host, the host may be characterized as resistant. In case of tolerance, slight injury is noticed in spite of an attack of target pest and diseases.

Mechanisms of Insect Resistance: Antibiosis, Antixenosis, Tolerance and Avoidance

Basis of Resistance

1. **Morphological characters imparting insect resistance in vegetables**

Crop	Pest	Characters conferring resistance
Potato	Green peach aphid, Leafhopper	Glandular trichomes
Brinjal	Fruit & Shoot borer	Compact vascular bundles in the thick layer of lignified cells and low pith area
Tomato	Thirps, aphid, green house white fly	Glandular trichomes
Peas	Aphid	Colour and shape of foliage

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Faba bean	Aphid	Trichome density
Cucumber Muskmelon	Pickle worm	Glabrous leaves
Pumpkin	Squash vine borer	Tough vascular bundles in the stem
Cauliflower	Cabbage flea beetle	Waxy coating on leaf surface
Onion	Thirps	Glossy foliage

2. Biochemical characters conferring insect resistance in vegetables

Crop	Pest	Characters conferring resistance
Potato	Potato beetle aphid	Glycoaloid content, Solanine
Tomato	Fruit borer White fly	Phenolics such a chlorogenic acid alkaloid Tomatine
Cucumber	Mite	Cucurbitacin
Summer squash	Squash bug	Amino nitrogen
Muskmelon	Fruit fly	Low TSS
Summer squash	Pickle worm	D-glucose and More TSS
Cole crops	Aphids Cabbage root fly	Sinigrin Low glocosinolates
Turnip	Fruit fly	Aglycone 2- Phenylethyl idothiocyanate
Lettuce	Root Aphid	Isochlorogenic acid

Strategies for resistance breeding

The resistance breeding program should have a defined objective and progress of it should be frequently reviewed and revised on this basis. The basic sequential approach is broadly applicable, for all the vegetable crops.
(1) Define problems, both existing and potential.
(2) Define objectives, based on real problems.
(3) Develop screening methods and sequences.
(4) Plan the hybridising program
(5) Make crosses; harvest, and germinate seed.
(6) Conduct early screening, preferably in a greenhouse.
(7) Plant survivors as candidates in nursery trials. Eliminate preselection that do not meet essential objectives.
(8) Propagate the apparent best candidates from phase I nursery.
(9) Proceed to second test level as early as possible.

Sources of resistance: Landraces or improved variety, germplasm collection, wild species and genes from unrelated organisms

Tomato

Fruit borer	EC-262, 2669, 490, 491, 6200, 7764, 2630, 6987, 9227 *L. hirsutum, L. hirsutum f. glabratum* IC 1112064,
Leaf miner	*L. hirsutum, L. hirsutum f. glabratum*, Pearson

Brinjal

Pest	Resistant sources

Resistant to shoot and fruit borer	*S. khasianum, S. sisymbriifalium, S. melongena,* Aushey, Black Beauty, H-165, H-407, H-408), *S. incanum, S. gilo, S indicum.* F1 progenies of *S. melongena ×S. incanum*, PPC, AM 62, SM 17-4, *S integrifolium, S. sisymbriifolium, S xanthocarpum*
Jassid (Amrasea biguttula biguttula)	S488-2, S 34, S 258, 'Manjari Gota'
Aphis gossypii	*S. sisymbriifolium, S. mammosum*

Bhendi

Mites	EC 305694. EC 305695. EC 305714. EC 306731
Jassids	*A. moschatus A. crinitus*, EC 305656
Multiple resistance	IIHR 68-1, 81-1, 15-1
Fruit borer and Jassids	*A.caillei and A.tetraphyllus*
Muskmelon Fruit fly and leaf caterpillar	*C.melo var.callosus*
Onion: Thrips	*A.fistulosum*

Breeding methods: Introduction, Selection (Pure line selection, SSD and Bulk population), Mutation breeding, Hybridization and Genetic Engineering

Salient achievements in India

In India, breeding for resistance to various pest has been attempted and success has been achieved in many vegetable crops.

Crop	Variety/Hybrid	Resistance to	Method
Brinjal	Pant Samarat	Shoot and fruit borer	Selection
	PPI-1	Shoot & fruit borer (M.T)	Single line selection
	Manjari Gota	Jassid	
	Annamalai	Aphid	
Tomato	Pusa Uphar	Fruit borer	Hybridization
	Paiyur-1	Fruit borer	Pusa Ruby×Co3
Capsicum	Bhaskar	Thrips and Mites	Hybridization
Cabbage	Green Acre, Red Rock, Red Pickling	Cabbage butterfly	Introduction
	All season, KK cross	Cabbage Aphids	
Ribbed Gourd	PKM-1	Pumpkin beetle, fruit fly	Mutation
Sweet Potato	CO-CIP-1	Root Weevil	Clonal selection
Peas & Beans	JP-179, JP-854 and JP-747	Leaf miner	
	Ooty-1	White fly, Pod Borer	Pure line selection
	Sofia 135 and Sutton Phenomenon	Stem fly	
Muskmelon	Csaba	Pumpkin beetle	
Winter Squash	Arka suryamukhi	Fruit fly	

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Onion	Pusa Ratnar, Hissar-2, Kalianpur Red round,Udaipur 101,102,103 CO-2 (Clonal selection)	Thrips	
Carrot	Nantes	Carrot fly	
Chilli	Pusa sadabahar,	Thrips	
Bhendi	Punjab Padmini, IIHR-21, Ae-15 Red-I and II, Red Wonder CoBH-1, Pusa-A-4	Jassids and cotton bollworm Shoot and Fruit borer	Hybridization
Pumpkin	Arka suryamukhi	Fruit fly	Hybridization

Advantages of pest resistance

- Reduces recurring expenditure
- Reduces environment hazard
- Comparable with other measures of insect pest control
- Safeguard against the release of varieties

Problems in breeding for pest resistance

- Reduces the quality of the produce or unfit for consumption
- Genes for insect resistance are available in the related wild species
- Long term programme
- Breeding for insect resistance to one insect leads to the susceptibility to another pest

  Eg. Cucurbitacin free (Resistant-Spotted cucumber beetle & Susceptible - Two Spotted spider mite)

Future thrust

The growing global demand for increased food production and consumers' need for high-quality food presents considerable challenges to scientists in industry, academia and government institutions. A combination of multiple disease resistance as well as transgenic strategies will therefore be needed to reduce the requirement for agrochemicals to control crop pests. Future research pest resistance will focus on the successful integration of transgenic strategies into breeding programs to develop the durable resistance of new commercial varieties, in combination with a selective use of low doses of fungicides and pesticides. In the longer term it is envisaged that farmers will achieve optimal pest and disease control in individual crops by balancing the use of transgenes, pesticides through integrated crop management.

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Climate-smart agriculture: an answer to changing environment

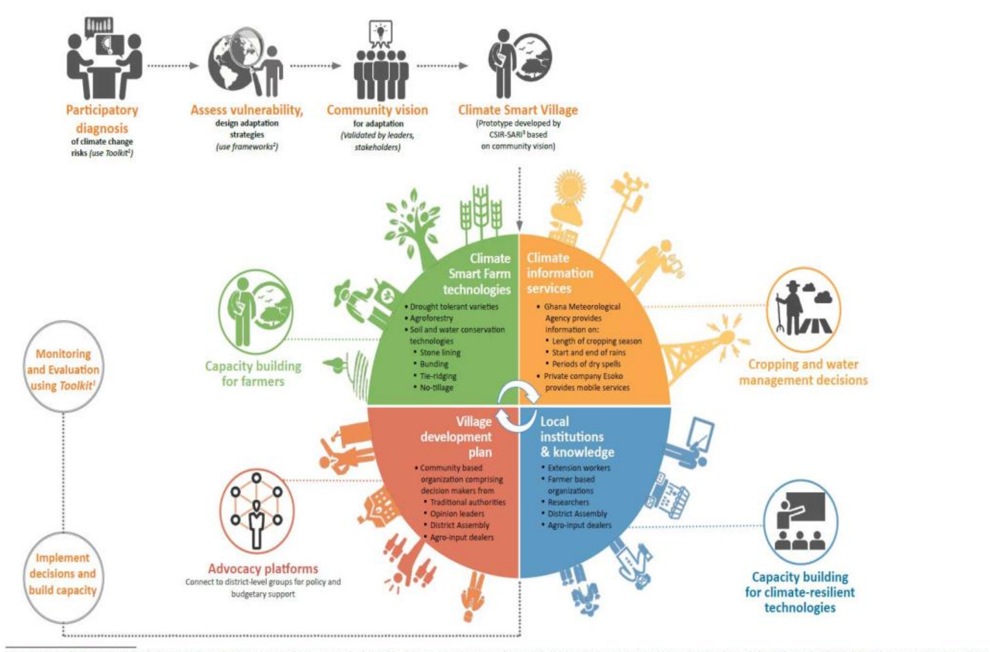
Article id: 23372

Selukash Parida[1]*, Soumya Kumar Sahoo[2] & Akankhya Guru[3]
[1]Ph.D. Scholar, Department of Plant Physiology, COA, OUAT, Bhubaneswar,
[2]Ph.D. Scholar, Department of Plant Physiology, COA, IGKV, Raipur
[3]Ph.D. Scholar, Department of Plant Physiology, IAS, BHU,Varanasi

Climate-smart agriculture is not distinct from sustainable agriculture; rather, it is a way of combining different sustainable approaches to tackle the unique climate challenges of a particular farming community. The first step is to assess the particular climate threats, as a farm facing severe water shortages will need different strategies than one facing daily flooding, for example. We use a variety of tools to assess the climate risk and vulnerability of a landscape, taking the local ecosystems and the specific crop into account. Finding the right combination to manage a specific farm's climate challenges—and to build resilience to future impacts—is what makes climate-smart agriculture "smart."

INTRODUCTION

Climate change can interfere with food availability, reduce food access and impact the quality of the food. For example, expected temperature increases, changes in patterns of precipitation, changes in extreme weather events and reductions in water availability can all result in reduced agricultural productivity.Climate smart agriculture (CSA) is an integrated approach to managing landscapes—cropland, livestock, forests and fisheries--that address the interlinked challenges of food security and climate change. Developing agricultural strategies for food security in a changing climate and to make agriculture, forestry and fisheries more sustainable and more productive.



CSA technologies

- Crop rotation

- Water conservation
- Minimum or no tillage
- Application of organic fertilizer
- Efficient Irrigation Management
- Drought tolerant varieties
- Inter cropping
- Integrated nutrient management
- Renewable Energy
- Organic Practices
- Increasing Soil Health
- Keeping Agriculture Green
- Reducing Livestock Methane Emissions
- Pasture-Based Livestock Management
- Protecting Farmland
- Supporting Farmers Markets and Local Food
- Pushing for Climate-Friendly Policies
- Integrated soil fertility management

Three pillars of CSA

- Improve farmer productivity
- Make farms more resilient to climate impacts they're facing now
- Curb greenhouse gas emissions associated with growing food.

Outcome of CSA

- **Increased productivity:** Produce more food to improve food and nutrition security and boost the incomes of 75 percent of the world's poor that live in rural areas and mainly rely on agriculture for their livelihoods.
- **Enhanced resilience:** Reduce vulnerability to drought, pests, disease and other shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather patterns.
- **Reduced emissions:** Pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to suck carbon out of the atmosphere.

CONCLUSION

CSA involves farming practices that improve farm productivity and profitability, help farmers adapt to the negative effects of climate change and mitigate climate change effects, e.g. by soil carbon sequestration or reductions in greenhouse gas emissions. Climate-smart practices, such as the locally practiced conservation agriculture, aim at conserving soil moisture, retaining crop residues for soil fertility, disturbing the soil as minimally as possible and diversifying through rotation or intercropping.

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Disease Forecasting and modelling in horticultural crops

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Bichhinna Maitri Rout
Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION:

Plant disease forecasting is a management system used to predict the occurrence or change in severity of plant diseases. At the field scale, these systems are used by growers to make economic decisions about disease treatments for control. Often the systems ask the grower a series of questions about the susceptibility of the host crop, and incorporate current and forecast weather conditions to make a recommendation. Typically a recommendation is made about whether disease treatment is necessary or not. Usually treatment is a pesticide application. Forecasting systems are based on assumptions about the pathogen's interactions with the host and environment, the disease triangle. The objective is to accurately predict when the three factors - host, environment, and pathogen - all interact in such a fashion that disease can occur and cause economic losses.

In most cases the host can be suitably defined as resistant or susceptible, and the presence of the pathogen may often be reasonably ascertained based on previous cropping history or perhaps survey data. The environment is usually the factor that controls whether disease develops or not. Environmental conditions may determine the presence of the pathogen in a particular season through their effects on processes such as overwintering. Environmental conditions also affect the ability of the pathogen to cause disease, e.g. a minimum leaf wetness duration is required for grey leaf spot of corn to occur. In these cases a disease forecasting system attempts to define when the environment will be conducive to disease development.

Positive Forecast: Positive forecast employs need based chemical sprays, provides adequate protection to crop and reduce damage to environment.

Negative forecast: Negative forecast avoids unnecessary chemical sprays, no risk to the crop health and no disruption of environment.

A successful plant disease forecasting system includes:

- Reliability (use of sound biological and environmental data),
- Simplicity (the simpler the system, the more likely it will be applied and used by producers),
- Importance (the disease is of economic importance to the crop, but sporadic enough that the need for treatment is not a given),
- Usefulness (the forecasting model should be applied when the disease and/or pathogen can be detected reliably),
- Availability (necessary information about the components of the disease triangle should be available),
- Multipurpose applicability (monitoring and decision-making tools for several diseases and pests should be available),

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- Cost effectiveness (forecasting system should be cost affordable relative to available disease management tactics).

Examples of disease forecasting systems

Forecasting systems may use one of several parameters in order to work out disease risk, or a combination of factors. One of the first forecasting systems designed was for Stewart's Wilt and based on winter temperature index as low temperatures would kill the vector of the disease so there would be no outbreak. An example of a multiple disease/pest forecasting system is the EPIdemiology, PREdiction, and PREvention (EPIPRE) system developed in the Netherlands for winter wheat that focused on multiple pathogens. USPEST.org graphs risks of various plants diseases based on weather forecasts with hourly resolution of leaf wetness. Forecasting models are often based on a relationship like simple linear regression where x is used to predict y. Other relationships can be modelled using population growth curves. The growth curve that is used will depend on the nature of the epidemic. Polycyclic epidemics such as potato late blight are usually best modelled by using the logistic model, whereas monocyclic epidemics may be best modelled using the monomolecular model. Correct choice of a model is essential for a disease forecasting system to be useful.

Plant disease forecasting models must be thoroughly tested and validated after being developed. Interest has arisen lately in model validation through the quantification of the economic costs of false positives and false negatives where disease prevention measures may be used when unnecessary or not applied when needed respectively. The costs of these two types of errors need to be weighed carefully before deciding to use a disease forecasting system.

Computer based forecasting programes

1. BLITECAST-Late blight of potato
2. EPIDEM-Early blight epidemics in tomato
3. EPIVEN-Apple scab

CONCLUSION

In the future, disease forecasting systems may become more useful as computing power increases and the amount of data that is available to plant pathologists to construct models increases. Good forecasting systems also may become increasingly important with climate change. It will be important to be able to accurately predict where disease outbreaks may occur, since they may not be in the historically known areas. Plant disease forecasting systems help to determine the risk that a disease will occur, or that the intensity of the disease will increase.

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Food Grain Production towards Food Security in India

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[1*]Nevashini N, [2]Mahalingaraya
[1*]Research Scholar, Dept. of Agricultural Statistics, BCKV, Mohanpur, West Bengal
[2] M.Sc. in Agricultural Statistics, Kalaburagi, Karnataka

INTRODUCTION

Agricultural development policies in India aimed at reducing food insecurity, hunger, poverty and malnutrition. India, with estimated population of 1.11 million, accounts for 17% of world's population. The state of food insecurity and hunger in India is of considerable importance for global situation. Food security both at national and house hold level was focus of agricultural development strategies in India ever since mid-1960's, when country faced severe drought continuously for two years.so, to maximize the production of cereals, they build the base of food security on three key elements viz., (a) provision of an improved technology package to farmers (b) delivery of modern farm inputs, technical knowledge and instructional credit to farmers and (c) assurance of remunerative marketing and pricing environment for farmers. For achieving this objectives several policy instruments were used to influence production potential and marketing system of agricultural commodities.

Food security, as defined by the World Food Summit (WFS) and Food and Agricultural Organization (FAO), "exists when all people at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary and food preferences for an active life". The World Health Organization (WHO) states that there are three pillars that determine food security: food availability, food access, utilization. In 2009, FAO adds fourth pillar stability.

Availability: Food availability means the supply of food by production, distribution and exchange.

Access: Access of food refers to allocation and affordability of the food. The United Nation (UN) committee on Economic, Social and Cultural rights noted that cause of hunger and malnutrition are often not a scarcity of food but inability to access available food usually due to poverty.

Stability: Stability refers to the ability to obtaining the food over time. Stability of food could be transitory, seasonal or chronic in nature. Food-price spikes in market due to instability can cause transitory food insecurity. Regular pattern of growing seasons in food production result the seasonal food insecurity. Chronic food insecurity is long-term persistent lack of adequate food.

Utilization: It refers to metabolism of food by individuals. Food safety impacts food utilization and can be impacted by preparation, processing and cooking of food in community and household.

Agriculture plays an important role in providing food availability globally. Food production is base for food security. India's population is likely to reach 1.5 billion by 2030, the challenge facing country is to produce more from diminishing per capita arable land and irrigation water resources and expanding abiotic and biotic stress (Swaminathan and Bhavani, 2013).

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Figure 1

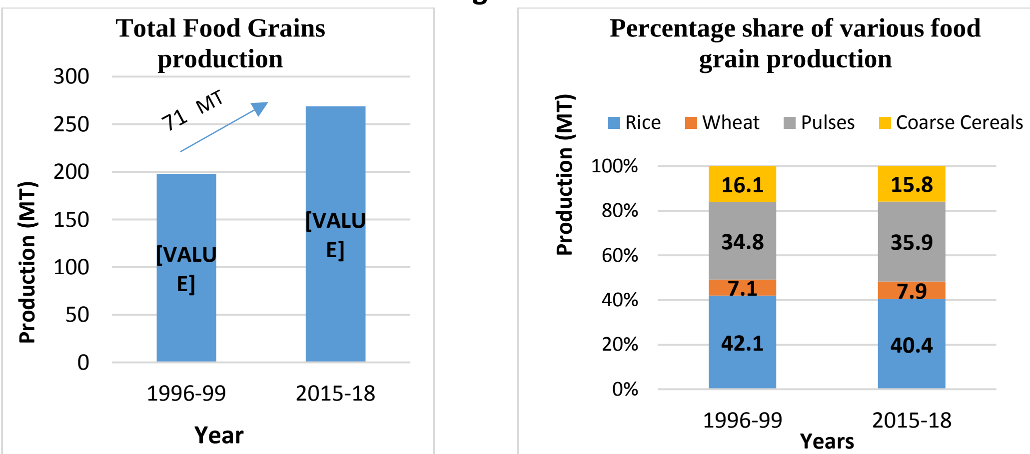
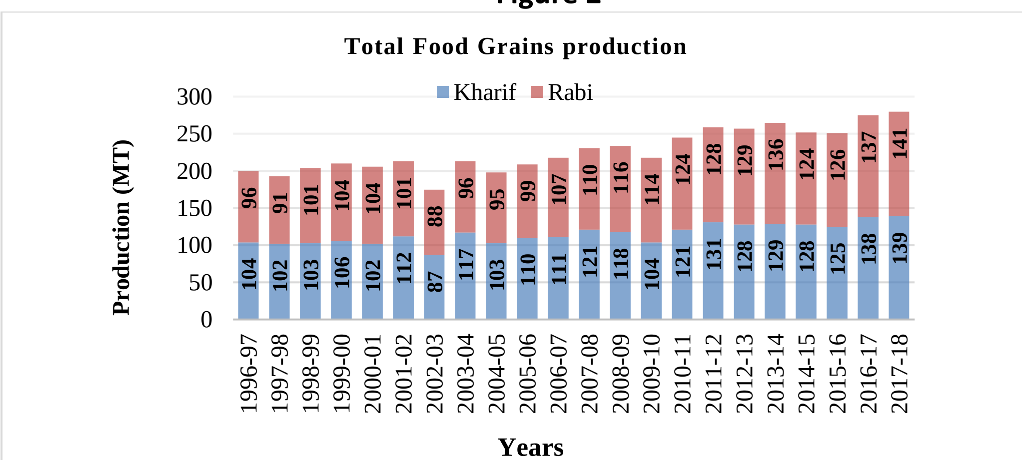


Figure 2



Source of Data: Food and Nutrition Security Analysis,India,2019

India is known for its diversity, which is seen in variety of food grain production in different states of the country. The production and yield of food grains is used as a proxy indicator of food availability at the state level. Figure 1. Represents the changes in total food grains production and Percentage share of various food grain production from 1996-99 to 2015-18 in India. India also experiences various cropping season viz., Kharif and Rabi. Figure 2, represents the level and trend of production of total food grains in Kharif and Rabi season in India during 1996-2018. The result showed that overall trend of production was increasing for food grains.

The categories of food grains in India is rice, wheat, coarse cereals and pulses. India currently produces about 280 million tonnes (MT) of food grains to meet the needs of population of 1365 million (*Source*: Ministry of Agriculture and Farmers Welfare, Gov. of India and UN Report, 2019).

Rice is one of the principle food crop, India has largest area under rice cultivation. India is one of largest producer of rice next to China, accounting for 20% of all world rice production. For year 2017, India

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produced 111 MT with an increase of 1.80% over previous year. Next to rice, wheat is staple food for millions of Indians. India is one of the largest producer of wheat in the world after Russia, USA and China, accounts for 8.7% world's total production of wheat. India produced 99 MT in the year 2017.

Population explosion and food demands are moving parallel. Traditionally we consume various coarse grain (Jowar, Bajra, Ragi, Maize, Small Millets and Barley etc.).Though the coarse grain production has increased, it has not touched the level of other cereals. Per capita consumption of coarse cereal in India declined from 1988 to 2017 about 15 %. The recent National Nutrition Monitoring Bureau report indicates though the average consumption of cereals and millets tend to decrease, but it was above or (equal) to recommended dietary allowance. Pulses are one of the most important segments of human diet in India sub-continent along with cereals because it is excellent source of protein. During 2010, India imported 3.5 MT tons of pulses from various countries as pulse production was lowered due to drought and which was unable to fulfil demand (Vishwajith *et. al.,* 2014). Still to meet the demand, about 1.5 to 2.5 million tons of pulses need to be imported every year. India has produced 15 MT pulses in the year 2017 with productivity 1648 kg/ha.

CONCLUSION

According to United Nations Report (2019) around 2027, India is projected to overtake China's population. Sustainable supply of agricultural produce is a major issue for the country to mitigate the challenges of food and nutritional security. Food security may be defined as economic access to food and its utilization along with food availability. Climate change and shortfall in agricultural growth are threat to food security in twenty first century.so, monitoring the sufficient production of food grains are important. The policy of self-sufficiency and government intervention to ensure physical and economic access should also be strengthened.

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PIEZOMETER in landfill and groundwater monitoring

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Kiran S C
Ph.D. Scholar Department of Forestry and Environmental Science, UAS, GKVK Bengaluru.

India is rapidly shifting from agricultural-based nation to industrial and services-oriented country. Industrialization is most important in uplifting the nation's economy, on the other hand it leads to serious problems relating to environmental pollution which consequently leads to enormous quantity of solid/liquid wastes. About 31.2% population is now living in urban areas, over 377 million people are living in 7,935 towns/cities (Census, 2011). India is a vast country divided into 28 States and 8 Union Territories. There are eight major metropolitan cities *i.e.,* Delhi, Mumbai, Kolkata, Bengaluru, Chennai, Hyderabad, Ahmedabad, and Pune. These cities having population more than 10 million, are basically state capitals, union territories, and other business/industrial-oriented centres which generate huge amount of municipal solid waste per day, and if it continues in the same pace it will cause high risk and contamination of ground water/surface water. A harmonious and balanced relationship between human and nature on the earth is vital for the survival of life and sustainable growth. With advent of time, human beings directly or indirectly interfered with the natural environment for their need, comfort and luxury. One of the major cause for pollution of air, water and soil is the way municipal solid waste is being managed. This solid waste problem is prevalent across the globe and is a serious issue in developing countries such as India. The waste generation rates are increasing and the characteristics are changing with increase in Population explosion, Industrial development, and Living standards, particularly in growing cities such as Bengaluru. Areas near landfills have a greater possibility of groundwater contamination because of the potential pollution source of leachate originating from the nearby dumping site. Such contamination of groundwater results in a substantial risk to local groundwater resource user and to the natural environment. The impact of landfill leachate on the surface and groundwater has given rise to a number of studies in recent years and gained major importance due to drastic increase in population

Open dumping is usually low economic way at the cost of environmental degradation or pollution of air, water and soil, hence most of the dumping sites in India are open dumping with low maintenance. Precipitation that infiltrates the solid wastes disposed on land mixes with the liquids already trapped in the crevices of the waste and leach compounds from the solid waste. The leachate thus formed contains dissolved inorganic and organic solutes. In course of time, the leachate formed diffuses into the soil and changes the physicochemical characteristics of water. Leachate from a solid waste disposal site is generally found to contain major elements like calcium, magnesium, potassium, nitrogen and ammonia, trace metals like iron, copper, manganese, chromium, nickel, lead and organic compounds The leachate migrates from unsaturated zone to ground water table. When leachate mixes with ground water it forms a plume that spreads in the direction of flowing ground water contaminating the ground water of the locality. The degree of contamination in the aquifers depends on the transport rate of contaminants and depository conditions at the site as the contaminants permeate through the soil media. Heavy metal pollution is major concern in relation to groundwater and municipal solid waste, because at present the ground water is the major source of potable water especially in rural areas, whereas in urban areas the water may supplied by

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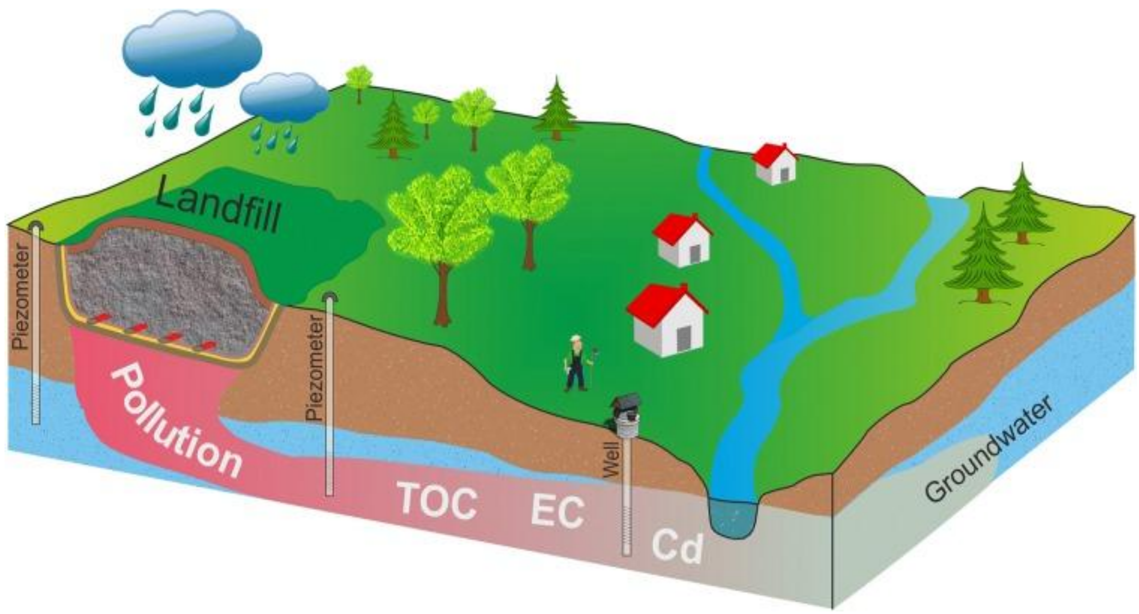
rivers or lakes, hence utmost care should be taken in prevention of water pollution. Before setting up of landfill site the area should be examined in all terms; Pore water pressure, depth of water table, water flow direction using the help of Piezometer, which may help in taking a decision whether we have to install the site or not.



Usually the ground water near the dumping site will be high in TOC, pH and some heavy metals. The possible remedial measures; Minimization of groundwater contamination below the landfill should be ensured by the leachate collection system and reinforced by suitable operation of the landfill site. An appropriate operation of a landfill site, maintaining the leachate at the lowest level possible, is the key element of the protection of the water environment neighbouring landfill sites. This is important in the context of treatment of groundwater as a major source of water supply in both urban and rural areas. Proper design of landfill sites will avoid groundwater pollution.

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Managing Crop Water Requirements for Vegetable Production

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Mukesh Kumar Mehla[1], Khyati Singh[2]
[1]Department of Soil and Water Engineering, College of Technology and Engineering, MPUAT, Udaipur, Rajasthan, India-313001.
[2]CCS Haryana Agricultural University, Hisar, Haryana, India-125004

INTRODUCTION

The cultivation of vegetable crops during hot-dry periods is common practices in northern plains of India. The meteorological data may indicate adequate rainfall for crop production during a given month still there can be water deficit in the soil because of uneven distribution of rainfall in a month. It may rain heavily during a single week, whereas the remainder of the month may be too dry for the proper growth and development of crop. A yield loss of 40 to 60 percent can be expected due to inadequate rainfall, poor quality and inconsistent supplies of irrigation water (Evans *et al.*1991a). Vegetable crops require a fairly constant supply of water during the growing season to produce good quality produce and higher yield. As vegetables are considered as high value crops, a proper irrigation schedule makes a good sense in economic terms (Evans *et al.*1991b). In general, commercial vegetables should not be grown without irrigation, otherwise, you will not be able to get good quality produce and earn good profits.

In this context, micro irrigation system is most beneficial for irrigating vegetable crop as they use less water and provide better return over time. Micro irrigation systems that can be used for irrigating vegetable crop are described as below:

Sprinkler irrigation system: They are high volume systems that includes overhead sprinkler and self-propelled gun traveller systems. One advantage to these systems is that they are relatively inexpensive compared to low volume systems. Since the technology is rather simple, installation, operation and maintenance of these systems is fairly easy to learn. Also, if equipped with the proper nozzles, sprinkler systems can be used for frost freeze protection and evaporative cooling.
One disadvantage to high-volume systems is the wetting of plant leaves that occurs each time the system is used, which may promote foliar disease problems. Wind may also cause problems with maintaining an even distribution of water. The labour required to move irrigation equipment can be a challenge and should not be taken lightly.

Drip irrigation system: They are low volume systems that includes drip or trickle irrigation, and low-volume sprinklers such as micro sprays and micro spinners. In field vegetable production, drip tape is normally used. The major advantages of low-volume systems over high volume systems are the ability to manage timing and placement of soil moisture and to use less total water to produce a crop. Low-volume systems reduce energy costs, keep foliage drier, and can be used to apply fertilizer and insecticides directly to the root zone, and are known as fertigation and chemigation, respectively. Other advantages are reduction in runoff, the ability to do other cultural practices while irrigating, and, in some cases, reduce labor requirements. When combined with other practices, such as raised beds, black plastic mulch, and closer

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plant spacings, the use of low-volume systems can result in increased yields, early harvests, better quality and higher profits.

The major disadvantage to low-volume systems is the higher start up and operation costs. Low-volume systems also require learning a new technology and the willingness to manage a more intensive system. For example, fields must be monitored regularly for clogged emitters and leaks.

Mulching

Apart from application of different irrigation system, the soil moisture content or water requirement by vegetable crops can be also be maintained by the effective use of mulching. Mulches are beneficial in decreasing water loss from the soil around plants. Mulches also serve other purposes, *i.e*., maintain the soil temperature, reduced weed growth and reduced fertilizer leaching. Some growers use organic mulches, such as straw, hay, peanut hulls, leaf mold, compost, sawdust, wood chips, shavings and animal manures, without irrigation to hold in soil moisture (Sanders, 2001). Organic mulches can also be used with overhead or drip irrigation systems. The plastic materials used as mulch are poly vinyl chloride or polyethylene films. Plastic mulch, however, should not be used without irrigation and is most effective with drip irrigation. Irrigation and rainfall will penetrate organic mulch, but not plastic mulch. It is important to have good moisture in the soil when mulch is applied. Soil under plastic mulch should never be allowed to dry out, because rewetting the entire bed is difficult with drip irrigation.

CONCLUSION

Water is a simple but necessary requirement for plant growth. Strategies such as crop diversification and mulches can be used to cope with drought situations, but it is difficult to substitute for the timely application of water. Growing of vegetables without irrigation facilities is risky and can lead to huge crop losses. There are many different types of irrigation systems available. One must decide which system fits the crop requirement and budget. A good source of water is a necessity for producing quality vegetables.

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Marker assisted backcross breeding

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Bichhinna Maitri Rout
Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION:

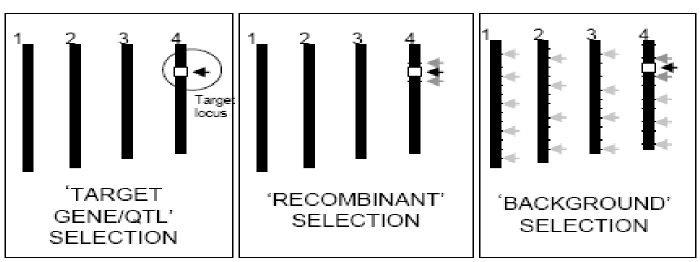
The development of DNA (or molecular) markers has irreversibly changed the disciplines of plant genetics and plant breeding. While there are several applications of DNA markers in breeding, the most promising for cultivar development is called marker assisted backcross breeding (MAB).

Marker assisted backcross breeding (MAB) is a diagnostic tool for gene introgression in backcross programmes, it is one of the most anticipated and frequently cited benefits of molecular markers as indirect selection tools in breeding programs. Backcross breeding (trait introgression) has long been valuable strategy in plant breeding for a number of crops .The goal of backcrossing is to move a single trait of interest (e.g., disease resistance from a wild relative or a transgene from a donor line) in to the genome of a commercially valuable variety without losing any part of the commercial variety's existing genome. The plant with gene of interest is called donor parent, while the commercially viable variety is the recurrent parent.

Using DNA markers can accelerate backcrossing programmes significantly. For example most conventional backcrossing programmes require 4-6 generations before sufficient recurrent parent genome is recovered to release the line commercially, using markers we can reach the same goal in two to three backcross generations there by cutting 1-2 years of the product development cycle.

There are three levels of selection in which markers may be applied in backcross breeding.

- In the first level, markers may be used to screen for the target trait, which may be useful for traits that have laborious phenotypic screening procedures or recessive alleles.
- The second level of selection involves selecting backcross progeny with the target gene and tightly-linked flanking markers in order to minimize linkage drag. We refer to this as 'recombinant selection'.
- The third level of MAB involves selecting backcross progeny (that have already been selected for the target trait) with 'background' markers. In other words, markers can be used to select against the donor genome, which may accelerate the recovery of the recurrent parent genome.



Three levels of selection during marker-assisted backcrossing

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The success of MAB depends upon several factors, including the distance between the closest markers and the target gene, the number of target genes to be transferred, the genetic base of the trait, the number of individuals that can be analyzed and the genetic background in which the target gene has to be transferred, the type of molecular marker(s) used, and available technical facilities. Identification of molecular markers that should co-segregate or be closely linked with the desired trait (if possible, physically located beside or within genes of interest) is a critical step for the success of MAB. The most favorable case for MAB is when the molecular marker is located directly within the gene of interest (direct markers). MAB conducted using direct markers is called gene assisted selection.

The different stages in selection strategy involve:
I. Selecting individuals that carry the target allele (referred as foreground selection).
II. Selecting individuals homozygous for recurrent parent alleles at markers flanking the target allele.
III. Selecting individuals homozygous for recurrent parent alleles at all remaining markers on the same chromosome as the target allele.
IV. Selecting one individual that is homozygous for recurrent parent alleles at the maximum number of all markers across the whole genome.

The last three steps of the four-stage selection strategy are called background selection.

Recurrent parent (P1) × Donor parent (P2))

F1 × P1

BC_1F_1

1. Identification of **BC_1F_1** individuals that are heterozygous for the closest marker (foreground selection) and single or doublen homozygous for the flanking markers (limited background selection on the chromosome carrying the gene of interest)
2. Backcross the selected **BC_1F_1** individuals with **P1** to produce **BC_2F_1**

BC_2F_1

Foreground selection
Whole genome background selection
Identification of BC_2F_1 individuals that are heterozygous for the closest marker and double homozygous with the highest proportion of the recurrent parent genome
Self the selected individuals to produce BC_2F_2

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BC_2F_2

Foreground selection
Phenotypic selection for improved trait(s)
Self selected individuals to produce BC_2F_3

BC_2F_3

Biochemical and/or phenotypic evaluation of improved lines

Improved line

Schematic representation of gene introgression using MAB

Strategies for optimization of MAB process:

- Number of BC generations
- Reducing marker data points (MDP)
- Strategies for 2 or more genes/ QTLs

Marker assisted foreground selection

On the basis of genotypes at the target locus and two flanking markers loci there are five types of individuals:

a) Type 1 (an individual heterozygous for the donor allele at the target locus and homozygous for the recurrent parent alleles at both flanking markers).

b) Type 2 (an individual heterozygous for the donor allele at the target locus and homozygous for the recurrent parent allele at one of the flanking markers).

c) Type 3 (an individual heterozygous for the donor allele at the target locus and homozygous for the recurrent parent allele at one of flanking markers, irrespective of the genotype at the other flanking marker).

d) Type 4 (an individual heterozygous for the donor allele at the target locus and heterozygous for the recurrent parent alleles at both flanking markers).

e) Type 5 (an individual homozygous for the recurrent parent allele at the target locus; i.e., it is not a carrier of the target allele).

From the first backcross generation (BC_1), one individual of the most desirable type is selected in the given order: Type 1 > Type 2 or Type 3 > Type 4. If in generation BC_1 more than one individual satisfying the strongest condition is found, selection between them can be performed on the basis of analysis of other marker loci (located either on the carrier or on non-carrier chromosomes) to determine the most desirable individual for producing BC_2.

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Marker assisted background selection:

Phenotypic selection for 'good agronomic type' has always been practiced along with backcross selection. The objective of the background selection is to accelerate the return to recipient parent genome outside the target gene so as to:

1) Reduce the length of the intact chromosomal segment of donor type dragged around the target gene on the carrier chromosome.
2) Reduce donor genome on the non-carrier chromosomes to the maximum extent.

Reduction in donor genome content around target gene on a carrier chromosome can be achieved by selecting for individuals that are heterozygous at the target locus, and homozygous for recurrent parent alleles at two markers flanking the target locus on each side (such individuals are termed double homozygote's The probability to obtain such double homozygote individuals depends on the distances between the target gene and the flanking markers, total duration of the breeding program (number of successive backcross generations that are to be performed), and the number of individuals to be genotyped at each generation. Flanking markers between the target allele are necessary to remove linkage drag, and the optimal distance between a target gene and flanking markers governs the selection intensity that can be exerted.

For a better reduction of linkage drag, flanking markers should be chosen as closely linked to the target locus as possible. The probability to obtain double homozygote individuals for close markers in one single BC generation is very low. Hence, it is generally preferable to perform selection on at least two successive BC generations; i.e., selecting for a single homozygote on one side of the target in BC_1, and then for a single homozygote on the other side in BC_2.

Applications of MAB

1) When phenotypic screening is expensive, difficult or impossible.
2) When the trait is of low heritability (incorporating genes that are highly affected by environment).
3) When the selected trait is expressed late in plant development, like fruit and flower features or adult characters in species with a juvenile period.
4) For incorporating genes for resistance to diseases or pests that cannot be easily screened for due to special requirement for the gene to be expressed.
5) When the expression of the target gene is recessive.
6) To accumulate multiple genes for one or more traits within the same cultivar, a process called gene pyramiding

CONCLUSION

MAB is a methodology that has already proved its value. It is likely to become more valuable as a large number of genes are identified and their functions and interactions elucidated

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Mutation Breeding: An approach towards crop improvement

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Dinesh Nagar[1] and Bichhinna Maitri Rout[2]
[1]Ph.D , Rajasthan Agricultural Research Institute, Durgapura, Jaipur
[2]Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION: Mutation is sudden heritable change in the characteristic of an organism. Mutations produced by changes in base sequences of genes (as a result of base pair transition/deletion/duplication or inversion) are known as gene mutation or point mutation. Some mutations may be produced by changes in chromosome structure / even in chromosome number, they are termed as chromosomal mutation. Gross chromosomal changes via., deletion i.e. loss of some base sequences of genes/ duplication i.e. doubling of base sequences/ inversion i.e. rearrangement of base sequences and as such their order is reversed/ translocation i.e. change in the position of gene sequences of a chromosome or more often exchange of gene sequences between different chromosome are detectable cytologically under microscope. When the mutant character shows cytoplasmic or extranuclear inheritance, it is cytoplasmic mutation. Bud mutation or somatic mutation is used to denote mutations occurring in buds or somatic tissues which are used for propagation. Eg. Clonal crops.

Types of mutations

1. Spontaneous mutation/Natural mutation

Mutations occur in natural population (without treatment by man) at a low rate. The frequency of spontaneous mutations generally is 1 in 10 lakhs (10^{-6}).

2. Induced mutation/Artificial mutation

Mutations induced by treatment with certain physical or chemical agents artificially is known as induced mutation and the agents used for producing/inducing them is termed as **mutagens** and the process of treating the biological material with mutagens are known as **mutagenesis** and its utilization in crop improvement is known as **mutation breeding**.

Induced mutation occurs at a higher frequency but induced mutations

i. rarely produce new alleles, they produce alleles which are already known to occur
ii. comparable to spontaneous mutation in their effect and the variability it produces.

General characteristics of mutation

1. Mutations are generally recessive. But dominant mutations also occur.
2. Harmful to the organism. Most of the mutations have deleterious effects, but a small proportion is beneficial.
3. Mutations are random. They may occur in any genes.
4. Mutations are recurrent. Same mutations occur repeatedly.
5. Commonly show pleiotrophy.

Effects of mutation

Mutations are harmful and they reduce the viability of the individual that carry them. Based on their viability, mutations are grouped into four types.

i. **Lethal** – Recessive lethals that kill the individual that carry them in the homozygous state. Eg. Albina chlorophyll mutation
ii. **Sublethal/Subvital** – Do not kill the individual carrying them but reduce their viability. Sublethal, viability percentage is less than 50% and subvital, it is much more than 50%.
iii. **Vital** – Do not kill or reduce the viability of the individual carrying them. Can be utilized in the crop improvement but the frequency is much lower.

Mutagens

Agents used for induction of mutations are known as mutagen.

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I. Physical mutagen

1. Ionizing radiations

a. Particulate radiation – α rays, β rays, Fast neutrons & Thermal neutrons

b. Non particulate radiation – X rays, γ rays

2. Non-ionizing radiations - UV rays

II. Chemical mutagen

a. **Alkylating agents** – Sulphur and Nitrogen mustard, Ethylene imines, Ethyl Methane and Methyl Methane Sulphonate
b. **Acridine dyes** – Ethidium bromide, Acridine Orange and Acridine yellow
c. Nitrous acid, Sodium azide, Bromouracil etc.

X rays and Gamma rays

These are non-particulate electromagenetic radiation with a wavelength of 0.001 to 10°A or 10^{-4} to 1 nm. They are high energy radiations consist of photons. X rays are produced in X ray tube and gamma rays are obtained by the radioactive decay of radium, ^{14}C, ^{60}Co etc. Common source used for biological study is ^{60}Co.

Method of mutation breeding

Exposure of biological material to physical mutagen is known as **irradiation**.

Objectives – should have well defined objective

Selection of variety – Variety selected for the mutagenesis should be the best variety available in the crop.

Part of the plant to be treated – Seeds, pollen grains, vegetative propagules (buds/cuttings)

Dose of mutagen

Mutagen treatment reduces germination, vigour, growth rate and fertility. There is considerable killing of plants at various stages. The damage increased with the increase in mutagen dose but not proportional. An optimum dose is the one which produces the maximum frequency of mutation and cause minimum killing. **LD_{50}** is that dose of mutagen which would kill 50% of the treated individual.

Seeds and Vegetative propagules after giving mutagen treatment planted immediately in the field and that is M_1 generation whereas in case of pollen grains, the irradiated pollen grains are dusted in the flower and the plants raised from the seeds extracted from the pollinated fruits are M_1 generation.

Handling of mutagen treated population

Seeds and vegetative propagules treated plants produce chimeras. A **chimera** is an individual with one genotype in some of its parts and another genotype in the other. Shoot tip meristem usually has two functional layers: outer (giving rise to epidermis and leaf mesophyll) and inner layer (producing the rest of the plant tissues including reproductive organs). When the entire inner and outer layer is affected, the chimera is known as **periclinal chimera** (inner or outer periclinal depending on the part affected) while a **sectorial chimera** affects only a part of the inner or outer layer (inner or outer sectorial).

Seed propagated – only the inner chimera (periclinal and sectorial) will be transmitted to the next generation, outer chimera will not be recovered since this layer does not contribute to production of gamates.

Vegetative propagation – Outer and inner periclinal chimeras are utilized and the sectorial chimera is unstable in clonal crops.

Procedure

Mutations for oligogenic traits

M_1 - Mutagen treated plants are space planted. M_1 plants will be chimeras. About 20 seeds from each plant are harvested separately to raise M_2 generation.

M_2 - About 2000 individual plant progenies are grown and regular observations are made to detect distinct mutations in M_2. Plants from rows containing or suspected to contain the mutant allele are harvested separately to raise M_3 generations. If the mutant is distinct, it is selected for multiplication and testing.

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M_3 – Progeny rows from individual selected plants are grown. Poor and inferior mutant rows are eliminated. If the mutant progenies are homogenous, 2 or more M_3 progenies are harvested in bulk for preliminary yield trial in M_4.

M_4 – A Preliminary Yield Trials is conducted with a suitable check and promising mutant lines are selected for replicated MLT.

M_5 to M_8 - replicated MLT are conducted and the outstanding line may be released as a new variety.

Mutations for polygenic traits

M_1 - Mutagen treated plants are space planted. M_1 plants will be chimeras. About 20 seeds from each plant are harvested separately to raise M_2 generation.

M_2 - About 2000 individual plant progenies are grown and vigorous, fertile and normal looking plants that do not exhibit a mutant phenotype are selected and their seeds are harvested separately to raise M_3 progeny rows.

M_3 – Progeny rows from individual selected plants are grown. Observations are made for small deviations in phenotype from the parent variety. Inferior rows are discarded. Few rows may be homogenous and would be harvested in bulk. Superior plants selected from superior progenies is done in M_3 rows showing segregation.

M_4 – Bulked seed from previous generation may be planted in a preliminary yield trial with a suitable check, superior progenies are selected for replicated MLT. Segregated progenies may be subjected to selection until they become homogenous only if they are promising.

M_5 to M_8 – Preliminary yield trials and MLT are conducted depending upon the stage when the progenies become homogenous.

Advantages:

- Cheap and rapid method of developing new varieties
- Induction of desirable mutant allele, which is not present in germplasm
- Induced mutagens is used for the induction of CMS
- More effective for the improvement of oliggogenic traits
- Production of haploids by irradiating pollens
- Simple, quick and the best way when a new character is to be induced

Limitations:

- Generally random and unpredictable
- Useful mutants are rare and predominantly recessive
- Mutants can be strong negative pleiotropic effects on other traits
- Health risks: handling, chemical mutagens, radiations, fast neutrons treatment
- Most mutants are of no use to breeding even if a large number of mutants can be produced
- Field trialing and germplasm storage can be expensive and require a lot of space and careful management if large mutant populations are handled.

CONCLUSION

The mutation process generates random genetic variations, resulting in mutant plants with new and useful traits. Mutation breeding uses a plant's own genetic makeup, mimicking the natural process of spontaneous mutation. Crop varieties generated through the exploitations of mutation breeding are significantly contributing to global food and nutritional security and improve livelihoods.

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Concept and Utilization of Polyploidy in Crop Improvement

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Kuldeep Nagar (1), Deepayan Roy (2), Pooja Kanwar Shekhawat (3) and Nikki Kumari (4)

(1)Division of Plant Breeding and Genetics, Rajasthan Agricultural Research Institute, Durgapura 302018 (Jaipur), INDIA.

(2)Department of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar 263145 (Uttarakhand), INDIA.

(3)Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana 141027, (Punjab), INDIA.

(4)Department of Genetics, Indian Agricultural Research Institute, Pusa, (New Delhi), INDIA.

INTRODUCTION: The condition of an organism having multiple copies (more than two) of the basic set of the chromosomes (*x*) is called polyploidy (Ramsey and Schemske, 1998, Acquaah, 2007 and Chen, 2010) may occur naturally or by induction. Nearly all plants and animals probably have some polyploidy tissue i.e. plant endosperm is triploid, liver of mammals are polyploid, wheat is hexaploid and strawberry is octoploid. There are various methods for the origin of polyploids include, including somatic chromosome doubling during mitosis, Non-reduction meiosis leads to the production of unreduced gametes endoreplication and polyembryony. It was first reported in *Oenothera lamarckiana* (evening primrose) by Hugo De Vries as '*gigas*' the mutant was the earliest example of natural polyploidy (Ramsey and Schemske, 1998). Monoploidy is the presence of a single copy of a genome (*x*) or a plant with the gametic chromosome number produced from a true diploid species. All monoploids are haploid but all haploids are not monoploid.

Polyploidy provides a way for the creation and adaptation of new species. One in every 100,000 angiosperms plants are founded as polyploids (Comai, 2005). Ploidy affects structural and anatomical characteristics of the plant through increased leaf and flower size, stomatal density, cell size and plastid count is known as gigas effect (Acquaah, 2007), which is utilized in vegetative crop production and decorative breeding. Physiological changes also renowned to travel in conjunction with order duplication. This primarily results from modification of metabolism leading to a general increase in secondary metabolites (Levin, 2002) has found applicable in the breeding of medicative herbs for production of prescription drugs, vegetative a part of edible vegetative portion, hybrid vigor from interspecies crosses is one in every of the foremost exploited benefits of polyploid in plant breeding (Meru, 2012). Four types of polyploids (autopolyploid, allopolyploid, segmental allopolyploid and alloautoployploid) have been distinguished by Stebbins in 1947).

Autopolyploids or autoploid contain multiple copies (more than two) of the basic set (x) of chromosomes of the same genome (Acquaah, 2007 and Chen, 2010). Many crop plants have undergone polyploidy during their evolutionary process spontaneously through the process of chromosome doubling (Broertjes, 1976). Natural autoploids include Banana (3X), Potato (4X), Peanut (4X), Alfalfa (4X) and Coffee (4X). Ornamentals (tulip and hyacinth), forage grasses (ryegrasses) and other commercial crops have yielded superior varieties through spontaneous chromosome doubling. e.g. Pusa giant in berseem contain 20-30% more green fodder, Double steel and Tetra Petkus in ryegrass, Triploid tea clone has larger and heavier shoots, more vigor and hardness, Tetraploid tea (TV29) and Triploid Watermelon, using Kihara's technique in 1951. The induced autotetraploid crop is used for the production of seedless triploid hybrids fruits in the watermelon crop. Such polyploids are induced through the treatment of diploids with mitotic inhibitors, dinitroaniles and colchicine. Triploid Sugar beet, larger roots compared to diploids, Tetraploid Grapes (Muscat Bailey A) have larger fruits and relatively fewer seeds per berry and Autotetraploid Red Clover with higher hay yields.

Allopolyploids/alloploids are a combination of genomes from different species (Acquaah, 2007) result from the hybridization of two or more genomes followed by chromosome doubling or by the fusion of unreduced gametes between different species. It has a key role in the process of speciation for angiosperms and ferns (Chen, 2010). To differentiate between the sources of the genomes in an alloploid, each genome is designated by a different letter. Alloploids possesses a significant role in crop improvement through the evolution of crops. Many crop plants are allopolyploids either through intentional hybridization and selective breeding (some blueberry cultivars) or result of polyploidization event has taken place in ancient times like maize (Harlan, 1975), Bread Wheat, Cotton, *Brassica* spp. and Tobacco. Alloploids utilized as a bridging species, a breeding the strategy that utilizes the reproductive superiority of polyploids. When sexual incompatibilities between two species are due to ploidy levels, transitional crosses can be carried out followed by chromosome doubling to produce fertile bridge hybrids. This method has been used to breed for superior tall fescue grass (*Fescue arundinacea*) from Italian ryegrass (2n=2x=14) and tall fescue (2n=6x=42) by using meadow grass (*Fescue pratensis*) as a bridge species (Acquaah, 2007). The same principle has been applied in fixing heterozygosity in hybrids by doubling the chromosomes in the superior progeny (Comai, 2005). Use of alloploids for creation of new crop species also have a significant role in crop improvement e.g. *Raphano brassica, Triticale hexaploid, Galeopsis tetrahit* (2n=32) and *Primula kewensis (2n=36).*

Segmental allopolyploid carries more than two incompletely distinct genomes which lead to the formation of both bivalents and multivalents during chromosome pairing (Stebbins, 1947 and Levin, 2002). Some degree of homology (partial homology) may exist between some chromosomes of one genome and those of the other genome. This type of chromosome pairing is called heterogenetic pairing or allosyndetic pairing may cause genetic imbalance to result in sterile progeny. e.g. *Solarium tuberosum* (4x = 48) and *Delphinium gypsophilum*.

Autoallopolyploids, a condition where an allopolyploid individual also shows the characteristics of auto-polyploidy for one or more genomes. If there are two genomes (A and B genome) the auto-allopolyploid may be AAAABB, AABBBB or AAAABBBB. Thus autoallopolyploidy is possible from the level of hexaploidy (6x) and above. this term was used by Kostoff in 1939. e.g. Decaploid triticale (AABBDDRRRR). Some of the artificially synthesized allopolyploids in Brassica are also auto-allopolyploids, such as *Brassica napocampestris*, (2x = 58, AAAACC) and *B. napoleracea* (2n = 56, AACCCC). The most significant role of polyploidy is used for increased heterozygosity in the population. Roose *et al*., 1976 showed that allotetraploids in *Tragopogon* had mount state at isozyme loci, representing the mix of divergent genomes. Within the allotetraploids, *Tragopogon mirus* and *Tragopogon miscellus,* thirty-third and forty third, of the loci examined were duplicated. All allopolyploid is heterozygous through the nonsegregating, mounted state.

Recurrent formation of polyploidy has significant genetic implications. The majority of polyploidy plant species that examined with molecular markers showed to be polyphyletic, having arisen multiple times from an equivalent diploid species Polyphyletic polyploid species angiosperms and embrace each autopolyploid e.g. *Heuchera grossulariifolia* (Soltis *et al*., 1995 and Cook *et al*., 1999). Use of RAPD markers to check the hypothesis that isotopically identical populations of *Tragopogon mirus* has an equivalent plastid deoxyribonucleic acid haplotype and rDNA repeat were of separate origin which 'identical' populations of Tragopogon miscellus additionally were of separate origin.

The industrial application of polyploidy involves chromosome doubling techniques that have an apparent effect on many physiological properties of a plant. The most discernable of these has been the increase in secondary as well as primary metabolism (Levin, 2002). The resulting increase in secondary metabolites, in some cases by 100%, after chromosome doubling, has been widely exploited in the breeding of narcotic plants such as cannabis, datura and atropa. In vitro secondary metabolite production systems have also been developed. The production of the antimalarial sesquiterpene and artemisinin has been enhanced sixfold by inducing tetraploids of the wild diploid *Artemisia annua* L. (clone YUT16). Attempts have been made to improve the production of pyrethrin, a botanical insecticide, by chromosome doubling of *Chrysanthemum cinerariifolium*. Other plants whose production of terpenes has increased following artificial chromosome doubling include *Carum cari*, *Ocimum kilmandscharicum* and *Mentha arvensis* (Levin, 2002).

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Major limitations of autopolyploids are lesser dry matter, high sterility and poor seed set. Triploids cannot be maintained except through clonal propagation and Undesirable features and unpredictable effects. In the case of allopolyploids, effects cannot be predicted, defects in synthesized allopolyploids, extensive breeding for synthetic breeding and Smaller promising proportion are the major limitations which restricts its use in crop improvement. Future strategies in the utilization of polyploidy in crop improvement are the development of genome sequencing, modern molecular biology and bioinformatics techniques, Epigenetic influence on genotype and phenotype of polyploid model plants and Third Generation Genomic Technologies.

CONCLUSION

With knowledge of the origins, variations and characteristics of different types of polyploids, there are many opportunities for developing and utilizing polyploids in plant improvements. Significant opportunities include developing sterile cultivars, overcoming barriers to hybridization, restoring fertility in wide hybrids, enhancing flower size, increasing hybrid vigor and improving pest resistance and tolerance to environmental stress.

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Protected cultivation of vegetable crops

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Khyati Singh[1]*, Mukesh Kumar Mehla[2]
[1] CCS Haryana Agricultural University, Hisar, Haryana, India-125004
[2] Department of Soil and Water Engineering, College of Technology and Engineering, MPUAT, Udaipur, Rajasthan, India-313001

Vegetables are important source of nutrients and minerals and known to be health food and aids in overcoming micronutrient deficiencies globally. The cultivation of vegetable crops provides opportunities of generating higher farm income. The vegetables production across the world has doubled over the last quarter century. Mostly vegetable crops are environment sensitive, and thus very high or very low temperatures and deficient soil moisture constitute the major causes of low yields. The share of India in the world vegetable market is around 14%. It produces 184.39 million tonnes of vegetables from an area of 10.25 million hectares and an average productivity of 17.97 MT/ha. In spite of being the second largest producer of vegetables in the world after China, the per capita consumption of vegetables in our country is very low against WHO standards, *i.e*., 180 g/day/capita against 300 g/day capita recommended by FAO). Several methods can be adopted to increase the production of quality produce and consumption of vegetables such as increasing area under vegetable hybrids, using improved agro-techniques and cultivation of vegetable crops under protected conditions. The off-season cultivation of vegetable crops and improved storage infrastructures should be promoted to avoid the flooding of vegetables in the market in natural season and generating higher profits. Vegetables can be cultivated as off-season crops under greenhouse technology where temperature and moisture can be controlled for obtaining good quality produce.

Protected cultivation

The cultivation of vegetables under partially or fully controlled environment conditions is known as protected cultivation. This can be achieved by the use of sound engineering principles inside greenhouse structures to modify natural micro-environment around plants to raise the optimum plant growth and yield with increased input use efficiency.

The greenhouse is an enclosed structure which is covered by transparent or translucent cladding material like glass or plastic. The greenhouse covered with glass is termed as glasshouse, while, covered by plastic sheet is termed as polyhouse. In India, tomato, sweet pepper and cucumber are most extensively grown under greenhouses. Other crops like lettuce, broccoli, kale, cauliflower, brinjal, artichoke, arugula, etc. can also be grown under greenhouse structures. This technique ensures the year-round supply of vegetables with an efficient resource use efficiency. The requirement of water and energy in such cultivation can be reduced with addition of novel techniques like micro irrigation-cum-fertilization (fertigation), misting, fogging and rainwater harvesting to these structures.

Common types of greenhouses being used in India

1. **Plastic greenhouses with natural ventilation**: These types of structure can be made using plastic films like polyethylene, polyester and PVC. The structural cost of this type of greenhouse is low due to inexpensive plastic films and the light transmission through these films is comparable to the glass material. Now a days, UV stabilized LDPE films are used to counter the serious effect of high solar radiation on the plastic films.
2. **Greenhouses with fan and pad cooling system:** This type of structure is based on evaporative cooling system, has exhaust fan at one end and porous pad at the opposite side of the greenhouse. The water flows down from corrugated fibre cooling pads and is recirculated through the pipes. The running fans pulls the cooled air through the wetted pads which moves across the greenhouse and evaporates lowering the temperature of inside greenhouse

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3. **Walk-in tunnels**: They are temporary structures constructed by GI pipes and transparent plastic of 180-200 micron thickness. The main objective of such structure is to fetch maximum price off-season produce of vegetable crops.
4. **Plastic low tunnels:** these structures are used in dry temperate areas of Himachal Pradesh to protect the crops against extreme low temperature during winter season. It uses plastic film of 20-25 micron thickness stretched over a bent GI of 8 mm diameter.
5. **Insect proof net houses**: These are temporary or permanent structures that uses a 40 or 50 mesh size net as covering material. The temporary structure can be a walk-in-tunnel shape and structure with double door entrance facilities, while, the permanent structure can have either flat roof or dome shape. Its main aim is to protect the crops against insect-pest attack.
6. **Shade net houses**: These are low cost, temporary or semi-permanent structures designed to reduce temperature and high light intensity inside the structure. It provides 40-60% shade over the plants.

Advantages of protected vegetable cultivation

There are several advantages of growing of vegetable under such protected structures. It reduces the amount of water and chemicals used in production of high value vegetables compared to open field conditions by increasing the input use efficiency. It helps in delivering year-round production of vegetables and protects the vegetables from adverse climatic abrasions. Under different systems of protected production, cropping of multiple vegetables on the same piece of land is possible. One of the major advantages of greenhouse is that off-season vegetables production has been made possible so that the farmers can get better returns. Apart from producing quality seedlings for healthy crop stands after transplanting, it reduces the expenditure of protection measures (insecticides, fungicides, weedicides, etc). Also, the management and control of diseases, insect-pests and weeds is easier in protected structures. The production of disease-free seed production of costly vegetables becomes easy under protected structures. The controlled environmental conditions result in early raising of nurseries, their seed production and protecting the valuable germplasm. The new techniques such as cultivating grafted plantlets, hydroponics and aeroponics is also possible under protected cultivation.

Problems in protected vegetable cultivation

The construction of greenhouse structure is an expensive affair, also the short life and non-availability of cladding materials create problems in adoption of greenhouse cultivation practices among farmers with zero risk affordability. The lack of appropriate tools and machinery that can be utilized inside these structures increases the efforts by manual or labour.

Conclusion and future prospects

The adoption of greenhouse technology is still not common in India and efforts have to be made by concerned agencies to reach the global standards. The design and construction of polyhouses should be standardized including cost effective and indigenously available cladding and glazing material. Now a days computerized control system are available to maximize returns, it includes time base/volume base/sensor based irrigation system, opening and closing of ventilators and side wall roll up curtains, CO_2 generator, climate, temperature, humidity, heat radiation, EC, pH, ppm level of elements in irrigation water etc. can be controlled according to the requirement of plant. ICAR and SAU's should take active part in major research activities on growing of vegetables under protected covers. Government should take more initiatives to promote the greenhouse technology among the farming community of the country.

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RNAi: An innovative approach in vegetable crop improvement

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Bichhinna Maitri Rout
Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

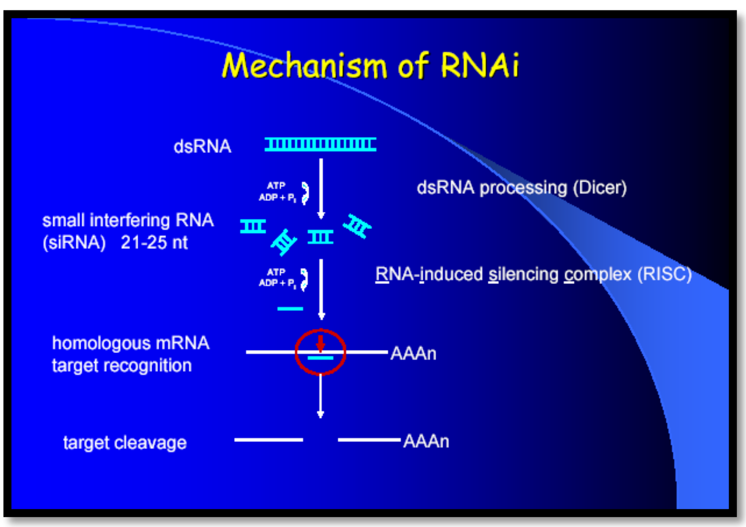
INTRODUCTION

RNA interference (RNAi) is a method of blocking gene function by inserting short sequences of ribonucleic acid (RNA) that match part of the target gene's sequence, thus no proteins are produced. Since Science named it as "Breakthrough of the Year" and Fortune magazine hailed it as "Biotech's Billion Dollar Breakthrough" in 2003, RNAi has significantly gained prominence as the method of choice for researchers sleuthing the structure and function of important genes. RNAi has provided a way to control pests and diseases, introduce novel plant traits and increase crop yield.

How RNAi Works?

1. The entry of long double stranded RNA, such as an introduced transgene, a rogue genetic element or a viral intruder, triggers the RNAi pathway of cells. This results in the recruitment of the enzyme Dicer.
2. Dicer cleaves the dsRNA into short, 20-25 basepairs long, fragments, called small interfering RNA (siRNA).
3. An RNA-induced silencing complex (RISC) then distinguishes between the two siRNA strands as either sense or antisense. The sense strands (with exactly the same sequence as the target gene) are degraded.
4. The antisense strands on the other hand are incorporated to the RISC. These are used as guide to target messenger RNAs (mRNA) in a sequence-specific manner.

Messenger RNAs (mRNA), which codes for amino acids, are cleaved by RISC. The activated RISC can repeatedly participate in mRNA degradation, inhibiting protein synthesis.



RNAi for Disease and Pathogen Resistance

Gene silencing was first used to develop plant varieties resistant to viruses. Engineered antiviral strategies in plants mimic natural RNA silencing mechanisms. This was first demonstrated when scientists developed Potato virus Y-

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resistant plants expressing RNA transcripts of a viral proteinase gene. Immunity has since been shown to other viruses such as the Cucumber and Tobacco Mosaic Virus, Tomato Spotted Wilt Virus, Bean Golden Mosaic Virus, etc. among many others. In addition, plants can also be modified to produce dsRNAs that silence essential genes in insect pests and parasitic nematodes.

RNAi for Male Sterility

RNAi has also been used to generate male sterility, which is valuable in the hybrid seed industry. Genes that are expressed solely in tissues involved in pollen production can be targeted through RNAi. For instance, scientists have developed male sterile tobacco lines by inhibiting the expression of TA29, a gene necessary for pollen development. RNAi was also used to disrupt the expression of Msh1 in tobacco and tomato resulting to rearrangements in the mitochondrial DNA associated with naturally occurring cytoplasmic male sterility.

RNAi and Plant Functional Genomics

A major challenge in the post-genomic era of plant biology is to determine the functions of all genes in the plant genome. Compared to other techniques, RNAi offers specificity and efficacy in silencing members of a gene or multiple gene family. In addition, the expression of dsRNAs with inducible promoters can control the extent and timing of gene silencing, such that essential genes are only silenced at chosen growth stages or plant organs.

There are several ways of activating the RNAi pathway in plants. The various RNAi techniques have advantages and disadvantages with respect to how persistent their effects are and the range of plants to which they can be applied. These include the use of hairpin RNA-expressing vectors, particle bombardment, Agrobacterium- mediated transformation and virus-induced gene silencing (VIGS).

Engineering Plant Metabolic Pathways through RNAi

RNAi has been used to modify plant metabolic pathways to enhance nutrient content and reduced toxin production (Summarized in Table 1). The technique takes advantage of the heritable and stable RNAi phenotypes in plants.

Table 1. Examples of novel plant traits engineered through RNAi.

Trait	Target Gene	Host	Application
Enhanced nutrient content	Lyc	Tomato	Increased concentration of lycopene (carotenoid antioxidant)
	DET1	Tomato	Higher flavonoid and b-carotene contents
	SBEII	Wheat, Sweet potato	Increased levels of amylose for glycemic management and digestive health
Ethylene sensitivity	LeETR4	Tomato	Early ripening tomatoes
	ACC oxidase gene	Tomato	Longer shelf life because of slow ripening
Reduced production of lachrymatory factor synthase	lachrymatory factor synthase gene	Onion	"Tearless" onion

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Using RNAi in Genetically Modified Plants

A source of dsRNA must be introduced into a plant's DNA to create plants that use RNAi-mediated traits and that pass those traits on to the next generation. This is done using the same techniques of genetic modification used to produce other biotechnology plants being grown today. The RNAi-mediated trait can be introduced into the plant genome as a DNA molecule made from opposite strands of the gene to be suppressed. One segment is inverted with respect to the other, and the segments are separated by a short "loop" segment so that the resulting RNA can fold back on itself to form a double stranded structure. In practice, segments of more than one gene can be included to provide suppression of multiple genes.

Applications: Pest Control

The digestive system in an insect or a nematode is very different from the digestive system in mammals, and we now know that dsRNA designed to suppress specific genes in some pests, can be provided in the diet to suppress or kill those pests. The sequence specificity of RNAi presents the opportunity to selectively target some pest species while sparing desirable species. Unlike some chemical pesticides, RNAi in plants is not expected to have any effect on non-target insects and nematodes, birds, reptiles, fish, or mammals. All transgenic-plant-mediated insect control technology commercially available today is based on the plants producing proteins derived from a specific type of bacteria, *Bacillus thuringiensis*, or Bt. Insect resistance to Bt has not been a significant problem to date, but risk of development of resistance to these proteins can be further reduced with the use of non-Bt-crop or natural refuges of non-resistant plant hosts. Combining Bt technology with a second, independent mode of insect control via RNAi would both enhance product performance and further guard against the development of resistance to Bt proteins.

RNAi: The Environment

The environmental safety assessment approach to RNAi is still under development. RNAi and other forms of RNA-mediated gene regulation are ubiquitous in the environment because they are important in all living things. Despite this, we are not aware of environmental interactions mediated by double-stranded RNA. The stability of free RNA in the environment is limited, and as discussed above, mammals as well as birds and reptiles, effectively resist the effects of exogenous RNA. For non-pesticidal uses of RNAi, there is little reason to expect effects beyond the modified plant itself. The need, if any, for environmental studies in this situation remains to be defined. For pesticidal RNAi, as for any pesticide, appropriate non-target-species and environ-mental fate studies will be performed. General studies demonstrating a lack of RNAi effect in certain species or classes of animals (such as the lack of effects on mammals) or a lack of stability in the environment may address many issues without the need for gene- and target-species-specific studies. RNAi gene-specific studies on selected, agronomically important organisms may be necessary to address effects on non-target species such as nematodes or insects which are not inherently resistant to RNAi mediated by exogenous RNA.

CONCLUSION

With RNAi, it would be possible to target multiple genes for silencing using a thoroughly-designed single transformation construct. Moreover, RNAi can also provide broad-spectrum resistance against pathogens with high degree of variability, like viruses. Recent studies have hinted possible roles of RNAi-related processes in plant stress adaptation. Although much progress has been made on the field of RNAi over the past few years, the full potential of RNAi for crop improvement remains to be realized. The complexities of RNAi pathway, the molecular machineries, and how it relates to plant development are still to be elucidated.

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SCAR (Sequence Characterised Amplified Region) markers in horticultural crops

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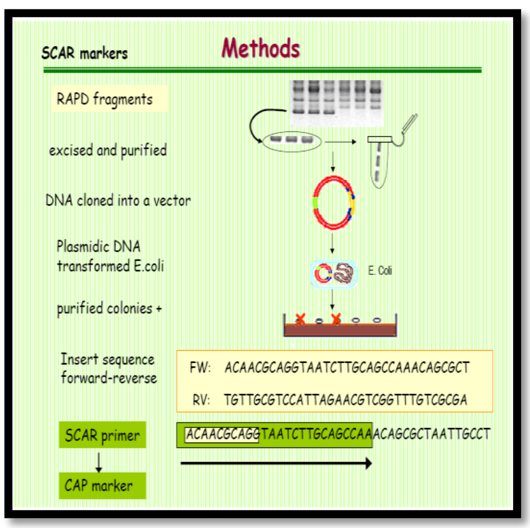
Bichhinna Maitri Rout
Division of Vegetable Science, Ph.D. Scholar, ICAR-IARI, New Delhi

INTRODUCTION

Michelmore *et al*. and Martin *et al*. introduced this technique wherein the RAPD marker termini are sequenced and longer primers are designed (22–24 nucleotide bases long) for specific amplification of a particular locus. SCARs are DNA fragments amplified by the Polymerase Chain Reaction (PCR) using specific 16-24 bp primers, designed from nucleotide sequences established in cloned RAPD (Random Amplified Polymorphic DNA) fragments linked to a trait of interest. SCAR is an example of a polymorphic region of known sequence. By using longer PCR primers, SCARs do not face the problem of low reproducibility generally encountered with RAPDs. Obtaining a co dominant marker may be an additional advantage of converting RAPDs into SCARs. SCARs take advantage of a band generated through a RAPD experiment. This technique converts a band prone to difficulties in interpretation and/or reproducibility into being a very reliable marker.



Steps to obtain SCAR polymorphisms:

A potentially interesting band is identified in a RAPD gel

↓

The band is cut out of the gel

↓

The DNA fragment is cloned in a vector and sequenced

↓

Specific primers (16-24 bp long) for that DNA fragment are designed

↓

Re-amplification of the template DNA with the new primers will show a new and simpler PCR pattern

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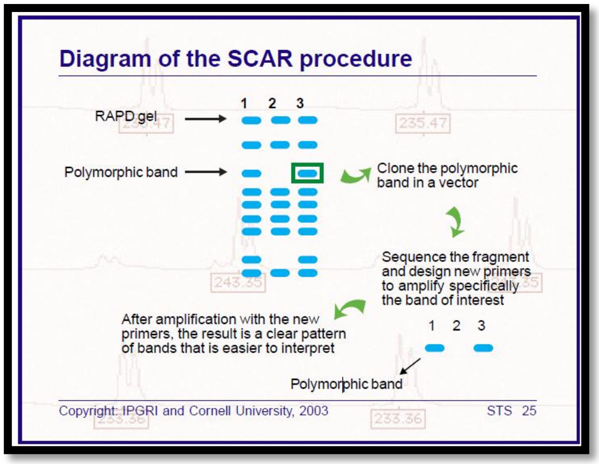

Advantages

- Simpler patterns than RAPDs
- Robust assay due to the design of specific long primers
- Mendelian inheritance. Sometimes convertible to co dominant markers

Disadvantages

- Require at least a small degree of sequence knowledge
- Require effort and expense in designing specific primers for each locus

Application:

- Non-pungent Capsicum contains a deletion in the capsaicinoid synthetase gene, which allows early detection of pungency with SCAR Markers
- SCAR marker used for detection of *Bacillus* strain TS02 sprayed on strawberry plants to bio-control powdery mildew in fields
- Molecular characterization of the SCAR markers tightly linked to the Tm-2 locus of the genus *Lycopersicon*- the *Tm-2* gene and its alleles conferring to mosaic virus resistance in tomato originate from *Lycopersicon peruvianum*, a wild relative of tomato and a fragment of the same size as that of a SCAR marker was amplified in the ToMV-susceptible tomato line with no *Tm-2*
- Development of species-specific SCAR markers for identification of three medicinal species of *Phyllanthus*- *Phyllanthus amarus, P. debilis* L. and *P.urinaria*
- Co-dominant SCAR marker for detection of the begomovirus resistance *Ty2 locus* derived from *Solanum habrochaites* in tomato Germplasm

CONCLUSION:

These markers will facilitate the introgression of the genes of interest into breeding lines for the development of new cultivars with improved nutritional value.

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Nanotechnology: A future prospects for improvement of soil and water system]

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Swarbinay Mahanta, Priyanka Ghatak and Deblina Ghosh
Ph.D Scholar, Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India

INTRODUCTION:

The term '*nano'* originated from the Greek *nanos* which means 'dwarf'. It is one billionth of a meter. Therefore, whenever we think about nanoscience or nanotechnology, very small objects come to the mind. Indeed, this branch of science and technology deals with materials having at least one spatial dimension in the size range of 1 to 100 nm.

These can include fullerenes, metal clusters (agglomerates of metal atoms), large molecules, such as proteins, and even hydrogen-bonded assemblies of water molecules, which exist in water at ambient temperatures.

Nanoparticle is the most fundamental component in the fabrication of a nanostructure, and is far smaller than the world of everyday objects that are described by Newton's laws of motion, but bigger than a simple molecule that are governed by quantum mechanics.

Nanoparticles show properties sharp contrast to their bulk in many respects which is utilised for its use in 'nanotechnology'.

Classification of Nanoparticles:

Types of Nanoparticles(NPs)	Examples of such type
1. National NPs-a)Inorganic b)Organic	- Silicate Clays, Fe, Al Oxides/ Hydroxides etc. - Humic Acids, O.M including black Carbon and Biopolymers as Polysaccharides etc.
2. Incidental NPs	- Anthropogenic, Pyrogenesis etc.
3. Engineering NPs	- Designed & Synthesised by Man

Nanotechnologists are capable of self assembling atoms into structures with highly controlled properties. These nanostructures may be zero dimensional (nanoparticles), one dimensional (nanowires), two dimensional (thin films) or three dimensional (arrays, hierarchical structures).A comparative dimension of different nano and micro structures in biology (Mishra *et al*., 2013).

Properties of Nanoparticles:

I. Nanoparticles are unique because of their large surface area and this dominates the contributions made by the small bulk of the material. Zinc oxide particles have been capable to block UV radiation compared to its bulk substitute.

II. Nanoparticles are small enough to confine their electrons and produce quantum effects. One example of this is that in solution gold nanoparticles appear deep red to black.

III. An important physical property of nanoparticles is their ability to form suspensions.

IV. Clay nanoparticles, when incorporated into polymer matrices, increase reinforcement, leading to stronger plastics. These nanoparticles are hard, and impart their properties to the polymer (plastic).

Application of Nanotechnology to improve the quality of soil and water:

I. Nanofertilizers in improvement of nutrients use efficiency:

Nowadays, nanotechnology is transferred from the experimental into the practical areas. Modern nanotechnology has provided the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or controlled-release vectors for building of so-called "smart fertilizer" as new facilities to enhance nutrient use efficiency and reduce costs of environmental protection. Encapsulation of fertilizers within a nanoparticle is one of these new facilities which are done in three ways a) the nutrient can be encapsulated inside nanoporous materials, b) coated with thin polymer film, or c) delivered as particle or emulsions of nanoscales dimensions (Rai *et al*., 2012). In addition, nanofertilizers will combine nanodevices in order to synchronize the release of fertilizer-N and -P with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water, and air (DeRosa *et al*., 2010).

II. Slow or controlled released Nanofertilizer:

Coating and binding of nano and subnano-composites are able to regulate the release of nutrients from the fertilizer capsule. It is found from various research is that a nano-composite consists of N, P, K, micronutrients, mannose and amino acids enhance the uptake and use of nutrients by grain crops. Moreover, nanotechnology could supply tools and mechanisms to synchronize the nitrogen release from fertilizers with crop requirements. This will be accomplished only when they can be directly internalized by the plants. Zinc–aluminum layered double-hydroxide nanocomposites have been employed for the controlled release of chemical compounds which act as plant growth regulators. Studies has been shown that fertilizer incorporation into cochleate nanotubes (rolled-up lipid bilayer sheets), had improved crop yield (DeRosa *et al*., 2010).

III. Nanoporous zeolites: useful for 'on demand' fertilization and water retention:

Nano clays and zeolites that are a group of naturally occurring minerals with a honeycomb-like layered crystal structure are other strategies for increasing fertilizer use efficiency. Its network can be filled with nitrogen, potassium, phosphorous, calcium and a complete set of minor and trace nutrients. So acts as a nutrients supply that are slowly released "on demand". However the main application of zeolites in agriculture is in nitrogen capture, storage and slow release.

Zeolite (aluminium silicates) assists water infiltration and retention in the soil due to its very porous properties and the capillary suction it exerts. Acting as a natural wetting agent, it is an excellent amendment for non wetting sands and assists water distribution through soils (Prasad *et al*., 2014).

IV. Role of nanotechnology in irrigation filtration water:

Nano-enabled water treatment techniques based on membranes filters derived from carbon nanotubes, nanoporous ceramics, and magnetic nanoparticles inspite using chemicals and UV light are common in traditional water treatment .

V. Magnetic nanoparticles for filtration:

At very low magnetic field gradients, the use of magnetic nanoparticles and magnetic separations is now possible. Nanocrystals, such as monodisperse magnetite (Fe3O4) have a strong and irreversible interaction with arsenic while retaining their magnetic properties (Yavuz *et al*., 2006). A simple handheld magnet can

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be used to remove nanocrystals and arsenic from water. Such a treatment could be used for irrigation water filtration process

VI. Use of Nanotechnology in remediation of heavy metal from polluted soil and water:

Nanotechnology offers a number of emerging techniques such as nanoparticles; nano scale zero valent iron "nZVI", nZVI-bentonite, nano alginite, nano carbon, bentonite, and dendrimers; are used as a potential sorbents to eliminate Cd and Pb from polluted soil. These nanoparticles are prepared in lab either using bottom-up or top-down, then characterized using transmission electron microscope (TEM).
Magnetic nanoparticle or magnetic separation is also another technique which is very stonng interaction with arsenic and can easily remove arsenic from water (Yavuz *et al*., 2006).

Scope of future research:

Nanotechnology is still now in nursery stage for agriculture and lot more research is expecting near future. This new technology has hedge prospectus for biological field. New research also aims to make plants use water, pesticides and fertilizers more efficiently to reduce pollution and to make agriculture more environmental friendly.

CONCLUSION:

Nanotechnology has great potential in agriculture as it can enhance the quality of life through its applications in these fields. Globally, many countries have identified the potential of nanotechnology in the agricultural sector and are investing a significant amount in it. Equal importance has been given to the social issues associated with nanotechnology and to improve public awareness.

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The truth of vertical farming in India

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Deblina Ghosh, Priyanka Ghatak and Swarbinay Mahanta
Ph.D Scholar, Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India

INTRODUCTION:

The importance of agriculture in India can be testified by the fact that 58% of the Indian workforce relies on the agricultural activities to earn the bread and butter for their families. Nevertheless, feeding a population of nearly 1.3 billion is not an easy task, especially when the scientists claim that the earth has lost a third of its arable lands over the last 40 years. It is predicted that the world population will reach 9 billion by 2050, of which 70% will live in urban centres. This change, alongside a changing climate, will strain Earth‘s resources, specifically the ability to supply food. A valuable investigation would be to determine other ways to supply food to cities alongside current agricultural practices in a sustainable manner. A silent revolution is underway in the agriculture sector, which is going to be quite evident in the days to come. With the global population is set to reach near 10 billion mark by 2050, the food production must increase by 70 percent, estimates the United Nations. Looking at the ever increasing rate of growth in population, we must find the alternative. In the pursuit of finding the solution, concepts such as vertical farming are like boon for the Indian agriculture scenario.


What is Vertical Farming?

Vertical farming is the practice of growing crops in vertically stacked layers in a controlled environment, where a natural environment is modified to increase the crop yield. The environment modification generally covers four aspects of the farming, which are: (a) physical layout, (b) lighting, (c) growing medium, and (d) sustainability feature.

The plants are vertically stacked in a tower-like structure. This way, the area is minimized that is required to grow plants. Another aspect that amends the natural setting is the use of artificial lights. A combination of natural lights and artificial lights is required to maintain a perfect environment for an efficient growth of the plants. The third aspect is the growing medium for the plants. Instead of soil, aeroponic, hydroponic or

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aquaponic growing mediums are used as the growing medium. The fourth aspect that makes vertical farming way more beneficial is the sustainability factor that it offers. Vertical farming is sustainable as it requires 95% less water as compared to other farming methods.

History of Vertical Farming:

In 1915, Gilbert Ellis Bailey coined the term "vertical farming" and wrote a book titled "Vertical Farming". In the early 1930s, William Frederick Gerick pioneered hydroponics at the University of California at Berkley. In the 1980s, Åke Olsson, a Swedish ecological farmer, invented a spiral-shaped rail system for growing plants and suggested vertical farming as a means for producing vegetables in cities. Professor Dickson Despommierin in 1999 came up with an idea of vertical farming. His concept was to grow the food in urban areas itself utilizing less distance and saving the time inbringing the food produced in rural areas to the cities.

Systems of Vertical farming

1. Hydroponics-

It is a method of growing food in water using mineral nutrient solutions without soil. In hydroponic systems, the roots of plants are submerged in liquid solutions containing macronutrients, such as nitrogen, phosphorus, sulphur, potassium, calcium, and magnesium, as well as trace elements, including iron, chlorine, manganese, boron, zinc, copper, and molybdenum. Additionally, inert (chemically inactive) mediums such as gravel, sand, and sawdust are used as soil substitutes to provide support for the roots. The basic advantages of this method are it reduces soil-related cultivation problems like soil borne insects, pest and diseases.

2. Aeroponics

In aeroponics, there is no growing medium and hence, no containers for growing crops. A liquid solution with nutrients is misted in air chambers where the plants are suspended. By far, aeroponics is the most sustainable soil-less growing techniques, as it uses up to 90% less water than the most efficient conventional hydroponic systems and requires no replacement of growing medium. Moreover, the absence of growing medium allows aeroponic systems to adopt a vertical design, which further saves energy as gravity automatically drains away excess liquid. As the plants are tied to a support and roots are sprayed with nutrient solution, it requires very less space, very less water and no soil.

3. Aquaponics

It is a bio-system that integrates recirculated aquaculture (fish farming) with hydroponic vegetable, flower, and herb production to create symbiotic relationships between the plants and the fish. It achieves this symbiosis through using the nutrient-rich waste from fish tanks to "fertigate" hydroponic production beds. In turn, the hydroponic beds also function as bio-filters that remove gases, acids, and chemicals, such as ammonia, nitrates, and phosphates, from the water. Simultaneously, the gravel beds provide habitats for nitrifying bacteria, which augment the nutrient cycling and filter water. Consequently, the freshly cleansed water can be recirculated into the fish tanks.

4. Controlled-environment agriculture

Controlled-environment agriculture (CEA) is the modification of the natural environment to increase crop yield or extend the growing season. CEA systems are typically hosted in enclosed structures such as greenhouses or buildings, where control can be imposed on environmental factors including air, temperature, light, water, humidity, carbon dioxide, and plant nutrition. In vertical farming systems, CEA is often used in conjunction with soilless farming techniques such as hydroponics, aquaponics, and aeroponics.

Advantages of vertical farming:

1. The first and the major advantage of vertical farming is producing extremely high yields per available land or area i.e. almost 80% more harvest per unit of area.
2. Continuous crop production: Producing the food throughout the year without the risk of vagaries of nature of nature like floods, heavy rains, uneven rains, hail and snowfall, drought, dry spells, extreme high temperatures, cold waves, epidemics of pest and diseases, etc.
3. Vertical farming uses 70 to 95 % less water compared to traditional farming.
4. No chances of soil born disease and pest attack.
5. Pesticide free or organic food is produced as there is no use of pesticides.
6. Due to reduced food supply chain, consumers get the fresh produce with its original nutrient qualities.
7. It allows farmers to grow plants in the indoor setting. Many farmers don't have arable lands, so for them vertical farming is a solution.
8. Less deforestation and land use, this means less erosion and less flooding It will lead to greening of the urban areas and help to reduce the rising temperatures and mainly the air pollution in cities.

Disadvantages of vertical farming:

1. Initial huge cost for establishing the vertical farming system is the major problem. It will include the cost erecting the structures along with its automation like Computerized and monitoring systems, remote control systems and software's, automated racking and stacking systems, programmable LED lighting systems, climate control system, etc.
2. The excess nutrients used in vertical farming may interfere and contaminate the main urban water system if not taken care of.
3. LED lighting systems emit heat though small amount will create problem of maintaining the temperatures especially in summer months and may overload the air conditioning systems which will again incur high energy cost.
4. Only certain crops can be grown through this method. Like small and medium-size crops. Crops that are mostly grown through this method are mushroom, spinach, tomato, leafy plants etc.
5. The wastewater and sludge from soils, from the vertical farms need an additional costly filtration system in order to be recycled and conservative of the water resources.
6. Displacement of agricultural societies, potential loss or displacement of traditional farming jobs.

CONCLUSION

India has one of the largest arable lands in the world and the food production has always been on par with the rest of the economies. Even though vertical farming is a great investment, not just for Indian economy but for the world over, there are far bigger issues for the Indian agricultural community to presently tackle that are killing its production value.

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Key factors gravely impacting agricultural production in India are:

1. Lack of proper storage
2. Lack of all-weather roads for efficient transportation
3. Lack of expert advice on crop management and future planning
4. Lack of proper delivery methods
5. Lack of electricity supply throughout the day

Vertical farming is definitely a solution to critical problems in Indian farming, but there are challenges like acceptance of vertical farming by Indian farming community.

The initial huge cost of infrastructure for a large-scale farm is a major hurdle for implementing vertical farming in India. Vertical farming in India has to face other challenges like public awareness, inclusiveness of farming community, technical know-how, cost incurred in managing and mainlining the vertical farm systems, and also its economic viability.

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Mullukurichi - In the Cradle of Kolli Hills

Article id: 23385
V. Keerthana
Assistant Professor
Imayam Institute of Agriculture and Technology, Thuraiyur – 621 206
Affiliated to Tamil Nadu Agricultural University, Coimbatore.

In all things of nature, there is something of the marvelous. Mullukurichi is such a kind of village that is located under the foothills of kolli malai. The village is enjoying most of the privileges from the mother god kolli ranges. We have searched on the sources available for satisfying the needs of this village. In that kolli hills occupies the major part. It is contributing for the food necessities of the village and makes the village being independent of the outer source for food.

INTRODUCTION*:*

Mullukurichi is a village in Namagiripet union in Rasipuram taluk, Namakkal district in Tamil Nadu state. The name reason for this village is Mullai and Kurinji which shows that this village comprises of mountains and forest regions. There are many villages located around the village. The people of the village does not need any other source for their food necessities. The mother kolli provides most of their needs and makes them self-sufficient. Let us see that the presence of kolli hills produces what impact on the village Mullukurichi.

Divine kolli:

Kolli hills is a preserved mountainous area of the Eastern Ghats located at the eastern border of Namakkal district. The elevation of the central region of the hill ranges from 1000m to 1350m above the mean sea level. Kolli itself can be divided into two main components; the periphery and the central part. Periphery is covered with uninhabited forests lying on more or less steep and largely contributes to the rich biodiversity attributed to the region. The central part is inhabited and is covered mostly by agricultural area.

The people of kolli hills was called as Malayali's and they classified land as vayal, mettukadu, kollakadu. The population of kolli hills is distributed in fourteen nadu's and 305 hamlets. There were many villages where agriculture is the major occupation. All types of fruits and vegetables are being cultivated in kolli hills and supplied to the villages at the foot hills.

Villages such as poosani kuliyal, sengarai, cholakadu, semmedu, vaasanoorpatti, poongavanam, maasi periyasamy, poosa, nariyangadu, nevakodu, serndhakaadu, avurikaadu, pungampatti, menur, sannangarai, paalampatti, thottikarai, othakadai, paapadam, tirupuli, poondhottam, asakaadu, thevanur, and valaaram etc. were cultivating fruit crops such as pine apple, jack fruit, butter fruit, egg fruit, naaval ,kodai orange and many other fruits. The very special malai vaalai of kolli is available only at Kolli hills and Mullukurichi people can get access to it. All types of vegetable are being cultivated in kolli hills including beetroot and broccoli etc. except carrot, potato and some crops. Coffee is major crop being cultivated there.

Kolli hills is famous for its spices. Spices includes pepper which is the major crop of kolli, cardamom, cinnamon, clove, nutmeg, thippili etc. are being cultivated there. All these vegetation's depends only on

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rainfall. Kolli hills is nourished with full of rainfall and very fertile organic soil and the produces will have better medicinal qualities. Natural farming is the only cultivating method in kolli hills.

All the produce will be brought to meet the necessities of Mullukurichi by road ways. The produce will also brought to solakaatu sandhai which is held twice a week on the kolli hills. Semmedu is the head of all villages of kolli hills. This made the village of Mullukurichi self-sufficient in food resources.

Pleasant weather:

The village is always enjoying mild climate throughout the year due to the presence of kolli hills. Kolli hills get rain from both southwest monsoon and northeast monsoon and this makes the village enjoying both the monsoons. The source of irrigation for the village is rainfall due to kolli hills and the Vaachukkal River from kolli hills.

CONCLUSION:

The kolli hills are featured in several works of classical Tamil literatures such as Silapathigaram, Manimekalai, Purananooru, Ingurunooru. The region was ruled by Valvil Ori around 200AD who is praised as one of the seven great philanthropists of ancient Tamil Nadu. The hills serves as the metaphor of that great legend Ori and providing all its resources to its villages. Mullukurichi is blessed to have its presence under the foot hills of mother kolli and should know the way to use it democratically.

"God had given the gift of life; it is up to us to give ourselves the gift of living well"

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Plant Growth Promoting Rhizobacteria for enhanced Crop Production

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Yogendra Singh
Assistant Professor (Senior Scale)-Biotechnology,
Department of Plant Breeding and genetics, JNKVV, Jabalpur

Plant Growth Promoting Rhizobacteria (PGPR) were first defined by Kloepper and Schroth to describe soil bacteria that colonize the roots of plants following inoculation onto seed and that enhance plant growth. The following are implicit in the colonization process: ability to survive inoculation onto seed, to multiply in the spermosphere (region surrounding the seed) in response to seed exudates, to attach to the root surface, and to colonize the developing root system. The ineffectiveness of PGPR in the field has often been attributed to their inability to colonize plant roots. A variety of bacterial traits and specific genes contribute to this process, but only a few have been identified. These include motility, chemotaxis to seed and root exudates, production of pili or fimbriae, production of specific cell surface components, ability to use specific components of root exudates, protein secretion, and quorum sensing. The generation of mutants altered in expression of these traits is aiding our understanding of the precise role each one plays in the colonization process. Progress in the identification of new, previously uncharacterized genes is being made using nonbiased screening strategies that rely on gene fusion technologies.

Mechanisms of Action:

PGPRs enhance plant growth by direct and indirect means, but the specific mechanisms involved have not all been well characterized. Direct mechanisms of plant growth promotion by PGPRs can be demonstrated in the absence of plant pathogens or other rhizosphere microorganisms, while indirect mechanisms involve the ability of PGPRs to reduce the harmful effects of plant pathogens on crop yield. PGPRs have been reported to directly enhance plant growth by a variety of mechanisms: fixation of atmospheric nitrogen transferred to the plant production of siderophore that chelate iron and make it available to the plant root, solubilization of minerals such as phosphorus, and synthesis of phytohormones. Direct enhancement of mineral uptake due to increases in specific ion fluxes at the root surface in the presence of PGPRs has also been reported. PGPR strains may use one or more of these mechanisms in the rhizosphere. Molecular approaches using microbial and plant mutants altered in their ability to synthesize or respond to specific phytohormones have increased understanding of the role of phytohormone synthesis as a direct mechanism of plant growth enhancement by PGPRs. PGPR that synthesize auxins and cytokinins or that interfere with plant ethylene synthesis have been identified.

PGPR as Bio fertilizers:

Free-living PGPR have shown promise as biofertilizers. Many studies and reviews have reported plant growth promotion, increased yield, solubilization of P (phosphorus) or K (potassium), uptake of N (nitrogen) and some other elements through inoculation with PGPR. In addition, studies have shown that inoculation with PGPR enhances root growth, leading to a root system with large surface area and increased number of root hairs. A huge amount of artificial fertilizes are used to replenish soil N and P, resulting in high costs and increased

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environmental pollution. Most of P in insoluble compounds is unavailable to plants. N2-fixing and P-solubilizing bacteria may be important for plant nutrition by increasing N and P uptake by the crop plants, and playing a crucial role in biofertilization. N2-fixation and P-solubilization, production of antibiotics, and other plant growth promoting substances are the principal contribution of the PGPR in the agro-ecosystems. More recent research findings indicate that the treatment of agricultural soils with PGPR inoculation significantly increases agronomic yields as compared to un inoculated soils.

Nitrogen Fixation: Nitrogen fixation is one of the most beneficial processes performed by rhizobacteria. Nitrogen is a vital nutrient to plants and gaseous nitrogen (N_2) is not available to them due to the high energy required to break the triple bonds between the two atoms. Rhizobacteria, through nitrogen fixation, are able to convert gaseous nitrogen (N_2) to ammonia (NH_3) making it an available nutrient to the host plant which can support and enhance plant growth. The host plant provides the bacteria with amino acids so they do not need to assimilate ammonia. The amino acids are then shuttled back to the plant with newly fixed nitrogen. Nitrogenase is an enzyme involved in nitrogen fixation and requires anaerobic conditions. Membranes within root nodules are able to provide these conditions. The rhizobacteria require oxygen to metabolize, so oxygen is provided by a hemoglobin protein called leghemoglobin which is produced within the nodules. Legumes are well-known nitrogen-fixing crops and have been used for centuries in crop rotation to maintain the health of the soil.

Table 1. PGPR and their effect on growth parameters/ yields of crop/fruit plants.

S.N	PGPR	Crop parameters
1	*Rhizobiumleguminosarum*	Direct growth promotion of canola and lettuce
2	*Pseudomonas putida*	Early developments of canola seedlings, growth stimulation of tomato plant
3	*P. flurescens*	Growth of pearl millet, increase in 4growth, leaf nutrient contents and yield of banana (*Musa*)
4	*Azotobacter* and *Azospirillum*spp.	Growth and productivity of canola

Phosphate solubilising Bacteria (PSB):

These are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds. P-solubilization ability of rhizosphere microorganisms is considered to be one of the most important traits associated with plant phosphate nutrition. It is generally accepted that the mechanism of mineral phosphate solubilization by PSB strains is associated with the release of low molecular weight organic acids, through which their hydroxyl and carboxylgroups chelate the cations bound to phosphate, thereby converting it into soluble forms. PSB have been introduced to the Agricultural community as phosphate Biofertilizer. Phosphorus (P) is one of the major essential macronutrients for plants and is applied to soil in the form of phosphate fertilizers. However, a large portion of soluble inorganic phosphate which is applied to the soil as chemical fertilizer is immobilized rapidly and becomes unavailable to plants. Currently, the main purpose in managing soil phosphorus is to optimize crop production and minimize P loss from soils. PSB have attracted the attention of agriculturists as soil inoculums to improve

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the plant growth and yield. When PSB is used with rock phosphate, it can save about 50% of the crop requirement of phosphatic fertilizer. The use of PSB as inoculants increases P uptake by plants. Simple inoculation of seeds with PSB gives crop yield responses equivalent to 30 kg P_2O_5 /ha or 50 percent of the need for phosphatic fertilizers. Alternatively, PSB can be applied through fertigation or in hydroponic operations. Many different strains of these bacteria have been identified as PSB, including *Pantoea agglomerans* (P5), *Microbacterium laevaniformans* (P7) and *Pseudomonas putida* (P13) strains are highly efficient insoluble phosphate solubilizers. Recently, researchers at Colorado State University demonstrated that a consortia of four bacteria (sold commercially as Mammoth P), synergistically solubilize phosphorus at a much faster rate than any single strain alone.

Rhizobium and phosphorus (P) solubilizing bacteria are important to plant nutrition. Thesemicrobes also play a significant role as PGPR in the biofertilization of crops. These bacteria secrete different types of organic acids (e.g., carboxylic acid) thus lowering the pH in the rhizosphere and consequently release the bound forms of phosphate like Ca3 (PO4)2 in the calcareous soils. Utilization of these microorganisms as environment-friendly biofertilizer helps to reduce the use of expensive phosphatic fertilizers. Phosphorus biofertilizers could help increase the availability of accumulated phosphate (by solubilization), increase the efficiency of biological nitrogen fixation and render availability of Fe, Zn, etc., through production of plant growth promoting substances.

Phytohormone Production:

Plant hormones affect gene expression and transcriptionlevels, cellular division, and growth. They are naturally produced within plants, though very similar chemicals are produced by fungi and bacteria that can also affect plant growth. A large number of related chemical compounds are synthesized by humans. They are used to regulate the growth of cultivated plants, weeds, and in vitro-grown plants and plant cells; these manmade compounds are called plant growth regulators or PGRs for short.The enhancement in various agronomic yields due to PGPR has been reported because of the production of growth stimulating phytohormones (*Table* 2) such as indole-3-acetic acid (IAA), gibberellic acid (GA3), zeatin, ethylene and abscisic acid (ABA).

Table 2. Examples of different phytohormone-producing PGPR.

S.N	**Phytohormones**	**PGPR**
1	Indole-3-acetic acid (IAA)	*Acetobacter diazotrophicus* and*Herbaspirillum seropedicae*
2	Indole-3-acetic acid (IAA)	Indole-3-acetic acid (IAA)
3	Gibberellic acid (GA3)	*Azospirillumlipoferum*
4	Abscisic acid (ABA)	*Azospirillum brasilense*

Recent studies confirmed that the treatment of seeds or cuttings with non-pathogenic bacteria, such as *Agrobacterium, Bacillus, Streptomyces, Pseudomonas, Alcaligenes,* etc. induce root formation in some plants because of natural plant growth promoting substances produced by the bacteria. Although the mechanisms are not completely understood, root induction by PGPR is the accepted result of phytohormones such as auxins, growth inhibiting ethylene and mineralization. Environment-friendly applications in agriculture have gained more importance, in particular in horticulture and nursery production. The use of PGPR for nursery material multiplication may be important for obtaining organic nursery material because the uses of all formulations of synthetic plant growth regulators, such as indole-3-butyric acid (IBA), are prohibited in organic agriculture throughout the world.

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Classification of organic compounds present in the rhizosphere

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Saptaparnee Dey[1] and Sudip Sengupta[2*]
[1]*Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi-110012*
[2] *Department of Agricultural Chemistry & Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, 741252*

Rhizosphere and rhizodeposits:

The rhizosphere is defined as the soil volume influenced by root activity (Hinsinger, 1998) i.e. it is the zone of the soil which is directly under the influence of metabolizing plant roots. This small and particular soil volume is characterized by fluxes and gradients of both organic and inorganic compounds that are fundamental to rhizosphere processes. These latter, in turn, are able to influence considerably the transformations and flows of nutrients from soil to plant. Rhizosphere processes and the rhizosphere effects on plants are governed mainly by the release from roots, which is a complex mixture of low and high molecular weight substances (such as protons, carbohydrates, organic acids, amino acids, phytosiderophores, phenolics and enzymes).

These substances are able to induce fundamental changes in the chemical, physical and biological characteristics of the part of soil closely surrounding the roots. They are involved in important pedogenic and rhizospheric processes involving fundamental functions such as

- Modulation of nutrient availability (Fe, P, Zn)
- Root protection against toxic metals (Al, Zn, Cd) or pathogens (Bais et al., 2004) and
- Attraction and/or repulsion of microorganisms (Bais et al., 2006) which may enhance or restrict these rhizosphere processes, can play an important role in determining nutrient availability for plants in the rhizosphere.

In higher plants, a substantial proportion (20–60%) of photosynthetic carbon is allocated below-ground (Grayston et al., 1996). Depending on root activity, 15–60% of this carbon fraction is used for root respiration and is released as CO2. However, a substantial proportion of assimilates reaches the rhizosphere as organic carbon, as rhizodeposition. Amount and composition of the released compounds are highly variable and affected by multiple factors. Estimates of rhizodeposition range from 800 to 4500 kg C/ha/year (Kuzyakov and Domanski, 2000) and can comprise up to 70% of the carbon (C) translocated below-ground in perennials and up to 40% in annual plants. Free amino acids and proteins usually make up only a minor fraction of organic compounds released from undamaged plant roots (typically 1–2% of released C) (Jones and Darrah, 1994), therefore it is assumed that N rhizodeposition may be related to root turnover or efflux of inorganic N forms such as ammonium and/or nitrate (Jones et al., 2009).

Classes of rhizosphere deposition:

There are mainly five types of rhizosphere deposition- exudates, secretion, mucilage, mucigel and lysate.

Exudates: Low molecular weight compounds which are easily leaked out from plants via cell junction are called exudates. The large concentration gradient of low molecular weight (LMW) solutes usually existing between the cytosol (millimolar concentrations) and the rhizosphere (micromolar concentrations as a consequence of microbial degradation), promotes outward diffusion of LMW compounds. Moreover, the outward positive electrochemical potential gradient, created by proton extrusion via proton motive H+ ATPases, further promotes outward diffusion of LMW compounds which are negatively charged at the pH of the cytosol (7.0–7.5), such as organic acids and amino acids (Neumann, 2007). As they are highly soluble in nature, so plants need not use their energy for exudation, so it is a passive way. In the rhizosphere, these compounds may contribute to nutrient cycling as C and N sources for rhizosphere microorganisms. Major fractions of LMW compounds detected in root exudates include sugars, organic acid anions, amino acids and various phenolics. Due to rapid microbial decomposition, the half-life of many LMW compounds in the rhizosphere is only 1–5 hours (Jones et al., 2004). The root exudate fraction may be further subdivided into (a) low-molecular-weight organic compounds permanently lost from root cells by diffusion (diffusates), (b) root secretions with special functions in nutrient mobilization, detoxification, and defense reactions or as root signals, released by controlled mechanisms via membrane channels or transport proteins, and (c) metabolic waste products released as root excretions. Carbon input into soils via root exudation may comprise 5–10% of the net fixed carbon in soil-grown plants (Jones et al., 2004), immobilization of exudates on the soil matrix by adsorption and complexation can protect against biodegradation and substantially increase their residence time in soils.

Secretions: It is similar to exudation but here high molecular weight compounds are released by the plants in active process i.e. plants need to use their metabolic energy to release those compounds. Polygalacturonic acid, polysaccharides are mainly released by roots through secretion.

Mucilage: Mucilage is mainly secreted via Golgi apparatus of hypersecretory cells of the root cap as a high molecular weight gelatinous polygalacturonic acid polysaccharide and is subsequently transferred during root elongation to older root zones, but epidermal cells are also able to secrete mucilage. Root mucilage forms a gelatinous layer surrounding root tips and is one of the few clearly visible signs of organic C excretion from roots (Jones et al., 2009). This substance is mainly composed of polysaccharides, proteins and some phospholipids (Read et al., 2003) and they are plant specific. Maize (Zea mays) root mucilage contains high levels of galactose, xylose, arabinose, rhamnose, and glucose, and lower levels of uronic acid, mannose and glucuronic acid. The amounts of mucilage synthesized in vitro range from 11 to 47 µg MS / mg MS root growth (Nguyen, 2009). The initiation of mucilage synthesis actually takes place in the endoplasmic reticulum and completes in the Golgi saccules. The slime is transported to the plasmalemma by the Golgi vesicles and it is discharged between the plasmalemma and the cell wall by exocytosis. All these processes are energy-dependant. The passage through the cell wall is not systematic and the mucilage can accumulate at the inner wall surface. It is assumed that if both the degree of hydratation of the mucilage and the cell turgor are sufficient, the slime moves passively through the cell wall and forms a

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droplet at the root tip (Morre et al., 1967). The passage through the cell wall is probably due to an increase in the permeability of the middle lamella. Under controlled conditions, the formation of the droplet follows a 3–4 hour cycle (Morre et al., 1967). The root cap mucilage is able to hydrate extensively. But if the soil is unsaturated, the root cap mucilage appears as a dry coating over the apex and does not form a droplet as it is often observed in vitro. Mucilage and living border cells tightly adhering to the root form rhizosheath. The sheath is not observed just behind the root tip because the epidermis of this area has a thick complex surface on which mucilage does not adhere (McCully, 1999). The formation of the rhizosheath from root cap mucilage suggests that its mineralization by microorganisms is reduced or very slow. In vitro, root mucilage can readily be utilised by rhizosphere bacteria as a sole source of carbon. However, in the rhizosphere, mucilage mineralization may be delayed by the preferential use by microorganisms of root exudates, which are more readily available and by the protection of mucilage due to its adsorption to the soil matrix.

Mucigel: Mucilage is further transformed by micro organisms. Mucilage along with soil colloids, soil organic matter, microorganisms, sloughed off cells of plant tissue form mucigel. In non-sterile media, mucilage also includes substances produced by microbial degradation of the cell walls. In soil-grown plants, the mucilage is usually invaded by microorganisms, and both organic and inorganic soil particles are embedded in it. This mixture of gelatinous material, microorganisms and soil particles is termed mucigel.

Lysate: Lysate comes out from mature cortical cells when plasmalemma fails. Again, many plants can produce large numbers of metabolically active root —border cells, which are programmed to separate from each other and to be released from the root cap periphery into the external environment. The separated cells adhere to the root tip in the absence of free water. The daily rate of border cell production is highly variable among plant species, from a dozen in tobacco to more than 10,000 cells/day for cotton and pine, with release rates being highly dependent upon the prevailing environmental conditions. Plant roots also release a wide range of proteins (secretory proteins) including various enzymes. Secretory proteins are synthesized by polysomes attached to the endoplasmic reticulum (ER) and are segregated into the ER lumen already during the translation process. During the passage through the Golgi apparatus, transfer vesicles containing the secretory proteins are separated from vesicles with vacuolar destination. After reaching the plasma membrane, the proteins in the vesicles are released into the apoplasm via exocytosis. All processes linked with exocytosis strongly depend on calcium ion supply. A wide range of internal and external factors determine amount and composition of rhizodeposition. Rhizodeposition can be stimulated by increased mechanical impedance of the growth substrate, by toxic elements and low pH in the soil solution, limitation of nutrients, high light intensity, elevated atmospheric CO2 concentrations, temperature extremes, and the presence of microorganisms. Depending on origin and release mechanisms, rhizodeposition may be subdivided into two main fractions: (i) lysates of sloughed-off cells and tissues originating from root turnover which can comprise up to 50% of the below ground carbon translocation and (ii) organic compounds released from intact root cells as so-called root exudates. Carbon input into soils via root exudation may comprise 5–10% of the net fixed carbon in soil-grown plants (Jones et al., 2004). A significant proportion of C also reaches the soil via mycorrhizal hyphae which may be comparable with that

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of fine roots. In case of ectomycorrhizal fungi, hyphal carbon input may even be the dominant pathway of carbon transfer into the soil (Godbold et al., 2006).

CONCLUSION:

Rhizodeposits are usually aplenty but their classification can unearth new research potentials for their utilization in various responses of soil favouring plant growth and development. The nutrient cycling, soil aggregation, better plant stand etc. as influenced by such deposits further usher the potentiality of the increased volume of production by biotechnical and genetic engineering of plants. This being a new area of research can in future be a holistic solution to agriculture under variable resource environment.

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Thrips tabaci- a pest of major concern in onion and its sustainable way of management

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M. Soniya Devi, Usha, V.K. Mishra and Ashim Debnath[1]
College of Agriculture, Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, India 284003
[1]Narendra Dev University of Agriculture and Technology,Faizabad, Uttar Pradesh 224229

INTRODUCTION

Onion is a vegetable that is widely cultivated throughout the world. Onions and related allium crops are subjected to attack by a variety of diseases and arthropod and nematode pests that can reduce crop yield and quality. Among the insect pests, onion thrips, *Thrips tabaci* Lindeman has become a global pest of increasing concern in the past three decades.

Brief description on thrips

Thrips is a regular and potential pest of onion and cause considerable yield losses. It belongs to the order Thysanoptera, Suborder Terebrantia and Family Thripidae. The life stages exhibited by *T. tabaci* consist of four immature stages, two of which are active and two of which are inactive. The two active immature stages are termed first and second stage larvae (nymph) and the inactive stages are called as pre-pupa and pupa. First stage larvae are extremely small, around 0.5 mm in length and begin to feed very quickly after hatching. The nymph with the help of rasping and sucking mouthpart lacerate the leaves and suck the plant sap. First stage larvae feed constantly for a few minutes after their emergence until they have reached a size that is roughly twice their original length, approximately 1 mm on onion then they undergo the moulting process. Following the second larval stage, the thrips move into a two stage period of inactivity, usually takes place in the surrounding soil. The first of these two stages is called the pre-pupa. At this point, wing buds are visible on the immature thrips, which is immobile. The pre-pupa eventually moults into the final immature stage, the pupa, which is immobile. Once the thrips has developed fully inside its pupal case, the adult emerges.

Nature of damage

Immature and adult thrips feed with a punch-and-suck behavior that removes leaf chlorophyll causing white to silvery patches and streaks. Feeding of *T. tabaci* destroys the epidermal cells of onion, causing the leaf whitening. Reproduction of *T. tabaci* is entirely parthenogenetic. They can damage crop indirectly even through the transmission of lethal plant viruses. They are responsible for the transmission Iris yellow spot virus. Thrips attack onion at all the stages of crop growth but their count increases from bulb initiation and remain high up to bulb development and maturity. However, once established and growing vigorously, most plants could tolerate feeding damage.

The seasonal occurrence and development of all the insect pests are much dependent upon the prevailing environmental factors such as temperature, relative humidity and precipitation. The total variability in thrips population in crops is determined by the natural growth of population and the influence of weather on activity and rate of multiplication of the insects. Weather variables including rainfall, temperature, relative humidity and wind have been reported as important factors that significantly affect thrips population. In rabi onion, the population reaches its peak at the end of march month and beginning of April.

It is difficult to control this pest with insecticides because of its small size and cryptic habits. Failure to control this pest causes considerable damage and results in immense economic losses by remarkably reducing yield. Farmers are extensively using different types of insecticides for controlling the pest. However, a repeated application of chemicals is not a desirable practice, as this could lead to undesirable resistance problems. To avoid further resistance in this pest, different non chemical methods need to be evaluated. Multi-pronged pest management strategies that boost onion plant health and tolerance to thrips, in addition to suppressing thrips densities, have to be developed for the most sustainable and economically viable thrips management tactics.

Strategy for minimizing thrips population

- Removal of volunteer onion plants and weeds around the cultivated fields
- Early transplanted onions were well established before infestations became severe and without application of insecticides significantly higher yields can be achieved.
- Straw mulching also reported to be helpful in reduction of its population.
- Sanitation through destruction of cull onions, volunteer onion plants and weed hosts in the field after harvest is essential because they can serve as an overwintering site of *T. tabaci.*
- Live barrier crops used surrounding onion are 2 rows of maize, an outer row of maize + an inner row of wheat and 2 rows of wheat lowers the number of thrips.
- Blue sticky traps are more preferred for catching thrips than the other coloured traps (Devi and Roy, 2017).
- The entomogenous fungus, *Metarhizium anisopliae*, has the potential to control onion thrips in onion
- Some of the predators of onion thrips include *Aelothrips* spp., green lacewing, *Chrysoperla* spp. larvae, minute pirate bug, *Orius* spp., coccinellid, *Coleomegilla maculata* and big-eyed bug, *Geocoris* spp.
- IPM module can be adopted as it will help in sustainable management without deteriorating much resources and polluting the environment (comprised of wheat and maize as barrier crops, seed treatment with imidacloprid 70WS and spraying of *Beauveria bassiana* 10 SC and spinosad 45SC at ETL) (Devi and Roy, 2018)

CONCLUSION

Thrips has become the pest of worldwide concern in different host crop. Its attack leads to the reduction of considerable amount of yield. As the size of thrips is very small and remains hidden in the innermost part of tender leaves, it is a cumbersome task to control the thrips with application of insecticides. Hence, a suitable combination of different management techniques needs to be adopted for the sustainable production of onion crop.

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Role of insects in environment

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V. K. MISHRA, USHA & M. SONIYA DEVI
College of Agriculture, Rani Lakshmi Bai Central Agricultural University, Jhansi-284003

INTRODUCTION

Insects represent a specific group of animals both in the variety of biological features and in their diverse functions in ecosystem .There are some 5 to 30 million insect species estimated in the world. Insects are those that cause disease or compete for human agricultural products, but these insects represent only a small fraction of the world's insect population. In reality, most insects are *beneficial* to humans and the environment, not detrimental. Without insects, the environment could not function as it does, yet few of us have considered how these numerous and varied organisms actually affect our lives (Hevel, 2005). Insects play one of the most important roles in their ecosystems, which include many roles, such as soil turning and aeration, dung burial, pest control, pollination, and wildlife nutrition.

a. Soil turning and aeration: Insects play a key role in breaking down mulch, converting it into rich humus and improving the soil fertility, texture and structure. Example- Decomposition is a process that recycles nutrients back to the soil from formerly living organisms. The process can involve soil organisms breaking-down large pieces of organic matter into smaller ones which is done by many insect.

b. Plant-shredding insects: Plant-shredding arthropods break down dead plant matter to eat bacteria and/or fungi present on the matter. This shredding action helps to incorporate organic material into the soil. Most plant shredders are diplopods and crustaceans, but some insects, such as cockroaches, also shred dead plant matter.

c. Scavengers: Predacious arthropods feed on the live or dead bodies of other soil organisms. The digestion of the organisms breaks down the nutrients present in their bodies and adds to the organic matter of the soil.

d. Herbivorous insects: Herbivorous soil-dwelling arthropods eat the roots of plants, and include insects such as mole crickets and root maggots. In a healthy and balanced soil environment, herbivorous soil insects stimulate plant root growth while cycling and adding nutrients to the soil through their feces.

e. Fungus-eating insects: Fungus-eating arthropods keep fungal growth under control. Moreover, they cycle and release fungal growth nutrients through digestion and excretion of fecal matter. Silverfish are the most prevalent fungus-eating and soil-dwelling insects. These insects live near plant roots to take advantage of the fungus feeding ground that roots supply (Magallon and Sanderson, 2001).

f. Dung burial: Confining large mammals in small areas creates challenging waste-management problems. Fortunately, insects—especially beetles in the family Scarabaeidae (Ratcliffe 1970)—are very efficient at decomposing this waste.

g. Role in pest control

- **Insect predators:** Predators are mainly free-living species that directly consume a large number of prey during their whole lifetime.

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- Ladybugs, and in particular their larvae which are active between May and July in the northern hemisphere, are voracious predators of aphids, and will also consume mites, scale insects and small caterpillars.
- The larvae of many hoverfly species principally feed upon greenfly, one larva devouring up to fifty a day, or 1000 in its lifetime. They also eat fruit tree spider mites and small caterpillars. Adults feed on nectar and pollen, which they require for egg production.
- **Parasitoid insects:** Parasitoids lay their eggs on or in the body of an insect host, which is then used as a food for developing larvae. The host is ultimately killed. Most insect parasitoids are wasps or flies, and usually have a very narrow host range.

h. Role in pollination: Pollination is the process by which pollen is transferred in the reproduction of plants, thereby enabling fertilization and sexual reproduction. Most flowering plants require an animal to do the transportation. While other animals are included as pollinators, the majority of pollination is done by insects.

i. Relationship to humans

- Many insects have a parasitic relationship with humans such as the mosquito. These insects are known to spread diseases such as malaria and yellow fever and because of such, mosquitoes indirectly cause more deaths of humans than any other animal.
- Many insects are considered pests by humans. Insects commonly regarded as pests include those that are parasitic (mosquitoes, lice, bed bugs), transmit diseases (mosquitoes, flies), damage structures (termites), or destroy agricultural goods (locusts, weevils).
- Some of the more popular insects and arachnids eaten around the world include crickets, cicadas, grasshoppers, ants, various beetle grubs (such as mealworms), the larvae of the darkling beetle or rhinoceros beetle, various species of caterpillar (such as bamboo worms, mopani worms, silkworms and waxworms), scorpions and tarantulas.
- The value of commercially produced insect-derived products, such as honey, wax, silk, or shellac, and any value derived from the capture and consumption of insects themselves can also not be ignored.

j. Role in biological research: Insects play important roles in biological research. For example, because of its small size, short generation time and high fecundity, the common fruit fly *Drosophila melanogaster* is a model organism for studies in the genetics of higher eukaryotes. *D. melanogaster* has been an essential part of studies into principles like genetic linkage, interactions between genes, chromosomal genetics, development, behavior, and evolution.

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Effect of gold rush (migration) on hill agriculture (the unseen gold)

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Rajan Singh Gusain[1*], Pramod Sharma[2] and Kriti Semwal[3]
[1]M.Sc. Student, Department of Soil and Water Management, Dr YSP UHF, Nauni. HP-173230
[2]P.hD Scholar, Department of Seed Science and Technology, Dr YSP UHF, Nauni. HP-173230
[3]M.Sc. Student, Department of Fruit Science, Dr YSP UHF, Nauni. HP-173230

INTRODUCTION

The increasing rate of displacement of people from Uttarakhand's Kumaon and Garhwal district causes negative impact on the socio-economic environment in the area. Uttarakhand predominantly hilly region fall into the lower Himalayan range known as Shiwalik hills. Mountains include some of the most fragile ecosystems since they are particularly sensitive to changes resulting from natural and anthropogenic factors. Mountain communities rely mainly on subsistence farming, livestock, and income generation through small scale trade, and wages and casual labour for their livelihood. According to Food and Agricultural Organization (FAO) more than 75% of the land surface of the world's mountain regions as inadequate or marginally suitable for farming. It has also been noted that the proportion of poor and vulnerable people increases with elevation (Joshi B., 2018). There are indications that poverty inequality between people on mountain and those living in other areas is rising. Currently, mountain ecosystems as well as mountain communities are particularly threatened by the ongoing processes of global environmental change, population dynamics, and economic globalization (ICIMOD, 2010).

Riches of hill agriculture in Uttarakhand

The climatic conditions of this region are extremely favorable for the cultivation of various agricultural crops such as finger millet (kharif) , barnyard millet , black gram, horse gram (kulth), black soybean, barley , lentil, madwa (ragi) etc. as well as medicinal and aromatic crops such as *cinnamon tamala, Juniper communis* etc. Besides, medicinal flora such as 102 species of etheno medicinal plants belong to 48 families are being used in folk medicinal system by the indigenous people of the region; a boon that can be attributed to the unique location of the region with its setting in the Himalayan range that has bestowed the region with the congenial climate and soil for specific medicinal crop production which is not seen anywhere else in the world. The hill agriculture system of Uttarakhand has also a great potential to be developed as a paradigm of organic cultivation since the use of toxic chemicals such as pesticide, fertilizer etc is very low in hills (mostly in the upper hills) because of low temperature that generally prevents the outbreak of pests and the consequent spreading of disease, etc. As a result, the food produced in these hills is very nutritious and can fetch high prices if marketed under the tag of organic foods from the Uttarakhand hiils.

The forests of the region are well known for the benefits such as they yield in the form of providing timber, shelter, food and source of earning livelihood to the inhabitants. Forests have been saviors of humans since early times. The people living in the hills belong to the specific culture, tribes and have specific indigenous technical knowledge (ITK). As a result, many of the forest products prepared by them are unique and have become famous worldwide and in several cases have earned the status of Geographical indices which can be attributed to the magic blend of latitude and longitude and their hardwork & ITK. One such example is of Geographical indices is "Uttarakhand Tejpatta (GI)" i.e. *cinnamon tamala* in which is native to the hills of Nainital, Chamoli, Tehri, Bageshwar, Almora, Pithoragarh & Champawat. These are grown by tribal people at height of 1000 to 2000 meters and have high medicinal value. The bright red flower of *Rhododendron arboreum* commonly known as "Buransh flower" is also another forest product that has great medicinal value. However, despite the abundance of resources that nature has bestowed on this region, the large scale displacements of the natives of the region to the cities has become a major cause of concern for these hills that are fast losing their guardians. Many of the houses are left with just one occupant, most often an elderly person residing in a house built by his / her son or daughter and taking care of 10 other unpeopled houses like a watchman because the occupants have moved away to settle in plains leaving behind deserted structures that once were people's homes. The once prosperous farming zones of the hills have now turned barren and been consumed by wilderness. Furthermore, large tracts of the previously cultivable lands have today become prone to erosion due to heavy rainfall and landslides in the absence of agricultural activities. All these facts underscore the sad reality of Uttarakhand, mainly hilly region where majority of the population has migrated to plain regions of Dehradun, Delhi, Haridwar, etc. As per the 2011 census of Uttarakhand, 1,053 villages out of a total of 16,793 villages have become 'ghost villages' since they have no inhabitants on records while another 405 villages have population less than 10. The number of such ghost villages has reportedly risen particularly after the natural calamities; the havoc wreaking earth quake and flash floods of 2013. Recent media reports put the number of such ghost village at 3500. It has been reported that the number of such abandoned villages risen after the massive disaster of 2013 (Mamgain and Reddy, 2015). Recent media reports put the number of such ghost village at 3500.

CONCLUSION

The only possible solution to this problem is that the natives of the region, especially the youth realize the true value of their region and instead of falling prey to the lure of the city life, explore means of earning their livelihoods in their region. The rich flora, forest wealth, fertile lands and abundance of natural resources can provide great means of self sustenance for the youth of the day. It cannot be deny the fact that the hills have several problems like scattered lands, tough terrains, difficult transportation, shortage of basic amenities etc that may pose a serious challenge to anyone wanting to earn a livelihood from agriculture in this region. Therefore there is a need to join hands and start to make sincere efforts, drawing attention of the concerned authorities and finding solutions to the myriad problems that plague this region. Instead of turning their backs on the region and being lured by the comforts of the cities, the youth of the region need to come forward and shoulder the responsibility of developing the region and harnessing the huge potential of resources that nature has bestowed upon the region. This may be the only way to revive the lost glory of a region that may otherwise be lost to the ages.

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Soil Degradation: A global problem endangering sustainable development

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Manisha Apraj[1], Roshan Jadhav[2]
[1]Ph. D. Scholar, Department of soil science and agricultural chemistry
[2]Ph. D. Scholar, Department of plant physiology
PGI, MPKV, Rahuri, Dist- Ahmednagar (413 722)

INTRODUCTION:-

Soil degradation in India is estimated to be occurring on 147 million hectares (Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity, and 7 Mha from a combination of factors. This is extremely serious because India supports 18% of the world's human population and 15% of the world's livestock population, but has only 2.4% of the world's land area. Despite its low proportional land area, India ranks second worldwide in farm output. Agriculture, forestry, and fisheries account for 17% of the gross domestic product and employs about 50% of the total workforce of the country.

Soil Degradation

Soil degradation, decline in its capacity to support functions and provide ecosystem services, is caused by erosion, salinization, elemental imbalance, acidification, depletion of soil reduction in soil biodiversity and structure and tilth. Land degradation is not being adequately addressed, but is of vital importance to raise awareness so that future land management decisions can lead to more sustainable and resilient agricultural systems. Of India's total geographical area (328.7 Mha), 304.9 Mha comprise the reporting area with 264.5 Mha being used for agriculture, forestry, pasture and other biomass production. The severity and extent of soil degradation in the country has been previously assessed by many agencies .According to the National Bureau of Soil Survey and Land Use Planning ~146.8 Mha is degraded. Water erosion is the most serious degradation problem in India. Based on first approximation analysis of existing soil loss data, the average soil erosion rate was ~16.4 ton $ha^{-1}year^{-1}$ .Nearly 29% of total eroded soil is permanently lost to the sea, while 61% is simply transferred from one place to another and the remaining 10% is deposited in reservoirs

Extent of land degradation in India, as assessed by different organizations.

Organizations	Assessment Year	Degraded Area (Mha)
National Commission on Agriculture	1976	148.1
Ministry of Agriculture-Soil and Water Conservation Division	1978	175.0
Department of Environment	1980	95.0
National Wasteland Development Board	1985	123.0
Society for Promotion of Wastelands Development	1984	129.6
National Remote Sensing Agency	1985	53.3
Ministry of Agriculture	1985	173.6
Ministry of Agriculture	1994	107.4
NBSS&LUP	1994	187.7
NBSS&LUP (revised)	2004	146.8

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Causes of Soil Degradation

Physical Factors

There are several physical factors contributing to soil degradation distinguished by the manners in which they change the natural composition and structure of the soil. Rainfall, surface runoff, floods, wind erosion, tillage, and mass movements result in the loss of fertile top spoil thereby declining soil quality. All these physical factors produces different types of soil erosion (mainly water and wind erosion) and soil detachment actions, and their resultant physical forces eventually changes the composition and structure of the soil by wearing away the soil's top layer as well as organic matter. In the long-term, the physical forces and weathering processes lead to the decline in soil fertility and adverse changes in the soil's composition/structure.

Biological Factors

Biological factors refer to the human and plant activities that tend to reduce the quality of soil. Some bacteria and fungi overgrowth in an area can highly impact the microbial activity of the soil through bio-chemical reactions, which reduces crop yield and the suitability of soil productivity capacity. Human activities such as poor farming practices may also deplete soil nutrients thus diminishing soil fertility. The biological factors affect mainly lessens the microbial activity of the soil.

Chemical Factors

The reduction of soil nutrients because of alkalinity or acidity or water logging are all categorized under the chemical components of soil degradation. In the broadest sense, it comprises alterations in the soil's chemical property that determine nutrient availability. It is mainly caused by salt buildup and leaching of nutrients which corrupt the quality of soil by creating undesirable changes in the essential soil chemical ingredients. These chemical factors normally bring forth irreversible loss of soil nutrients and productivity capacity such as the hardening of iron and aluminum rich clay soils into hardpans.

Deforestation

Deforestation causes soil degradation on the account of exposing soil minerals by removing trees and crop cover, which support the availability of humus and litter layers on the surface of the soil. Vegetation cover primarily promotes thee binding of the soil together and soil formation, hence when it is removed it considerably affects the capabilities of the soil such as aeration, water holding capacity, and biological activity.

When trees are removed by logging, infiltration rates become elevated and the soil remains bare and exposed to erosion and the buildup of toxicities. Some of the contributing activities include logging and slash and burn techniques used by individuals who invade forest areas for farming, rendering the soils unproductive and less fertile in the end.

Misuse or excess use of fertilizers

The excessive use and the misuse of pesticides and chemical fertilizers kill organisms that assist in binding the soil together.The complex forms of the fertilizer's chemicals are also responsible for denaturing essential soil minerals, giving rise to nutrient losses from the soil. Therefore, the misuse or excessive use of fertilizers increases the rate of soil degradation by destroying the soil's biological activity and builds up of toxicities through incorrect fertilizer use.

Industrial and Mining activities

Soil is chiefly polluted by industrial and mining activities. As an example, mining destroys crop cover and releases a myriad of toxic chemicals such as mercury into the soil thereby poisoning it and rendering it unproductive

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for any other purpose. Industrial activities, on the other hand, release toxic effluents and material wastes into the atmosphere, land, rivers, and ground water that eventually pollute the soil and as such, it impacts on soil quality

Improper cultivation practices

There are certain agricultural practices that are environmentally unsustainable and at the same time, they are the single biggest contributor to the worldwide increase in soil quality decline. The tillage on agricultural lands is one of the main factors since it breaks up soil into finer particles, which increase erosion rates. The soil quality decline is exuberated more and more as a result of the mechanization of agriculture that gives room for deep plowing, reduction of plant cover, and the formation of the hardpan. Other improper cultivation activities such as farming on steep slope and mono-cropping, row-cropping and surface irrigation wear away the natural composition of the soil and its fertility, and prevent soil from regenerating.

Urbanization

Urbanization has major implications on the soil degradation process. Foremost of all, it denudates the soil’s vegetation cover, compacts soil during construction, and alters the drainage pattern. Secondly, it covers the soil in an impermeable layer of concrete that amplifies the amount of surface runoff which results in more erosion of the top soil. Again, most of the runoff and sediments from urban areas are extremely polluted with oil, fuel, and other chemicals.

Overgrazing

The rates of soil erosion and the loss of soil nutrients as well as the top soil are highly contributed by overgrazing. Overgrazing destroys surface crop cover and breaks down soil particles, increasing the rates of soil erosion. As a result, soil quality and agricultural productivity is greatly affected.

Major Threats:-

Soil Erosion

In general, soil erosion is more severe in mountainous than in undulating and plain areas. Inappropriate soil management, unsuited to the location like tilling along the slope, lack of crop cover during heavy rainfall, etc. is responsible for accelerated soil erosion with consequent loss of land productivity. Soil erosion by water is one of the most serious degradation in the Indian context.The land degradation due to wind erosion is limited to arid and semiarid regions of India, including the states of Rajasthan, Haryana, Gujarat and Punjab. Removal of natural vegetative cover resulting from excessive grazing and the extension of agriculture to the marginal areas is the major human-induced factors leading to accelerated wind erosion.NBSS & LUP and the Central Soil Water Conservation Research and Training Institute (CSWCRTI) have jointly initiated the preparation of soil erosion maps of different states using the components of Universal Soil Loss Equation obtained from field data available in soil resource maps generated by NBSS.

Salinization and Alkalization

The expansion of irrigation has been one of the key strategies in achieving self-sufficiency in food production. The net irrigated area in India has increased from about 22 M ha in 1950 to about more than 51 M ha at present. In most of the expansion, the area is increased under canal irrigation that leads to rise in groundwater Table resulting in the soil deterioration through accumulation of salts. These soils contain excessive amount of either soluble salts or exchangeable sodium or both affecting crop yields and crop production certain states like Rajasthan and Haryana are endowed with 84 and 62% of poor quality groundwater, respectively. Continuous use of such waters for irrigation to agricultural crops is bound to increase the problem of salinity and sodicity in India.

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Acidity

The largest areas covered by acid soils in India belong to laterites and various latosolic soils e. g. Ferruginous red soils, ferruginous gravelly red soils, mixed red and black, or red and yellow soils. It is reported that about 6.98 M ha area is affected by acid soils; which is about 9.4% of TGA. Acid soils develop in humid and per-humid areas pertaining to states of Assam, other North east area, West Bengal, Bihar, Odisha, Andhra Pradesh, Kerala, Madhya Pradesh, Karnataka, Maharashtra and Tamil Nadu. These soils formed due to excessive leaching of cations with high rainfall, resulting in lowering of pH and loss of soil fertility. Acid soils pose typical water management problems, which are mostly associated with physical and chemical properties of soils. Kaolinite dominated light textured acid soils have very high saturated hydraulic conductivity leading to heavy percolation losses.

Soil Organic Carbon Losses

Alfisols, Ultisols and Oxisols are prone to chemical deterioration owing to nutrient depletion due to pedogenic processes for soil development. The base saturation of these soils is very less specially in Ultisols and Oxisols as compare to Alfisols. In India, nearly 3.7 M ha is deteriorated due to depletion of organic matter Removal or in-situ burning of crop residues, no or least addition of organic manures, and intensive cultivation are the major reasons for the depletion of soil organic carbon.

Nutrient Imbalance

Balanced nutrient supply is essential for achieving high crop yields, but excessive and/or imbalanced nutrient inputs may pose risk pressure on the environment, human health and ecosystems. Nutrient losses could occur in many ways, i.e., via emission to the air as NH_3, N_2O, NO, and N_2, and discharge to the water through runoff, leaching and erosion. After 1980s, fertilizer was more widely used than manure in agriculturally developed states such as Punjab, Haryana and Orissa. The wide use of fertilizer and booming developed of the livestock production contributed to the vast N losses to the environment. The nutrient imbalance in soils could have much impact on crop production and environmental protection.

Pollution/Contamination by Toxic Substances

Both geogenic and anthropogenic factors cause pollution/contamination of soil and water resources. However, their impact varies with rainfall pattern, and depth and geology of aquifer. Applications of sewage sludge to agricultural soils, and irrigation of field crops with sewage water and untreated industrial effluents alone, or in combination with tube well /canal water, are common practices, especially in the vicinity of large cities, as these are considered reusable sources of essential plant nutrients and organic C. Large variations in the composition of sewage waters of industrial and non-industrial cities of Punjab have been reported. In general, Pb, Cd and Nickel (Ni) were in higher Concentration in effluents of industries manufacturing metallic products as compared with textile and woolen industries.

Soil Sealing and Capping

Drastic and often irreversible land use changes such as the conversion of forest to agro-industrial land, extractive mining activities, as well as extensive horizontal expansion of cities have been resulting in the soil sealing and capping.

<u>Sustainable Soil Management</u>

Five Basic Principles:

- Maintain Soil Livestock: They recycle nutrients and many other benefits!
- Cover the soil (Mulching): You may loose nutrients due to erosion and temperature extremes.

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- Minimum or No Tillage: It speeds the organic matter decomposition Also, Moldboard plough destroy the soil population beside speeding humus decomposition.
- Maintain Nitrogen in Soil: Higher nitrogen (N) in soil means higher decomposition of organic matters and vice versa. Also, Low N starves plant.
- OM degradation should be less than its addition to maintain the soil fertility.

Methods of soil conservation

Contour Barriers: Stones, grass, soil are used to build barriers along contours. Trenches are made in front of the barriers to collect water.

Rock Dam: Rocks are piled up to slow down the flow of water. This prevents gullies and further soil loss.

Mulching: The bare ground between plants is covered with a layer of organic matter like straw. This helps to retain soil moisture.

Terrace Farming: This is a process in which hill slopes are used as cultivable land. The farmer cuts terraces into slopes to create flat areas to grow crops because flat land is scarce in hilly regions.

Intercropping: Different crops are grown in alternate rows and are sown at different times to protect the soil from rain wash.

Crop Rotation: This is a cropping practice in which different crops are grown in systematic succession. Crop rotation involves growing of such crops in succession so as to add nutrients to the soil.

Contour Ploughing: This is a cropping method in which the farmer ploughs the land along a slope rather than up and down the slope. It reduces erosion.

Shelter Belts: In the coastal and dry regions, rows of trees are planted to check the wind movement to protect soil cover.

Prevention of Overgrazing: Animals like sheep and goats must be checked. Fodder should be raised as a crop. The free movement of the animals in the fields should be avoided.

Afforestation : Another very effective method to conserve soil. It means, planting of trees on a large scale. Large number of trees reduces wind speed and free flow of water. Thus, this method stops soil from being carried away and helps in conserving the soil to a great extent.

CONCLUSION

Appropriate mitigation strategies of the nearly 147 Mha of existing degraded land of India are of the utmost importance. With changing climate, land degradation is expected to only increase due to high intensity storms, extensive dry spells, and denudation of forest cover. Combating further land degradation and investing in soil conservation is a major task involving promotion of sustainable development and nature conservation. Sustainable agricultural intensification using innovative farming practices have tremendous potential of increasing productivity and conserving natural resources, particularly by sequestering SOC (both labile and recalcitrant) and improving soil quality. Novel Conservation Agriculture practices include: mulching, growing of cover crops, strip cropping, use of organic manure and soil conditioner etc. Improved grazing practices, irrigation management, control on industrial and municipal wastes, control and management on mining are a few other solutions for preventing land degradation. Finally, another critical challenge is controlling fragmentation of land holdings. This could be achieved by providing security of land rights and land tenure and encouraging the efficient use of marginal lands.

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AI in Agriculture

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Moumita Baishya
Assistant Professor, Department of Agricultural Statistics, School of Agriculture, GIET University, Gunupur, Odisha-765022

INTRODUCTION:

Artificial intelligence (AI) characterise as a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation. With its rapid technological advancement and vast area of application, AI is becoming pervasive very rapidly because of its robust applicability in the problems particularly that cannot be solved well by humans as well as traditional computing structures. Such an area of extreme importance is agriculture where about 30.7% of the world population is directly engaged on 2781 million hectares of agricultural land. In India about 70% population lives in village area who are directly or indirectly engage in Agriculture. However, sufficient extension worker are not there in our country to support farmer community on the right time. Venture like Agriculture is not so smooth running, it faces several challenges from sowing to harvest. The major issues are pest and disease infestation, inadequate application of chemicals, improper drainage and irrigation, weed control, yield prediction, etc. AI techniques can enabled us to capture the intricate details of each situation and provide a solution that is best fit for that particular problem.

Application of AI in Agriculture:

Crop management: In general, crop management systems provide an interface for overall management of crops covering each aspect of farming. The idea of using AI technique in crop management was first proposed in 1985 by McKinion and Lemmon in their paper "Expert Systems for Agriculture". Another corn crop protection expert system was proposed by Boulanger. In 1987, Roach et al. proposed an expert system POMME for management of apple plantation. Stone and Toman came up with an expert system for cotton crop management COTFLEX. An image based AI technique was proposed by Li, S. K. et al., for wheat crop, by using pixel labelling algorithm followed by Laplace transformation to strengthen the image information. The best network obtained had five hidden layers trained up to 300000 iterations and had an accuracy of 85.9% on average.

Pest Management: Pest infestation is one of the alarming problems in agriculture which leads to heavy ecomonic losses. Over decades researchers have tried to mitigate this menace by development of computerized systems that could identify the active pests and suggest control measures. The knowledge involved in agricülral management is most of the times imperfect, vague and imprecise hence the rule base

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expert system may lead to uncertainty. To capture this uncertainty, several Fuzzy logic based expert systems were proposed including Saini et al., Siraj and Arbaiy, Peixoto et al, IPEST by Hayo et al., Roussel et al., Shi et al., Jesus et al. An objected oriented approach to frame a rule base was taken by Ghosh et al., in developing TEAPEST, an expert system for pest management in tea.

Disease management: The image sensing and analysis ensure that the plant leaf images are sectioned into surface areas like background, diseased area and non diseased area of the leaf. The infected or diseased area is then cropped and sent to the laboratory for further diagnosis. This further renders assistance in the identification of pest and sensing nutrient deficiency. Significant expertise and experience is required in order to detect an ailing plant and to take necessary steps for recovery. Computer aided systems are being used worldwide to diagnose the diseases and to suggest control measures. At very early stage, rule based systems were developed which includes Byod and Sun, Sarma et al., Balleda et al. Tilva et al., proposed a fuzzy logic based model to forecast diseases based on leaf wetness duration. Sannakki et al., enforced a fuzzy logic approach coupled with image processing to detected percentage of infection in leaf. A system using k-means segmentation algorithm was developed by Al-Hiary, et al. and Bashish et al. Dr. Wheat is a web based expert system developed by Khan et al., for diagnosis of wheat diseases.

Agricultural product monitoring and storage control: Apart from pests and diseases monitoring, storage, drying, grading of harvested crops are also very important aspects of agriculture. This section addresses various food monitoring and quality control mechanisms that employ the concept of artificial intelligence. Several fuzzy logic based systems were designed, which includes Kavdir et al., Gottschalk et al., and Escobar et al.

Irrigation and Soil management: Issues pertaining to soil and irrigation management are very vital in agriculture. Improper irrigation and soil management lead to crop loss and degraded quality. This section highlights some researches carried out in soil and irrigation management assisted by artificial intelligent techniques. Brats et al. designed a rule based expert system for evaluation of the design and performance of micro irrigation systems. Sicat et al. used farmers' knowledge to model a fuzzy based system to recommend crops depending on land suitability maps generated by the fuzzy system. Other fuzzy based systems include Si et al., Tremblay et al. Valdes-Vela et al. used a Takagi Sugeno Kang fuzzy inference system to estimate the stem water potential of a plant based on meteorological and soil water content data. Arif designed an artificial neural network based system for estimation of soil moisture in paddy.

Weed management: Application of herbicides have a direct implication on human health and environment as well. Modern AI methods are being applied to minimize the herbicide application through proper and precise weed management. Pasqual designed a rule based expert system for identifying and eliminating weed in crops like oats, barley, triticale and wheat. Burks et al. used machine vision with a back propagation trained neural network to identify weeds of five distinct species.

Yield prediction: The crop yield prediction is very beneficial for marketing strategies and crop cost estimation. Moreover, in the age of precision agriculture analysis of relevant factors that directly effects the yield can also be done through prediction models. Liu et al., used an artificial neural network model employing back propagation learning algorithm to predict yield from the soil parameters. The other remarkable works include Kaul et al., Uno et al., Singh, and Rahaman and Bala built a neural model for

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predicting tomato yield, growth and water use in a greenhouse environment. In a different approach, Pahlavan et al. used energy output as a measure of yield for basil plants in greenhouse.

CONCLUSION:

To exploit the tremendous scope of AI in agriculture, applications should be more robust. Then alone it will be in a position to handle frequent shifts and changes in external conditions. This would facilitate real time decision making and sequentially utilize appropriate model/program for gathering contextual data efficiently. AI solutions have to become more viable to assure that this technology reaches the farming community. If the AI cognitive solutions are offered in an open source platform that would make the solutions more affordable, which eventually will result in faster adoption and greater insight among the farmers. Thus, we should promote AI specially in Agriculture for the betterment of our farmer.

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TURMERIC AND CURCUMIN: The golden spice of life

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Shikha and Diksha Singh
Research Scholar, Human Nutrition, GBPUA&T Pantnagar

Turmeric sometimes called the Golden Spice or Indian saffron, is a plant with a long history of medicinal use, dating back nearly 4,000 years. Ground turmeric root has been used in Indian and Chinese cooking, and its medicinal benefits are as well-prized as its unique flavor.

What is Turmeric?

Everyone tasted turmeric powder in a dish, you're likely to remember its potent, bold flavor. Used for centuries as both food and medicine, turmeric belongs to the ginger family. Turmeric rhizomes (stems) are dried and ground to a yellow powder. Among the benefits that Bowden says deserve a whole book, turmeric can normalize the chronic inflammation that plays a role in nearly every disease. The anti-inflammatory benefits of turmeric have been incredibly well researched. Turmeric has been used medicinally for various conditions including rheumatoid arthritis, skin cancer, and digestive disorders. However, you can't mention the numerous medicinal or therapeutic benefits of turmeric without discussing a specific polyphenol or antioxidant called curcumin.

Turmeric's benefits come from curcumin

Turmeric — most of this spice's anti-inflammatory, antioxidant, and other glory comes from its active ingredient, curcumin.

What is Curcumin?

Curcumin belongs to a family of compounds called *curcuminoids*. Two other well-studied curcuminoids, bisdemethoxycurcumin and demethoxycurcumin, provide additional antioxidant and other nutrient support. Curcumin offer countless potential benefits, but there is one problem. There is very little bioavailability. In other words, your body can only absorb a very small amount after consuming it.

The solution could be this: Combine black pepper and turmeric. Like turmeric, black pepper is an aromatic spice with lots of benefits, thanks to its major bioactive element piperine. And curcumin plus piperine may mean even greater benefits for your health than turmeric alone.

Getting the Benefits of Turmeric

That's not to say turmeric doesn't have other benefits. In fact, more than 100 components have been isolated from turmeric, including volatile oils and nutrients. While less-studied than curcumin, they likely carry their own anti-inflammatory, antioxidant, and other benefits.

"Turmeric is also one of the easiest spices to use, "It has a really pleasing taste and a beautiful color, and it tastes good on almost any food you can think of."

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How Curcumin Affects the Body?

Curcumin is a workhorse molecule, curcumin influences multiple biochemical pathways including those that impact inflammation and cancer.

Some of the best-known health issues that curcumin can benefit include:

- **Cancer:** Research shows curcumin can influence the natural treatment of several cancers including colon, stomach, lung, breast, and skin cancers.
- **Rheumatoid arthritis:** Curcumin shows promise for those with autoimmune diseases including rheumatoid arthritis. Some studies show curcumin has a similar impact to NSAIDs without the side effects of medications.
- **Osteoarthritis:** Animal studies show curcumin's anti-inflammatory and antioxidant benefits significantly slow osteoarthritis progression and relieve pain.
- **Gastrointestinal (GI) disorders:** Curcumin's anti-inflammatory benefits can support people with GI disorders including inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), Crohn's disease, and ulcerative colitis.
- **Oxidative stress:** As an antioxidant, curcumin is a free radical scavenger that also binds and eliminates potentially damaging metals including iron and copper.
- **Brain health:** Oxidative stress and inflammation play a role in many neurodegenerative diseases including Alzheimer's disease. Research shows curcumin protects your brain cells against oxidative stress-induced damage, lowers inflammation, and protects your energy-producing mitochondria.
- **Depression:** Oxidative stress and inflammation also contribute to depression. Depression, like any disease, is *multifactorial,* meaning multiple culprits contribute. One study found using 500 mg of curcumin twice daily for four to eight weeks provided anti-depressive benefits for people with major depressive disorders.
- **Anxiety:** Animal studies also show curcumin can positively impact the behavioral symptoms associated with anxiety.
- **Cholesterol levels:** As little as 500 mg of curcumin for one week can improve your lipid profile including total cholesterol and HDL (your "good" cholesterol) levels.
- **Liver health:** Research shows curcumin's antioxidant and anti-inflammatory benefits can prevent the progression of non-alcoholic fatty liver disease (NAFLD).
- **Cystic fibrosis:** Curcumin's antioxidant and anti-inflammatory properties can also aid in the treatment of cystic fibrosis, characterized by chronic respiratory infections and inflammation.

Turmeric Beverages

As a spice, turmeric is well-known in savory dishes such as curry. But turmeric is a versatile herb that can be used to make anything from ice cream and cookies to stuffed turmeric leaves or Moroccan chicken. Here are a few turmeric recipes for beverages you can try.

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Ginger and Turmeric Tea

Ingredients:

- 2 cups water
- 2 teaspoons grated fresh ginger or 1/2 teaspoon ground ginger
- 2 teaspoons grated fresh turmeric or 1/2 teaspoon ground turmeric
- 1 tablespoon maple syrup or honey
- 1 tablespoon freshly squeezed lemon juice

Directions:

- Bring water to boil.
- Add ginger and turmeric.
- Simmer for 10 minutes.
- Pour through strainer into a mug.
- Add lemon juice and maple syrup, mix well.
- Enjoy.

Turmeric Iced Lemonade

Nothing says summer like a cold glass of lemonade. Adding turmeric gives it a fun twist while allowing you to reap all the benefits that lovely spice has to offer.

Ingredients:

- 2 cups water
- 1.5 cups ice
- 1/2 cup freshly squeezed lemon juice
- 1-2 teaspoons turmeric powder, to taste
- 1/4 teaspoon ginger powder, optional
- Stevia drops (1/4-1/2 teaspoon) or sweetener of choice, to taste
- Dash of black pepper

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Jeevamrita is a Beneficial Component for Plants

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Sharvan Kumar
Ph. D. Scholar (Vegetable Science), College of Horticulture & Forestry, Department of Vegetable Science, A.N.D.U.A. & T., Kumarganj, Ayodhya 224229 (U.P.)

INTRODUCTION

Jivamrita is a rich bio-formulation containing consortia of microbes. It is a mixer of cow's dung, cow's urine, sugarcane juice, virgin soil and pulse flour. Jivamrita/Jeevamrita is a fermented microbial organic component. It provides nutrients, but most importantly, Jeevamrita also helps to prevent fungal and bacterial plant diseases.

Ingredients which required for preparation of jeevamrita

1. Water (200 liter)
2. Cow dung (10 kg)
3. Cow urine (4 liter)
4. Pulse flour (2 kg)
5. Natural soil (1 kg)

Ingredients required for preparation of jeevamrita

How to prepare jeevamrita

1. Put 200 liters of water in a barrel and add 10 Kg fresh cow dung and 5 to 10 liters aged cow urine. Add 2 Kg of Jaggery or sugarcane juice.

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2. 2 Kg of pulse flour (Basan) and a handful of (250g) soil from the bund of the farm or natural soil. We collect the soil near of Neem or Banyan tree because this soil rich in microorganism and beneficial bacteria and free from the harmful elements.
3. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrita is ready for application. 200 liters of jeevamrita is sufficient for one acre of land.

Benefits of jeevamrita

1. Jeevamrita, which boost the plant growth and the plant, gives good yield.
2. It gives resistance against pest and diseases.
3. It increases beneficial organism activity and promotes organic carbon in the soil.

Jeevamrita application

Apply the jeevamrita to the crops twice a month in the irrigation water or as a 10% foliar spray. Source: http://www.fao.org If you find this information useful, click on the yellow thumbs up sign under the photo and also share this with your farmer friends using the options given below.

Microbial load in Jeevamrita

Microorganisms	**Population (cfu ml^{-1})**	**Parameter**	
		pH	8.2
Bacteria	15.4 x 10^5	**Soluble salts (EC)**	5.5 dsm^{-1}
Fungi	10.5 x 10^3	**Total nitrogen**	4.0 per cent
Actinomycetes	6.8 x 10^3	**Total phosphorus**	155.3 ppm
P solublizers	2.7 x 10^2	**Total potassium**	252.0 ppm
Free living N_2 fixers	3.1 x 10^2	**Total zinc**	2.96 ppm
		Total copper	0.52 ppm
		Total iron	15.35 ppm
		Total manganese	3.32 ppm

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CONCLUSION

Liquid Organic preparations jeevamrita contain higher number of bacteria, fungi, actenomycets, N-fixers and Psolubilizers from the studies it is evident that jeevamrita to be used between 9 to 12 days after preparation. The application of this liquid formulations would supplement the application of biofertilizers and they can be prepared easily by locally available materials by the farmers, in rural areas.

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Biofortification: A Zero Hunger Challenge

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Gayatri Kumawat[1], Rohit Kumar Kumawat[2], Priyanka Kumawat[3]
[1]Research Scholar, Department of Plant Breeding and Genetics, Sri Karan Narendra Agriculture University, Jobner, Rajasthan.
[2]Research Scholar, Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur.
[3]Research Scholar, Department of Horticulture, Swami Keshwanand Rajasthan Agricultural University, Bikaner.

Food is the moral right of all who are born into this world - Borlaug

INTRODUCTION

The three billion of peoples worldwide suffer micronutrients deficiency in which 2.5 billion suffer from Zinc deficiency, 1.6 billion populations suffer from Iron deficiency, 1 billion people reside in iodine deficient regions and 400 million people have vitamin A deficiency. Malnutrition accounts ~30 million death/year (WHO, 2012). India is one of the countries having problem of malnutrition. More than 50% of women, 46% of children below 3 years are underweight and 38% are stunted. As per India state hunger index, all the states are with serious to alarming indices with M.P. most alarming (Word Bank).

How can we Nourish 1.3 Billion People?

Food availability is neither a problem, nor it like to be. More important is what kind of food will be available i.e. nutritious crops and bio-fortified crops.

Bio-fortification:

Biofortification made up of two term; Greek word “bios” means “life” and Latin word “fortificare” means “make strong”. Biofortification is a method of breeding crops to increase their nutritional value or increasing genetically the bio-available mineral content of food crops (Brinch-Pederson *et al*., 2007).

Intervention	**Scope**	***Economics***
Supplementation	It is generally recommended during pregnancy or in severe Zn deficiency for a shorter period.	It is costly and only recommended when a very quick response is required
Fortification	It is effective but limited to urban areas.	It is very uneconomical if carried out for longer period of times.
Food Diversification/ modification	It is applicable only where alternative food products are available with high adoptability.	It is economically feasible and sustainable intervention
Bio-fortification	It is targeted and reachable	It is cost effective and sustainable approach. It has added benefit of yield increase on Zn deficient soils and seems permanent solution to the problem

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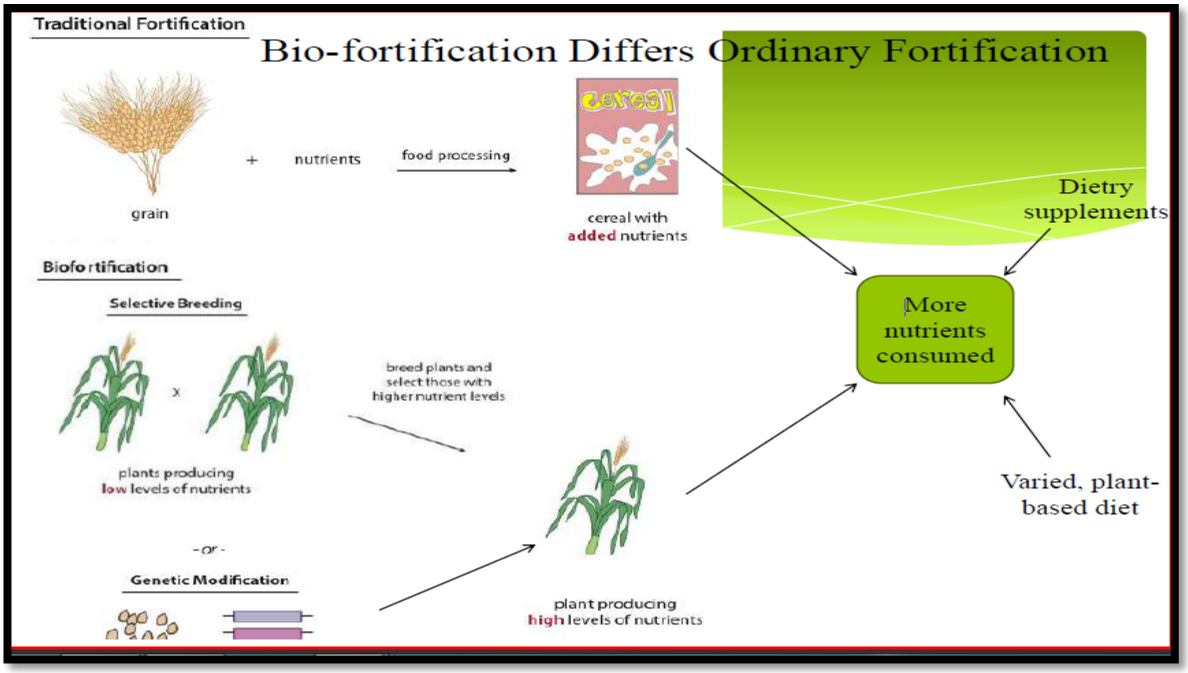

Indian Parliament recently has passed a budget which includes $15 million for biofortification (DBT) for rice, wheat and maize over five years.

Agronomic Biofortification is the application of micronutrient-containing mineral fertilizer (blue circles) to the soil and/or plant leaves (foliar), to increase micronutrient contents of the edible part of food crops.

Genetic Biofortification is a strategy that uses plant breeding techniques to produce staple food crops with higher micronutrient levels, reducing levels of anti-nutrients and increasing the levels of substances that promote nutrient absorption. Crops can be improved through conventional breeding (Iron bean, pearl millet, Vitamin A cassava, Vitamin A maize, Vitamin A sweet potato, Zinc rice, Zinc wheat) and transgenic approaches (Quality protein maize, Golden rice and High iron rice). Average daily requirement of Zn is 15-20 mg/day and for Fe is 20 mg/day (ICMR, 2010).

PATHWAY FOR GENETIC BIOFORTIFICATION

Discovery:

- Identify target population
- Set nutrient target level
- Screen germplasm and gene discovery

Development:

- Breed bio-fortified crops
- Test the performance of new crop varieties
- Measure nutrient retention in crop

- Evaluate nutrient absorption and impact

Dissemination:

- Develop strategies to disseminate the seed
- Promote marketing and consumption of biofortified crops
- Improve nutritional status of target population

ICAR Biofortified Varieties: Sustainable Way to Alleviate Malnutrition

Rice:

CR Dhan 310: Protein 10.3% (Pure line variety)
DRR Dhan 45: Zinc 22.6 ppm (Pure line variety)

Wheat:

WB 02: Zinc 42 ppm & Iron 40 ppm (Pure line variety)
HPBW 01: Iron 40 ppm & Zinc 40.6 ppm (Pure line variety)

Maize:

Pusa Vivek QPM9 Improved: Provitamin-A 8.15 ppm, lysine 2.67% & tryptophan rich hybrid 0.74%
Pusa HM4 Improved (lysine 3.62% & tryptophan 0.91% rich hybrid),
Pusa HM8 Improved (lysine 4.18% & tryptophan 1.06% rich hybrid)
Pusa HM9 Improved (lysine 2.97% & tryptophan 0.68% rich hybrid).

Pearl millet:

HHB 299 (Iron 73.0 ppm & Zinc 41.0 ppm rich hybrid)
AHB 1200 (Iron 73.0 ppm rich hybrid)

Lentil:

Pusa Ageti Masoor (Iron 65.0 ppm rich pure lie variety).

Mustard:

Pusa Mustard 30 (low erucic acid less than 2.0 % pure line variety)
Pusa Double Zero Mustard 31 (low erucic acid less than 2.0 % & low glucosinolate less than 30.0 ppm pure line variety).

Cauliflower:

Pusa Beta Kesari 1 (β-carotene 8.0-10.0 ppm rich pure line variety).

Sweet Potato:

Bhu Sona (β-carotene 14.0 mg/100g rich pure line variety)
Bhu Krishna (anthocyanin 90.0 mg/100g rich pure line variety).

Pomegranate:

Solapur Lal (iron 5.6-6.1 mg/100g, zinc 0.64-0.69 mg/100g & vitamin-C 19.4-19.8 mg/100g rich hybrid).

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IMPORTANCE OF CROP BIOFORTIFICATION

- To overcome the mal-nutritions in human beings
- To increment of nutritional quality in daily diets
- To improvement of plant or crop quality and increment of variability in germplasm
- Biofortification for important crop plants through biotechnological applications is a cost-effective and sustainable solution for alleviating VAD, etc.

'Forget climate change, we should spend on nutrition' ...

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From The Times

May 31, 2008

'Forget climate change, we should spend on nutrition'

(Edgard Garrido/Reuters)

Malnutrition in mothers and their young children will claim 3.5 million lives this year

Mark Henderson, Science Editor, in Copenhagen

TIMES RECOMMENDS

- Prince Philip attacks big families
- Take a dip in Dubai-on-Thames
- Eco Worrier: How can I persuade my husband to use a push mower?

BLOG: GREEN CENTRAL

Intelligent, informed insights

CONCLUSION

Micronutrient deficiencies reflects a diet quality problem of poor population that remain to been solved. Bio-fortification addresses this problem head on. Bio-fortification offer sustainable solutions to the escalating micronutrient-related malnutrition problems.

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High-Throughput Phenotyping

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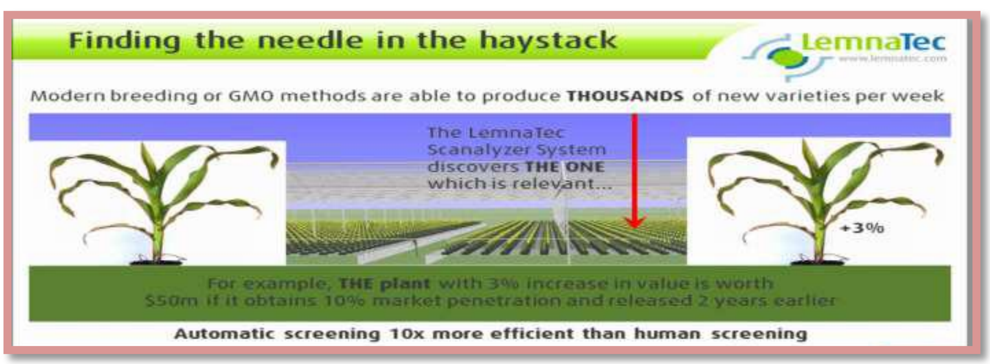
Gayatri Kumawat
Research Scholar, Department of Plant Breeding and Genetics, Sri Karan Narendra Agriculture University, Jobner, Rajasthan.

INTRODUCTION

A deeper understanding of the biological-agricultural processes mediated by plant genomes is needed to develop crops with improved stress resilience and yield potential. Connecting genotype to phenotype for quantitative plant traits on a genome level necessitates high-density genetic markers and large population sizes to gain sufficient power and resolution. While the recent advancements in sequencing technologies have provided almost unlimited access to high-density genetic markers, large-scale rapid and accurate phenotyping of complex traits remains a major constraint. High-throughput phenotyping (HTP) tools with improved spatial and temporal resolution can help address this phenotyping bottleneck (White *et al*., 2012). Several HTP platforms including greenhouse, ground-based, and aerial systems have been demonstrated for crops (Crain *et al*., 2016), such as enabling the dissection of stress and growth traits in controlled conditions (McCormick *et al*., 2016).

The term phenomic refers to sum total of phenotypes at various levels ranging from molecules to organs and the whole organism. High throughput phenotyping are fully automated facilities in greenhouses or growth chambers with robotics, precise environmental control, and remote sensing techniques to assess plant growth and performance. High throughput is essential for phenotyping in different growth conditions of many different lines- mutant populations, mapping population, breeding population and germplasm collection. The Plant Accelerator's phenotyping capacity, which is built around the LemnaTec Scanalyzer 3D platform, consists of four smart houses; these are fully climate controlled greenhouses equipped with computer controlled conveyor belts carrying up to 600 plants per room. Each smart house is linked to one of two imaging halls, within which are five imaging chambers. Cameras in these chambers record images of plants in a range of different wavelengths, from far infrared through to UV-fluorescence and providing a diversity of phenotype information. Visible cameras quantify overall plant morphology, size, color, shoot mass and other physical characteristics, near infra-red cameras detect water content of the leaves and soil, far infra-red provides information about leaf temperature and transpiration rate, and UV lighting detects chlorophyll.



Accelerating Plant Phenomics ***i.e.*** High-throughput screens, multiple camera units, non-destructive measurements, quantitative analysis, monitor growth dynamics, stress assessment, link to genomics and

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opening new prospects. The various parameters are measured by HTP i.e. Leaf area, leaf colour, leaf angle, leaf rolling, leaf elongation, chlorophyll content, stem diameter, plant height/width, stress pigment concentration, tip burn, internode length, seed number, seed size, tiller number, flowering time and germination time.

Steps involved in phenotyping

- Plant phenotyping system focusing in the different stage of the plant.
- It has the capability to image plants in a greenhouse by automatically moving plants.
- Positioning them in front of a stereoscopic camera.
- Proprietary software analyzes the images to extract phenotypic-related information.

Scanning in different wavelength and modes

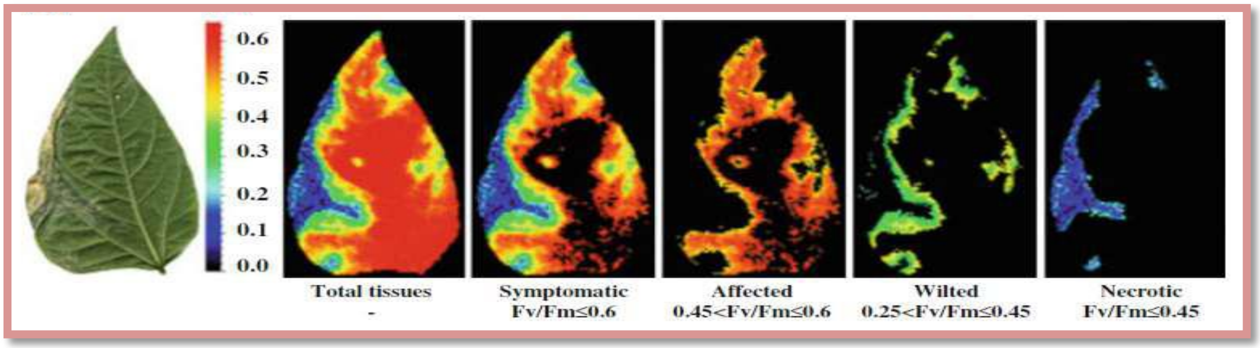
1. **Scanning by visible light (RGB):** High-resolution color images for comprehensive morphological and growth phenotyping. Under reproducible illumination conditions provide the best basis for comprehensive phenotyping. High-resolution color images are taken from the top and several sides.

2. **IR infrared light:** With infrared light, high-throughput 3-D imaging systems provide a unique chance to quantify temperature differences (e. g. within leaves and between plants

3. **Fluorescence Imaging**

Chlorophyll Fluorescence: The light energy absorbed by green plants meets one of the following three fates:

- One part of this energy is used for electron transport and carbon assimilation (Photochemical quenching).
- Another fraction of the incident light energy is dissipated as heat via the xanthophyll cycle (non-photochemical quenching).
- Finally, the remainder of light energy is emitted as fluorescence.

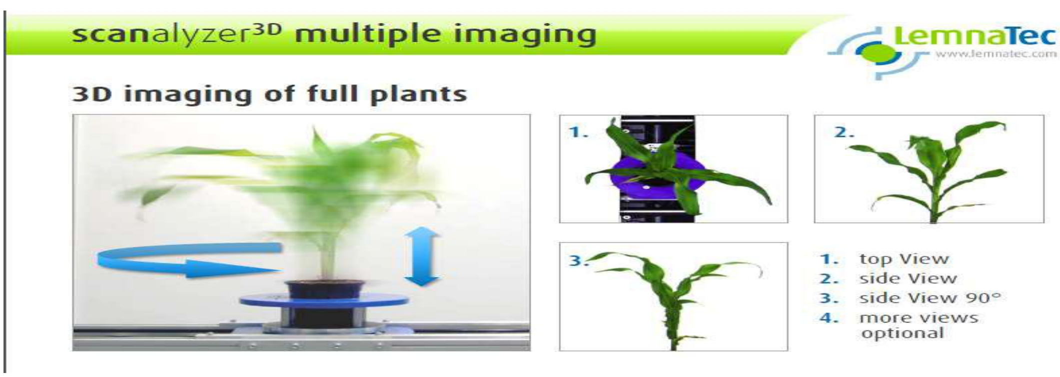


4. NIR / RGB: Near-infrared (NIR) cameras study water content and movement in leaves and soil. They use light in the NIR region of the spectrum (900–1550 µm). Plants are grown in clear pots so roots can be photographed while the plant is growing. Soil NIR measurements are used to calculate: how much water the roots remove from the soil, where and how much water the plant is using.

5. Far infrared (FIR) imaging: Cooler plants have better root systems and take up more water.

6. Magnetic resonance imaging (MRI): Magnetic resonance imaging (MRI) is used to study plant roots. MRI uses a magnetic field and radio waves to take images of roots. MRI allows the 3D geometry of roots to be viewed just as if the plant was growing in the soil.

7. Three-dimensional (3D) imaging: Digital photos of the top and sides of plants are combined into a 3D image. Measurements that can be taken using a 3D image include: shoot mass, leaf number, shape, angle, leaf color and leaf health.



8. IRGA: Uptake of CO2 can be measured with the means of an IRGA (Infra-Red Gas Analyzer) which can compare the CO_2 concentration in gas passing into a chamber surrounding a leaf/plant and the CO2 leaving the chamber.

9. Infrared Thermometer- for monitoring evapotranspiration rates in crops and in the observation of daily crop temperatures.

10. Canopy sensor: Minolta SPAD-502 meter

11. Mini Plant Photosynthesis Meter.

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Image Analysis software are LemnaGrid, LemnaMiner, LemnaLauncher, LemnaControl LemnaBase, LemnaShare, LemnaCount and LemnaTrack.

Application

- Plant Phenotyping & Functional Genomics
- Breeding of new Traits
- High Content & High Throughput Screening
- Life Science Research & Drug Discovery
- Quality Control

Advantages

- Interconnected breeding and trait validation process.
- The development of information and data storage technologies, providing suitable tools for the analysis of complex structures of plants.
- The need to accelerate breeding.
- The impossibility for individual breeders and senior research experts to acquire all important data themselves, in order to keep in control of subjectivity effects.
- To quantify more complex traits.
- The necessity to spot increasingly smaller differences.

Disadvantages

- High developmental cost.
- For Image analysis and data interpretation well trained person required.

CONCLUSION

Current phenotyping is largely extensive hence need for intensive approach. Available methods are not satisfactory, hence urgent need to develop suitable statistical models. Software developed for statistical analysis should permit automated data analysis. Integration of all phenomics related research as did for genomic efforts. Phenomics teams must be transdisciplinary.

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Important pests of Makhana (*Euryale ferox* Salisb.) and its management

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Vadivel C
Department of Entomology, Bihar Agricultural University, Bhagalpur, Bihar - 813210

INTRODUCTION

Makhana (*Euryle ferox* Salisb.) is also known as Gorgon nut or foxnut, a prickly water lily grown in aquatic ecosystem. It is a unique and potential aquatic cash crop cultivated in Bihar, Assam, West Bengal, Manipur, Tripura, Eastern parts of Odisha, Madhya Pradesh, Rajasthan and Eastern Uttar Pradesh. However, its commercial cultivation is limited to North Bihar, Manipur, parts of Assam, West Bengal and Madhya Pradesh. In India, Bihar state alone accounts for 80 % of the Makhana production. Currently, 40 – 45 % of Makhana crop is cultivated in lowland rice field condition and rest are traditionally grown in the pond system. Makhana seeds are also called as Black Diamond, which is unique and highly nutritious (good source of fiber, vitamin B along with Ca, K, Fe and Zn). Now a days, reduction in Makhana seed production is seen due to change in cropping system and crop intensification, occurrence of biotic (pest and diseases) and abiotic factors has been observed.

Makhana and its importance

It is a tropical and subtropical climate plant, belongs to the family Nymphaeaceae. Due to less production and perennial in nature, Makhana requires less land preparation and grows well in stagnant water bodies of 0.2 to 2 m depth, with thick rhizomatous stem, deeply rooted in cluster form in sediment. Generally, foxnut is cultivated either in water bodies/ponds having water depth of 4 to 6 feet or 1 to 2 feet deep shallow agricultural fields. The importance of this crop is cumulative quantity of highly enriched carbohydrate, protein and low-fat content. The raw Makhana contains 76.9 % carbohydrate, 12.8 % moisture, 9.7% protein, 0.9 % phosphorous, 0.5 % minerals, 0.1 % fat, 0.02 % Ca and 0.0014 % Fe whereas popped Makhana contains 84.9 % carbohydrate, 4 % moisture, 9.5 % protein and 0.5 % fat. In India, it is also considered as the ‘food of god’, as it is normally used as ‘prasad’ during religious offerings. Makhana has a lot of medicinal uses in the Indian and Chinese system of medicine. It is mostly used as a stomachic and for treatment of articular pains, micturition and seminal loss. It is also utilized to overcome postnatal weaknesses in women and in case of men, its aphrodisiac and spermatogenic potential is utilized. Makhana is one of the prominent nutritious aquatic crops which can be utilized for improving water bodies productively through efficient carbon sequestration and improved production technologies. The cultivation and harvesting of Makhana is very arduous, toiling and time-consuming.

The major limitations in growing Makhana are as follows:

1. No ownership of lands
2. Lack of scientific knowledge of cultivation
3. Lack of credit facility
4. Lack of improved variety
5. Labour intensive process

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Important pests of Makhana

The production and productivity of Makhana crop is low due to many constrictions, of which insect pests are of chief importance. Until now, there are scanty reports on the occurrence and status of pests, the four-dozen insect and eight gastropod species were found associated with Makhana crop (Mishra et al, 1992).

The major insect pests are as follows:

1. **Aphid: *Rhopalosiphum nymphaeae* (Aphididae: Hemiptera)**

Occurrence: The peak activity of aphid is from February to March and it sharply weakens and vanishes in the month of April. Cloudy weather with western winds favours the aphid infestation.

Damage symptoms: Both nymph and adult suck the sap from upper surface of leaves. In the advanced stage, the affected part of leaves turns yellowish or rust red resulting in fast decay and yield reduction.

Management: Seed treatment with Imidacloprid 70WS @ 5gm/kg seed and root dip treatment @ 5 gm/litre of water for half an hour along with three foliar sprays of NSKE @ 5% effectively control the aphids. Some of the natural enemies of aphid are, *Scymnus sp.* (more effective), *Coccinella septumpunctata, Menochilus sexmaculatus* and *Brumus sp*.

2. **Case worm: *Elophila crisonalis* and *E. depunctalis* (Pyralidae: Lepidoptera)**

Occurrence: The case worm appears in February on the crop with peak activity from March to June and their population declines in July.

Damage symptoms: The larvae of case worms are one of the major pests of Makhana as it causes heavy damage and significant reduction in yield of the crop. The young larvae start feeding by scraping the leaf surface either in middle or at the margin and make an oval case by cut out the portion of the leaf and remain inside it, and move with the case on the leaves.

Management: Spray NSKE @ 5 % for managing the larval infestation.

3. **Leaf midge or Rib borer: *Chironomus spp.* (Cheronomidae: Diptera)**

Occurrence: It appears in February and lasts for the month of August. However, the population goes down from August onwards.

Damage symptoms: The larvae of Chironomid were observed in developed ribs under the leaf surface. They easily move inside the aerenchymatous cavities of midribs of the leaves. The affected leaves turn yellow and decay fast which result in yield reduction.

Management: The effective control measures are seed treatment with Imidacloprid 70WS @ 5gm/kg seed and root dip treatment @ 5 gm/litre of water for half an hour along with three foliar sprays of NSKE @ 5%.

The minor pests are as follows:

1. **Singhara beetle: *Galerucella birmanica* (Chrysomelidae: Coleoptera)**

Occurrence: It appears in the last week of March and show increasing trends in April with maximum population in May. The pest starts to decline from May end and disappears in June.

Damage symptoms: Both grub and adult damage the younger and mature leaves and integument of Makhana fruit. The most destructive stage is grub.

2. **Leaf sucking bug: *Plea liturata* (Pleidae: Hemiptera)**

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Occurrence: The pest appears in the month of January in nursery and show increasing drifts from mid-February with maximum population in March and April.

Damage symptoms: The population of bug is low and observed on leaves, tender shoots and roots of Makhana. Both the nymph and adult suck the cell sap from the under surface of the tender leaves, shoots and roots of the crop.

3. Gastropods

Occurrence: Different species of Molluscs were found throughout the crop growth season with increasing trend from February to April with maximum in May- July and their incidence was found till the harvest of the crop in the month of August.

Damage symptoms: The adults feed on host plant tissue and cause fast decay of affected plants. This is a threat in Makhana crop as it is found in entire crop growth period and led to significant yield reduction.

CONCLUSION

Makhana is an aquatic crop with enormous export potential and it is an important source of income for poor fishermen. Realizing economic damage and yield reduction due to insect pests, eco-friendly management practices are needed for their effective control in Makhana crop to realize maximum yield potential.

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Impact of coronavirus (COVID-19) on Indian economy

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[1]Sunil Kumar, [2]Pratibha B Thombare & [3]Pandurang A Kale
[1]Subject Matter Specialist (Agricultural Extension), Krishi Vigyan Kendra, Kolhapur-II Maharashtra
[2]Subject Matter Specialist (Home Science), Krishi Vigyan Kendra, Kolhapur-II Maharashtra
[3]Subject Matter Specialist (Agronomy), Krishi Vigyan Kendra, Kolhapur-II Maharashtra

INTRODUCTION

The World Health Organisation (WHO) has declared that the new coronavirus outbreak is a public health emergency of international concern, officials announced on Thursday, 30thJanurary, 2020. WHO proposed calling the disease "2019-nCoV acute respiratory disease." The 2019 novel corona virus (2019- nCoV) originating in Wuhan, China, has spread to 24 more countries alarming public health authorities across the world. More than 4,900 people have died and over 132,000 have been infected globally, according to the WHO on 13 march, 2020. According to Situation report-48 on Coronavirus disease 2019 (COVID-19) on 08th march 2020 Over 100 countries have now reported laboratory-confirmed cases of COVID19. The report stated that globally 105586 confirmed (3656 new) cases have been reported, whereas in China 80 859 confirmed (46 new) 3100 deaths (27 new) and Outside of China 24 727 confirmed (3610 new) 484 deaths (71 new) (WHO Situation Report-48, March 2020). Delhi has reported six positive cases and Uttar Pradesh 10 so far. Karnataka has five coronavirus patients, Maharashtra 11 and Ladakh three. Besides, Rajasthan, Telangana, Tamil Nadu, Jammu and Kashmir, Andhra Pradesh and Punjab have reported one case each. Kerala has recorded 17 cases, including three patients who were discharged last month after they recovered from the contagious infection with flu-like symptoms (Economic times, 2020).

Impacts

The trade impact of the coronavirus epidemic for India is estimated to be about 348 million dollars and the country figures among the top 15 economies most affected as slowdown of manufacturing in China disrupts world trade, according to a UN report. Whereas according to Asian Development Bank (ADB) the Covid-19 outbreak could cost the Indian economy between $387 million and $29.9 billion in personal consumption losses (https://www.livemint.com/). For India, the trade impact is estimated to be the most for the chemicals sector at 129 million dollars, textiles and apparel at 64 million dollars, automotive sector at 34 million dollars, electrical machinery at 12 million dollars, leather products at 13 million dollars, metals and metal products at 27 million dollars and wood products and furniture at 15 million dollars. China has seen a dramatic reduction in its manufacturing Purchasing Manager's Index (PMI) to 37.5, its lowest reading since 2004. This drop implies a 2 per cent reduction in output on an annual basis. This has come as a direct consequence of the spread of corona virus (COVID-19) (The Hindu). When we see the China's Share in total import to India, India's total electronic imports account for 45% of China. Around one-third of machinery and almost two-fifths of organic chemicals that India purchases from the world come from China? For automotive parts and fertilisers China's share in India's import is more than 25%. Around 65 to 70% of active pharmaceutical ingredients and around 90% of certain mobile phones come from China to India.

Sector-wise impact on Indian industry

Chemical Industry: Some chemical plants have been shut down in China. So there will be restrictions on shipments/logistics. It was found that 20% of the production has been impacted due to the disruption in raw material supply. China is a major supplier of Indigo that is required for denim. Business in India is likely to get affected so people securing their supplies. However, it is an opportunity. US and EU will try and diversify their markets.

Auto Industry: Its impact on Indian companies will vary and depend upon the extent of the business with China. China's business no doubt is affected. However, current levels of the inventory seem to be sufficient for the Indian industry. If the shutdown in China continues then it is expected to result in an 8-10% contraction of Indian auto manufacturing in 2020.

Electronics Industry: The major supplier is China in electronics being a final product or raw material used in the electronic industry. India's electronic industry may face supply disruptions, production, reduction impact on product prices due to heavy dependence on electronics component supply directly or indirectly and local manufacturing.

Foreign Trade: China has been India's largest source of imports since 2004-05, shows data from the Centre for Monitoring Indian Economy (CMIE) database. In 2018-19, the latest period for which annual data is available, it had a share of 13.7% in India's total imports. Any major disruption in the Chinese economy can disrupt these imports and hence both production processes and supply of consumer goods in India.

India Only Has Limited Ties With China

Based on contribution to GDP

Country	Export to China (% GDP)	Intermediate goods (% GDP)	Tourism from China (% of GDP)	Average
Vietnam	13.6	7.9	2.9	8.1
Taiwan	15.9	4.7	1.1	7.2
Thailand	5.7	2.5	5.9	4.7
Singapore	13.8	1.3	1.8	5.7
Philippines	2.6	1.7	4.4	2.9
Malaysia	9.6	2.5	1.5	4.5
South Korea	7.9	1.5	0.9	3.5
New Zealand	5.3	0.5	1.8	2.6
Australia	5.2	0.4	1.6	2.4
Japan	2.7	0.4	2.2	1.8
Sri Lanka	0.5	2.0	1.4	1.3
Indonesia	2.6	1.1	0.8	1.5
Pakistan	0.6	1.8	0.4	1.0
Iran	2.2	0.7	0.0	1.0
India	0.6	0.7	0.2	0.5

Note: ranking is based on z-scores of the numbers shown in the table.
Source: WTTC data, trademap.org, Worldbank, Rabobank
Bloomberg | Quint

Effect on Poultry: The poultry industry in different parts of the country has been hit hard amid rumours that the novel coronavirus can transmitted through consumption of chicken, the prices of which have fallen considerably as a result. about two crore people employed in the poultry industry across the country have been impacted. People were avoiding consumption of meat, fish, chicken, and egg etc. Due to the fall in demand, wholesale price of chicken had dropped by as much as 70 per cent.

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Agriculture tourisim

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Samarjeet singh*, Akanksha singh
Department of Agricultural& Extension,Sardar vallabhbhai patel University of Agriculture & Technology, Meerut-250110 (U.P)

INTRODUCTION

Agritourism can be defined as the act of visiting a working farm or any agricultural, horticultural or agri-business operation for the purpose of enjoyment, education or active involvement in the activities of the farm or operation. Now-a- days the urban areas population is increasing due to increased migration village areas. The life of urban people is limited to their homes, offices, television, clubs, videogames, fast foods, mobile phones, etc. Urban people also want to enjoy rural lifestyle and they are curious to know about what agriculture is all about? How the cultivation of crops takes place, experience ploughing the land, milking the cow, want exposure allied agriculture activities like poultry, fishery, forestry, bee keeping, organic farming, terrace gardening, horticulture, floriculture, etc. The concept of Agri-Tourism which includes farmer, village and agriculture offers a good opportunity to satisfy the curiosity of urban population. EcoAgri- Tourism concept brings urban people closer to the nature and rural activities, in which the people participate, get entertainment and feel the pleasure of tourism.

Agri-tourism in India

The 'Tenth Five Year Plan' opened up following opportunities for agri tourism in India. Indian tourism industry is growing at 8.7% - The World Tourism organization has estimated that the tourism industry is growing at the rate of 2.5% a year and there will be more than one billion tourists visiting various parts of the world. But the Indian tourism industry is growing at the rate of 8.7% which is more than 2½ times that the growth rate at global level. By introducing Agri-Tourism concept, not only present growth rate is sustained but also this value addition contributes to further growth. As a result of boosting rural development from tourism point of view and encouragement of tourism infrastructure development in rural areas by state governments, AgriTourism Development Corporation was established on 16th May 2004 in Maharashtra. Its aim is to promote Agro Tourism to help rural youth to earn good respectable living in the village and on the farm itself. The credit of launching and running successfully the first Agritourism centre in Maharashtra, goes to ATDC (Agri Tourism Development Corporation) located at Malegaon, Baramati. Shri Pandurang Taware is the man behind the initiative. He is the father of innovating agri tourism concept in Maharashtra and in India.

Role of Agri-tourism in Rural Development

1. It ensures cash flow during the off season.
2. It creates opportunity to sell the experience of agricultural venue.
3. It provides opportunity to sell products grown and harvested in agricultural operation.
4. It generates employment to a part of rural population.
5. It helps in conserving and communicating the values of rural life and agriculture.

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Benefits of Agri-tourism For Farmers

1. Expanding farm operations
2. Improving farm revenue streams and additional income source for the farmers to protest against income fluctuation.
3. Developing new consumer market niches
4. Increasing awareness of local agricultural products
5. Improving farm living conditions, working areas and farm recreation opportunities
6. Developing managerial skill and entrepreneurial spirit
7. Increasing the long term sustainability for farm businesses.

Problems of Agri-tourism

1. The India has a greater potential of the development of the Agri tourism centres due to the good natural and climatic conditions. But there are some problems in the process of Agri tourism development. Major problems are follows,
2. Lack of perfect knowledge about the agro-tourism.
3. Weak communication skill and lack of commercial approach of the farmers.
4. Lack of funds to develop basic infrastructure for the agrotourism.
5. Presence of unorganized sector in the Agri tourism industry.

Issues needing attention for the promotion of Agri tourism in India

Publicity: It is difficult to provide publicity to a remote Agri tourism unit. Hence, either collectively such Agri tourism operators can provide publicity or organizations like ITDC, State tourism development corporations, NGOs, press and tour operators can take up this responsibility.
Transport: Reaching the remote Agri tourism units is the greatest challenge due to lack of approach roads and poor transportation facilities in rural areas.
Accommodation: Safe and clean accommodation is must in Agri tourism. Urban and foreign tourists look for these minimum facilities.
Public - Private partnership: Agripreneurs, farmers' organizations, cooperatives, NGOs and agribusiness companies can take up these ventures with the help of farmers and government agencies tour operators.

CONCLUSION:

Agritourism is complimentary to traditional agricultural activities. It is an opportunity for farmers to use the available resources in a diversified and innovative way. It creates a win –win situation to farmers as well as tourists. Agri tourism is unraveling the various facets of village and life with farming. Farmers earn better from innovative use of available resources and the tourist can enjoy village life and nature in an affordable prices. Not only are those, the villages also benefited due to the development of agro tourism. Some cases of agro tourism in Maharashtra have proved that agro tourism not only bring development of farmers but to the village as a whole from social and economic angle

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Scope of organic crop production

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Yumnam Sanatombi Devi* and Anju Keisham
Department of Agronomy, College of Agriculture, CAU Imphal

INTRODUCTION

Organic Agriculture is a production system that sustains the health of soils, ecosystem and people (IFOAM). The term 'organic' was first used in relation to farming by Northbourne (1940) in his book "Look to the Land". Continuous and injudicious use of heavy doses of fertilizers and plant protection chemicals potentially impair the soil microbial activity, leading to poor soil health (Singh *et al.,* 2007) and also increases cost of production and energy use, decline in soil fertility and loss of crop and soil biodiversity. In order to overcome this problem, alternative strategies and approaches are required to reduce soil degradation and increase soil fertility level for sustainable crop production. Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy making arena, its entry into anonymous global market and the transformation of organic products into commodities. During the last two decades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almost a century of development organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people. The Ministry of Commerce launched the "National Organic Program" in April 2000 and APEDA is implementing the "National Program of Organic Production" in 2004. Currently India ranks 33rd in term total land under organic cultivation. (FiBL and IFOAM 2012).Prime Minister Narenda Modi envisions the entire north east to be a hug of organic farming. Sikkim only state which has adopted organic (chemical fertilizer\pesticide\insecticide free) farming on a universal basis.

Problem of present day agriculture

Fertilizers are the essential among different factors contributing towards agricultural production. The benefits of increased use of fertilizers in achieving targets of food grain production are well established. Further, chemical fertilizers alone are unable to maintain the long term soil health and sustain crop productivity as they are unable to supply all the essential nutrients, particularly the trace elements (Subbha Rao and Srivastava, 1998). Some problem face due to present day agriculture:

Salinity problem: At present one third of cultivable land area of the world is affected by salt. In India about 7 million ha of land are estimated to be salt effected which may be saline or sodic. Salinization of salt is cause by excessive irrigation and sodic soil having carbonate and bicarbonate of sodium and pH exceed 8.

Pollution of water: Chemical and fertilizers flown by wind and irrigation water.

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Fertilizers related problems: Most of the chemical fertilizers used in modern agriculture have NPK which are essential macronutrients. Excessive fertilizer use has caused deficiency of micronutrient Zn in soil which affecting productivity of the soil. Nitrate pollution, nitrogenous fertilizers applied in the field often leach deep into soil and ultimately contaminate ground water. If it excess 25 mg/L cause "Blue Baby Syndrome" methaemoglobinemia which even lead to infant death. A large proportion of N and P used in crop field is washed off and along with runoff water reach the water bodies causing over nourishment of lakes a process called Eutrophication. Due to this, lakes get invaded by algal blooms and often produce toxin and badly affect food chain. Thus excessive use of fertilizer in agricultural field that make ecosystem gets degraded.

How to start implementing organic practices?

The procedure of conversion of a farm commonly consists of three steps. In a first step, it is recommended to collect information on appropriate organic farming practices. In a second step, the most promising organic practices should be tried out on selected plots or fields to get familiar with. In a third step, only organic procedures should be implemented in the entire farm.

Organic farming is a production system which avoids or largely excludes the use of synthetically produced fertilizer, pesticides, growth regulators and livestock feed additives to the maximum extent possible, organic farming system relay upon crop rotation, crop residues, animal manures, legumes, green manures, off farm organic wastes, mineral bearing rocks and bio fertilizers to maintain soil productivity and to supply plant nutrients and biological means to control insects, weeds and diseases (Campbell, 2011).

Component of organic farming:

1. Crop rotation: It is a systematic arrangement for the growing of different crops in a more or less regular sequence on the same land covering a period of two years or more. The selection of optimal crop rotation is important for successful sustainable agriculture. Crop rotation is very important. Soil fertility management, weed, insect and disease control. Legumes are essential in any rotation and should 30 to 50 percent of the land. A mixed cropping, pasture and livestock system is desirable or even essential for the success of sustainable agriculture.

2. Organic manure: The organic manure is derived from biological sources like plant, animal and human residues. Organic manure act in many ways in augmenting crop growth and soil productivity. The direct effect of organic manure relates to the uptake of humic substances or its decomposition products affecting favourably the growth and yield of plants. Indirectly, it augments the beneficial soil microorganisms and their activities and thus increases the availability of major and minor plant nutrients.

a) Bulky organic manure: It generally contains fewer amounts of plant nutrients as compared to concentrated organic manure. It includes FYM, compost and Green manure.

- **FYM:** It refers to the well-decomposed mixture of dung, urine, farm litter and left over or used up materials from roughages or fodder fed to the cattle. The waste material of cattle shed consisting of dung and urine soaked in the refuse is collected and placed in trenches about 6 m long, 2 m wide and 1 m deep. Each trench is filled up to a height of about 0.5 m above the ground level and plastered over with slurry cowdung and earth. The material is allowed to decompose undisturbed 3-4 months for anaerobic microorganism for completion of fermentation. FYM becomes ready to apply after 3-4 months. Well-rotted FYM contains 0.5% N, 0.2% P205 and 0.5% K2O.

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- **Compost:** Large quantities of waste material are available as vegetable refuse, farm litter, such as weeds, stubble, sugarcane trash, sewage sludge and animal waste in houses and in areas like human and industrial refuse; therefore, excreta can be converted into useful compost manure by conserving and subjecting these to a controlled process of anaerobic decomposition. Compost is used in the same way as FYM and is good for application to all soils and all crops.
- **Green Manuring:** It is a practice of ploughing or turning into the soil undercomposed green plant tissues for the purpose of improving physical structure as well as fertility of the soil. From the time immemorial the turning in a green crop for improvement of the conditions of the soil has been a popular farming practice. Green Manuring, wherever feasible, is the principal supplementary means of adding organic matter to the soil. It consists of the growing of quick growing crop and ploughing it under to incorporate it into the soil. The green manure crop supplies organic matter as well as additional nitrogen, particularly if it is a legume crop, which has the ability to fix nitrogen from the air with the help of its root-nodule bacteria. A leguminous crop producing 25 tons of green matter per hectare will add about 60 to 90 kg of nitrogen when ploughed under. This amount would equal an application of 3 to 10 tons of FYM on the basis of organic matter and its nitrogen contribution. The green manure crops also exercise a protective action against erosion and leaching. The most commonly used green manuring crops are: Sunhemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Cluster bean (*Cyamopsis tetragonoloba*), Senji (*Melilotus parviflora*), Cowpea (*Vigna catjang*, *Vigna sinensis*), Berseem (*Trifolium alexandrium*).

b) Concentrated Organic Manure: Concentrated organic manures are those materials that are organic in nature and contain higher percentage of essential plant nutrients such as nitrogen, phosphorous and potash, as compared to bulky organic manures. These concentrated manures are made from raw materials of animal or plant origin. The concentrated organic manures commonly used are oilcakes, blood meal, fishmeal, meat meal and horn and hoof meal.

3. Biofertilizers: It has been observed that there is decline in crop yield due to continuous apply of inorganic fertilizers. Therefore, increasing need is being felt to integrate nutrient supply with organic sources to restore the health of soil. Bio-fertilizer offers an economically attractive and ecologically sound means of reducing external inputs and improving the quality and quantity of internal sources. Bio-fertilizer is microorganism's culture capable of fixing atmospheric nitrogen when suitable crops are inoculated with them. The main inputs are microorganisms, which are capable of mobilizing nutritive elements from non-usable form to usable form through biological process. These are less expensive, eco-friendly and sustainable. The beneficial microorganisms in the soil that are greater significance to horticultural situations are biological nitrogen fixers, phosphate solubilisers and mycorrhizal fungi.

4. Bio-pesticide: Bio-pesticides are natural plant products that belong to the so-called secondary metabolites, which include thousands of alkaloids, terpenoids, phenolics and minor secondary chemicals. These substances have usually no known function in photosynthesis, growth or other basic aspects of plant physiology; however, their biological activity against insects, nematodes, fungi and other organisms is well documented.

Botanical insecticides are ecologically and environmentally safer generally affect the behaviour and physiology of insects rather than killing them. Among the botanical pesticides investigated. Neem (Azadirachta indica) has justifiably received the maximum attention. All parts of the Neem tree possess insecticidal property but seed kernel is most active.

Bio pesticides and other preparations of plant origin used in agriculture seem to have a good scope especially in view of the environmental problems being faced with the synthetic agrochemical. Some of the commonly used botanical Insecticides are Nicotine, Pyrethrum, Rotenone, Subabilla, Ryanin, Quassia, Margosa, Acorus etc. Their used need to be promoted under the Integrated Pest management Programmes.

5. Vermicompost: It is organic manure produced by the activity of earthworms. It is a method of making compost with the use of earthworms that generally live in soil, eat biomass and excrete it in digested form. It is generally estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tons of humus per year. These are rich in macro and micronutrients, vitamins, growth hormones and immobilized microflora. The average nutrient content of vermicompost is much higher than that of FYM. It contains 1.60% N, 5.04% P2O and 0.80% K2O with small quantities of micronutrients. Application of vermicompost facilitates easy availability of essential plant nutrients to crop.

6. Animal husbandry: In an organic system, the welfare of the animals is considered very important.
• Animals should not be kept in confined spaces where they cannot carry out their natural behaviour such as standing and moving around in an inadequate amount of space. However, care should be taken that animals do not damage crops.
• Food for animals should be grown organically.
• Breeds should be chosen to suit local needs and local conditions and resources.

Advantages of organic farming

- Organic matter supplies all the essential macro and micro plant nutrients.
- Organic matter improves physico-chemical and biological properties of soil.
- Organic matter recycling is renewable and thus energy resources can be made available for organic production.
- Organic farming improves agro eco-system and helps stopping environmentally degradation.
- Organically grown crops are preferred most by people as it is believed to be more nutritious compared to the conventional ones.
- Organic produce fetches more prices in the national and international market.

CONCLUSION: Organic farming can be a viable alternative production method for farmers, but there are many challenges. One key to success is being open to alternative organic approaches to solving production problems. Determine the cause of the problem, and assess strategies to avoid or reduce the long term problem rather than a short term fix for it.

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e-NAM

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Akanksha singh*, Samarjeet singh
Department of Agricultural & Extension, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110 (U.P)

National Agriculture Market or eNAM was launched by the Ministry of Agriculture, Government of India. The electronic market pilot across India was launched on 14 April 2016 by Prime Minister of India, Narendra Modi. e-NAM is an online trading platform for agricultural commodities in India. The market facilitates farmers, traders and buyers with online trading in commodities. The market is helping in better price discovery and provides facilities for smooth marketing of their produce. The market transactions stood at 36,200 crores by January 2018, mostly intra-market. Over 90 commodities including staple food grains, vegetables and fruits are currently listed in its list of commodities available for trade. The eNAM markets are proving popular as the crops are weighed immediately and the stock is lifted on the same day and the payments are cleared online. In February 2018, some attractive features like MIS dashboard, BHIM and other mobile payments, enhanced features on the mobile app such as gate entry and payment through mobile phones and farmers database is helping adoption even more. The present trading is done mostly for intra-market, but in phases, it will be rolled out to trade in inter-market, inter-state, creating a unified national market for agricultural commodities.

Objectives

- Single point levy of market fees, i.e. on the first wholesale purchase from the farmer.
- A national e-market platform for transparent sale transactions and price discovery initially in regulated markets.
- Liberal licensing of traders/buyers and commission agents by State authorities without any pre-condition of physical presence or possession of shop /premises in the market yard.
- One license for a trader valid across all markets in the State.
- Harmonization of quality standards of agricultural produce and provision for assaying (quality testing) infrastructure in every market to enable informed bidding by buyers. Common tradable parameters have so far been developed for 25 commodities.
- Provision of Soil Testing Laboratories in/ or near the selected mandi to facilitate visiting farmers to access this facility in the mandi itself. M/s. Nagarjuna Fertilizers and Chemicals Ltd. is the Strategic Partner (SP) who is responsible for the development, operation and maintenance of the platform. The broad role of the Strategic Partner is comprehensive and includes the writing of the software, customizing it to meet the specific requirements of the mandis in the States willing to integrate with NAM and running the platform.

Market

On the e-NAM platform, farmers can opt to trade directly on their own through the mobile app or through registered commission agents. The eNAM is linked with 585 markets (APMCs) in 16 states and 2 union territories, with over 45 lakh farmer membership in 15 states. The markets is helping traders and exporters in procuring quality products in bulk, at one place and ensure transparent financial transactions. The Government plans to connect over 22,000 village, local farmers markets, with the platform. To provide better grading and assaying services, the Agriculture Department is looking at looping in AGMARK for better certification.

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Advantages

- **Farmers**- They can sell products without the interference of any brokers or middlemen there by making competitive returns out of their investment.
- **Traders-** Traders will be able to do secondary trading from one APMC to another one anywhere in India. Local traders can get access to the larger national market for secondary trading.
- **Buyers, Processers & Exporters-**Buyers like large retailers, processors or exporters will be able to source commodities from any mandi in India there by reducing the inter-mediation cost. Their physical presence and dependence on intermediaries will not be needed.
- **Consumers - e**NAM will increase the number of traders and the competition among them increases. This translates into stable prices and availability to the consumers.
- **Mandis** - There will be a reduction in book keeping and reporting system as it will be generated automatically. Monitoring and regulation of traders and commission agents become easy. Transparency in the process eliminates the scope of manipulation of tendering/auctioning process. Market allocation fee will increase due to an accounting of all transactions taking place in the market. It will reduce the manpower requirements as the tendering/auctioning process is carried out electronically. For instance, the system declares the winner of lots within a few seconds. It eliminates information asymmetry as all the activities of an APMC can be known directly from the website.
- **Others -** e-NAM aims to improve the marketing aspect of the agriculture sector. With one license for the entire state and single point levy, an entire state becomes a market and the market fragmentation within the same state gets abolished. It will improve the supply chain of commodities and reduces wastages

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Role of green manuring in organic farming

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Anurag Kumar Singh*[1], Brijesh Kumar Chaudhary[1], Vivek Kumar[2]
[1]Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005
[2]Department of Plant Physiology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005

Organic farming is sustainable crop production system, which avoids or largely excludes the use of synthetically chemical compounded fertilizers, growth regulators. It rely on crop residues, animal manures, crop rotations, green manures, legumes, off farm organic wastes and aspects of biological pest control for maintaining soil fertility and productivity and also physical condition of soil to supply plant nutrient status and to control insect, pests, disease and weeds. Green manuring is element of organic farming. Green manuring is the practice of enhancing the soil productivity and fertility by ploughing under or soil incorporation of any green manure crops although they are green after they start flowering. The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility. The decaying of the organic matter affected the availability of the soil nutrients such as nitrogen, sulphur. Crop which is grown for green manuring are called green manure crops. Several estimates suggested that a 40- 50 days old green manure crop can be suppled up to 80-100 kg. N/ha. Yet if half of this N is crop utilizable, a green manure crop can be a substitute to 50-60 kg. fertilizer N/ha .
Many potential green manuring legumes are cowpea, mung, bean, guar, dhanicha, sunhemp, and berseem etc. Mung bean, Dhanicha, Sunhemp, and Guar grown during *kharif* season as green manuring crops have been reported to add 8-21 tones of green matter and 42-95 kg. of N/ha. Likewise, berseem, cowpea and Khesari cultivated during *rabi* season can be contributed 12-29 tons of green matter and 67-68 kg of N/ha.

A) Green leaf manuring

Where the application of green leaves, succulent green materials and twigs of trees, herbs and shrubs collected from plants grown in wastelands, field bunds, degraded lands and nearby forest. They are mixed into the soil 15-30 days before sowing of the crops depending on the tenderness of the foliage or plant parts is known as green leaf manuring. Green leaf manuring is known as off farm green manuring.

B) *In situ* green manuring

In situ green manuring is also called as On–farm green manure or legume green manuring. In *situ* green manuring, the short duration legume crops are grown and covered in the same site when they achieve the age of 60-80 days after sowing. This system of on-site nutrient resource generation is most prevailing in northern and southern parts of India, where rice is being taken as major crop in the existing cropping systems. Almost any crop can be used for green manuring, but legumes are mostly preferred because of their ability to fix more nitrogen as compare cereals from the air. Green manuring with legumes (clovers, lentils, peas, etc.) is called legume green manuring. These crops should be turned into the soil before setting of seeds. Legume green manuring could be profitably used on lands where, it was not possible to add animal manures.

Important techniques of green manuring:

The maximum advantage from the green manuring crop cannot be obtained without knowing the**:**

(a) Time of sowing of the green manuring crop:

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Sowing time of the green manure crop varies according to local conditions and resources available. Normally, green manure crop is sown directly after monsoon rains. But, if water facility is available, green manure crop can be grown-up as catch crop after harvesting of rabi crop through April and May. Dhaincha and Sunnhemp are suitable for growing in April-May and can be covered in June-July before planting of main *kharif* crop. In rainfed areas intercropping of dhaincha with paddy in row ratio of 4:1 can be done. Also sunhemp and cowpea can be intercropped in generally spaced crop such as, sugarcane, maize and cotton.

Green manure crops and under sowing: Under sowing involves growing a green manure at the same time as that of main crop. Sometimes they are sown with the crop or slightly later when the crops are already growing. This reduces competition between the green manure and the crop.

(b) Appropriate stage of burying of green manure crop:
Burial of green manure crop at right time added maximum nitrogen and organic matter. This specific stage is when plant is young and has started flowering, as the basic target of green manuring is for providing maximum succulent green matter at burying. During early period of crop growth protein, N content water soluble constituents are maximum, whereas, cellulose, lignin fiber, hemicelluloses and C:N ratio are less. so, tissues of immature plants generally decompose more rapidly as compared to matured plants. Delay of even 15- 20 days decrease nitrogen content and add to C:N ratio, fibre, hemicelluloses, cellulose, lignin making it difficult for soil microorganisms to act and decompose.

Technique and depth of burial of green manure crop: Before a crop is sown the green manure is dug back into the soil. Green manures should not be ploughed in as this buries the plants and the nutrients too deep. They should be turned in just under the soil surface. Here, it decomposes and the nutrients held inside green manure plants are released. Immature crop can decompose at any depth, but mature crop should be buried at less depth. If the weather is dry green manure crop should be buried at more depth compared to moist season. If moisture in soil is less water should be supplied externally. Green manure crop should be buried at higher depth in sandy soil and in heavy soils at less depth for proper decomposition.

(c) Minimum time interval between burial of green manure crop and the sowing of the next crop: The time interval should be such that it allow complete decomposition of the turned in green manure crop before planting of the next crop. Time interval depends on the following factors: 1) Climatic conditions, 2) nature of buried green material. Crop should be sown after 35- 45 days of burial of green manure crop as green manure crop takes about 4-6 weeks for complete decomposition. If the green manure crop is succulent, then there is no harm in transplanting the paddy immediately after turning in the green manure crop However, in case of woody then sufficient time should be allowed for its decomposition. Green manure crop was intercropped in between the rows of the main crops like paddy, cotton, sugarcane etc. Then, it is buried in the succulent stage for it's rapid decomposition. The physico-chemical properties of soils are affected significantly due to adding of organic matter in the form of green manures. It improves soil texture, structure, infiltration rate, bulk density and water holding capacity of soil. It is marked from that merger of subabool, sunnhemp and crop residues were equally effective in increasing infiltration rate of soil while the water use efficiency of sorghum was increased significantly with the green leaf manuring of sunnhemp, subabool and fertilizer application over crop residues.

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Oilseed based intercropping system for increasing farm income”

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Tushar Vaghela
[1] Ph. D. Scholar, Dept. of Agronomy, NAU, Navsari (Gujarat)

Oilseed crops are grown primarily for the oil contained in the seed. India has the largest area about 28.05 million hectares and production about 32.74 million tons of oilseeds in the world. Among the nine oilseed crops, seven crops (soybean, groundnut, rapeseed-mustard, sunflower, sesame, safflower and niger) are grown for edible oil and two crops (castor and linseed) are grown for non-edible oil in the country. Among the oilseed crops, rapeseed-mustard ranked next to ground nut and soybean in contribution to the oilseed production. Oilseeds are mainly used for extraction of edible oil and it is the chief source of fats and proteins. In general oilseed crops are grown as a sole crop. Cultivating oilseed crops as a sole crop with wide spacing is usually found to be risky and less remunerative. Intercropping in oilseed crops is of significance because of higher profit and stabilized yield advantage, especially under adverse weather conditions. This practice leads to some benefit like yield advantage as compared to sole cropping and greater stability of yield over different seasons. Intercropping system utilizes resources efficiently and increases the productivity.

INTRODUCTION:

Oilseed crops are grown primarily for the oil contained in the seed. India has the largest area about 28.05 million hectares and production about 32.74 million tons of oilseeds in the world. Among the nine oilseed crops grown in the country, seven are of edible oil (soybean, groundnut, rapeseed-mustard sunflower, sesame, safflower and niger) and two are of non-edible oils (castor and linseed) Among the oilseed crops, rapeseed-mustard ranked next to ground nut and soybean in contribution to the oilseed production. Oilseeds are mainly used for extraction of edible oils and it is the chief source of fats and proteins. In general oilseed crops are grown as a sole crop. Cultivating oilseed crops as a sole crop with wide spacing is usually found to be risky and less remunerative. Intercropping in oilseed crops is of significance because of higher profit and stabilized yield advantage, especially under adverse weather conditions. The basic concept of intercropping system involves growing together two or more crops with the assumption that two crops can exploit the environment better than one and ultimately produce the higher yield (Reddy and Willy, 1981) because the component crops differ in resources use and when grown together they complement each other and make overall better use of resources. This practice leads to some benefit like yield advantage as compared to sole cropping and greater stability of yield over different seasons. Intercropping system utilizes resources efficiently and increases the productivity.

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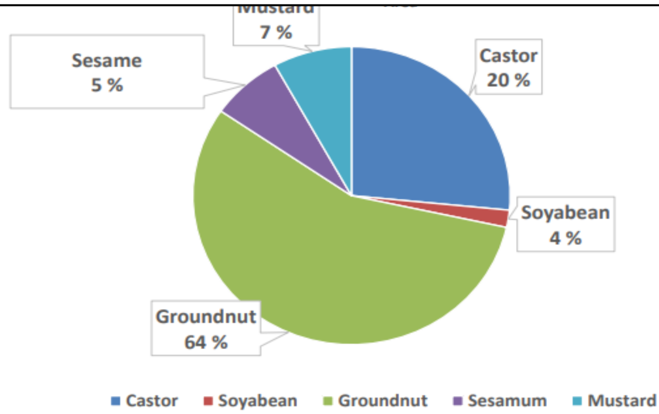
Percent area of oilseeds in Gujarat state



Source: 2017-18, (NFSM) Final advance estimate

Intercropping system following in India

▪ Soybean based ▪ Soybean + Groundnut ▪ Soybean + Pigeon pea ▪ Soybean + Pearl millet ▪ Soybean + Sorghum ▪ Soybean + Cotton ▪ Soybean + Castor	▪ Castor based ▪ Castor + Sesame ▪ Castor + Pearl millet ▪ Castor + Groundnut ▪ Castor + Mung bean ▪ Castor + Urdbean ▪ Castor + Pigeon pea	▪ Groundnut based ▪ Groundnut + Castor ▪ Groundnut + Pigeon pea ▪ Groundnut + Sunflower ▪ Groundnut + Sesame
▪ Sesame based ▪ Sesame + Groundnut ▪ Sesame + Black gram ▪ Sesame + Pigeon pea	▪ Sunflower based ▪ Sunflower + Ground nut ▪ Sunflower + Castor	▪ Mustard based ▪ Mustard + Chick pea ▪ Mustard +Groundnut
▪ Safflower based ▪ Safflower + Wheat ▪ Safflower + Chick pea ▪ Safflower + Linseed	▪ Linseed based ▪ Linseed + Chick pea ▪ Linseed + Wheat ▪ Linseed + Safflower	

Intercropping

- Intercropping is growing two or more crops simultaneously on the same piece of land with a definite row pattern.
- It is the intensification of cropping in time and space dimension.

Why intercropping?

1. Stability: Intercropping adds diversity to the cropping system and diversity tends to lead to stability.

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2. Reduced chemical use: Intercropping may allow for lower input levels in cropping system by reducing fertilizer and pesticide requirements.
3. Over yielding: Over yielding occurs when the yield produced by an intercrop is larger than the yield produced by the component crops grown in monoculture on the same total land area.

Over yielding is calculated using the LER.

- When the LER is greater than 1, over yielding is occurring and the intercrop is more productive than the component crops grown as sole crops.
- When the LER is less than 1, no over yielding is occurring and the sole crops are more productive than the intercrop.

Why intercropping is needed?

- Small holding size of land in India.
- Small and marginal farmers (more than 80%).
- Better utilization of land, labour and capital to increase the production per unit time and space.
- Productivity is low of cereal crops as compared to fruits and vegetables.
- Increase the water and fertilizer use efficiency
- Adds diversity to the cropping system and diversity leads to stability.

Criteria for selection of intercrop

The following points to be considered while selecting crops for intercropping system:

- Tall growing crops with short growing crops
- Bushy crops with erect growing crops
- Fast growing crops with slow growing crops
- Deep rooted crops with shallow rooted crops
- Short duration crops with long duration crops
- Legume crops with non-legume crops
- Crops should have least allelopathic effect
- Different groups of crop should be selected to avoid the insect and disease incidence

Interactions in intercropping

- Light use efficiency (LUE)
- Water and nutrient
- Allelopathy
- Annidation: a) Space b) Time
- Competition
- Other complementary effects

Principles of intercropping

- Should be shorter duration and of faster growing habits.
- Should have complementary effects rather competitive effects

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- Should have similar agronomic practices.
- Erect growing crops should be intercropped with cover crops.
- The component crops should have different root depth.
- Select crops as per the characteristics and constraints of soils.

Types of Intercropping

- Mixed intercropping
- Row intercropping
- Strip Inter-cropping
- Relay inter-cropping
- Parallel Cropping
- Companion Cropping
- Multistoried Cropping or Multi-tire cropping

Two basic series for intercropping on the basis of plant population

1. Additive series:

- In such type of intercropping, one crop is main crop or base crop and another crop is intercrop.
- The plant population of base crop is same to recommended population in pure stand where as that of intercrop is less.

2. Replacement series:

- Both the crops are component crops. Neither is the base crop nor is the inter crop.
- It means the plant population of both component crops is less than their recommended population in pure stand.
- This type of intercropping is widely adopted in western countries.

Indices used in intercropping

- Land Equivalent Ratio (LER)
- Crop Equivalent Ratio
- Relative Crowding Coefficient (RCC)
- Aggressivity (A)
- Competition Index (CI)
- Competition Ratio (CR)
- Competition Coefficient (CC)
- Area Time Equivalent Ratio (ATER)
- Staple Land Equivalent Ratio (SLER)
- Land Equivalent Coefficient (LEC)
- Crop Performance Ratio (CPR)
- Monetary Yield Advantage (MAI)

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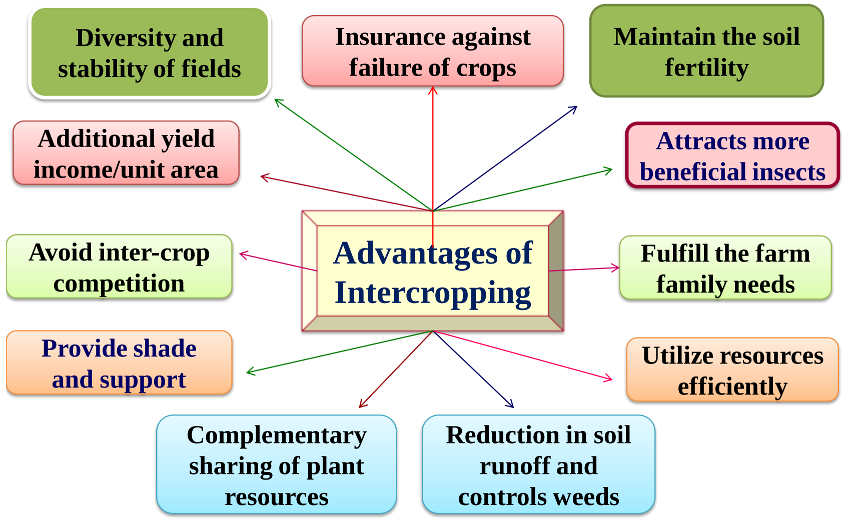
Advantages of intercropping



CONCLUSION

From the foregoing discussion it can be concluded that oilseed based intercropping system *i. e.* oilseed crops + pulse crop, oilseed crops + cereal crops, oilseed crops + millets etc. Improve the soil fertility, increase the equivalent yield of crops, LER and net return.

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Role of Agricultural Extension in the Dissemination of Sustainable Agricultural Development

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Deepak Chand Meena* and Ninad Bhatt
Ph.D. Research schooler, National Dairy Research Institute, Karnal, Haryana

INTRODUCTION

Sustainable agriculture, is very difficult to define, its include the practices of low input agricultural production technologies, which attempts to ensure the profitability of farms while preserving the environment. And from the market point of view, these products obtained are sold at profitable prices which would provide incentives for farmers to adopt the necessary methods (Niamh Dennehy *et al*., 2000). different programs and goals and then allocate resources towards those goals. It Provide efficient and effective need-based extension services to all categories of farmers, to enable them to optimize their use of resources, in order to promote sustainable agricultural and socioeconomic development

Agricultural extension services is the bedrock of Agricultural development, however, the development of the sector cannot be achieved without an efficient and effective extension system. Thus, there is the need for a well-articulated and comprehensive Agricultural Extension Policy, which depends on Decentralization and Pluralism to development of Agricultural extension system. Agricultural extension services system is composed of a large number of varying elements, but there are some commonly known services which are essential to Sustainable agricultural development in spite of their various organizational schemes and arrangements, They include: agricultural research, agricultural extension, agricultural education and farmer's training centers, agricultural credit, marketing system for purchasing inputs and selling agricultural produce, transport facilities, (Weitz, 1971, Umali 1994).

Role of agricultural extension in the sustainable agricultural development

Agricultural extension policy is a part of national development policy in general and of agricultural and rural development policy in particular. Hence, the problems of establishing or maintaining an effective agricultural extension service can be traced back to the lack of a realistic policy or an unstable policy framework for charting of the extension system. In developing national agricultural extension policies, representatives of all major groups of farmers should be directly involved and other relevant agricultural organizations, should have a comprehensive agricultural extension policy which provides for coordination with research and education. Although it is hard to defend public funding of agricultural extension if the benefit is only for the farmers who use this service. There are many situations where the public at large also profits from the extension services, and this requires large increases in current budget allocations and innovative public-private partnerships to make these investments.

Agricultural extension can receive and expand project funds, enter into contracts and agreements and maintain revolving accounts that can be used to collect fees and thereby recovering operating costs The fees collected could be a potential source of funds for Agricultural extension to meet its declining operational funding Improving the competitiveness of farmers by financing agricultural extension may be a more effective and less costly way. However, people may realize what they have to pay in taxes to finance agricultural extension, but not what they would pay if import duties on food products were raised . Fee-for-service Agricultural extension is provided for by Agricultural extension management (or another sector) and

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paid for by the farmers. Small groups of farmers usually contract the services. The single most important feature of privatized extension systems is not a change in the source of funds but rather a change in the nature of incentives that drive information provision Such changes certainly expand extension's ability to provide solutions to a wide range of complex problems while reducing costs and maintaining quality. Sustainable agricultural development programs worldwide have recognized that local participation is the key to the sustainable transfer and long-term adoption of new technologies and approaches. Interactive participation is the approach that facilitates this kind of Sustainable agriculture programs. The main aim of the reorientation Agricultural extension programs was to encourage collaboration and integration by extension, research, tertiary institutions, participation of local stakeholders (different categories of farmers, plus representatives from private sector, rural banks, Agricultural organizations) and planning, and implementation of Sustainable agricultural development programs. Managers are related to policy formation in two ways. First, they play a crucial role in implementing organizational policies that have been established by higher management. Second, they create policies within their departments as guides for their own work groups. To achieve these linkages, need to restructure with new expertise and skills and with a new set of decentralization procedures, which are less hierarchical and more flexible, to respond to the emerging needs of farmers at the local level and to improve the cooperation of cross of Pluralism extension approach among different government departments and other development agencies. (Figure 2)

Linking Decentralization of Agricultural Extension Systems to Sustainable agricultural development

De-concentration is defined as the transfer of effective control by central Managements to regional and provincial Managements or other field level offices. In addition, this strategy may include the participatory involvement of farmers in the managerial processes for agricultural development District extension director received and followed instructions from the senior management of the agricultural extension with limited involvement of subordinate staff. The staffs are involved in the development of the case organization’s annual extension plan and each staff member is responsible in consultation with his supervisor, for the development of his own annual work plan and training program.

The Move towards Pluralism for Sustainable agricultural development

Agricultural extension Managements can establish different collaborative working relationships with Agricultural Development organizations based on trust and mutual respect, to obtain access to resources for extension delivery Farmers and staff training. The main challenge in installing a proper pluralistic agricultural extension mechanism is the effective coordination among various organizations, especially in matters of development when competent non-public institutions are present in the country. The modality of using more than one organization, whether public or private, for delivering extension services is to help in achieving the desired goals. In addition, agricultural research institutes, agricultural universities and farmers’ associations, participate in the delivery of extension services. Here, agricultural extension refers to the cultivation of farmers’ organizations that aim to increase agricultural productivity and to improve the everyday life of farmers. The agricultural technology distribution is a model which shows the relationship among agricultural research, agricultural extension and farmers. Based on the agricultural technology distribution, agricultural extension process is a scientific knowledge the results of agricultural research to the techniques and transmits the techniques to the farmers to help them adopt the techniques and increase production by using them. Agricultural research and technology identification are often relevant to all public and private extension service providers. Here, most extension services oversight is an inherent aspect of the public sector's responsibilities for policy formulation, and design of reforms to promote pluralistic extension institutional arrangements farmers to collectively find solutions to their problems. Economic and social issues require the allocation of appropriate resources for this work; this entails a commitment to develop proficiency local groups to participate in these processes. Farmers belonging to farmers organizations are more aware of the constraints they were facing to improve their production than non-members. This may be due to the fact that most extension programmes were intended for farmers' organizations instead of individual farmers. The involvement of public organizations in institutional research and extension activities can lead these institutions to establish complementary relationships with such organizations as the Agricultural Research Institutes, the Ministry of Agriculture, and similar agricultural development organizations.

CONCLUSION

Extension can give good result through encourages more contact and open communication to build respect and trust among the staff, gives a level of flexibility to field staff to design their location-specific extension activities with farmers and effective coordination among various organizations. Further and concrete studies are needed because of complexity of the impact evaluation; it is necessary to combine studies using different perspectives in order to increase the scope and rigor of results. If studies are coordinated (e.g. Contribution of decentralization and the Pluralism of access to provides a framework for Agricultural extension staff to participate with farmers and other organizations in facilitating development planning and activity implementation for sustainable agricultural development).

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Diseases transmission in bovines through semen

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Ninad Bhatt, Nripendra Pratap Singh, Deepak Chand Meena
National Dairy Research Institute, Karnal, Haryana - 132001

INRODUCTION

Bovine reproduction depends on a high percentage of natural service. Selecting a bull thus becomes a critical element leading to serious economic consequences if a particular bull has problems regarding infertility or is a disease transmitter. Just as a cows fertility may be affected by a large number of infectious agents, the bull is exposed to the very same specific agents and many others directly affecting reproductive activity. Diseases transmitted through semen may directly causes failure of cows to conceive and loss of pregnancies through abortion or resorption of fetuses and indirectly affects the fertility of bull. Various microorganisms including bacteria, viruses, and protozoa can be transmitted through semen. World Animal Health Organization has listed several diseases as having proven importance in transmission through semen and most important diseases are discussed in this communication.

BRUCELLOSIS: It is one of the most important disease transmitted through semen, leading to heavy economic losses to the farmers. In cattle, Brucellosis is caused by *Brucella abortus* and it is further classified into 7 biovarieties. It causes abortion in last trimester of pregnancy (7-9 months), retention of fetal membranes, indurations of mammary glands in cows and orchitis and vesiculitis in males. Serological tests are applied routinely to monitor for Brucellosis. Indirect and competitive ELISA formats have been developed and evaluated in several countries. Laboratory tests include isolation or demonstration of the organism in tissues or fluids, and serological tests and agglutination tests on milk or seminal plasma. At present time Brucellosis in cattle is considered an incurable disease, although 15 percent of cattle recover from naturally acquired infections. Vaccination of all animals is a logical control measure. Live strain 19 vaccine and the killed 45/20 vaccine have both played an important role in the control of Brucellosis. However, strain 19 may produce permanent infections in bulls similar to those of natural disease. So vaccination of bulls is not recommended. New vaccines such as RB51, can induce a protective immune response but the value of these vaccines in the field remains to be tested. Females are vaccinated at six month of age.

Campylobacteriosis: Infection with *Campylobacter fetus* in cows is characterized by infertility, embryo death and abortion at about 3-5 month of pregnancy. In bulls, infection is not accompanied by either pathological lesions or modifications in the characteristics of the semen. Bulls marked for AI must be declared free of such diseases even though adding antibiotics to semen leads to this pathogen being easily controlled. Diagnosis can be done with the help of direct culture of prepucial smegma, FAT and vaginal mucus agglutination test. Treatment includes broad spectrum antibiotics parentally.

Leptospirosis: Clinically, bovine leptospirosis can be acute (septicaemia, hepatitis, nephritis), subacute (nephritis, agalactia), chronic (abortion, stillbirth, infertility) or, in its most common form, asymptomatic. *Leptospira* spp. are vehiculated by semen, as they survive at freezing and cryoconservation temperatures. The reference laboratory test for serological diagnosis of Leptospirosis in cattle is the microscopic agglutination test (MA). Treatment of bulls with 25 mg of dihydrostreptomycin (DHS) per kg body weight has been approved internationally to stabilise low antibody titres and to prevent shedding of Leptospira.

Infectious Bovine Rhinotracheitis (IBR): causative agent of IBR is Bovine Herpes Virus -1 causes abortion in late gestation, infectious pustular balanoposthitis in bulls, infectious pustular valvovaginitis in cows, pustules in

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vulva/vagina, glans penis & prepuce and ulcers in vulva/vagina. This is one of the most important viral diseases as the state of viral latency implies that infected animals become carries for life and frequent viral reactivation is caused by stress factors. Diagnoses include virus isolation, fluorescent antibody test (FAT) technique and ELISA. IPV is self limiting and treatment with antibiotics may be necessary to reduce the likelihood of this sequel.

FMD: It is considered as one of the most important disease of the world affecting the export of semen. FMD virus has been found in bull semen up to four days, before and well after (37 days) the appearance of clinical sings of the disease. Affected bulls are reluctant to serve and their semen quality is poor. The virus may also multiply in the skin around the preputial orifice and contaminates semen during ejaculation. FMD virus is preserved by semen freezing and during storage and can cause infection in inseminated females.

Mycoplasma: *Mycoplasma bovigenitalium* occurs most often in bulls genital tracts. It's presence in the prepuce and preputial orifice does not cause lesions; on the contrary, if it reaches the testicles and nearby glands it may cause lesions leading to low spermatic motility and reduced resistance to freezing and unfreezing. Contamination of semen with *Mycoplasma* also originates from using diluters containing egg yolk or milk. Cows infected with these pathogens present severe salpingo-oophoritis. It is also considered an important pathogen which could affect embryo production in vitro through semen. The antibiotics most used in semen (gentamycine, tylosin, lincomycine and spectinomycine) did not control its presence or growth in cultures made from semen samples taken from AI-destined bulls.

CONCLUSION: Bulls responsible for the majority of diseases have few, if any, detectable signs. There are generally no changes to the appearance of the sexual organs, no change in libido, and no changes noticeable in routine semen evaluations. Heifers are more likely to be open because they lack the natural immunity of the older cows because they have had less exposure to the disease. Though correctly assumed to be a cause of infertility, it is not uncommon to experience fetal losses. Use of Breeding Soundness Examination is also of limited value as the organisms responsible seldom cause any changes to the physical appearance of the sexual organs. Semen evaluation is also typically normal as the organisms are found on the surface of the penis and prepuce not in the semen itself. An important aspect of the control of these diseases is vaccination. A vaccination program should be in place for all herds that is comprehensive for all diseases that exist within the herd or that may become a problem. These diseases in cattle cost the cattle industry hundreds of billions of dollars annually. Yet, the use of effective control measures including bull management and vaccination offer cattlemen reliable, cost effective controls.

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Effect of Soil Management Practices on Nutrient Availability in Soil

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[1]Dharmendra Chaudhari [2] Tushar Vaghela.
[1] Ph. D. Scholar, Dept. of Agronomy, NAU, Navsari (Gujarat)
[2] Ph. D. Scholar, Dept. of Agronomy, NAU, Navsari (Gujarat)

Soil management practices are targeted to provide adequate crop nutrition and to ensure durable soil fertility. Soil management practice has the greatest effect on soil physical, chemical and biological properties. The aim should be to produce the maximum economic levels of production, maintain the value of the farm and minimize pollution. Different soil management practices like tillage, use of organic manures, bio fertilizer, green manure crop, soil amendments, integrated nutrient management and cropping system which are important to maintain or improve soil quality. Well managed soils also improve the performance of crops. In appropriate management leads to soil degradation, erosion, loss of organic matter and nutrients.

INTRODUCTION:

Different soil management practices

1. Tillage
2. Use of organic manures
3. Use of bio-fertilizer
4. Use of green manure crops
5. Integrated nutrient management
6. Use of soil amendments
7. Cropping system

Tillage

Tillage is physical (Mechanical) manipulation of soil

Soil properties affected by tillage

- Crop residue cover
- Nutrient availability
- Structure and aggregate stability
- Water relationships
- Temperature

Crop residue management

- Cost effective
- Economically beneficial to many producers and more importantly to society.
- Alternative for nutrient requirement
- Improve soil properties
- Improve species diversity of soil biota quality

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Organic manure

- Provides all the nutrients that are required by plants but in small quantities.
- Supply organic matter to the soil.
- Helps to maintaining C:N ratio in the soil.
- Improves the physical, chemical and biological properties of the soil.
- Provide foods to soil micro organism.
- Increases the water holding capacity of the soil.
- Due to increase in the biological activity, the nutrients that are in the lower depths are made available to the plants.
- Acts as mulch, thereby minimizing the evaporation losses of moisture from the soil.

Biofertilizer

"Biofertilizers or bio inoculants are the preparations containing microorganisms beneficial to agricultural production in terms of nutrient supply"

Why do use bio-fertilizers?

- Nitrogen fixation through the rhizobactria deposits the nitrogen in the soil.
- Phosphobactaria convert insoluble phosphorus in to soluble form, ultimately available to plants.
- Minimize the losses due to natural processes of de-nitrification and leaching of nitrogenous fertilizers.
- Help in mineralization of plant nutrients.
- It is the low monitory input.
- Eco-friendly and pollution free.
- Large scale commercial production of Biofertilizers *viz.*, *Rhizobium, PSB, Acetobacter, Azospirillum* and *Azotobacter* have been started using fermented technology at NAU, Navsari since 2008-09.
- This has potential to save at least 10-20% of chemical fertilizers and improve soil fertility by eco- friendly ways. (General findings)
- Within five years of setup, the unit has distributed more than 6 lakh liters of Biofertilizers to the farmers under the brand name of the university "NAUROJI".

Green manuring

- Increases the organic matter in the soil.
- Modifies soil physical, chemical and biological environment.
- Help in returning the different plant nutrients to the surface soil layer from the sub-surface soil layer.
- Improve the soil structure.
- Reduce the soil loss caused by runoff and erosion.
- Some residual effect in relation to supply of different plant nutrient and there by it help in the better growth to the next crop.

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Integrated nutrient management

- Judicious combination of organic, inorganic and biofertilizers, which replenishes the soil nutrients removed by the crops is referred as Integrated nutrient management.
- To sustain the productivity of different crops and cropping systems, efficient nutrient management is vital.
- The basic concept of integrated nutrient management is the adjustment of nutrient
- Supply to an optimum level for sustaining the desired crop productivity.
- Conjunctive use of mineral fertilizer with organic and biological sources of plant nutrients commonly referred as integrated nutrient supply system, is an established agro-technique for sustaining nutrient use efficiency and restoring soil physical, chemical and biological property.

Integrated Nutrient Management Intended for Four Major Goals

- Maintain soil fertility
- To ensure sustainable productivity
- To prevent degradation of the environment
- To reduce expenditure on the cost of chemical fertilizers.

Soil amendments

- Gypsum reclaims the sodic soil by lowering the soil pH. In alkali soil, gypsum increase the aeration and water holding capacity.
- Pyrite also used as soil amendment to reclaim the sodic soil.
- Press mud as soil amendment aggregates the soil particle and increases the aeration and water holding capacity.
- Organic matter improves the soil physical and chemical structure. Act as a buffering agent in soil and it reclaim the sodic soil. Organic matter in soil increases the CEC, water holding capacity and aeration.
- Lime reclaims the acidic soil by increase the soil pH.

Cropping system

- Important component of a farming system.
- It also implies both temporal sequences of crop and the management (crop and soil) practices adopted to grow them.
- Effects on accumulation of soil organic matter or soil organic carbon because it affects many of the other soil properties and processes important for soil quality.
- Also enhance nitrogen fixation, use efficiency of water and nutrient through conservation tillage, cover crops, improved methods of soil structure, nutrient management, crop residue management, drainage irrigation management, erosion control and crop rotation.
- Rotational cropping play significant role in conserving soil, maintaining soil fertility, controlling pests and also helps to break up insect and disease cycles.

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Inappropriate soil management practices

Lead to:

- Soil degradation
- Soil erosion
- Loss of organic matter
- Soil compaction
- Acidification
- Loss of nitrates, phosphates, and pesticides
- Accumulation of salts and trace elements
- Increased run-off loss of fertilizers and pesticides to water systems

How low organic matter is affect the nutrient availability?

- Decreased of mineralization process in soil
- Decreased the Carbon content in soil
- Decreased the microbial activity in soil
- Decreased Availability status of nutrients in soil
- Poor physical condition of soil
- Surface soil loss increase
- Decreased the CEC of soil

CONCLUSION

Tillage practices improve nutrient availability by improving soil physical condition. Use of organic manure, bio-fertilizer and green manure improve the physical, chemical and biological properties of soil. Integrated Nutrient Management and cropping system having leguminous or green manure crops help into recycling of nutrient and ultimately helps to improve availability of nutrient in soil. Soil amendments helps in correction of particular soil problem which improve the physico-chemical properties of soil. Hence, proper soil management practices play important role in nutrient availability and maintain soil health too.

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Past, Present and Future Aspects of Indian Pig Production

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Ninad Bhatt, Nripendra Pratap Singh, Deepak Chand Meena
National Dairy Research Institute, Karnal, Haryana - 132001

INTRODUCTION

Animal husbandry and livestock sectors are critical for rural livelihood and economic development of the country. India possesses one of the largest livestock wealth in the world and a quarter of the agricultural gross domestic product is contributed by the livestock sector. Among the livestock species, pig finds an important place as it being reared by socio-economically weaker sections of the society. Pig as compared to other livestock species has a great potential to contribute to faster economic return to the farmers, because of certain inherent traits like high fecundity, better-feed conversion efficiency, early maturity and short generation interval. Pig farming also requires small investment on buildings and equipment's. It has immense potential to ensure nutritional and economic security for the weaker sections of the society.

Past and present scenario of pig farming in India

India Pig Farming sector is highly un-organised and some of the salient features are following. In India, 70% of the pig population is reared under traditional small holder, low-input demand driven production system, except for limited number of semi-commercial pig farms in Kerala, Punjab and Goa. The typical production system consists of a simple pigsty and feeding comprises locally available grains, vegetables and agricultural by-products along with kitchen waste. Pork consumption being popular among select populations, improved pig husbandry programmes and pig-based integrated fish farming have significantly contributed in the poverty alleviation strategies of the Government.

Breeding Level: Over 20% of the pigs kept in India are crossed with exotic breeds, but with a large amount of inbreeding because of non-systematic breeding and selection. In nutshell, the pig rearing is still unorganized venture that requires science and technology driven support to make it a vibrant enterprise.

Demographics - The total pigs in the country have decreased by 12.0 % over the previous census and the total pigs in the country are 9.06 million numbers in 2019.The total Pigs contribute around 1.7% of the total livestock population. Out of the total population, number of males are 4.96 million (3.68 million indigenous and 1.28 million exotic) and 5.33 million are females (4.16 million indigenous and 1.17 million exotic).

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Pig population in India and its changes -

Table 16: Pig Population 2012 & 2019 of Major States

S.No.	States	Population (In million) 2012	Population (In million) 2019	% Change
1	Assam	1.64	2.10	28.30
2	Jharkhand	0.96	1.28	32.69
3	Meghalaya	0.54	0.71	29.99
4	West Bengal	0.65	0.54	-16.63
5	Chhattisgarh	0.44	0.53	20.01
6	Uttar Pradesh	1.33	0.41	-69.37
7	Nagaland	0.50	0.40	-19.65
8	Bihar	0.65	0.34	-47.14
9	Karnataka	0.30	0.32	6.25
10	Mizoram	0.25	0.29	19.26

Pork Meat Scenario in India

Regulatory status: In India, domestic meat production and processing is governed by the 'Meat Food Products Order' (MFPO), 1973. However, with the creation of the Food Safety and Standards Authority of India (FSSAI), the MFPO was brought under the umbrella of the Food Safety and Standard Regulations, which is overseen by FSSAI.

Pork production: Pork production in India is limited, representing only 9% of the country's animal protein sources. Production is concentrated mainly in the northeastern corner of the country and consists primarily of backyard and informal sector producers. According to 19th Livestock Census of India (2012), the total swine population, while small, has grown consistently over the past 50 years. However, in the most recent decade, the population has declined to approximately 10 million head from a high of 14 million in 2003, as indicated by the 17th Livestock Census of India.

Indian pork consumption can be divided into two segments:

The vast majority takes place in the informal sector in the form of locally raised fresh pork meat. This meat is not widely distributed in the organized retail sector. Given cultural perceptions and consumer perceptions about pork meat, consumption of fresh local meat is limited to north eastern India where pork consumption is more prevalent. The second segment of the pork market deals with high-value imported products. These products include cured meats such as sausages, ham, bacon and canned meat products, as well as small quantities of frozen meat. They are typically found in most leading Indian hotels catering to international business travellers and tourists. Additionally, there is demand for imported pork products amongst well-travelled Indian consumers and foreigners residing in India.

Regional Pork Demand: India's States and regions are diverse in terms of economic factors affecting food demand, including population, income, and urbanization. North-East India: The eight states in North East India (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura) are

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ethnically and culturally akin to South East Asia and are amongst the poorest in India with a much higher proportion of the population below the poverty line (35%) than the national average (26%). For the majority tribal population, livestock keeping – especially pig keeping - is integral to their way of life in the NE Region. There is a growing demand for pork due to increasing per capita income, urbanization and changes in lifestyle and food habits. Much of this demand is met from imports from other states in India and from Myanmar. North East India has much higher pork consumption that the rest of the country. Of these states, Nagaland has the highest per capita consumption. The tribal population in particular appears to consume more pork on average than other groups. Traders in both Assam and Nagaland reported that the demand for pork was increasing along with prices.

South India: Goa, Karnataka, Andhra Pradesh, Tamil Naidu, Kerala, Bangalore -States are meat-eaters and small Christian sectors also consume pork. - Pork is a popular meat in Goa and the eastern states of India. - It is eaten by the Portuguese Christians in Goa.

Kolkata (West Bengal) - Community of immigrants and descendants; Chinese population of 7000.So the demand of pork meat is high.

Trade (Import and Export) of Pork and Pork Products

With a high proportion of Muslims and vegetarians in the population, pork consumption per person in India is negligible. However, demand from the hotel, restaurant and institutional sector as well in high-end retailers helped to push up imports to 527 metric tons (581 US tons) last year. Imported products included pork belly, chops, loin, tenderloin, neck, shoulder, spare ribs, bacon, ham, salami and sausages.

The market for imported pork products in India is limited to the Hotel, Restaurant and Institutional sector (HRI), as well as other niche and specialty markets. Indian pork imports consist almost entirely of processed products. A small portion of these imports include imports of high quality frozen pork meat.

Future aspects of pig farming –

The main objective future concern is to double the Pork production. This will increase the income of the Pig rearing farmer / entrepreneur so as to achieve the Honourable Prime Minister's plan for doubling the farmer's income. Since Indian pigs are of low productive indigenous breeds with high potential, this doubling of production can be envisaged by incorporation of superior germplasm of high genetic merit through import and eventually, to fetch an increase in the income of the pig farmer.

The present shortfall of pork in the country is about 0.48 million tonne or in other words there is a deficit of 48.38%. There is an urgent need to narrow the gap by scientific pig farming along with post-slaughter pork processing and development of products with improved shelf-life to promote the pork industry. This becomes a greater challenge, as there exists a low productivity index among Indian pig breeds with respect to potential growth rates and mature weight which may be considered as a gap to fulfilling the meat demand. So, National Action Plan for pig farming was formed in order to double the meat production to meet the domestic production and to get more access to export markets.

So the main objectives of National Action Plan are –

1. To increase the production and productivity of Piggery sector.
2. To meet the domestic requirement of pork and to tap the export potential of the sector.

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3. Organization of sector and Development of Agri-preneurship

Key Strategies

To increase the production and productivity of Piggery sector and to Increase the High Genetic merit Population, the National Action Plan envisages the Genetic Improvement of Non-Descript Pigs by Cross Breeding with High Genetic merit exotic germplasm. In this case, through Artificial Insemination by importing 19, 34,600 number of exotic boar semen doses.

Suggested Action Plan

Breed Improvement becomes a greater challenge, as there exists a low productivity index among Indian pig breeds with respect to potential growth rates and mature weight which may be considered as a gap to fulfilling the meat demand. Hence, it is suggested to extend the breed improvement programme with the use of genetically high quality semen through Artificial Insemination, throughout India. This will help to increase the income of the Pig rearing farmer / entrepreneur/ NGO / Cooperative Society

To meet the domestic requirement of pork and to tap the export potential of the sector, the following are key strategies

(1) Marketing and Processing by convergence with schemes of MOFPI, APEDA etc.

(2) Organization of sector and Development of Agri-preneurship

The Entrepreneurship in the Pig farming can be increased by several folds through different Livestock Farmers Groups/Breeder's Association suggested to be in line with ATMA farmer groups with 20 farmers in each group. Also, one 35 of the main goals of Piggery development is to increase the export of pork. To tap the international markets, we need to keep the sanitary and Phyto-sanitary requirements of the country, wherein "traceability "of the animal product is mandatory. So, these commodity based/farming based groups will help for the tagging and other identification procedures. These groups will also help for the co-ordination of the marketing and value addition of the products as well as the animals.

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Development of marker-free transgenic plants

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Bharati Lap[1] and Nongthongbam Olivia Devi[2]
[1,2]Ph.D. Scholar, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam, Ri-bhoi district, Meghalaya-793103

INTRODUCTION: Transgenic or genetically modified (GM) crops are plants with genetically engineered modified genome having a foreign gene incorporated in them by using recombinant DNA (rDNA) technology leading to the creation of plants with new characteristics. These foreign genes or the gene of interest (GOI) may be of biotic, abiotic stress resistance genes and are known as the transgene. These transgenes are originated and isolated from different kingdoms, genus or species and plants transformed with such transgene in them are called transgenic plants. Plant transformation is the ability of the host genome to integrate foreign DNA into itself and its efficiency to regeneration into a transformed cell. Various techniques are used to deliver the marker genes into the plant system. Some of the most commonly used techniques are *Agrobacterium*-mediated gene transfer, biolistic, electroporation, *etc*. The transformation efficiency requires the use of selectable marker genes to identify transgenic plants. The frequency of recovering transgenic lines from the non-transformed cells without selection is usually low. Hence, to identify transgene in any plant, selectable marker genes are used. Selectable marker genes are those genes which when introduced confers artificial traits in an organism/plant. To efficiently distinguish between a transformed and a non-transformed cell, selectable markers such as antibiotic resistance genes *(nptII* and *hpt* genes for resistance to the aminoglycoside antibiotics, kanamycin, and hygromycin), anti-metabolite genes or herbicide resistance genes (*bar* gene for resistance to herbicide phosphinothricin) are used. Reporter genes such as β- glucuronidase (GUS), green fluorescent protein (GFP) and luciferase (LUC) are also used for checking the level of expression of the incorporated transgene. When selection pressure such as the addition of antibiotics in the growth media is used, it is called negative selection. These marker genes are genetically linked with the target gene or may be located on the same chromosome as the target gene and near enough to it so that the two genes are inherited together. However, these selectable marker genes have no further application after the selection of transformation events. So, there are concerns and worries related to the use of marker genes in crop production.

A total of around 70 countries have adopted GM crops but it has been grown in only 26 countries so far. India approved the commercial production of GM crops (cotton) in 2002. Crops like soybean, cotton, canola, sugarbeet, brinjal, papaya, sugarcane, squash, alfalfa, melon, potato, maize, rice, and chickpea have been developed with modified traits. These transgenic plants are important to feed the ever-growing population as the demand for food is greatly increasing every year. Transgenic technology accelerates not only the overall production and yield but also shortens the time taken to develop a transgenic as compared to a new variety developed through conventional plant breeding approaches. But there are public, regulatory and environmental problems that hamper its commercial production and utilization. This also leads to technological disadvantage as the transgenes may induce a pleiotropic effect under certain conditions (Abdeen *et al.*, 2009; Miki *et al.*, 2009). One of the most important fears is the horizontal gene transfer (HGT) *i.e.*, the transfer of the genetic material directly to a living cell or an organism followed by its expression in the host, like transgenes from the crop to the weeds (herbicide resistance genes) or from the crop to pathogens (antibiotic resistance genes). HGT has been known to occur only among unrelated species, such as between plants and microbes, as well as between microorganisms of different species (Thomson, 2000). The flow of genes through vertical or horizontal gene transfer with associated microorganisms might induce the development of resistance in non-target organisms which will affect the biodiversity of beneficial and antagonistic micro-organisms. One other risk includes the invasiveness of the plant or dispersal of the plant itself into the native ecosystem causing

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indirect impacts on the diversity of crops. Thus, the development of efficient techniques for the removal of selection markers, as well as the directed integration of transgenes at safe locations in the genome, is the best way to tackle the presence of marker genes in the host plant. The sexual crossing also raises the problem as transgenes integrate at random location in the genome causing unpredictable expression patterns and redundancy of transgenes in the genome that may trigger homology-dependent gene silencing. Therefore certain regulations encourage the removal of the selectable markers from the transgenic plants (EFSA, 2004).

Strategies for the development of marker-free transgenic plants

Different approaches have been developed and used to develop marker-free transgenic plants. These have been used successfully in many crops like tobacco, citrus, tomato, wheat, rice, potato, cassava, maize. Generally used methods are:

i) **Transformation without selection**: It is one of the simplest methods for obtaining a marker-free transgenic as there is no selectable gene involved. However, the efficiency of transformation is very low. De Buck *et al.*, (1998) reported that no transgenic *Arabidopsis* were obtained after infecting the roots via *Agrobacterium tumefaciens* and regenerated on non- selective media. However, they obtained a transformation frequency of 18% on tobacco protoplast transformation.

ii) **Co-transformation**: Method of transformation using the selectable marker gene (SMG) and the target gene (TG) on separate constructs by using *the Agrobacterium* or biolistic approach. Different combinations of SMG and TG have been used for co-transformation;

a) Different *Agrobacterium* strains carrying two different vectors and introduction of two plasmids in the same tissue through biolistic approach

b) Use of same *Agrobacterium* cell having two different vectors

c) Use of T-DNAs within a single binary vector.

Since the SMG and TG are not linked, SMG can be eliminated by selecting plants having the TG after independent segregation and recombination that occurred during sexual reproduction. The efficiency of this method ranges from 30 to 50 %. Nowadays, plant DNA (P-DNA) having a T-DNA border like sequence rich in A/T content has been found in rice and *Arabidopsi*s making it possible to be used for transformation instead of using *Agrobacterium* strain.

iii) **Transposition**: It is based on the concept of the *Ac/Dc* genes of maize. The marker is inserted in a transposable element, co transformed with the gene of interest (GOI) and plants with the GOI are selected after segregation. Sometimes, the marker gene gets lost after transposition. Transposon induced dissociation of marker occurs resulting in reinsertion of the GOI in locus other than the locus where the marker was located. This method requires the segregation of transgene and marker, as well as the transposons, tends to insert itself into the linked position making it low efficient in eliminating the marker gene. Transposition induces rearrangements in the genome that includes deletions, inverted duplications, inversions, and translocations.

iv) **Homologous recombination**: Recombination is a very clear phenomenon in biological systems. It occurs between two homologous DNA molecules. It is well known that the efficient repair mechanism of the double-stranded breaks (DSB) of the cells is important for their survival. The two repair pathways the cell follows are Homology dependent repair pathway (HDR) and Non-homologous end joining (NHEJ) (Orel *et al.*, 2003). Therefore, this method follows the use of the DNA repair machinery of the plant cells. During the repair process, the marker gene may either be deleted or converted. Orel *et al.*, (2003) also showed that the frequency of deletion associated pathway is about five times more than that of gene conversion.

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v) **Site-specific recombination**: In site-specific recombination, the exchange of DNA strand takes place between segments possessing only a limited degree of sequence homology (Coates *et al.,* 2005). Recombination occurs between two homologous DNA strands. But, bacteriophage recombination occurs in specific sites between the excision site of phage and chromosome of bacteria that have certain sequence homology. Three major site-specific recombination systems are known in the plants:
a) *Cre/lox* site-specific recombination system from bacteriophage P1
b) *FLP/FRT* recombination system from *Saccharomyces cerevisiae*
c) *R/RS* recombination system from *Zygosaccharomyces rouxii*

In this system *cre, FLP, R* is the recombinase enzyme and *lox, FRT, RS* are the recombination sites (Fig. 1). A transgenic plant containing the gene of interest along with the marker gene that is present between two recognition sites can be crossed with a transgenic plant expressing the recombinase gene. This recombinase gene eliminates the marker gene that is located between the excision sites. Once the marker gene is excised it is lost in vivo (Perez *and Angenon*, 2013) and thereby produce marker-free plants after segregation. The major limitation is that they are time-consuming, laborious and mostly applicable to sexually reproducing crops only.

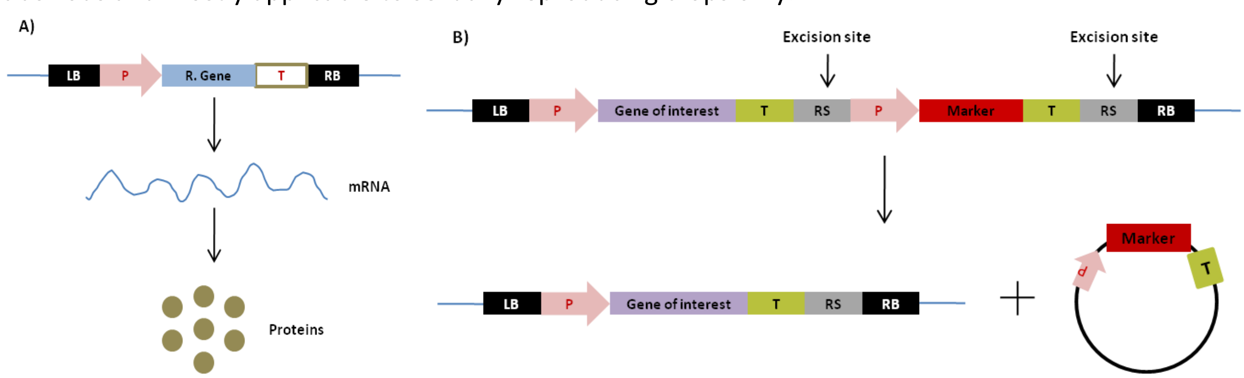

Fig. 1: Diagram representing the production of marker-free plants using site-specific recombination method. A) Region of Transfer DNA (T-DNA) showing transcribed mRNA and protein expression of recombinase gene encoding either *cre,* FLP, R gene controlled by a promoter; B) T-DNA region showing the location of the gene of interest and marker gene between excision/recombination sites. Recombinase gene excises the marker gene to produce marker-free transgenic plants with the presence of the gene of interest.
(**LB**: Left border, **RB**: Right border, **R.gene**: Recombinase gene, **P**: Promoter, **T**: Terminator, **RS**: Recombination site)

Re-transformation of a single line is also a feasible and important approach towards the selective introduction of multiple genes for complex traits such as broad pathogen resistance studies to avoid marker genes. The use of plant DNA (P-DNA) instead of any antibiotic or herbicide resistance gene markers will not be considered "foreign" DNA as they are isolated from the respective crop itself. This will, therefore, nullify the concerns regarding the spread of resistance genes into the environment.

CONCLUSION:

Development of transgenic plants without the marker gene but with the incorporation of agronomically important genes would help in the overall improvement of the crop. The use of novel genes having beneficial characteristics such as nutritive value, improved flavor, prolonged freshness, and even disease resistance enhances crop production. However, these methods of marker removal from the host cannot be applied to sterile plants (CMS, CGMS) and vegetatively propagated crops. They also impose a great difficulty and challenge on plants with a long life cycle such as trees as this approach requires the generation of many transformants to locate marker genes linked with the gene of interest and further crossing steps to remove the marker gene making it a labor-intensive work. Despite all these drawbacks, the advancement in transgenic technologies makes it possible and possesses the potential to engineer multiple transgenic traits with stable expression, prevention and elimination of undesirable transgenic material. It is now a critical requisite to produce marker-free transgenic plants for their commercial deployment to fulfill the ever-growing demands for crops.

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Advancement in quality of fertilizers: Nano Fertilizers

Article id: 23409
[1*]Shikha, [2]Arunima Paliwal
[1]Krishi Vigyan Kendra, Ranichauri, VCSG UUHF, Tehri Garhwal-249199, Uttarakhand, India
[2] AICRN-Potential Crops, VCSG UUHF, Garhwal-249199, Uttarakhand, India

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Nano technology is the emerging technology which give rise to the concept of nano fertilizers by providing the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or controlled-release vectors for building of so it is also called "smart fertilizer" as new facilities to enhance nutrient use efficiency and reduce costs of cultivation and environmental protection. Nano-fertilizers are very effective for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period.

Nano fertilizers are the important tools in agriculture to improve crop growth, yield and quality parameters with increase nutrient use efficiency, reduce wastage of fertilizers and cost of cultivation. Nano fertilizer refers to a product that delivers nutrients to crops in three ways. The nutrient can be encapsulated inside nano-materials such as nanotubes or nanoporous materials, coated with a thin protective polymer film, or delivered as particles or emulsions of nanoscale dimensions. Owing to a high surface area to volume ratio, the effectiveness of nano-fertilizers may surpass the most innovative polymer-coated conventional fertilizers. Ideally, nanotechnology provide devices and mechanisms to synchronize the release of nitrogen (from urea fertilizers) with its uptake by crops. The nano-fertilizers releases the nutrients on-demand by preventing them from prematurely converting into chemical/gaseous forms that cannot be absorbed by plants. Nano-fertilizers increase crop growth up to optimum concentrations further increase in concentration may inhibit the crop growth due to the toxicity of nutrient. Nanoparticles have high surface area, sorption capacity, and controlled-release kinetics to targeted sites making them "smart delivery system." Nanostructured fertilizers can increase the nutrient use efficiency through mechanisms such as targeted delivery, slow or controlled release.

Nano fertilizers are advantageous over conventional fertilizers as they increase soil fertility and crop quality. Nano fertilizers are non toxic and less harmful to environment and humans as compared to conventional ordinary fertilizers.The need of nano fertilizers comes out because the large-scale application of chemical fertilizers to increase the crop productivity is not a suitable option for long run because the chemical fertilizers has both positive and negative impact such as it increase the crop production and the other hand disturb the soil nutrient balance and decrease soil fertility. Long term and large-scale application of chemical fertilizers results in an irremediable damage to the soil structure, soil microbial flora, plants, nutrient cycles and even more on the food chains across ecosystems which leads to several heritable mutations in future generations of consumers. Nano-fertilizers provide more surface area for different metabolic reactions in the plant which increase rate of photosynthesis and produce more dry matter and yield of the crop. It is also prevent plant from different biotic and abiotic stress.The yield per hectare is also much higher than conventional fertilizers, giving higher return returns to the farmers.

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Concept of Nano-fertilizers: There are three main concepts of nano-fertilizers:

1. Automatic control and intelligent release of nutrients.
2. Nutrients deliver at active sites of plant.
3. Nano-particles internalized in plant system

Mechanisms of nutrients released by nano-fertilizers: Nutrients from Nano-fertilizers are released by different mechanism which are:

1. Diffusion, **2.** Dissolution, **3.** Biodegradation, **4.** Osmotic release, **5.** Molecular trigger

Type of Nano fertilizers

1. Encapsulated nano-fertilizers
2. Nanoporus nano-fertilizers
3. Nanotube nano-fertilizers
4. Nanoemulsion nano-fertilizers

Differences between ordinary and nano fertilizers

Ordinary Fertilizers	Nano Fertilizers
Low crop yield efficiency	High crop yield efficiency
Low nutrition providing value	Nano-technology has new opportunities to improve nutrition providing value.
A major source of water contamination and eutrophication	These fertilizers are specially modified so that nutrients build up in soil, thus reducing water contamination and eutrophication
These are a major source of harmful environment contaminating chemicals.	These fertilizers do not add any kind of harmful chemicals to the troposphere
These have very low mineral and salt value. Therefore, the cost and transportation efforts are maximized.	Cheap and easy access to these fertilizers.

Some Nano fertilizers present in the agriculture market

1. Nano Chitin Salt Fertilizer

i. The high protein of organic material
ii. Organic active N, P, K, Ca, Mg ,B, Fe and Zn
iii. Marine biological chitin.

2. Master Nano Chitosan Organic Fertilizer

This is organic fertilizer and Bio-polymer substances. Biological extract pure natural 100% safe for consumers who use non-toxic residues.

3. DOBOGEN: Manufactured from **nano** Silicate through a special progress Boast of high and quick absorption with excellent effects. This is chemical inorganic fertilizer.

4. Agrocare Enzyme Nano: It is organic liquid fertilisers

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5. **Febrant L:** Natural Power of Soil Processed by Worms (Vermicompost) with **Nano** Technology. Classification : Organic fertilizer
6. **Lithovit foliar Fertilizer:** Nano Hitec. highly activated extremely micronized limestone, penetrates the stomata and seizes CO_2 free inside at the cell membrane.
   Classification: Inorganic nano fertilizer.

Research and Development in India

1. **IIT Mumbai:** This institute is working on nanoclays
2. **TNAU:** The work on nano-fertilizers, Nano-herbicides, Nanoclays and nanozeolite is going on at TNAU.
3. **PAU:** The work on electron Microscopy of Nanoparticles is going on at PAU.
4. **G.B.P.U.A. & T. Pantnagar:** The work on Nano TiO_2 and Nano Gold particles is going on in this University.
5. **IISS:** Indian Institute of Soil Science, Bhopal has been patented Nano Rock phosphate, Nano Zinc and Nano Magnesium.

CONCLUSION

The emerging new science and technology, working with the smallest particle, the nanotechnology raises hope for new innovations in the agricultural field. It is emerges out as the new innovation by releasing the good quality of fertilizers in the form of nano fertilizers. They minimize cost and maximize profit because they are consumed in very low proportions. More focused research is required in the area of energy, environment, crop improvement, disease management and efficient resource utilization for increasing the productivity, profit, without hampering the natural ecosystem

Therefore, it is helpful to use nano fertilizers in a new advanced era and there is a great need to modify agricultural techniques to fulfill the requirement of present and upcoming generation for good agricultural prodction. Therefore more research and industrial setup should be implemented in the field of nano technology to give more emphasized in the quality of fertilizers by increasing the use of nano fertilizers for better food production.

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Effect of Vermicompost and plant hormones in plant growth and the physico-chemical properties of soil

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[1]Ajay Babu, [2]Shankar Ram*, [3]Vimal Kumar, [4]Ramawatar Meena and [5]Mintoo
[1]Research Scholar in Department of Soil Science and Agricultural Chemistry, B.H.U., Varanasi
[2]A.F.O. in Soil and Land Use Survey of India, Noida
[3]Technical Assistant in Krishi Vibhag, Mirzapur, Govt. of Uttar Pradesh
[4]Assistant Professor in Department of Soil Science and Agricultural Chemistry, B.H.U., Varanasi
[5]Technical Assistant in Krishi Vibhag, Jaunpur, Govt. of Uttar Pradesh

INTRODUCTION

Vermicompost is a nourishing organic fertilizer having high amount of humus, nitrogen (**2–3%**) phosphorous (**1.55–2.25%**), potassium (**1.85–2.25%**), micronutrients, more beneficial soil microbes like 'nitrogen-fixing bacteria' and mycorrhizal fungi. Vermicompost has been scientifically proved as miracle plant growth enhancer. Microbial population of N_2-fixing bacteria and actinomycetes increases by the application of vermicompost. The amplified microbial activities improve the availability of soil phosphorous and nitrogen. vermicomposting is an aerobic, biological method and is proficient to convert eco-friendly humus like organic substances.

Vermicompost stimulates to influence the microbial activity of soil, increases the availability of oxygen, maintains normal soil temperature, increases soil porosity and infiltration of water, improves nutrient content and increases growth, yield and quality of the plant.

Plant growth and yield Observations

In experiments the growth of plants was found to be significantly increased in plants treated with vermicompost. Plants treated with 50% vermicompost showed increased shoot length than GA and IAA treated plants. It was also reported the benefits of vermicompost as bedding media to promote seed germination, seedling growth and productivity of plants.

Organic amended in the form of vermicompost and vermiwash, when added to soil increase the yield and growth of plants. Length of the internode and diameter were increased significantly and maximum in vermicompost-treated plants than in GA- and IAA-treated plants. In plants treated with earthworm cast, the growth parameters of *Triticum aesticum* such as plant height, number of leaves and tillers, early ear heading, ear head length and dry matter per plant was found to be enhanced than the control plants.

The NPK content of vermicompost-amended soil was found to be enhanced when compared to the other amended soil. The soil amended with vermicompost provides the required nutrients, which are not available in chemically treated soil. This increased nutrient uptake by plants may have contributed to maximum growth in vermicompost treated when compared to other treatments.The carbon content in vermicomposted soil is found to release the nutrients slowly into the soil and thereby aiding the plants to absorb the available nutrients. Remarkable growth obtained in vermicompost-treated plants may be due to favorable and optimum temperature; moisture and a balance between organic and inorganic nutrients in the vermicompost have significantly aided in increased growth of plants. The enhanced growth in these plants may be due to improved soil health and the physico-chemical properties of soil were enhanced

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leading to an increase in both microbial activity and macro and micro nutrients. Vermicompost treatment enhanced the availability of nutrients in the soil.

The improvement of N_2 content in the soil may be due to the nitrogen in the vermicast, which results in nitrogen mineralization aided by microbes in the soil, through the degradation of the earthworm tissues. Elimination of pathogens as of wastes like cow manure and sludge of wastewater treatment plant may be applied for soil improvement which is very essential in preventing the spread and transmission of disease. The luxuriant growth, flowering and yield of the vegetable crops were promoted by the worms and vermicompost. The incidence of 'yellow vein mosaic; 'color rot' and 'powdery mildew' diseases was less in worm and vermicompost-treated plants.

CONCLUSION

The results of this study showed that 50% vermicompost treatment showed great potential to increase the performance, growth of plant and improvement of soil quality. The plants grown in vermicompost-amended soil showed enhanced growth rate when compared to plants treated with plant growth regulators (PGR). The study positively highlights the importance of organic farming; therefore, vermicompost may be put to good use as a natural fertilizer for cereals and vegetable crops for increased production and for sustainable agricultural systems.

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Mapping of the soil site characteristics to know the potentials and problems of the land -A case study in Elamdesam block, Kerala, India

Article id: 23411

***Chandrakala, M., & Srinivasan, R.**
National Bureau of Soil Survey and Land Use Planning, RC, Hebbal, Bangalore-560024, Karnataka, India

Detailed soil survey at 1:10,000 scale was carried out in Elamdesam block, Idukki district, Kerala with the objective is to map the some major soil site characteristics. Results revealed that Very deep (35.1 % area) soils occupy the dominant position followed by deep (14.28%) and moderately shallow (7.04%) soils. Well drained soils occur in large extent (44.2 per cent area) followed by somewhat poorly drained (14.79 % area) soils. Slope of the land varied from extremely sloping to moderately sloping (9.24% area), very gently sloping (25.9 per cent area), gently sloping (8.4 % area) and nearly level (14.8 per cent area). Surface soil texture is Sandy cay loam (32.42 % area), sandy clay (15.72 % area), clay (15.0% area) and clay loam. However, 32.1 per cent area is sub surface gravelly followed by non-gravelly (22.2 per cent area) and 10.12 percent area is both surface and subsurface gravelly.

INTRODUCTION

India is a global agricultural powerhouse. The country has 195 m ha under cultivation of which 63 percent are rainfed (roughly 125m ha) while 37 percent are irrigated (70m ha). In addition, forests covers 65m ha of India's land. Three agriculture sector challenges will be important to India's overall development and the improved welfare of farmers. Which are, raising agricultural productivity per unit of land through assessing problems and potentials of the land. Reducing rural poverty through a socially inclusive strategy that comprises employment through agriculture and third ensuring that agricultural growth responds to food security needs. Over exploitation of earth's natural resources has imposed a threat to sustainability. Hence, priority to be given for conservation in order to preserve the resources for posterity. Soil and water are the foremost critical resources for agriculture. Majority of the land in the study area are rainfed. Resource inventorization undertaken as part of soil survey activities helps to know the status of the natural resources, their limitations, potentials and constraints for crop production and thus its important to manage valuable resources through soil and water conservation measures. Detailed soil resource inventory (*Soil Survey Manual,* 1993) through characterization of soils provides an information into the potentials and limitations of the area. Information generated on soils could aid in farm level planning for sustainable production and resource conservation (chandrakala *et al.,* 2018b). Assessing the limitations of soil and land resource will assist in monitoring soil quality and implementation of soil conservation models. A case study was attempted in Elamdesam block of Idukki district, Kerala belong to tropical humid region with the objective is to study and characterise the land resources and to interpret the information to identify the problems, potentials and constraints of the soils of tropical humid region for resource conservation.

Materials & Methods

Details of the study area: Elamdesam block falls under the agro-ecological zone foot hills and high hills, the agro ecological units 12 and 14 i.e. southern and central foot hills and southern high hills, respectively. These units are subdivided in to forests, denudational hills, lateritic terrain and lateritic valley lying between north latitudes 9^{o} 46' 38.2" and 10^{o} 2' 18.14" and east longitudes 76^{o} 42' 59.49" and 76^{o} 53' 46.99". There are seven panchayats namely Vannapuram, Kodikulam, Karimannor, Udumbannoor, Alakode, Velliyamattom and Kudayathoor in the Elamdesam block and eight villages covering a total geographical area of 40,307 ha. Location map given in the figure 1. Geology of the area is charnockite and granite gneiss of the Archaen age. Elevation ranges from 30 m in low land to 850 m in high hills. Climate is tropical humid monsoon type. Rainfall ranges from 3462 mm to 3602 mm and mean annual temperature varies between 22 ^{o}C to 27 ^{o}C. Length of dry period is two to two and a half months. High hills are covered by mixed forest whereas foot hills and midlands have plantation of rubber, coconut, pepper, banana, pineapple, arecanut, cocoa, nutmeg, cashew where as low land is occupied by paddy and tapioca, banana, coconut arecanut and rubber were also cultivating in raised beds (Chandrakala *et al*., 2019a and Chandrakala *et al.,* 2019b).

Detailed soil survey (*Soil Survey Manual,* 1993) conducted during 2016, studied 134 soil profiles. 12 soil series and 31 soil mapping units identified in the study area. Ultisols, Inceptisols and Entisols forms the major soil type (Chandrakala *et al.,* 2018a). Using the soil site characteristic data and soil map data, different thematic maps on depth, soil drainage, slope, rock fragments/gavelliness and surface soil texture have been generated in the Arc GIS.

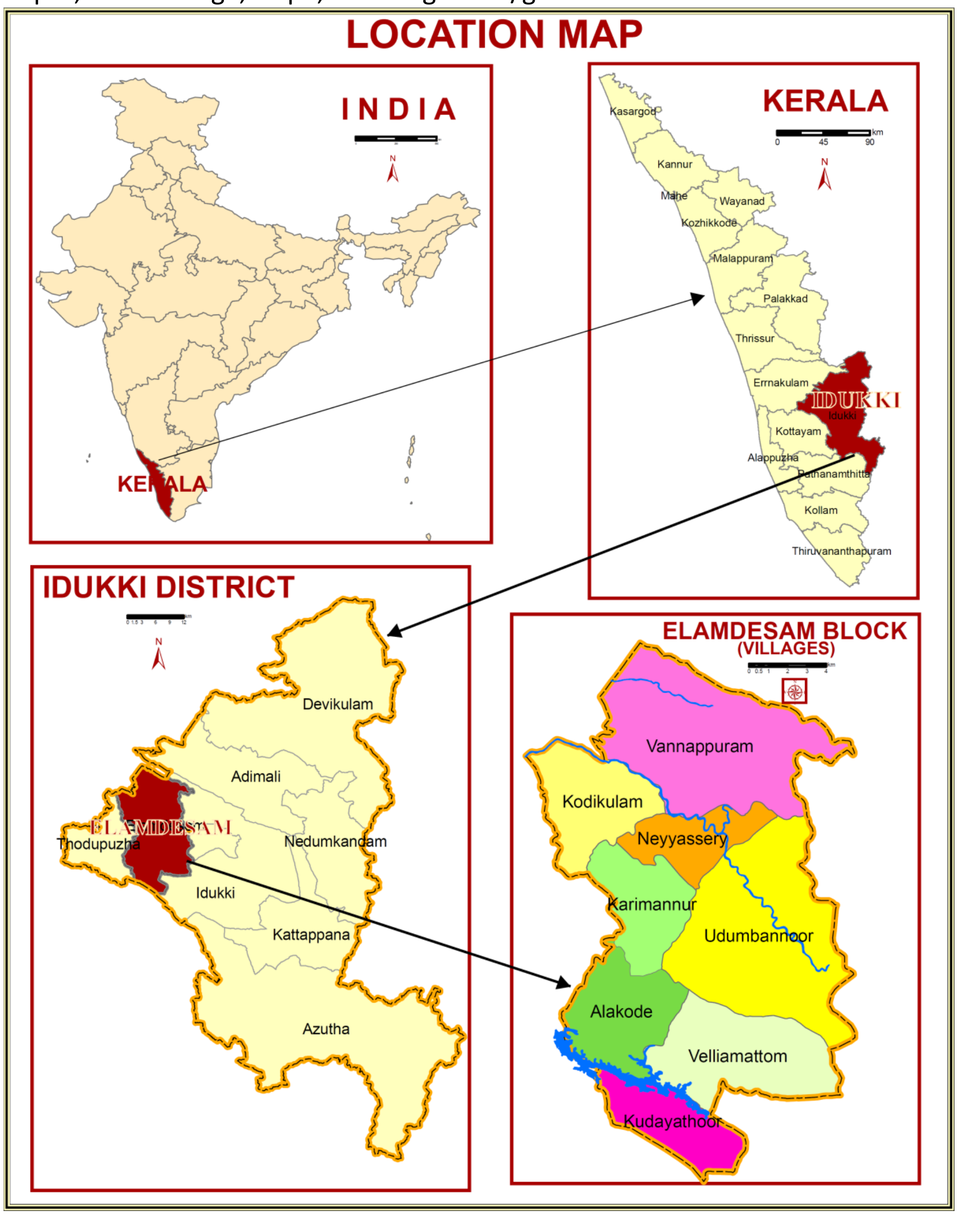

Fig. 1: Location map of the study area (Elamdesam block)

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RESULT & DISCUSSION

To help the various land users and land use planners to make use of the database effectively, various land user friendly interpretations were carried out for the study area and their salient findings are presented below:

Soil depth

Soil depth is one of the important characteristics used to group the various soils occurring in the area into different soil series. It determines the effective rooting depth of plants and the capacity of the soil to hold water and nutrients. Very deep (>150 cm) soils occupy the dominant position (35.1 %) followed by deep (100-150 cm) soils (14.3 %), moderately shallow (50-75 cm) soils (7.1 %), shallow (25-50 cm) soils (5.4 %) and moderately deep (75-100 cm) soils (2.5 %) (Map 1). Deep rooted crops can be cultivated in very deep, deep and moderately deep soils.

Soil drainage

The term drainage indicates how fast rain water after reaching the soil will get infiltrated into the soil and get percolated later to ground water. The rate of removal of added water (rainfall) from the soil is both by flow through the soil to underground storage and by run-off. Drainage is an important parameter affecting crop productivity and soil management. Most of the arable crops except paddy prefer well drained soils and if there is any change in the drainage, productivity is affected drastically. Site and soil characteristics, particularly the slope of the area, texture of the soil and depth of the ground water affect soil drainage. In the field, drainage classes are identified based on soil morphology and terrain features. The soil drainage classes given by the Soil Survey Division Staff (1993) and IARI (1971) were applied to the soil-site data to arrive at the drainage class for the mapping units. The various drainage classes identified and their extent of occurrences in the study area and their distribution is shown on the drainage maps (Map 2). Well drained soils occur in large extent (44.2 per cent) followed by Somewhat poorly drained 14.8 per cent and moderately well drained soils occur in 5.4 per cent of total geographical area (Map 2). Generally most of the crops can be cultivated in well drained condition except paddy which comes well even in somewhat poorly drained soils.

Slope

Slope plays an important role in the formation of soils, controls the process of erosion and alters the overall use of the land. The range of the slope used to group the various slope classes are indicated in map 3. There are seven classes of slope occurring in the block. Very gently sloping (1-3 %) lands distributed in large extent (25.9 per cent) followed by nearly level (14.8 per cent) and moderately sloping lands (9.3 per cent) and gently sloping lands (8.4 per cent). Nearly level, very gentle to gentle slopes are good for crop production, provided sufficient soil and water conservation measures are taken before cultivation of crops, while moderately sloping and rolling lands are good for plantations after bench terracing, while still steeper lands are put under mixed forest, reserved forests or forest plantations or plantations.

Surface soil texture

Soil texture indicates the relative proportion of sand, silt and clay fractions present in the soil. The texture of the surface layer or plough layer plays an important role in influencing the growth and yield of crops, particularly the shallow rooted crops. Depends on the amount of sand, silt or clay present in the soil, the soils are grouped into various textural classes like loamy sand, sandy loam, sandy clay loam, sandy clay and clay. It is one of the important parameter used to identify phases of soil series established. In the block the texture of the surface layer varies from sandy clay loam to clay. Sandy clay loam surface texture seen in around 32.4 per cent area in the surveyed area. Sandy clay present in 15.7 per cent area and clay present in 15.0 per cent area (Map 4). Loam soils are best for plant growth because sand, silt, and clay together provide desirable characteristics.

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Rock fragments:

Rock fragments refer to particles present in the soil having more than 2 mm diameter. Normally broken pieces of rock fragments, quartz and iron stone and iron gravels constitute the coarse fragments observed in Elamdesam. The presence of rock fragments in the soil hinders plant growth directly by impeding root development and seedling emergence and directly through reducing the volume of soil that can be drawn upon by plants for water and nutrients. In clayey soils, presence of coarse fragments helps in the free movement of water and air and upto some amount they are not a constraint for cultivation. Only when it exceeds some level (around 30 per cent), they affect the performance of the crops. Some of the soils occurring in the block has coarse fragments distributed either in the whole profile or confined to some depth in the solum. The amount of gravel and depth of occurrence were used as an important characteristic in grouping the soils into various soil series. Different gravelliness classes seen in the blocks studied (Map 5). In the area surveyed, sub surface gravelly occupied by 32.1 per cent area followed by non-gravelly (22.2 per cent area) and gravelly throughout profile (10.2 per cent).

CONCLUSION

Agriculture is the fundamental livelihood activity among the people in Elamdesam block. The soils, are shallow to very deep, gravels present in more than 50 percent of the study area which restricts cultivation of crops and also slope of the land is the major constraint for crop production in the study area. Soil and water conservation measures like cover crops, strip terracing, stone pitched contour bunds, earthen bunds, agroforestry and check dams adopted in the moderately sloping to steeply sloping land are also must for cultivation of crops.

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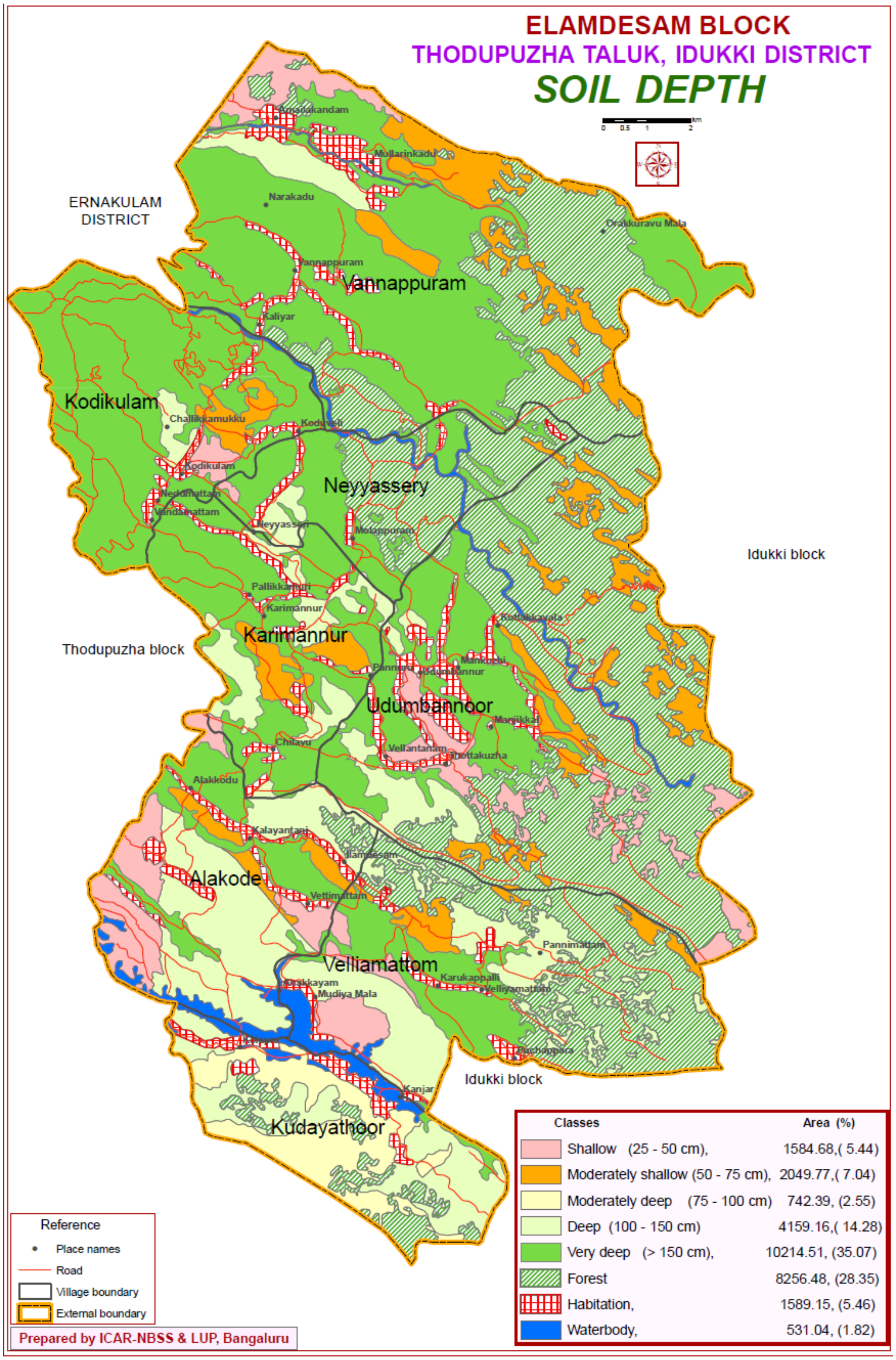

Map 1: Soil depth in Elamdesam block

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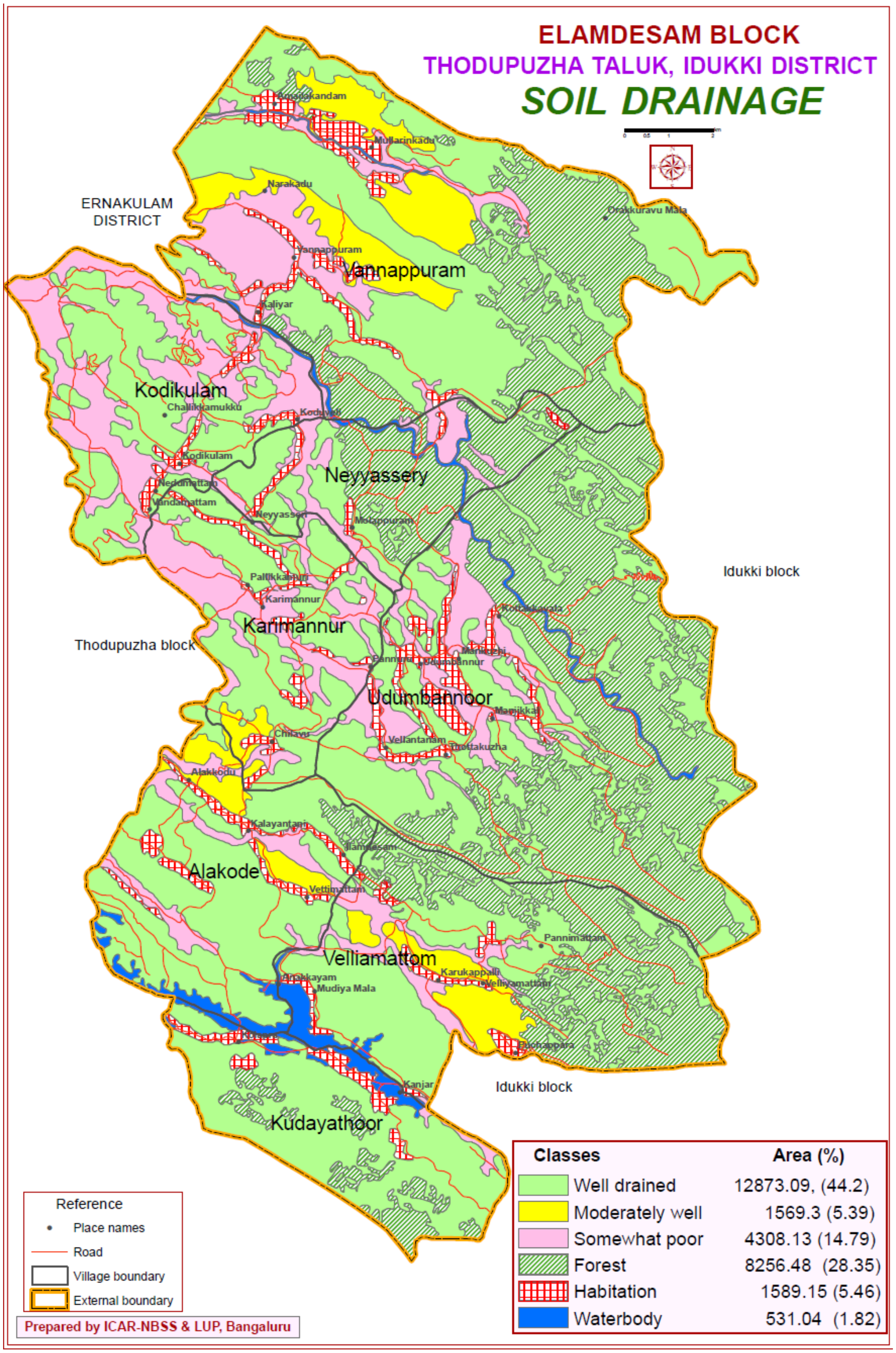

Map 2: Soil drainage in Elamdasam block

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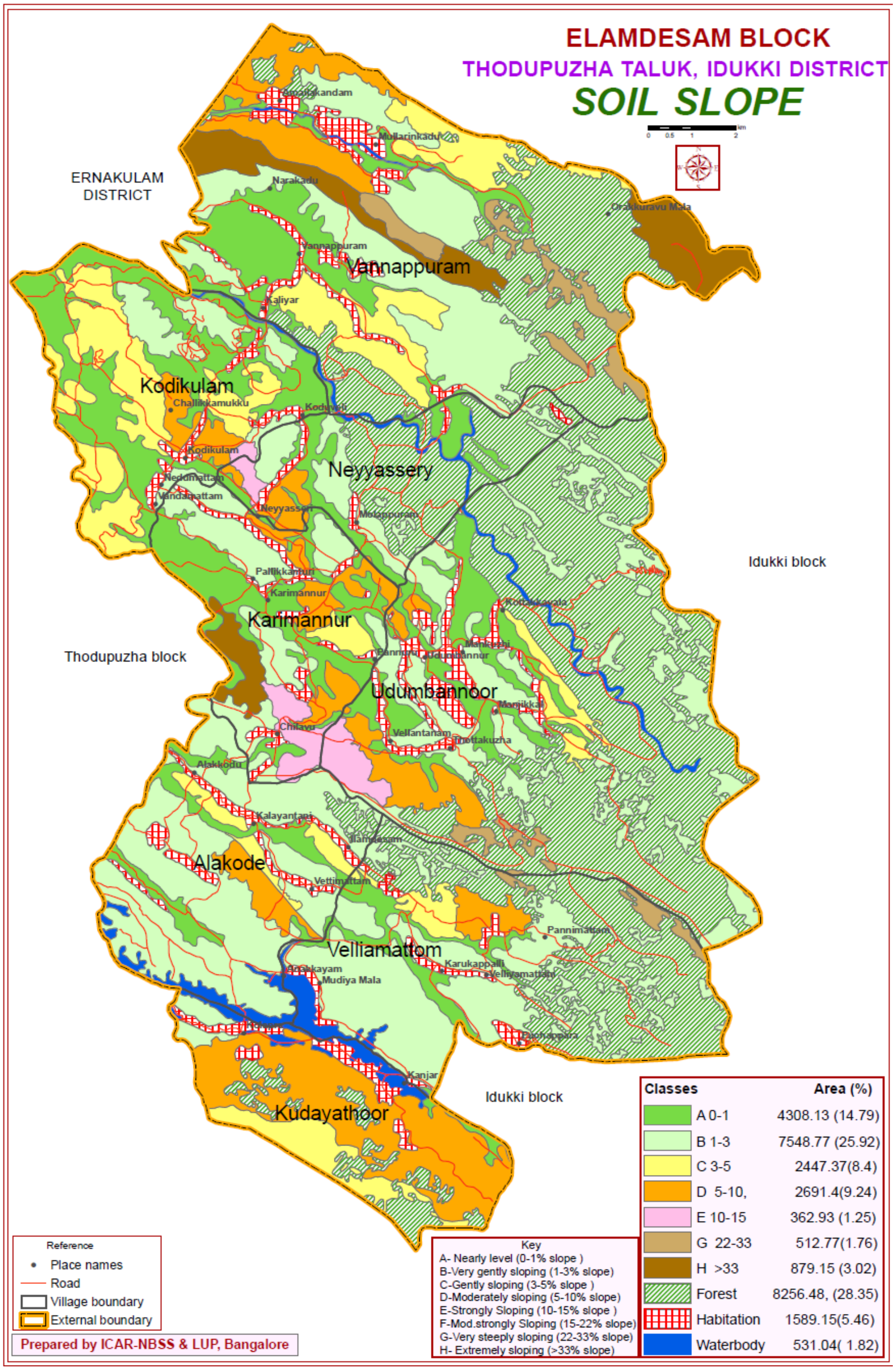

Map 3: Slope classes in Elamdesam block

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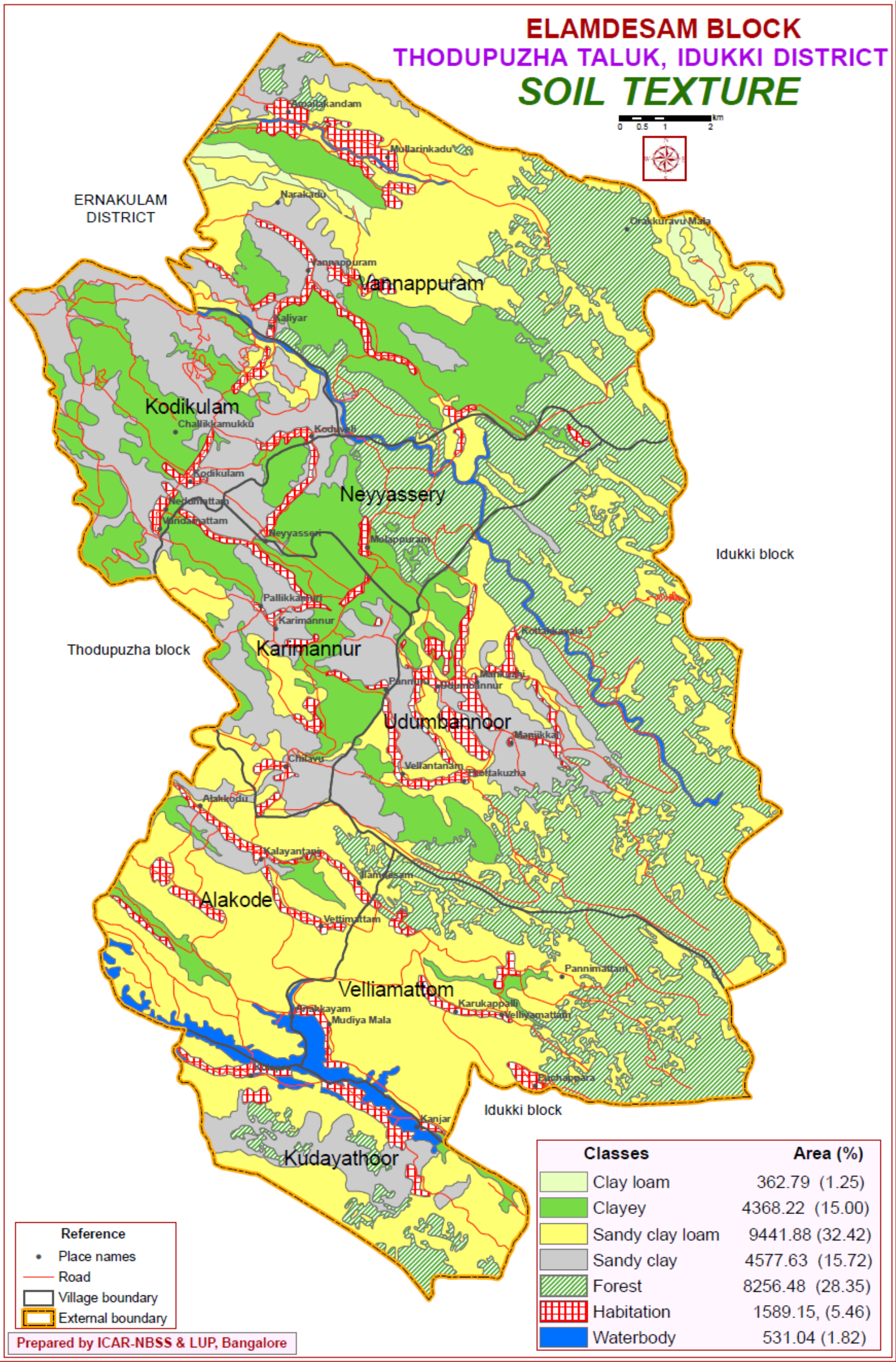

Map 4: Surface soil texture in Elamdesam block

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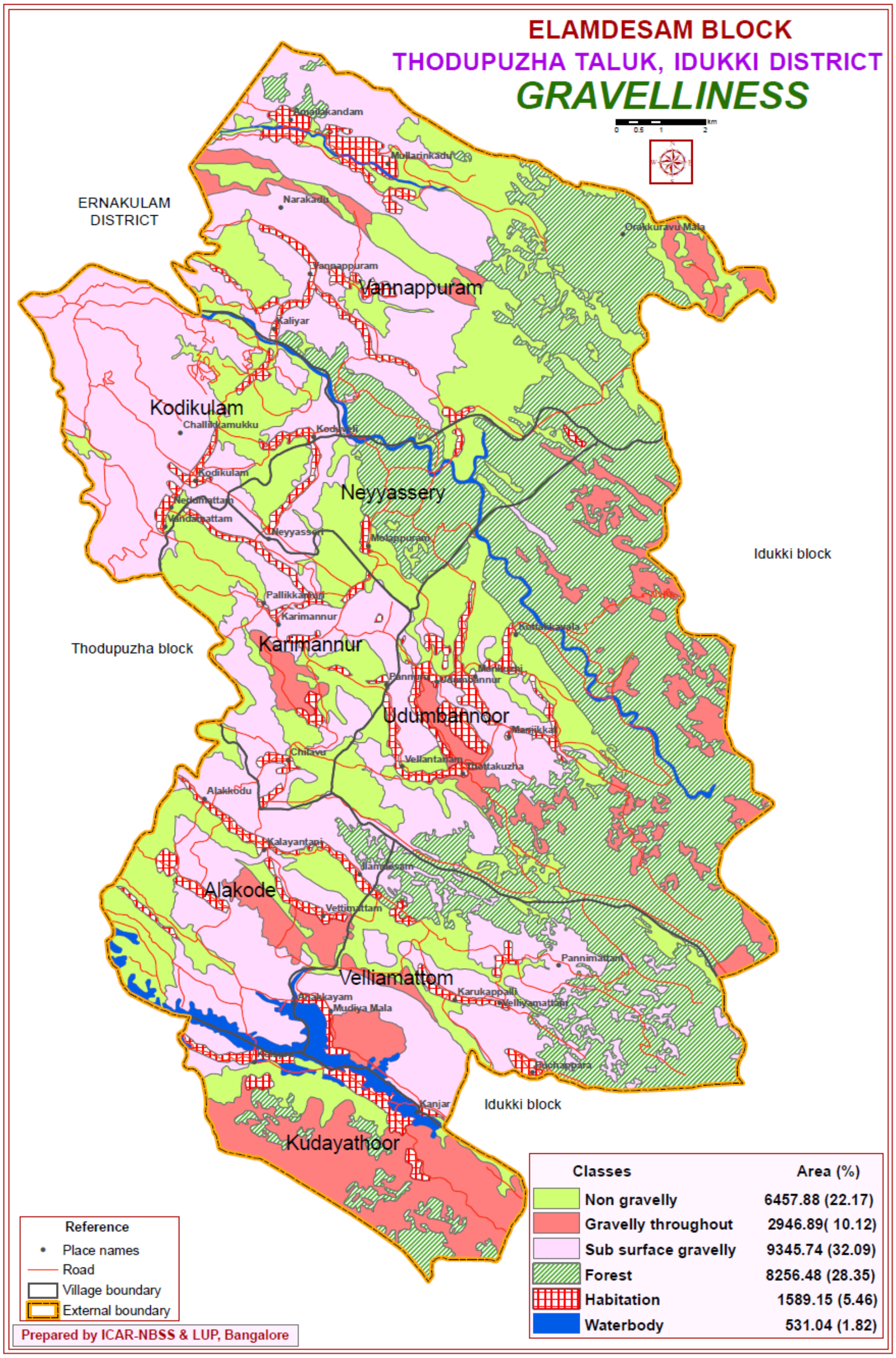

Map 5: Surface coarse fragments in Elamdesam block

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Biosensors and its Applications in Food Processing

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Faruk Ansari, Karishma Baidya and Alpana Singh
[1*&2] PhD Scholar and [3]Scientist
[1*]Dr. YSPHF, University Nauni, Solan, HP, India
[2]IGKV, Raipur, CG, India
[3]JNKVV,COA, Jabalpur, MP, India

INTRODUCTION

A biosensor is an analytical device which converts a biological response into an electrical signal (Fig. 1). The term 'biosensor' is often used to cover sensor devices used in order to determine the concentration of substances and other parameters of biological interest even where they do not utilize a biological system directly. Biosensors function by coupling a biological sensing element with a detector system using a transducer. The first scientifically proposed as well as successfully commercialized biosensors were electrochemical sensors for multiple analytes. The following statement is also defined for the biosensor, "A chemical sensing device in which a biologically derived recognition is coupled to a transducer, to allow the quantitative development of some complex biochemical parameter."

The Schematic diagram shown below for the biosensor is mainly divided into three sections. (i) Sensor: a sensitive biological element (biological material (eg. tissue, microorganisms, organelles, cell receptors, enzymes, antibodies, nucleic acids, etc), (ii) Transducer: it is the detector element (works in a physicochemical way; optical, piezoelectric, electrochemical, etc.) that transforms the signal resulting from the interaction of the analyte with the biological responsible for the display of the results in a user-friendly way, (iii) third section is the associated electronics, which comprises of signal conditioning circuit (amplifier), processor and a display unit.

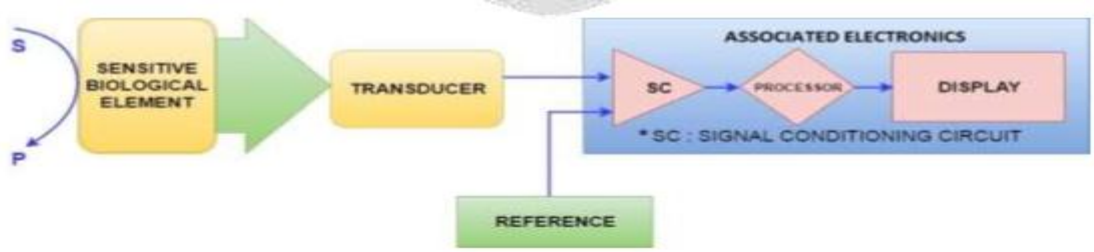

Fig -1: Schematic diagram showing main components of a biosensor

Working of a Biosensor

The electrical signal from the transducer is often low and superimposed upon a relatively high and noisy (i.e. containing a high frequency signal component of an apparently random nature, due to electrical interference or generated within the electronic components of the transducer) baseline. The signal processing normally involves subtracting a 'reference' baseline signal, derived from a similar transducer without any biocatalyst membrane, from the sample signal, amplifying the resultant signal difference and electronically filtering (smoothing) out the unwanted signal noise. The relatively slow nature of the biosensor response considerably eases the problem of electrical noise filtration. The analogue signal produced at this stage may be output directly but is usually converted to a digital signal and passed to a microprocessor stage where the data is processed, manipulated to desired units and output to a display device or data store.

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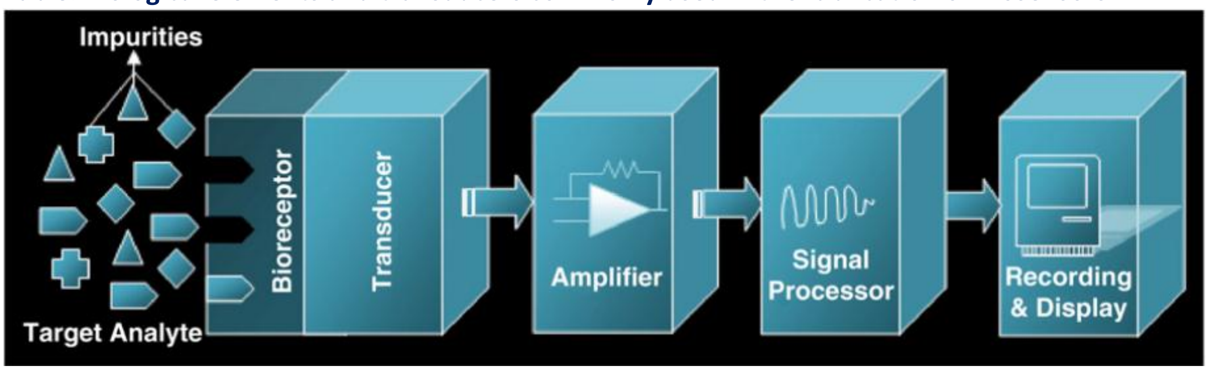
Principle of Biosensors

The bioreceptor recognizes the target analyte and the corresponding biological responses are then converted into equivalent electrical signals by the transducer. The amplifier in the biosensor responds to the small input signal from the transducer and delivers a large output signal that contains the essential waveform features of an input signal. The amplified signal is then processed by the signal processor where it can later be stored, displayed and analysed. The desired biological material (usually a specific enzyme) is immobilized by conventional methods (physical or membrane entrapment, non- covalent or covalent binding). This immobilized biological material is in intimate contact with the transducer. The analyte binds to the biological material to form a bound analyte which in turn produces the electronic response that can be measured. In some instances, the analyte is converted to a product which may be associated with the release of heat, gas (oxygen), electrons or hydrogen ions. The transducer can convert the product linked changes into electrical signals which can be amplified and measured.

Table. Biological elements and transducers commonly used in the fabrication of Biosensors



Basic Characteristics of a Biosensor

1. Linearity:

Maximum linear value of the sensor calibration curve. Linearity of the sensor must be high for the detection of high substrate concentration.

2. Sensitivity:

The value of the electrode response per substrate concentration.

3. Selectivity:

Interference of chemicals must be minimised for obtaining the correct result.

4. Response time:

The necessary time for having 95% of the response.

TYPES OF BIOSENSORS

Biosensors can be grouped according to their biological element or their transduction element. Biological elements include enzymes, antibodies, micro-organisms, biological tissue, and organelles. Antibody-based biosensors are also called immunosensors the method of transduction depends on the type of physicochemical change resulting from the sensing event. often, an important ancillary part of a biosensor is a membrane that covers the biological sensing element and has the main functions of selective permeation and diffusion control of analyte, protection against mechanical stresses, and support for the biological element. The most commonly used sensing elements and transducers are described below.

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Sensing Elements

Enzymes

Enzymes are proteins with high catalytic activity and selectivity towards substrates (see the article Enzyme Kinetics). They have been used for decades to assay the concentration of diverse analytes. Their commercial availability at high purity levels makes them very attractive for mass production of enzyme sensors. Their main limitations are that pH, ionic strength, chemical inhibitors, and temperature affect their activity. Most enzymes lose their activity when exposed to temperatures above 60^{o}C. Most of the enzymes used in biosensor fabrication are oxidases that consume dissolved oxygen and produce hydrogen peroxide [see Fig. 1(a)]. Enzymes have been immobilized at the surface of the transducer by adsorption, covalent attachment, entrapment in a gel or an electrochemically generated polymer, in bilipid membranes or in solution behind a selective membrane. Several reviews of enzyme immobilization have been published. Enzymes are commonly coupled to electrochemical and fiber optic transducers.

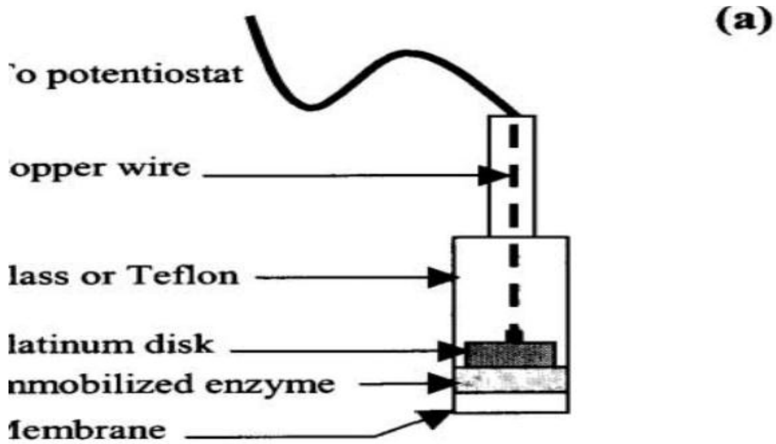

Fig: Amperometric enzyme membrane electrode

Antibodies

Antibodies are proteins that show outstanding selectivity. They are produced by b-lymphocytes in response to antigenic structures, that is, substances foreign to the organism. Molecules larger than about 10 kDa can stimulate an immune response. Smaller molecules like vitamins or steroids can be antigenic (also called haptens) but they do not cause an immune response unless they are conjugated to larger ones like bovine serum albumin. Many antibodies are commercially available and commonly used in immunoassays. Antibodies are usually immobilized on the surface of the transducer by covalent attachment by conjugation of amino, carboxyl, aldehyde, or sulfhydryl groups. The surface of the transducer must be previously functionalized with an amino, carboxyl, hydroxyl, or other group. A review of conjugation techniques can be found elsewhere. Antibodies share similar limitations with enzymes. Furthermore, binding may not be reversible and regeneration of the surface may require drastic changes in conditions like low pH, high ionic strength, detergents, etc. Therefore, efforts are being made to produce low cost, single use sensors. Probably the main potential advantage of immunosensors over traditional immunoassays is that they could allow faster and in-field measurements. Immunosensors usually employ optical or acoustic transducers.

Microbes

The use micro-organisms as biological elements in biosensors is based on the measurement of their metabolism, in many cases accompanied by the consumption of oxygen or carbon dioxide, and is, in most cases, measured

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electrochemically. Microbial cells have the advantage of being cheaper than enzymes or antibodies. Micro-organisms have been immobilized, for example, in nylon nets, cellulose nitrate membranes,or acetyl cellulose. Other biological elements such as animal of vegetable tissue and membranes as well as organelles and nucleic acids have been researched but are out of the scope of this article.

Transducer elements

These are physicochemical components which transform the biological signal, produced by biological component, into digital signals which are further processed by microprocessors into interpretable results. There are various types of biosensors, including electrochemical, acoustical, and optical sensors. The transducer is the biosensor component that responds to the primary signal from the recognition element and converts it to a form that can be amplified, stored, manipulated, displayed, and analyzed.

Electro-chemical

Amperometric and potentiometric transducers are the most commonly used electrochemical transducers. In amperometric transducers, the potential between the two electrodes is set and the current produced by the oxidation or reduction of electroactive species is measured and correlated to the concentration of the analyte of interest. Most electrodes are made of metals like platinum, gold, sliver, and stainless steel, or carbon-based materials that are inert at the potentials at which the electrochemical reaction takes place. However, because some species react at potentials where other species are present, either a selective membrane is used or an electron mediator that reacts at lower potential is incorporated into the immobilization matrix or to the sample containing the analyte. Potentiometric transducers measure the potential of electrochemical cells with very low current. Field effect transistors (FET) are potentiometric devices based on the measurement of potential at an insulator-electrolyte interface. The metal gate of a FET can be substituted by an ion selective membrane to make a pH transducer (pH ISFET). Enzymes have been immobilized on the surface of such pH ISFET to produce enzyme sensitized field effect transistors (ENFET). A complete description of such sensors can be found elsewhere.

Optical

Fiber optic probes on the tip of which enzymesand dyes (often fluorescent) have been co-immobilized are used. These probes consist of at least two fibers. One is connected to a light source of a given wave length range that produces the excitation wave. The other, connected to a photodiode, detects the change in optical density at the appropriate wavelength [see Fig. (b)]. Surface Plasmon resonance transducers, which measure minute changes in refractive index at and near the surface of the sensing element, have been proposed. Surface plasmon resonance (SPR) transducers have been proposed. SPR measurement is based on the detection of the attenuated total reflection of light in a prism with one side coated with a metal. When a p-polarized incident light passes through the prism and strikes the metal at an adequate angle, it induces a resonant charge wave at the metal/dielectric interface that propagates a few microns. The total reflection is measured with a photodetector, as a function of the incident angle. For example, when an antigen binds to an antibody that is immobilized on the exposed surface of the metal the measured reflectivity increases. This increase in reflectivity can then be correlated to the concentration of antigen. The basic theory of SPR excitation and some examples of its application to biosensors are presented elsewhere. A few SPR biosensors have been commercialized but no compact inexpensive portable device is available yet.

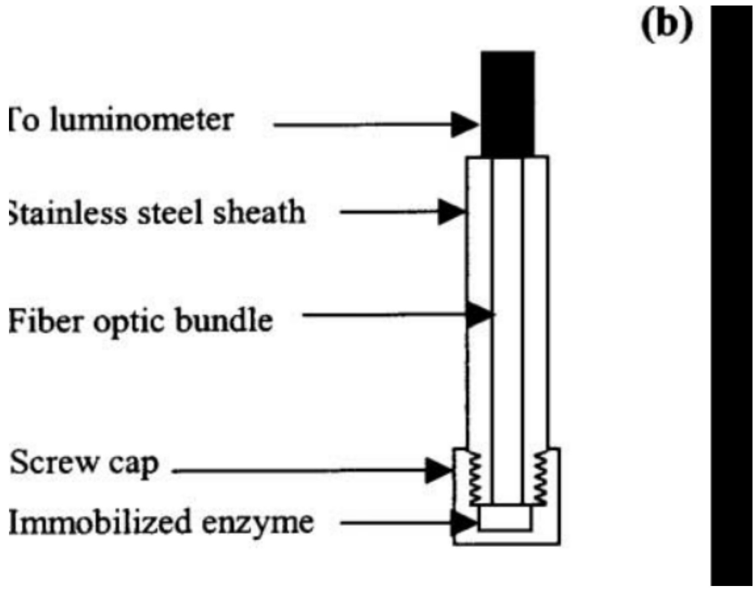

Fig: Fiber optic enzyme sensor

Acoustic

Electroacoustic devices used in biosensors are based on the detection of a change of mass density, elastic, viscoelastic, electric, or dielectric properties of a membrane made of chemically interactive materials in contact with a piezoelectric material. Bulk acoustic wave (BAW) and surface acoustic wave (SAW) propagation transducers are commonly used. In the first, a crystal resonator, usually quartz is connected to an amplifier to form an oscillator whose resonant frequency is a function of the properties of two membranes attached to it. The latter is based on the propagation of SAWs along a layer of a substrate covered by the membrane whose properties affect the propagation loss and phase velocity of the wave. SAWs are produced and measured by metal interdigital transducers deposited on the piezoelectric substrate as shown in Fig. 1(c).

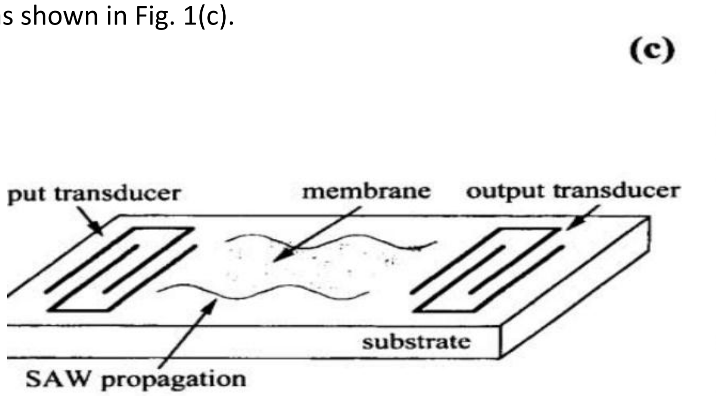

Fig: Surface acoustic wave propogation sensor

Calorimetric

Calorimetric transducers measure the heat of a biochemical reaction at the sensing element. These devices can be classified according to the way heat is transferred. Isothermal calorimeters maintain the reaction cell at constant temperature using Joule heating or Peltier cooling and the amount of energy required is measured. Heat conduction calorimeters measure the temperature difference between the reaction vessel and an isothermal heat sink

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surrounding it. Using highly conducting materials ensure quick heat transferred between the reaction cell and the heat sink. Finally, the most commonly used is the isoperibol calorimeter that also measures the temperature difference between the reaction cell and an isothermal jacket surrounding it. However, in this case the reaction cell is thermally insulated (adiabatic). This calorimeter has the advantage of being easily coupled to flow injection analysis systems [see Fig. (d)].

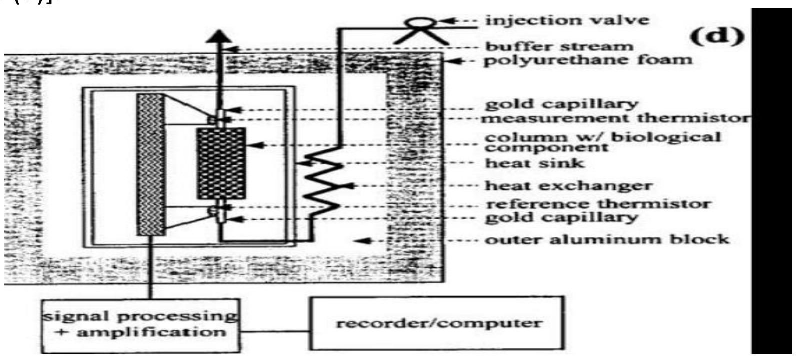

Fig: Enzyme thermistor

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Use of Cisgenesis Technique in Conventional Plant Breeding

Article id: 23413

Narayan Ram Gurjar[1], Kuldeep Sharma[2], Prateek Sharma[3*], and Vijay Kumar[2]
[1]Department of Genetics and Plant Breeding, Agriculture University, Jodhpur, Rajasthan
[2]Department of Entomology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan
[3]Department of Molecular Biology and Biotechnology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan

INTRODUCTION: Cisgenesis is a product designation for a category of genetically engineered plants. A variety of classification schemes have been proposed[1] that order genetically modified organisms based on the nature of introduced genotypical changes, rather than the process of genetic engineering. Cisgenesis, sometimes also called intragenesis, Cisgenesis and intransgenesis are two technically similar approaches to create genetic variability through gene-splicing technology. Cisgenic plants are defined as plants that have been genetically modified with one or more genes (including introns and flanking regions such as native promoter and terminator regions in a sense orientation) isolated from a crossable donor plant; that is, of the same or a closely related species or isolated from within the existing genome.

Concise Process of Cisgenesis:

Cisgenesis is one term for organisms that have been engineered using a process in which genes are artificially transferred between organisms that could otherwise be conventionally bred. Unlike in transgenesis, genes are only transferred between closely related organisms. However, while future technologies may allow genomes to be directly edited within an individual organism, currently nucleic acid sequences must be isolated and introduced using the same technologies that are used to produce transgenic organisms. The term was first used in a PhD thesis by Jan Schaart of Wageningen University in 2004, discussing making strawberries less susceptible to Botrytis cinerea.

Contribution of Cisgenesis in Conventional Breeding:

Virtually, cisgenesis has great potential to overcome a major bottleneck in traditional breeding. During introgression breeding, a wild plant with an interesting trait is crossed with a high-quality genotype, such as a cultivar. The wild plant, however, passes on not only its genes of interest to the progeny, but also other, sometimes deleterious, genes. This so-called linkage drag can slow down the breeding process tremendously, especially if the gene of interest is genetically tightly linked to one or more deleterious genes. To reduce linkage, drag, plant breeders usually need successive generations of recurrent backcrossing with the cultivated plant and simultaneous selection for the trait to generate a genotype in which the gene of interest is no longer linked to any undesired genes. By contrast, cisgenesis isolates only the gene of interest from the donor plant, which is then inserted into the recipient in one step. As no other genes are transferred, this method avoids linkage drag. This can enhance the breeding speed, particularly if several genes from different relatives must be combined into an elite variety, for example to obtain durable multigenic resistance. This is the main advantage of cisgenesis compared with traditional introgression breeding. Cisgenesis is a particularly efficient method for cross-fertilizing heterozygous plants that propagate vegetatively, such as potato, apple and banana. Cisgenesis has been applied to transfer of natural resistance genes to the devastating disease *Phytophthora infestans* in potato and scab (*Venturia inaequalis*) in apple. It can directly improve an existing variety without disturbing the genetic make-up of the plant. Traditional introgression breeding of cross-fertilizing plants does not allow the introduction of genes from wild germplasm without mixing up the combination of alleles in the existing heterozygous elite recipient genotype.

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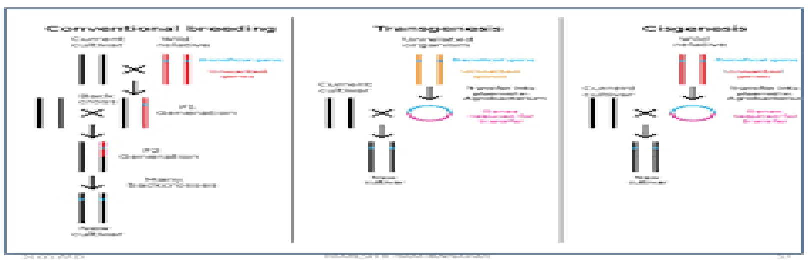
Cisgenesis and Transgenesis: Although transgenesis and cisgenesis both use the same genetic modification techniques namely the introduction of one or more genes and their promoters into a plant cisgenesis involves only genes from the plant itself or from a close relative, and these genes could also be transferred by traditional breeding techniques. If the current international GMO regulations, which are mainly based on the process of transferring transgenes, continue to fail to differentiate between cisgenic and transgenic plants, the use of cisgenesis could be seriously hindered. Only Canada now has a product-based rather than a process-based regulation system, and therefore has the legal possibility to control cisgenic plants less strictly than transgenic plants. Any restrictions on cisgenesis could block or delay further research on improving crop varieties, particularly as an increasing number of functional genes from crops and their crossable wild relatives are being isolated and are becoming amenable to cisgenesis. We argue that cisgenic plants are fundamentally different from transgenic plants, and should therefore be treated differently under GMO regulations. Some people believe that cisgenesis should not face as much regulatory oversight as genetic modification created through transgenesis as it is possible, if not practical, to transfer alleles among closely related species even by traditional crossing. The primary biological advantage of cisgenesis is that it does not disrupt favourable heterozygous states, particularly in asexually propagated crops such as potato, which do not breed true to seed. One application of cisgenesis is to create blight resistant potato plants by transferring known resistance loci wild genotypes into modern, high yielding varieties.



Need for Cisgenesis:

The prerequisite for cisgenesis is the isolation and characterization of genes of interest from crossable relatives. The rapidly increasing amount of DNA sequence information for individual genes, multigene families and whole plant genomes, combined with our increasing knowledge of gene functions, has enabled a directed search for beneficial alleles among cultivated plants and their wild relatives. In the past decade, a large number of natural genes from crops and their wild relatives have been isolated, many of which code for important traits such as disease resistance and quality. Many of these genes are now sufficiently characterized and are ready to be transferred into elite crops. However, whether this technique will develop into a powerful new tool strongly depends on several factors: how cisgenic plants are treated by existing legal frameworks, consumer acceptance of such products; whether these plants and any products derived from them must be labelled as GM; and intellectual property rights on GM technologies and genes. Although intellectual property and consumer acceptance are largely beyond the control of lawmakers and regulators, it would be sensible to regulate cisgenic plants differently to transgenic plants. Self-evidently, cisgenic plants should still be tested to confirm that they contain only the intended modifications and no foreign genes, such as a backbone gene from a plasmid. If such a foreign gene is unintentionally introduced, the plant is, by definition, transgenic.

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Conservation Tillage for Sustainable Agriculture Production and Eco-Safety

Article id: 23414

Banavath Mahesh Naik[1] & Karthika M[2]
[1] Ph.D Scholar, Department of Agronomy, College of Agriculture, GBPUA&T, Pantnagar.
[2] Ph.D Scholar, Department of Agronomy, College of Agriculture, PJTSAU, Hyderabad.

INTRODUCTION

Conservation tillage is any farming method of soil cultivation that can prevent losses of arable land by addition of previous year's crop residue on fields. Moreover, it also helps in the regeneration of degraded lands. It emphasis the maintenance of atleast 30 percent of the land under cultivation and also disturbance of the soil should be limited only to crop rows. Thereby, enhancing natural biodiversity above and below ground, which contributes altogether to sustained crop production.

Types of Conservation Tillage

No-Till

No -till is also known as zero till or direct drilling or slot planting or row till. In this practice primary tillage operation is completely avoided and secondary tillage is confined only in plant rows. No till is an agriculture technique to raise the crops and pasture without disturbing the soil to improve soil fertility by reducing the soil erosion, leaching of nutrients and increasing the organic carbon status and macrofauna which makes easily available of nutrient to crop plants.

Benefits:

- Prevent soil erosion especially in light texture soils that is sandy soils and dry soils.
- Hydrological characteristics like water infiltration and water holding capacity may be improved.
- Microclimate like soil temperature and aeration is maintained.
- Enhances the root growth and development by reducing the soil compaction.
- Soil biological activity may be improved.
- Fertility status of the soil increases.

Reduced Tillage

Reduced tillage is a practice by which soil disturbance is minimized and crop stubbles are retained on the surface or incorporated into the soil. Reduced tillage practices may progress from reducing the number of tillage passes by minimizing axle load and trafficking.

Ridge-Till

A system involving scalping and planting on elevated rows that remain undisturbed after establishment. The previous crop residue is cleared off from the planting ridges to the adjacent rows paving the way for planting.

Benefits:

- Controlled traffic.
- Crop residue management.
- Reduce herbicidal costs.
- Early soil warmup which is more important in poorly drained soils.

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Mulch-Till:
Keeping the soil covered by either growing a crop or crop residues left during fallow period is a new approach to farming called stubble mulch tillage. It is a year-round system of managing plant residue with implements that undercut residue, loosen the soil and kill weeds. Tillage tools such as chisels, field cultivators, disks, sweeps or blades are used. Weed control is accomplished with crop protection.
Benefits:

- Mulches intercept the raindrops thus reducing their dispersion action.
- Mulches increase the infiltration capacity.
- Mulches over the soil reduce the surface runoff thus reducing the sheet erosion.
- It maintains the soil cool and moist adaptive for good plant growth.

Modified forms of Conservation Tillage
Zone Tillage:
Zone tillage also known as deep zone tillage or vertical tillage is a modified deep tillage where only the narrow strips are tilled. It is a specific form of deep tillage designed to only disturb the soil in a narrow band directly below the crop row. The soil and residue in the inter-row are undisturbed providing surface cover and protecting the soil against erosion. It agitates the soil to reduce compaction and to improve internal soil drainage.

Strip Tillage:
Strip tillage is the modification of direct drilling system where only one-third of the soil is disturbed. A narrow strip is formed where the crop is sown and the strip is free from residue. It is also known as shallow zone tillage.

Need for more emphasis: Approximately one-third of the planet's soils are degraded. In many countries, intensive crop production has depleted soils, to the extent that future production in these areas is jeopardized. Healthy soils are the key to developing sustainable crop production systems that are resilient to the effects of climate change. They (CA) contain a diverse community of organisms that help to control plant diseases, insect and weed populations; recycle soil nutrients; and improve soil structure with positive effects on water holding capacity, nutrient retention and supply and levels of organic carbon.

Principles of conservation agriculture:
Conservation agriculture is based on mainly three principles,

1. **Continuous minimum mechanical soil disturbance**: The disturbed area must be less than 15cm or less than 25 percent of the cropped area which should be restricted only for placing the seed or fertilizer. This fights against soil erosion and preserves soil organisms.
2. **Permanent soil organic cover**: Ground area should have over 30 percent cover. This allows the retention of a protective layer of vegetation on the soil surface to suppress weeds, protect the soil from impact of rain drops and avoid soil compaction.
3. **Species diversification**: A well-designed crop rotation promotes good soil structure which contributes to nutrient cycling and plant nutrition and prevents phytosanitary diseases.

Plausible option for Eco-safety
Alarming increase in greenhouse gas causes degradation of soil, ecosystems, water etc. ultimately affecting the livelihood of majority of people leading to poverty resulting in deforestation, improper land use, the endless vicious cycle continuous. In addition, shifting to modern specialized farming which needs intensive tillage, Agro-chemicals etc.,

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lead to altered ecosystem abandoning soil sustainable practices like crop diversification and minimum disturbance of soil. Thus, degradation like soil erosion, increased CO_2 level and water pollution can be managed through adoption of conservation tillage which minimizes by carbon sequestration, good soil structure and by reducing runoff.

Prospective for Sustainable Agriculture Production

Conservation tillage improves the fertility status of soil through holistic management by reducing soil erosion, increased soil organic matter, water availability, biological activity, and soil structure, which ultimately leads to sustain and increase the crop growth and agronomic yield.

Policies in Conservation Tillage

In Africa, the Africa conservation tillage network (ACT) was established in 1998 to promote conservation agriculture as a sustainable means to alleviate poverty, make more effective use of natural and human resources, and reduce environmental degradation. The Chinese government is paying considerable attention to the development of CT, and a series of associated policies have been issued.

Socio Economic Development and Environmental Protection

- Less labour, time and cost are required under a reduced tillage system due to fewer tillage trips and cultivation operations for seedbed preparation. These saving range from Rs 113/ha to Rs 874/ha.
- A large number of studies have estimated the potential fuel cost saving as a result of reducing tillage. The range between Rs 163/ha and Rs 1293/ha.
- Zero-tillage technology reduce costs of field preparation up to Rs 3200/ha.
- It saves time and labour up to 10-20%
- A saving fuel consumption by 26.5-43.7 lit/ha. These results in reduced fuel cost and reduced carbon emitted to the atmosphere.
- Zero-tillage increases soil carbon from 0.1 to 0.7 m t/ha/yr under sub-tropical condition.

Benefits of Conservation Tillage

Resources (Time and Money)

- Decreased labour time.
- Due to less use of implements for tillage operation which saves money.
- Reduced fuel cost.
- Field preparation time is reduced.

Soil Health

- Improves soil aggregation.
- Enhance organic matter content in soil.
- Increased carbon which is the basic food material for macrofauna.
- Reduced soil erosion.
- Reduced soil compaction.
- Deeper root system and higher root volume.
- Enhance in mineralization process.

Water resources

- Improves water infiltration rate in soil.
- Enhances water availability and water holding capacity.

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- Reduce nutrient leaching and nutrient loss.
- Reduces algal blooms and dead zones.

Barriers for slow adoption of conservation agriculture

- Desirable objectives can vary across agro-ecosystems and socio-economic conditions.
- CA machinery and other inputs is another major reason for the lower uptake of CA particularly in eastern IGP.
- Weed management has been one of the constraints to adopt CA by smallholder farmers.
- Competing uses of crop residue as livestock feed, fuel, mulch, and compost, can impose a substantial challenge for the expansion of CA.
- Nutrient management is an important aspect of CA for crop productivity.
- Purchasing ZT drill machine or other CA machineries requires large investment and is beyond their capacity.

CONCLUSION:

The negative externalities of intensive agriculture to natural resources and environment are becoming increasingly apparent. CA is claimed to be a viable option for sustainable agriculture, and is being practiced in many developed and developing countries. The CA has been reported to reduce cost of production, while improving yield and conserving land and water resources. This indicates that there is an opportunity to enhance farm profitability and improve sustainability of agriculture in the resource poor regions through application of its principles.

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Cross protection of plant diseases

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Kuldeep Sharma[1*], Vijay Kumar[1], Gaurang Chhangani[1], M. K. Mahla[1], Prateek Sharma[2], and Narayan Ram Gurjar[3]
[1]Department of Entomology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan
[2]Department of Molecular Biology and Biotechnology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan
[3]Department of Genetics and Plant Breeding, Agriculture University, Jodhpur, Rajasthan

INTRODUCTION:

Cross protection refers to the ability of an attenuated virus to interfere with, and protect seedlings or plants from secondary infection by a closely related virus. Ideally, the protecting strain is non-aggressive and/or does not produce symptoms, but also has the ability to inhibit pathogenic effects normally induced by the challenge inoculated strain (Doods *et al.,* 1985). Both viruses are able to replicate, carryout cell to cell and long distance movement in plants when inoculated separately, but infection with the attenuated virus either mitigates or delays disease symptoms, or makes the host plant develop resistance to secondary infection by any related challenge virus (Freitas and Rezende, 2008; Hanssen *et al.,* 2010). It is also defined as the use of a mild strain of a virus to protect against the economic damage by severe strains of the same virus and also referred as homologous interference or super-infection exclusion. In 1926, McKinney demonstrated that when tobacco plants were infected with a mild dark green symptom inducing tobacco mosaic virus (TMV strain), the plants never developed additional symptoms of disease after secondary inoculations with a yellow mosaic-inducing TMV strain. Thung (1931) reported that mild dark green and severe yellow mosaic strains were antagonistic such that each multiplied and excluded the other in specific areas of the plant. Hamilton (1980) first suggested integrating the viral genome into plants for protection against viruses.

Need for cross protection:

Cross protection is mainly used when other control measures become not economical such as the complete absence of resistant varieties for many crops, the difficulties and lengthy time periods required to produce resistant crops through breeding. Most importantly, the continuing refusal to use genetically modified organisms in many countries especially in India. In plant disease diagnostics, cross protection has been used to characterize virus strains and establish their relatedness.

Characters of ideal mild strain:

It should be genetically stable, not prone to reversion. It should induce mild symptoms and not alter the marketable yield and quality of the target crop. It should be mild in all its cultivated hosts including those which are not target for the cross protection. It should be fully systemic. It should be able to protect against a wide range of isolates. It should not be easily spread by vectors to limit non intentional spread to other fields or crops. It should be easy to produce, check for purity, stable in storage and easy to inoculate.

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Procedure for cross protection:

- **Mass Production of mild strain:** Using local lesion host, application of mild strain, mechanical inoculation with hair brushes, cotton swabs, sponge pads, grafting techniques a use of spray guns. Evaluation for protecting ability of virus strain in green house condition and later in field condition.
- **Mild strain selection**-Observed naturally from severely infested fields. Eg. mild strains of *Cocoa swollen shoot virus* from cocoa and *citrus tristeza virus* from citrus. Severely infected plant with mildly infected axillary branch.
- **Heat or cold treatment**- Eg: *Soybean mosaic virus* (SMV) at 15^{o}C for 14 days.
- **Mutagenesis-** Usually with nitrous acid. Eg. Mild strains of PRSV.

Mechanisms of cross protection: Cross-protection is the result of the interaction of the below multiple pathways and mechanisms, which vary across groups of viruses.

- Exhaustion of metabolic precursors and/or essential nutrients by the attenuating strain.
- Depletion of replication sites through occupation of replication sites by the primary infecting strain.
- Encapsidation/capture of the genomic RNA of the super infecting strain in the coat protein of the vaccine strain.
- Prevention of the uncoating of the challenge virus by the CP of protecting strain.
- RNA silencing.
- Competition between the movement proteins to attach to plasmodesmata, preventing the systemic movement of severe strain.

Approaches include:

1. Coat protein mediated resistance.
2. Movement protein mediated resistance.
3. Replicase mediated resistance.

Coat protein mediated resistance:

The use of viral Coat protein (CP) as a transgene for producing virus- resistant plants is one of the most spectacular success achieved. Powell-Abel in 1986 first reported resistance against TMV in transgenic tobacco expressing TMV CP.

Movement protein mediated resistance: Movement protein (MP) are essential for cell-to-cell movement of plant viruses. These proteins have been shown to modify the gating function of plasmodesmata. The conferred resistance is believed to be by competition between wild-type virus-encoded MP and the preformed dysfunctional MP to bind to the plasmodesmatal sites. It has broad spectrum effect as it is effective against distantly related or unrelated viruses.

Replicase mediated resistance:

Replicase protein (Rep)-mediated resistance against a virus in transgenic plants was first shown in tobacco against TMV. It is effective for a narrow spectrum of viruses. To make the resistance broad-based,

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pyramid such genes from several dissimilar virus- sources into the test plant genome. Resistance generated by the use of Rep sequences is very tight.

Successful example of disease prevention using cross protection:

- **Citrus tristeza closteroviral cross protection:**

Citrus tristeza virus (CTV) is transmitted by the brown citrus aphid, *Toxoptera citricida.* Citrus tristeza virus is classified into many strains based on the symptoms they cause. These are seedling yellow, decline, stem-pitting, mild symptoms causing strains. In these strains, seedling yellow and decline can be controlled by using tolerant root stocks of sweet orange or Rangpur lime. While stem pitting strains of grapefruit and sweet orange cause significant damage to grapefruit or sweet orange regardless of their rootstocks. Control of CTV by cross protection is largely aimed at the stem pitting strains of grapefruit and sweet orange. Once the efficacy of the mild strains established, protected trees obtain rapidly by grafting scion buds from mild strain infected trees to healthy CTV tolerant rootstocks. By 1980, over 8 million trees of Pera sweet orange were cross protected.

- **Papaya ring spot potyvirus cross protection:**

Papaya ringspot potyvirus (PRSV) causes one of the most serious disease. It limits the economic viability and production of papayas and cucurbits around the world. When it is established in papaya (*Carica papaya* L.), it has proven difficult to control in many areas. Such as Hawaii, Taiwan, the Caribbean, Mexico, Brazil, Guam, the Philippines, and most recently, Australia. PRSV is transmitted by many species of aphids. Tolerance has been reported in a few papaya varieties and breeding lines but these selections are not widely planted because of relatively poor fruit quality. Selection and inoculation of naturally occurring mild strains have failed. Yeh and Gonsalves in 1984 were successful in selecting two mild strains HA 5-1 and HA 6-1.

- **Cucumber mosaic cucumo-virus satellite RNA cross protection:**

Cucumber mosaic virus is known to have the largest host range. It affects the vegetables like cucumber, squash, melons, peppers, beans, tomatoes, carrots, celery, lettuce, spinach, beets etc. Many isolates of CMV contain satellite RNAs. These RNA’s can cause severe necrosis on tomato plants whereas most actually attenuate symptoms of the infection. CMV is very difficult to control because of its wide host range and its transmission by numerous species of aphids. Cross protection to control CMV has been through the use of CMV strains carrying satellite RNAs that attenuate symptoms on vegetables. This approach has been used over several thousand acres in the People's Republic of China. CMV satellite RNA which attenuate disease symptoms is also called biological control agent (BCA).

- **Tomato mosaic virus cross protection:**

Tomato mosaic virus (ToMV) is very common in tomato crops. It causes severe symptoms on the fruit and dramatically reduces yields. Tomato mosaic is mechanically transmitted and spreads rapidly during cultural operations. Cross protection was suggested as a control for tomato mosaic in 1964.The first mild strains of ToMV were produced from virus infected tissue held above 44°C and was designated M strain. Successful protection was reported under commercial conditions from 1972-1983.

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Cross protection of fungi:

Many non-pathogenic fungal strains are used to control related pathogenic fungus. The mechanism may include competition, induced systemic resistance, antagonism. Baker and Mandeel did an experiment in which two non-pathogenic strains of *Fusarium oxysporum* (C5 and C14) were used to control *Fusarium* wilt of cucumber caused by *Fusarium oxysporum* f. sp. *cucumerinum*. They introduced non-pathogenic fungal strains of *Fusarium oxysporum* (C5 and C14) into the soil at 1.08 X 10^4 colony forming units (CFU). There was a significant reduction in germination of chlamydospores of *F. oxysporum* f. sp. *cucumerinum* by 23%. There was a reduction in disease incidence by 35%. The disease reduction was due to competition in rhizosphere and infection sites and enhanced resistance in the host.

Cross protection of Bacteria:

Agrobacterium tumefaciens causing crown gall of apple can be controlled by applying *A. radiobacter* strain K84 or strain 1026. The control is due to the production of bacteriocin agrocin 84 and efficient colonization of roots and wounds by biocontrol agent. Agrocin 84 is coded by the plasmid pAgK84. Bio agent also contains another plasmid, pNOC which codes for nutrients (opine) uptake and catabolism. Therefore, in natural situations strain K84 might proliferate at gall sites, stealing the pathogen's dedicated source of nutrients (opines), and also killing the pathogen by producing agrocin 84.

Advantages of cross protection:

- Viral cross-protection as a practical method is strictly limited to cases where no other solution is available.
- Useful especially during epidemics when no natural or transgenic resistance is available.
- In the future, “smart viruses” can be mild, vector non-transmissible and cloned, and which will protect against several viruses may be a feasible transitional solution until transgenic resistant plants are produced.
- These viruses could have added traits such as herbicide resistance or other traits to provide additional benefits to consumers and growers.

Limitations in cross-protection use:

- ✓ Incomplete protection and breakdown of protection may be happened. Loss of yields as a result of the mild strain infection in certain physiological instances. A strain that is mild in one crop might be severe in another crop plants. Difficulty in restricting the protector virus to the treated field, because of natural vectors can be occurred. In few instances’ synergism and ruinous interactions with other viruses can be occurred. Unavailability of mild strains of practical value.

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Management of Early and Late Blight of Potato

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Mahesh Singh, Ganesh Datt Bhatt and Amit Maurya*
School of Agriculture, Galgotias University, Greater Noida, Uttar Pradesh, 203201.
*Department of Plant Pathology , Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) 211007.

Potato (*Solanum tuberosum* L.) is an important vegetable crop, grown in many parts of the world. Early blight and late blight; two serious diseases of potato, are reported throughout the world. The terms "early" and "late" indicated that the relative time of their appearance in the field. Both diseases are caused by fungal pathogens namely; *Alternaria solani* and *Phytophthora infestans.* The diseases not cause only loss of yields but also reduce the quality of the crops.

Early Blight

Early blight of potato is caused by a fungal pathogen *Alternaria solani*; it is destructive disease in several states, causes heavy yield loss. The disease affects leaves, stems and tubers as well as it reduces size and quality of tubers. Premature defoliation may lead to considerable reduction in yield. The disease can also be severe on tomatoes, and can occur on other solanaceous crops and weeds.

Disease Symptoms:

The initial symptoms of early blight appear as small, circular or irregular, dark-brown to black spots on the lower leaves. At later stage these spots enlarge size and spread all over the plant parts. The spots develop with concentric rings looks like target board pattern. Spots may also develop on the tubers -- these spots are sunken or raised with a definite margin. The internal tuber tissues are brown to purple in color, some time with a yellowish margin.

Disease Cycle:

The fungus survives either on potato tubers or as infected crop residue either in the soil. The concentration of initial or primary inoculum from these reservoirs is usually low. The primary infection can occur from months November and early December, when frequent rains or dews occur and daytime temperatures remain near 22-25 ^{0}C. The fungus spores can penetrate the leaf surface directly through the epidermal cells and spots begin appearing within 3-4 days. The secondary spread takes place by wind-borne conidia between plants to plant and fields to fields.

Disease Management:

- Eradicate and destroy weeds and volunteer solanaceous crop plants.
- Use only disease free seeds for sowing.
- Crop rotation with non-susceptible crops at least 2-3 years.
- Maintain proper spacing between plants to plants and row to row.
- Avoid sprinkler or other overhead irrigation.
- Use optimum dose of fertilizers.
- Harvest when skin is mature to avoid infection of tubers.
- Spray the solution of Mancozeb 75 WP + 10 g urea per liter of water at 15 days interval when symptoms start or apply copper fungicides at early stage of disease infection.

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Late Blight

Late blight of potato is also known as potato blight. This disease was responsible for the Irish famine in the 1843-45. The organism can also infect some other members of the solanaceous crops. The pathogen was first described by M. J. Berkeley and subsequently named *Phytophthora infestans* by Anton de Bary. The disease can infect and destroy the leaves, stems and tubers of potato plants. The average annual losses due to late blight have been reported about 35% of total production in the country.

Disease Symptoms:

The first appearance of the disease is seen in the month of January. Small, dead, and brownish to purplish black lesions on the tips and margins of the leaflets shows at initial stage of the infection. Under favorable conditions (12–18°C temperature and more than 80% RH) the lesions rapidly increase in size and cover the whole surface of the leaf. The blighted leaves become curl and shrivel in dry weather and under moist conditions they decay and emit a characteristic odor. In the infected plant tubers get also infected. When the tuber is cut and open, there is a tan-brown, dry, granular rot appearance may be seen. Such infected tubers get easily rot in storage under warm or humid conditions.

Disease Cycle:

The pathogen survives with infected tubers between season to season on infected potato tubers as in the storage or in the soil after harvest. Infected tubers that are planted or other volunteer plants that survive the winter may be sources of the pathogen for primary infection. The pathogen is favored to high moisture and cool to moderate temperatures. Night temperatures of 11^0C to 15^0C and day temperatures of 16^0C to 20^0C are most favorable for disease development. Rain, dew and overhead sprinkler irrigation provide the water necessary for pathogen infection and development.

Disease Management:

- Destroy infected plant debris and other volunteer plants.
- Select disease free seed tubers for sowing.
- Do not mixes seed lots with infected tubers because cutting can transmit late blight.
- Treat the tubers with suitable fungicides.
- Avoid nighttime and flood irrigation.
- Select resistance variety such as Kufri Anand, Kufri Badshah, Kufri Arun, Kufri Himsona, Kufri Lalit, Kufri Pukhraj, Kufri Sadabahar, Kufri Sutlej for cultivation.
- Apply foliar fungicides application to overcome disease severity. Once late blight is start, only foliar fungicide applications can manage this infection in the field.
- Spray Dithane M-45 or Dithane Z-78 @ 2.5 kg/1000 liters of water per hectare. It should be repeated at 10-12 days interval.

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Artificial intelligence in Agriculture: An overview

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Abhisek Tripathy[1], Ashruti kesharwani[2], Pooja Konhar[3], Aditya Kumar Malla[4] and Jeebanjyoti Behera[5]
[1]Ph.D. Research Scholar, Dept. of Plant Pathology, O.U.A.T., Bhubaneswar
[2]Ph.D. Research Scholar, Dept. of Plant Pathology, I.G.K.V., Raipur
[3]Ph.D. Research Scholar, Dept. of Agricultural Entomology, I.G.K.V., Raipur
[4,5]Ph.D. Research Scholar, Dept. of Extension Education, O.U.A.T., Bhubaneswar

INTRODUCTION

The agriculture industry now is experiencing rapid growth and adopting advanced technologies in order to bolster the overall yield of the crops. Accessibility of a large number of equipment and state-of-the-art technologies like intelligent monitoring system, drones, and robots, among others has totally revolutionized this sector. Artificial Intelligence is one such vital technology in today's digital agriculture that is being implemented and deployed on a large scale for more sustainable use of available resources. Artificial intelligence technology is supporting different sectors to boost productivity and efficiency. AI solutions are assisting to overcome the traditional challenges in every field. Likewise, AI in agriculture is helping farmers to improve their efficiency and reduce environmental hostile impacts. The agriculture industry strongly and openly embraced AI into their practice to change the overall outcome. AI is shifting the way our food is produced where the agricultural sector's emissions have decreased by 20%. Adapting AI technology is helping to control and manage any uninvited natural condition. Today, the majority of start-ups in agriculture are adapting AI-enabled approach to increase the efficiency of agricultural production. The Market study report stated that the global Artificial Intelligence (AI) in Agriculture market size is expected to reach 1550 million US$ by the end of 2025. Implementing AI-empowered approaches could detect diseases or climate changes sooner and respond smartly. The businesses in agriculture with the help of AI are processing the agricultural data to reduce the adverse outcomes.

Advantage of implementing AI in Agriculture

The use of Artificial intelligence in agriculture helps the farmers to understand the data insights such as temperature, precipitation, wind speed, and solar radiation. The data analysis of historic values, offers a better comparison of the desired outcomes. The best part of implementing AI in agriculture that it won't eliminate the jobs of human farmers rather it will improve their processes.

- AI provides more efficient ways to produce, harvest and sell essential crops.
- AI implementation emphasis on checking defective crops and improving the potential for healthy crop production.
- The growth in Artificial Intelligence technology has strengthened agro-based businesses to run more efficiently.
- AI is being used in applications such as automated machine adjustments for weather forecasting and disease or pest identification.
- Artificial intelligence can improve crop management practices thus, helping many tech businesses invest in algorithms that are becoming useful in agriculture.

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- AI solutions have the potential to solve the challenges farmers face such as climate variation, an infestation of pests and weeds that reduces yields.

Impact of Artificial Intelligence in Agriculture

AI technology is rapidly rectifying the problems while recommending specific action that is required to overcome the problem. AI is efficient in monitoring the information to find solutions quickly. Let's see how AI is being used in agriculture to improve results with a minimal environmental cost. By implementing AI can identify a disease with 98% accuracy. Thus, AI helps farmers monitor the fruit and vegetable by adjusting the light to accelerate production.

Forecasted Weather data

AI in an advanced way is helping the farmer to remain updated with the data related to weather forecasting. The forecasted/ predicted data help farmers increase yields and profits without risking the crop. The analysis of the data generated helps the farmer to take the precaution by understanding and learning with AI. By implementing such practice helps to make a smart decision on time.

Monitoring Crop and Soil Health

Utilizing AI is an efficient way to conduct or monitor identifies possible defects and nutrient deficiencies in the soil. With the image recognition approach, AI identifies possible defects through images captured by the camera. With the help of Al deep learning application are developed to analysis flora patterns in agriculture. Such AI-enabled applications are supportive in understanding soil defects, plant pests, and diseases.

Decrease pesticide usage

Farmers can use AI to manage weeds by implementing computer vision, robotics, and machine learning. With the help of the AI, data are gathered to keep a check on the weed which helps the farmers to spray chemicals only where the weeds are. This directly reduced the usage of the chemical spraying an entire field. As a result, AI reduces herbicide usage in the field comparatively the volume of chemicals normally sprayed.

AI Agriculture Bots

AI-enabled agriculture bots help farmers to find more efficient ways to protect their crops from weeds. This is also helping to overcome the labor challenge. AI bots in the agriculture field can harvest crops at a higher volume and faster pace than human laborers. By leveraging computer vision helps to monitor the weed and spray them. Thus, Artificial Intelligence is helping farmers find more efficient ways to protect their crops from weeds.

Providing Image-based insights

With the help of computer vision technology and drone-based data collected, farmers can take immediate actions in real-time in order to generate the alert to speed up precision farming. This is one of the significant areas in today's farming. Computer vision technologies can be deployed in areas including disease detection, crop readiness and identification, field management, and soil survey and mapping.

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Managing Environmental Challenges

Environmental challenges like climate change and others are the biggest threats to agricultural productivity, but AI-powered techniques and data-driven farming can help in making it easier for farmers to navigate shifts according to environmental conditions. It assists to address climate change by powering smarter resource management.

Precision Farming

In this process, farmers can detect pests, diseases in plants, and poor plant nutrition of farms with the help of AI. Also, AI sensors can identify and target weeds and then decide which weed killers or herbicides to apply within the right zone. It assists to thwart over application of herbicides and excessive toxins that find their way in today's daily food. By leveraging AI, farmers are also creating seasonal forecasting models to enhance agricultural accuracy and productivity.

Challenging and Growing Factors of AI in Agriculture

Despite a huge number of opportunities for applications in agriculture, there is still a lack of familiarity with the latest technology across most of the world. Also, the high initial cost associated with the deployment of AI in agriculture can be a restraining factor towards digitalization of the agriculture sector. Rising investments in and adoption of AI and robotics are majorly accelerating the growth of the global AI in the agriculture market. AI applications in agriculture comprise agriculture robots, autonomous tractors, agricultural drones, crop health monitoring, facial recognition, and automated irrigation systems.

CONCLUSION

Today AI-powered technologies are used for solving several industries' purposes. AI is being utilized in sectors such as finance, transport, healthcare, and now in agriculture. AI is helping the farmers to monitor their crops without the need to invigilate personally into the farm. Many start-ups and enterprises are looking forward to AI development in agriculture. AI is redefining the traditional pattern of agriculture. The future of AI in agriculture is way ahead in offering radical transformation with advanced approaches.

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Effect of open dumping yard on groundwater pollution

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Kiran S.C.
Ph.D. Scholar, Department of Forestry and Environmental Science, UAS, GKVK Bengaluru.

Municipal Solid waste and water quality have become major environmental problems in recent years, especially metropolitan cities. Concerns regarding solid waste in the metropolitan are growing, especially in densely populated areas, not only because of the increase of waste caused by rapid urbanization, a growing population, improved living standards, and changing consumption patterns, but chiefly because of the lack of an efficient waste management system. If solid waste is not effectively and properly managed, it can result in adverse impacts on both environmental and human health causing air, soil, and water pollution and disease. Sustainable management of solid waste is important because of the vulnerability of natural resources such as surface waters and underground aquifers landscape, and biodiversity. Furthermore, the deterioration of natural resources may affect the economy of countries where metropolitan cities are the most important economic sector in IT&BT sectors.

Open dumping yard have been identified as one of the major threats to groundwater resources not only in India but throughout the world. More than 90% of the Municipal Solid Waste (MSW) generated in India is directly dumped on land in an unsatisfactory manner. The solid waste placed in landfills or open dumps are subjected to either groundwater underflow or infiltration from precipitation or any other possibility of infiltration of water. During rainfall, the dumped solid wastes receivers water and the by-products of its decomposition move into the water through the waste deposition. The liquid containing innumerable organic and inorganic compounds is called 'leachate'. This leachate accumulates at the bottom of the landfill and percolates through the soil and reaches the groundwater.

Areas near landfills have a greater possibility of groundwater contamination because of the potential pollution source of leachate originating from the nearby dumping site. Such contamination of groundwater results in a substantia risk to local groundwater resource user and to the natural environment. Groundwater pollution has become a global environmental problem that poses a continuous and serious threat to the ecological environment and human health. Landfill leachate, which contains many toxic and harmful substances such as heavy metals, persistent organic pollutants and bacteria, has become one of the main anthropogenic sources of groundwater pollution. Groundwater polluted by leachate will not only cause ecological problems such as water blooms and soil salinization, but also cause various aquagenic diseases once exposed to the human body through drinking or bathing. For example, drinking groundwater polluted by heavy metals (such as manganese and arsenic) in leachate for a long time will increase the risk of cancer and infant death, as well as induce motor and cognitive dysfunction in children. Moreover, nitrate (NO^{3-}) is ubiquitous in municipal solid waste landfills (MSWLs), and studies have shown that it is related to blue baby disorder.The impact of landfill leachate on the surface and groundwater has given rise to a number of studies in recent years and gained major importance due to drastic increase in population.

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Geriatric Nutrition

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Akanksha Singh[1] and Shashank Singh[2]
Ph.D. Research Scholar[1], Assistant Professor[2]
GBPUAT, Pantnagar, Uttrakhand[1], KNIPPS, Sultanpur, UP[2]

INTRODUCTION

GERONTOLOGY + GERIATRICS = THE SPECTRUM OF AGING

Gerontology is the study of normal aging, including factors in biology, psychology, and sociology. Geriatrics is the study of the chronic diseases frequently associated with aging, including diagnosis and treatment. Ageing is an inevitable developmental phenomenon bringing along a number of changes in the physical, psychological, hormonal and the social conditions. Define ageing in terms of the biology; referring to "the regular changes that occur in mature genetically representative organism living under reprehensive environmental conditions as they advance in chronological age." Aging is an irreversible biochemical change that occurs throughout an individual's life cycle and continues until death. Genes are the major determinants of nature of aging. Health and good nutrition may delay the process of aging. Aging varies among individuals depending on their nutritional status and living environmental conditions. Old age is a process which starts from the prenatal period and continues until the end of life. These are the changes of anatomic structure and physiological functions which take place dependent on time. World Health Organization (WHO) defines people of age 65 and above as "old age". According to the progress of the old age and changes in body functions; people between the age group 65–74 are classified as "young olds", 75–84 age group as "olds" and the group of age 85 and above is classified as "oldest old".

Many researchers have divided old age into three categories.

1. Early old age or young old age which extended from age 60 to age 69.
2. Old age or advanced old age, this begins at the age 70 and ends at age 79.
3. From the age 80 and the above is considered older old age

Process of ageing

Ageing is a normal process begins at conception and ends only with death. Individuals are known to age at different rates. Heredity and good nutrition may slow the ageing processes. Goal of nutritional care should be to help the aged achieve a healthy, purposeful and independent living. One prominent theory – the free radical theory- involves the continuous formation of free radicals as a result of exposer to oxygen and harmful exposure to environmental factor. These highly reactive substances lead to damage and alteration in the structure of proteins, lipids, carbohydrates and chromosomal material in cells which probably leads to changes associated with ageing.

Tissue damage by free radical or pro-oxidants like superoxide, peroxide and hydroxyl radicals is the basis for inflammatory and degenerative changes seen in variety of diseases like cancer. Endogenous antioxidants are Superoxide dismutase(SOD),catalase (CAT), glutathione peroxidase(GPX) which act together with glutathione (GSH) and NADPH with age in disease these antioxidants defenses are lowered and the vitamins A,C, and D get excessively utilized and a deficiency state occurs.

The process of ageing brings about physiological changes, psychological changes and immunological changes which influences the nutritional status. The changes associated with ageing are partly influenced by genetics, race and gender.

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Theories of Aging

Broadly, theories can be grouped into two categories: pre- determined and accumulated damage. A loss of efficiency comes about as some cells wear out, die, or are not replaced. This is sometimes referred to as the one percent rule; most organ systems lose approximately 1% of their functioning each year, starting at age 30. A recent theory is that the cause of age-related health decline is malfunctioning telomeres.

1. Free Radical Damage Theory: Splitting of covalent bond leads to formation of free radical during oxidative metabolism. During aging, free radical such as superoxide and hydroxyl causes changes in DNA, causes impairment of DNA replication and so causes cellular dysfunctioning.

2. Glycation Theory: During aging, blood and glucose level is elevated. So, there is linkage formed between excess glucose and protein and this leads to cellular dysfunctioning.

Physical changes occur in old age period

Body Weight: Generally, body weight begins to decrease after the age of 60. Especially the decrease in the weight becomes clear after the age of 80.

Body Composition: Some changes are observed in the body composition in line with aging. The amount of lean body tissue is decreases and the amount of fat tissue is increases. After the age of 80 and later, the speed of reduction in the fatless tissues increases. The amount of lean body tissue in the women is less than the men. The decrease in the amount of lean body tissue masses affects walking and balance by causing decrease in the amount of muscles and their strength. This factor increases the risk of falling and fracture.

Skeleton System: Decrease in the amount of calcium within the bones occurs in the old age. Women lose 40% of the total skeleton calcium in the old age period. Half of this loss occurs in the first five years after the menopausal period. This loss continues with a slowing rate. Furthermore, activity is reduced due to the limitations and decrease in the flexibility of the joints. This effect may create the risk of obesity due to the difficulties in access to food and limitations of physical activity.

Water Metabolism: Water percentage in the body decreases from 60% to 50%. Dependent upon the decrease in the feeling of thirst, water intake decreases. However, water loss from the body is more. Unless the water loss is compensated by the consumption of water and other drinks serious health problems may occur.

Role of Nutrients in Old Age Period

Nutrition plays an important role in the prevention, retardation and treatment of the diseases affiliated with aging. Adequate and balanced nutrition is important with respect to the perpetuation of the functional situation and protection from injuries. Energy need in the elderly may increase due to the diseases, injuries and fractions. In these types of situations where energy need increases, inadequate nutrition may cause the malnutrition. Inadequate nutrition increases the frequency of the chronic diseases and the number of deaths caused by these diseases. The nutrition conditions in the old age period are affected by the changes in the body, chronic diseases, and used medicines, physical, social or economic situation.

1. Energy: As a result of reduced basal metabolism and physical activity, the calorie requirements are about 25% less than those of normal individuals doing light work. The calorie intake should be adjusted to maintain the body weight constant in the case of old people with normal body weight. In the case of obese people, the calorie intake should be adjusted to reduce the body weight gradually to about normal level.

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The energy requirement decreases due to-

- ✓ Decreased Physical Activity
- ✓ Reduction in lean body mass and increase in adipose tissue
- ✓ Decrease in resting metabolic rate by 15-20 percent due to changes in body composition and physical inactivity. The calorie intake should be adjusted to maintain weight. The energy requirements for different age groups 60 years .

2. Protein: In view tendency to eat less as a result of decreased appetite and poor digestive capacity,old people are likely to consume less proteins and suffer from protein deficiency. Hence ,adequate protein intake should be ensured. The daily protein intake should be at least 1 to 1.4 gm per kg body weight. Since the calories are reduced without decrease in proteins the diet should be protein rich when compared to a normal adult diet.

3. Carbohydrate: Since the calorie requirement is reduced the carbohydrate content should also be proportionately reduced. Due to impaired glucose tolerance and gastro intestinal disturbances like constipation, emphasis should be on taking complex carbohydrates.

4. Fat: Fat is a concentrated source of energy, the diet should contain at least about 50gm fat. Half this quantity should be in the form of vegetable oils rich in essential fatty acids. The fat requirements are also reduced corresponding to the energy requirements. The intake of saturated fat should be less and that of unsaturated fat more.

5. Minerals: Calcium and iron deficiencies occur frequently as absorption of these nutrients is less efficient than in normal adults. The calcium intake should be not less than 1 gm and the iron intake 20mg.Calcium needs increases during old age due to increasing mobilization of calcium from bones and incidence of osteoporosis. During old age 1000mg of calcium is recommended per day because of the following reasons.

- ✓ Limited availability of calcium from foods.
- ✓ To compensate age related bone loss and to improve calcium balance.
- ✓ To prevent fractures and tooth decay.
- ✓ To compensate decreased efficiency in calcium absorption.

Aging does not affect iron needs. Hence iron needs are same as that for adults. Mild anaemia may affect the health of old people due to inefficient circulation. Therefore iron intake should be adequate during old age.

Vitamins: Mild deficiencies of several vitamins occur frequently among old people. It is therefore, essential to ensure adequate intakes of all essential vitamins. If the diet consumed does not provide adequate amounts of all vitamins, a multivitamin tablet providing the daily requirements of different vitamins should be taken daily.

- Vitamin A requirements remain the same i.e., 600 µg of retinol
- Inadequate exposure to sunshine may affect vitamin D levels in which case supplementation may be required. It is essential to include 400 IU of vitamin D daily.
- Vitamin C requirements increase due to stress and medications. The antioxidant vitamins such as vitamin E, carotenoids and vitamin C have been identified to promote health of the elderly.
- Vitamin B6 requirements are also increased due to atrophic gastritis which interferes with absorption. Liver dysfunction is an additional risk factor for Vit. B6 deficiency

Besides these various nutrients, water should be consumed in plenty as such or as fluids like buttermilk, fruit juice and soups. Intake of sufficient fluids reduces the load on kidneys and relieves from constipation by stimulating peristalsis.

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Water: The importance of adequate fluid intake so as to maintain the volume of urine excreted at a minimum of 1.5 litres is not generally recognized. Water can be consumed as such or in the form of buttermilk, fruit juices, porridges, soup, etc.

Roughage: Adequate intake of soft unavailable carbohydrates in the form of tender vegetables and fruits should be ensured to avoid constipation. The senile intestinal mucosa does not tolerate fibre from mature vegetables and bran cereal.

Changes in the organ functions

Changes in the functions of the organs in the body also occur in the old age period. The changes which may cause inadequate nutrition by affecting the nutritional conditions are as follows:

Decrease in the sense of taste and smell: With all the senses, a decrease in the sense of smell also occurs. Approximately, 25% of the individuals above the age of 65 are not able to define one or more than one of the four fundamental senses (hot, sweet, salty, sour) because of the decrease in the taste cells in the tongue and mouth space. The decrease in the sense of taste and smell may cause dislike of the consumed foods and may create risks for the nutritional condition due to decrease in appetite.

Decrease in the saliva secretion: The dry mouth which is a result of reduction in the saliva secretion affects the intake of food and complicates the swallowing of food. Dry mouth conditions may occur as a result of the treatment by medicines as well as being a result of aging.

Mouth and teeth problems: The decrease in the number of teeth and usage of dental prosthesis complicates the disintegration and chewing of some foods. The difficulty in chewing may be a barrier the intake of different nutritional elements.

Swallow difficulties: As a result of the decrease in the contraction ability of the esophagus, the swallowing of the chewed foods becomes complicated. This complication may reduce the appetite for food and the frequency of eating.

Decrease in the stomach functions: The decrease in the evacuation rate of the foods in the stomach may create a long-term satiety sense. This long-term satiety sense may create the risk of inadequate nutrition by causing the consumption of less food. With the decrease in the enzyme activity and quantity of the consumed food,the absorption of nutrients like calcium, iron, vitamin B12 and folic acid decreases. This condition may cause to anemia.

Decrease in the functions of liver and gallbladder: As a result of the decrease in the biliary enzymes, a decrease occurs in the body activity of the fat soluble vitamins. The speed of the blood stream from the liver is decreases.

Decrease in the functions of intestine: As a result of the changes in the small intestine, the utilization of nutrients in the body decreases.

Decrease in the functions of immune system: The multiplication of the immunity cells slow down and the body resistance to the infections decreases. As a result of the deficiencies in the immune system in the old age, frequency of upper respiration infections, other infections and cancer and the number of deaths caused by these diseases increases

Decrease in the functions of nervous system: As a result of the loss in the nerve cells, a decrease in the information storage and remembrance abilities occurs. Dementia and depression are the most prevalent symptoms. These changes hinder the intake of food.

Energy metabolism: The rate of basal metabolism slows down. Total energy consumption and the calorie requirement decreases.

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Remote Sensing and Water Quality

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Avish A.C. and Sanya C.S.
Assistant Professor(C), KCAET, Tavanur, Kerala-679573

Spectral properties of water vary with wavelength of incident radiation not only due to the molecular structure, but also due to impurities present in the water body. Hence, Remote sensing for mapping or monitoring water quality becomes quite complex. The water surface behaves as a partially diffused and partially specular reflector. Specular reflection is uniform at all wavelength, but absorption and back scatter produce distinctive spectral signature or spectral response pattern .Solar energy that is that is not spectrally reflected is reflected downward into the water body. This refracted energy is either adsorbed or get scattered. The remaining signal is indicative of water quality, which is volumetric reflectance or gets scattered energy caused by the material in water. In case of deep water, where the bottom reflectance is negligible, the reflectance comes from the surface of the water body. For shallow water the total reflectance is a function of both surface and bottom reflectance.

Advantages of applying remote sensing in compliance with other water quality monitoring programs as below:

- Gives a synoptic view of the entire water body for more effective monitoring of the spatial and temporal variation.
- Makes it possible to have a synchronized view of the water quality in a group of lakes over a vast region.
- Provides a comprehensive historical record of water quality in an area and represents trends over time. Prioritizes sampling locations and field surveying times.

Applications of remote sensing technique to determine water quality

- Runoff and Hydrological Modeling
- Flood management
- Watershed management
- Drought management
- Irrigation command area management

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Analytic Network Process

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Avish A C, Sanya C S
Assistant Professor(C), KCAET, Tavanur, Kerala - 679573

ANP is an improved method of AHP applied in MCDM. The ANP extended the traditional AHP scope by accounting with dependency among criteria and alternatives, and then occasionally it is called as a generalization of AHP. Since, the AHP assume that each concerning element in hierarchy model is specified to be independent. However, generally, decision problems are unable to be structured in hierarchy model totally, and, moreover, problems may involve with the dependence between upper-level elements and lower-level elements in a hierarchical model, since the AHP is not suitably applied with these interrelation problems. The ANP can be conducted in four main steps as follows.

1) Model the problem as a dependency network

The problem will be constructed to a network model consisting of elements and clusters. Each element in a cluster can depend on some or whole of the elements of any cluster, and this relationship is called outer dependence represented by arc connecting to other nodes in any other cluster. In the other hand, an interrelationship among elements within cluster is named inner dependence represented by a looped arc.

2) Calculating priorities among elements and establishing original or unweighted supermatrix

The second step concerns with prioritizing elements among inner elements and also outer elements. These priorities are obtained by making pairwise comparisons. In order to make a comparison, a generic question that must be encountered with is: How much more does one element influence on another element than the others? The process to perform pairwise comparisons and to obtain priority vectors of ANP is similar to the AHP.

3) Calculating priorities among clusters and establishing weighted supermatrix

The supermatrix is constructed according to the dependency network model and after that this matrix is processed to the weighted supermatrix. The weighted supermatrix can be obtained by determining a cluster comparison to acquire a priority vector. These comparisons indicate a relative importance of influences between each cluster. Subsequently, the perceived priority vector is multiplied to relating segments of the unweighted supermatrix. The obtaining vector will be applied to weight the relative matrix segments. For example, the first entry of priority vector is used to multiply with all concerning elements in the first matrix segment. Following this process for all columns, finally, weighted supermatrix can be obtained.

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PGR database Management

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Nandigam Swathirekha
Department of Genetics and Plant Breeding, Acharya N G Ranga Agricultural University, Agricultural College Bapatla, Andhra Pradesh.

INTRODUCTION:

A PGR Database is a centralized repository of information on plant genetic resources, conserved ex- situ in national gene bank in various forms (seed, tissue clone, cryo-sample, live plants) at a single or many locations.

Function - enhance accessibility to information associated with genebank collections conserved ex-situ.

Need for PGR database:

- ✓ Increase utilization of the genetic resource.
- ✓ manage systematically.
- ✓ Identify gaps in the collections.
- ✓ Make policy decisions & funding priorities.

Salient Features:

- ✓ Reliably Store.
- ✓ Retrieve.
- ✓ Process Data
- ✓ Generate Information From Across All Activities.

Factors affecting the usefulness of germplasm database system:

- Information quality - refers to accuracy, precision.
- Information accessibility - refers to relative ease in obtaining and manipulating information.
- Information presentation - capability of the system to format and summarize information the way users want it.

Minimum essential data required for PGR database

- ✓ Passport information - Complete name, address of collector, crop, botanical name, date, place of collection ,biological status, imp. traits.
- ✓ Characterization data - Minimal descriptors of various crops as designed by NBPGR.
- ✓ Evaluation data.
- ✓ Gene bank data.

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Problems faced in construction of PGR

- ✓ Illegible data
- ✓ Missing data
- ✓ Duplicate data
- ✓ Incomplete data
- ✓ Unverified data

Ways to manage it:

(i) Forced data entry for compulsory fields.

(ii) Entering the data correctly from a predefined list.

(iii) Cross-verification of data from master tables once generated and called for the purpose whenever required.

(iv) Fast, customized and robust data querying system.

Future Endeavors:

i) On-line data entry system that allows the data generator/providers to feed the data themselves through an authorized password based login.

ii) Providing a Google like search mechanism

iii) Inclusion of a GIS based module which needs agro-climatic and geographical information as much as possible related to the germplasm being supplied to the Bureau.

iv) Strengthening PGR Portal with an active participation of ICAR research community.

CONCLUSION:

Plant genetic resources are a very valuable source of information. Hence conserving these resources by means PGR database management will help us in retrieving the necessary information as fast as possible, so that its usage and management can be achieved up to the mark.

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Silvicultural practices for teak

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Anil Kumar Kori and Atul Singh,
Ph.D Scholar, Department of Forestry,
Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur (MP)

Common name	:	**Teak**
Scientific Name	:	***Tectona grandis***
Family	:	**Lamiaceae**

Distribution

Native to Southeast Asia (India, Myanmar, Thailand and Western Laos), Teak, is the most important of the three species in the genus *(T. hamiltoniana, T.phillipensis).* A Tare combination of durability, dimensional stability and strength properties make Teak a paragon of timber and as of date faces no threat of being eclipsed by any other timber species. Its latitudinal limits are 9 N - 25° N and its longitudinal limits 70 E - *100*° E. In its natural habitat, teak occurs in mixed deciduous forests normally constituting a small number of individuals but occasionally in pure stands. Since 1840 it is raised in plantations in India and Myanmar.

Physiognomy

A large, deciduous tree, it may reach a height of 30 to 40 m under favorable conditions. On good sites, clean boles of 15 to 30 m length are obtained. Fluting and buttresses are often found at the base of the trees. Bark is thick, grey or lightish brown, fibrous with shallow longitudinal fissures, peeling off in long thin narrow flakes on older trees. Leaves are large (25 - 50cm in length and 15-35 cm in width), elliptic or obovate; upper side green to dark green in colour; underside dense has whitish to tawny matt of wooly hairs. Leaf arrangement is opposite. The flowers are small, whitish and appear in large panicles containing up to a few thousand flower buds which open only a few at a time during the flowering period of 2 to 4 weeks. The fruit is a hard, irregularly rounded drupe containing 4 seed chambers. The pericarp consists of a thin papery exocarp, a thick felty, brown mesocarp and a stony endocarp. Only rarely do all the four seed chambers contain developed seed. Generally in a sample one seeded fruits abound (42-64%); 2 seeded account for 12-25%; 3 seeded vary from 2 to6%. 4 seeded account for 1-2%.

Large numbers (11-35%) are also found to be completely seedless. The teak fruit varies from 11 to 18 mm in cross section and average 2000 in a kg.' 'Phenology Age of trees at first flowering varies markedly depending on site, climate, silvicultural management and genetic linkage. Its natural habitat it comes to flowering in 6-8 year. But under plantation conditions size or height of the trees rather than age exercises a profound influence on flower initiation. Flowering generally occurs during June - July. The fruits attain full size and mature in about four months after fertilization (i.e. during October- November). A sign of maturity is their facile fall to the ground when the tree is agitated.

Silvicultural Characters

Teak seedlings are sensitive to frost and drought. It is a strong light-demander, intolerant of suppression and weeds. It is a fire resistant; seedlings and saplings killed back by fire and frost. It coppices and pollards vigorously, up to about middle age.

Climate and Soil

The tree grows under a wide ambit of pedo climatic situations from sea level up to an altitude of 1200m and in a precipitation range of less than 900 mm to more than 2500 mm. The most suitable soil for teak is the deep, well

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drained alluvium having relatively high contents of calcium and phosphorus. It tolerates a pH range of6.5 to 8.0 but good growth is attained on soils of pH 6.5 and an annual rainfall or 1500 mm. Teak is a pronounced light demander and does not tolerate suppression at any period of its growth. It is also fairly fire tolerant.

Nursery Technique

The unit of sowing is the fruit (drupe) which for practical reasons is termed seed; seeds that have been stored for at least one year germinate better than fresh seed. If use of seeds of the same year is necessitated they before sowing are subjected to a process of alternate wetting and drying of 24 hr duration each for 14 days. Use of large seeds more than 14mm in diameter gives better germination. Seeds are sown @ 1 kg m-2on raised nursery beds 10m long, 1 m wide and 0.5m in height and covered with soil to a depth equivalent to the fruit diameter.

To prevent soil erosion beds are reinforced on the sides with bamboo splits or other such material. Germination commences in about 15 days, accelerates during the next 15 days, declines thereafter. Majority of germinates will have appeared in 40 days, when the germ inability is around 40 per cent. The beds are watered twice daily for the first two months, once daily for the next three months and on alternate days thereafter. Super sized seedlings called "wolf' smother others. For field planting only stumps prepared from one year old seedlings are used as these promote faster growth and ideal bole form. Stumps are prepared by cutting away from the seedling everything except 2.5 cm of the shoot and 22.5 cm of the root. The stem portion receives an oblique cut and the root portion an horizontal cut. All laterals from the tap root are pruned away. The stumps should preferably be planted within 2 to 3 days.

Planting

Stumps are flush planted (in level with the ground) at a spacing of 2 x 2 m in crow bar pits. The initial plant density of 25000 ha^{-1} is reduced in a phased manner to an ultimate 80 to 100 ha^{-1} by an operation called thinning. A total of four thinning is given in the 5th, 10th, 18^{th} and 28_{th} years and at each thinning the existing population is reduced by half. The first two thinning are mechanical and are done according to a rule of thumb, in the first thinning alternate diagonal rows are removed; in the second thinning alternate rows are felled. The 3rdand 4thare silvicultural thinning in that they are restricted only to diseased and malformed trees. Trees possessing clean bole, cylindrical bole, straight bole, less taper, small crown and less fluting are retained. Final felling is done at the end of60 years. A single tree will yield 1.5 m_3 of timber. Its rotation is 40-60 years'; its yield is about 6500 cu.ft of stem wood per acre.

Utilization

Teak wood is globally renowned for its strength, durability, dimensional stability, working quality and non-corrosive property when in contact with metal. The durability is attributable to the deposition of polyphenols in its heartwood. On account of these outstanding properties, Teak is sometimes hailed as the Queen of timbers. Increasingly large quantities of Teak are used by the plywood industry for high grade commercial and tea-chest categories of plywood. Lops and tops and other rejects serve as fuel wood. The seeds contain oil to the extent of 44.5% and the oil is used in soap manufacture. Teak leaves are often used as platters.

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Role of Bio-control Agents in Sustainable Food Production

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Arunima Paliwal*[1] and Shikha[2]
[1]Assistant Professor, Agronomy, College of Forestry, VCSG UUHF, Ranichauri, Tehri Garhwal, Uttarakhand
[2]SMS, Soil Science, Krishi Vigyan Kendra, Ranichauri, Tehri Garhwal, Uttarakhand

Biological control can be defined as the use of an organism to reduce the population density of another organism and thus includes the control of animals, weeds and diseases. It act as part of pest management in agriculture, forestry and horticulture, with a key feature of future sustainable crop production. Thus, it is necessary to keep the population of pests at low level for long time either by reducing the population by natural enemies by repeated releases or by several additional methods. These methods include, *e.g.* resistant plants, cultural techniques, physical barriers, semio-chemicals and use of selective chemicals. Many biological control schemes use predatory insects and mites, parasitoids or nematodes, targeted against insect and mite pests; these are the so-called 'macrobial' agents. Several other 'microbial' agents (bacteria, viruses and fungi) have been developed and applied as arthropod biological control. Herbivorous insects and mites are also used in the biological control of weeds.

Modern Biological Control in Sustainable Agriculture: Restoring the Ecosystem Function of Pest Management

Before the large-scale application of chemical pesticides, biological control was one of the main pest management methods embedded in a 'systems approach' to pest prevention and reduction, covering animals, weeds and pathogens. It includes three methods of pest management: cultural control, host-plant resistance and biological control. Cultural methods used for prevention of the build-up of pest numbers are crop rotation, cover crops and manipulation of sowing and harvesting dates. Plants with high degree of resistance or tolerance to pests are also responsible for pest prevention, and other is natural, classical, inundative and conservation biological control. There are different types of biological control. Biological control will firstly be distinguished from natural control.

Thus, biological control is the use of an organism by man to reduce the population density of another organism, whereas natural control is the reduction in numbers of the species population by naturally occurring enemy with no human intervention.

There are three main techniques of biological control: *classical*, *augmentative* and *conservation* control.

1. **Classical control** is used mainly against 'exotic' pests that have become established in new countries or regions of the world. This type of biological control has been most successful with perennial crops, where the long-term nature of the ecosystem enables the interactions between pest and natural enemy to become fully established over a period of time. Eg. The successful import and release of the predatory ladybird *Rodolia cardinalis* for control of the accidentally introduced citrus pest *Icerya purchasi* in Mediterranean Europe around 1900.
2. **Augmentation** refers to all forms of biological control in which natural enemies are periodically introduced, and usually requires the commercial production of the released agents. *Inundation* involves the mass production and release of large numbers of the control agent. The aim is to create a

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massive ratio in favour of the natural enemy, analogous to the use of a pesticide, producing a rapid reduction or local extinction of the pest. Control is achieved mainly by the individuals that have been released rather than their offspring. However, the control is usually transient, and re-releases are required, sometimes more than once a year. Seasonal *inoculative* control is a form of augmentation in which natural enemies are mass reared in the laboratory in a similar way and periodically released into short-term crops where many pest generations can occur in each growing season.

3. **Conservation** control refers to the use of indigenous predators and parasitoids, usually against native pests. Various measures are implemented to enhance the abundance or activity of the natural enemies, including manipulation of the crop microclimate, creation of overwintering refuges, increasing the availability of alternative hosts and prey and providing essential food resources.

Bio-control Agents (BCAs): BCAs can be classified as: Macrobials: beneficials, nematodes; Microbials: virus, fungi, bacteria; Semio-chemicals: behaviour modifying agents for control of pest populations; Natural products: plant extracts with insecticide, fungicide or SAR (Systemic Activated Resistance) effect.

Selection of Successful Bio-control Agents (BCAs)

- Host specific with strong searching ability,
- Higher potential rates of increase than their prey,
- Readily adapt to environment conditions with sufficient reproductive capacity,
- Must be free of predators or parasites,
- Must be capable of seeking out it to the host.

Why Need For BCAs?

- Developments of pest resistance to chemicals,
- Stricter legislation on residue levels,
- Environmental protection laws contributed to development & registration of BCAs.

BCAs are used in two types of agriculture:

- *Organic farming* where no chemical inputs are permitted.
- *Integrated crop production programmes* which reduce pesticide use, resulting in improved conservation of the environment and better quality food (less pesticide residues).

Advantages of Biological Control over Chemical Control

- Predators and parasitoids are naturally occurring organisms with specific range of prey.
- Natural enemies actively seek out their prey and increase the level of control over time.
- Chemical pesticides kill the pest organism with many non-target species, including natural enemy species that may increase the pest which were easy to control.
- Chemical control is limited to the area within which the pesticide is applied. Thus, frequent application may be required that may results in pest resistance.
- Pest control must be cost effective. The natural enemies are more cost effective than pesticides.

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Future Perspectives

It is very tough task to convince farmers worldwide to adopt a systems approach to pest management and make greater use of biological control. Yet, an agricultural industry still dominated by pesticides, the biological control has found its place, particularly for the management of pests that are difficult to control with insecticides.

Based on the criteria of current evaluation methods, future perspectives are:

- Inefficient or hazardous natural enemies can be identified quickly and thus avoid unnecessary expenditure on further research.
- Practitioners will also have to spend time creating societal awareness about the benefits of sustainable and environmentally friendly pest management.

CONCLUSION

Though it is evident that biological control programmes have been successfully implemented in a wide range of crop environments in all parts of the world and the potential to increase the role of biological control is great, it remains the case that the adoption and implementation of this method of control is slow. However, that future pest management will depend strongly on biological control because it is the most sustainable, cheapest and environmentally safest system of pest management, with additional benefits for growers and consumers. Biological control is expected to account for a significantly increased proportion of all crop protection methods by the year 2050.

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Effect of Tillage on Soil Quality and Crop Productivity

Article id: 23425

Chetna S. Kumbhar[1] & Arti R. Gabhane[2]
[1]Ph.D. Scholar, [2]M.Sc. Student, Department Of Soil Science And Agricultural Chemistry, Dr. P.D.K.V. Akola, Maharashtra.444104.

What is Tillage?

The physical manipulation of the soil for the purposes of management of previous crop residues, control of competing vegetation, incorporation of amendments, preparation of seedbed.

Tillage is referred to as mechanical manipulation of soil using implement by loosening it for good germination of seeds, plant growth and help soil water conservation. It is the manipulation of soil with the help of implements to obtain a desired seed bed. Tillage is one of the most important components of conservation agriculture. It is labor-intensive activity in low resource agriculture of small land holders; It is capital and energy intensive activity in large scale mechanized farming. Judiciously used tillage can be useful asset in compaction, crusting, reduced infiltration, accelerated run off and erosion, and degradation of soil and environment.

Importance of Tillage:

- Soil conditioning
- Weed and pest suppression
- Incorporation and mixing
- Segeregation
- Crop residue management
- Stimulation of nutrient release

Objectives of tillage:

Breaking of soil, Crushing of clods, Improvement of soil structure, Increase of soil aeration & moisture holding capacity of soil, enhance nitrification, control the weed population, controlling insect pest population, control of soil erosion and mixing fertilizers and herbicides in soil.

Produce optimal conditions for seed germination and emergence, Increase water infiltration and aeration, eliminate the competition with weeds. Bury or incorporate organic material, crop residues and or manure aims to create a soil environment favourable to plant growth. Increase moisture storage capacity of soil profile management of crop residues, provide weed control, increase soil aeration improve temperature, facilitate seed germination and increase yield. It facilitates provide in situ moisture conservation, incorporation of manures, fertilizers, soil amendment into soil.

Effects of Tillage:

Positive effects

- Ploughing loosens and aerates the top layer of soil which can facilitate the planting of the crop.
- It helps in the mixing of residue from the harvest, organic matter (humus) and nutrients evenly throughout the soil.
- It is used for destroying weeds.

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Negative effects of ploughing

- Dries the soil before seeding.
- The soil loses a lot of its nutrients like carbon, nitrogn and its ability to store water.
- Erosion of soil.
- Decreases the water infiltration rate of soil.
- Reduces organic matter in the soil (Microbes, carbon compounds, earthworms, ants, etc.)
- Destroys soil aggregates
- Eutrophication
- Can attract some harmful insects to the field.

Types of Tillage:

1. Preparatory tillage
2. Minimum tillage
3. Zero tillage
4. Strip tillage
5. Rotary tillage
6. Mulch tillage
7. Combine tillage

Conservation tillage

Conservation tillage is defined as: "any tillage or planting system in which at least 30% of the soil surface is covered by plant residue after planting to reduce erosion. No tillage, minimum tillage, reduced tillage and mulch tillage are terms synonymous with conservation tillage. Appropriate tillage practices are those that avoid the degradation of soil properties but maintain crop yields as well as ecosystem stability. Conservation tillage provides the best opportunity for halting degradation and for restoring and improving soil productivity. In recent years interest in conservation tillage systems has increased in response to the need to limit erosion and promote water conservation.The total area under no-tillage/zero tillage in India it is about 3.43 m ha. Efforts to adapt and promote resource conservation technologies have been underway for nearly a decade. Spread of conservation agriculture have been made through the combined efforts of several SAU's, ICAR institutes and the CG promoted, Rice-Wheat Consortium for the Indo-Gangetic Plains.CA technologies is taking place in the irrigated regions of Indo-Gangetic plains where rice-wheat cropping system dominates. This systems have not been tried or promoted in other major agro-eco regions like rainfed semi-arid tropics, the arid regions

Factors affecting the choice of tillage practices

1. **Soil factors:**

Relief(slope), erodibility, erosivity, rooting depth, texture and structure, organic-matter content and mineralogy

2. **Crop factors:**
   Growing duration, Rooting characteristics Water requirement and Seed
3. **Climatic factors:**
   Rainfall amount and distribution, Water balance, Length of growing season, Temperature (ambient and soil), Length of rainless period

4. **Socio-economic factors:**
   Farm size, Availability of a power source, Family structure and composition Labour situation, Access to cash and credit facilities

Soil quality

- Soil quality can be seen as a conceptual translation of the sustainability concept towards soil.
- The capacity of a specific kind of soil to function, within natural managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation'.
- The degree of fitness of a soil for a specific use
- Within the framework of agricultural production, high soil quality equates to the ability of the soil to maintain a high productivity without significant to soil or environmental degradation.
- Evaluation of soil quality is based on physical, chemical and biological characteristics of the soil.
- With respect to biological soil quality, a high quality soil can be considered a 'healthy' soil.

Need of conservation:

- Conventional "arable" agriculture is normally based on soil tillage as the main operation.
- Soil tillage has in the past been associated with increased fertility, which originated from the mineralization of soil nutrients as a consequence of soil tillage.
- This process leads in the long term to a reduction of soil organic matter. Soil organic matter not only provides nutrients for the crop, but it is also, above all else, a crucial element for the stabilization of soil structure.
- This structural degradation of the soils results in the formation of crusts and compaction and leads in the end to soil erosion.
- Mechanization of soil tillage, allowing higher working depths and speeds and the use of certain implements like ploughs, disk harrows and rotary cultivators have particularly detrimental effects on soil structure.
- Excessive tillage of agricultural soils may result in short term increases in fertility, but will degrade soils in the medium term.

Effect of tillage on crop growth and production

Sub soiling or deep ploughing can reduce soil compaction on soil with root restricting layers and yield increases. Breaking up the hard pan enables plant roots to penetrate lower soil regions to obtain available soil moisture and nutrients. The relative yield increases due to sub soiling are frequently affected by rainfall distribution with the greatest benefits occurring in low rainfall year. Deep tillage breaks up high density soil layers improves water infiltration and movement in the soil enhance root growth and development and increases crop production.

CONCLUSION:

Tillage management can greatly modify soil properties related to soil quality and crop growth. Integration of tillage practices and management of balance nutrients through organic and inorganic sources helps to sustain the soil quality (Physical, Chemical and Biological properties) and productivity of crops. Adoption of efficient tillage practices is essential for sustenance of soil health in long run. Tillage intensity helps residue management and soil consolidation. Minimum Tillage helps to improve the soil physical, chemical and biological properties.

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Environment based agricultural management practices

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Sahaja Deva
Subject Matter Specialist (Crop Production), Krishi Vigyan Kendra, Kalikiri

Environment is the main factor that affects agriculture. Changes in environment increase pests and disease incidence and causes crop yield losses. Some of the key factors to be considered in agriculture are as follows:

1. After onset of monsoon if there is 60-75 mm rainfall, rainfed crops should be sown
2. Rainfed crops should be sown if there is 60-75 mm rainfall after June 1st
3. Fertilizers should be broadcasted if there is sufficient moisture in the field or if there is 20-25 mm rainfall
4. Herbicides should be sprayed 48 hours after sowing when there is sufficient moisture in the field.
5. After spraying of herbicides and plant protection chemicals there should be no showers for 4-6 hours
6. If wind speed exceeds 15 km/hr herbicides and plant protection chemicals should not be sprayed
7. Plant protection chemicals should not be sprayed when there is cloudy weather
8. Heavy rains and high relative humidity causes disease incidence in plants.
9. During water stress conditions, depending on crop growth 2% urea, DAP, potassium nitrate or multi-K should be sprayed for two or three times
10. Irrigation should not be given if there is forecast of rains
11. 2 cm water should be maintained at 4-5 days after sowing of rice
12. In cotton at 15 DAS and before flowering irrigation should be given if there is no forecast of rains.
13. During flowering to boll development there should be no water stress condition in cotton.
14. Optimum time of sowing for rainfed groundnut is July 1-31. Sowing in June or August will subject the crop to water stress conditions during pegging stage, pod development stage, seed formation stage which lead to severe yield loss. So sowing groundnut during july will give maximum yields.
15. Crop should not be subjected to moisture stress during flowering stage, pegging stage, pod formation stage and seed development stage.
16. In sunflower crop should not be subjected to water stress conditions during flowering and seed development stage
17. In pulses, crop should not be subjected to water stress conditions during flowering and seed formation stage
18. To obtain higher yields in crops 50 mm water should be given in red soils and 60 mm water should be given in black soils during critical stages.

Management practices if there is delay of monsoons:

Rice:

- Short duration varieties (110-120 days) or medium duration varieties (130-135 days) should be grown.
- Overaged seedlings should be planted closely.

Cotton:

- Short duration hybrids should be grown. Pests and disease incidence will vary based on environmental conditions because of which 30% of the yield will be lost. So pests and diseases should be controlled in time based on environmental conditions to reduce yield losses.

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Big data in agriculture sector

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V. Anandhi & M. Ananthi
Department of Physical Sciences and Information Technology
Tamil Nadu Agricultural University, Coimbatore 641003

Agriculture is the backbone of the Indian economy. India is a country of over a billion people in population, out of which, over 70% of the population lives in the rural areas. With 40% of the country's workforce, agriculture is a major industry and an influencer of the Indian economy.

Challenges in the Indian Agriculture Sector:

Application of science and new technologies is currently lacking within this space. Many companies and start-ups are looking to fill this information gap. If Big Data has made serious advancement in fields like information technology, healthcare, education and even sports, there is an obvious need for it in the agricultural industry too. While the vast majority of farmers and ranchers did great work for maintaining and increasing soil health using conservation practices alone, measurement tools will be instrumental in ensuring a sustainable farming future.

To maintain yields and meet the food demands of a growing population while also protecting natural resources required, making additional changes and data tools can help determine what these changes should be. The end result of gathering data is to analyse it and come up with actionable solutions with better results. For example, a satellite image of a plot of land has several layers of data embedded into a single spectrum giving us a tonne of information to analyse. The geospatial approach and satellite monitoring of farms have led to major advancement in how farmers and companies make their decisions. Big data technology is efficient, proven to work, and revolutionary, one of the major challenges - solutions to farming concerns lies in their proper application in the Indian agriculture sector is a bigger concern. Data analytics in the field of agriculture in India will make sure that in the coming years, farmers will see better days in the farm and their harvest.

Big Data:

Big Data, a revolutionary technology has already made waves in other Indian industries from IT to healthcare. And now, investors and market players are planning to leverage the potential of Big Data for the benefit of agriculture in India. Apart from major companies, it is the vision of several youth of the country that has attracted the use of Big Data for farming. The parameters associated with soil health and crop growth have had a very restricted scope for research and this technology immensely uses Big Data and Machine Learning technologies to solve the restriction and bring about insights on crop phenology. Electronic transactions in Indian agriculture sector are almost non-existent, and that is why most of the transactions are unrecorded. We help them provide insights about farm productivity, when to irrigate, sow, harvest, and the patch of land that can be used by farmers. We help banking and insurance companies in settlement of risk assessment, crop loss, and offer insights by analyzing current and historical satellite images. The satellite images are not only in a single visual spectrum but have multiple data layers which contain images merged into one to gather as much information as possible. However, data is one thing, and what we infer from data is another thing. We analyze data to make action oriented conclusion-able intelligence.

Facilities like satellite-based filed monitoring, embedded sensors on crops and fields, predictions on wind direction, fertilizer requirement notifications, pest infestations, GPS-enabled tractors, water cycles, and more are acting as points of rich data sources that could be used for better agriculture practices. Besides, Big Data and analytics now also enable monitoring and supervision for growth rate and nutrient requirements on a plant-by-plant basis. Moreover, analytics is enabling farmers to make data-based decisions like which crops to plant for their next

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harvest. The rich information on soil health, water availability, and predictions on rainfall and precipitation make this data source. It enables insurance companies, banks, traders, pesticide and seed manufacturing companies, and farmers the ability to take informed farming decisions by leveraging the combined potentials of technologies like Cloud Computing, Big data, Machine Learning, The Internet of Things, Web-based Software as a Service platforms. When it comes to the use of technologies, data analytics offers tremendous potential for improving cost to output ratio, reduce/optimize Input usage, increase yields, offer timely actionable information and do more.

Big Data Boosts Agricultural Growth:

Big data tools can help determine changes required to maintain yields and meet food demands. In agriculture, big data is often viewed as a combination of technology and analytics that can collect and compile novel data and process it in a more useful and timely way to assist decision making. Data mining is the computing process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning statistics and database system. The big data practice comprises capturing relevant data from a huge number of sources, collecting it and translating it into actionable information to improve business processes and solve problems at scale and speed. Real-time insights help performance optimisation advance analytics can show how farmers are utilising their inputs and what adaptations are required to take account of emerging weather events or disease outbreaks.

Big data connectivity has proven itself a key asset for companies seeking a competitive advantage over their competitors. Benefits include faster unearthing of valuable insights and the ability to develop and adapt products that meet specific customer needs on an ongoing basis. The development of highly-specific customer segmentation set has become possible to tailor product offerings to meet customer needs. Robots can play an important role in control, but it can be expected that the role of humans in analysis and planning is increasingly assisted by machines so that the cyber physical cycle becomes almost autonomous. Considering its potential, various agri-tech companies are providing their services to the producers to make the practice more approachable and available. There are various sensors collecting the available data. We can encounter autonomous vehicle devices in farmers place in the ground to measure soil moisture and nutrient, predictive weather stations and image-capturing satellites and drones mapping out land and measuring crop health. These insights are extremely important since they tell the farmer when and how much to irrigate a field, crop health, weather predictions, pest infestations and even drought conditions. Considering the increasing labour shortages in the sector the capacity for big data analysis that lessens the need for physical manpower is of great advantage for agriculture.

The big data revolution is most of the potential for value creation is still unclaimed. But it has set the industry on a path of rapid change and new discoveries. Stakeholders committed to innovation will likely be the first to reap rewards.

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FOREST FIRE - A burning issue

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V. Keerthana
Assistant Professor, Imayam Institute of Agriculture and Technology, Thuraiyur – 621 206
Affiliated to Tamil Nadu Agricultural University, Coimbatore.

Forest fires pose a serious problem worldwide. Both face growing risk of increasing population density, creeping urban sprawl from incursion into the urban wildland interface (WUI), and shifts in patterns of land-use interfering with social and ecological security. Such challenges are compounded by changing climatic and weather conditions. This chapter explores this complex forest fire phenomenon and illustrates the complexities of managing forest fire risk in ways that balance social and economic growth, environmental concerns, and living in a safe and competitive equilibrium with forest fires.

INTRODUCTION

In the recent years there is an alarming increase in the firing of forests. Forest Fire is the most common threat in the forest. This threat will also continue up to the flora and fauna. The woods are filled with dry senescent leaves and twinges during the summer, when there is no rain for months, which could burst into flames sparked by the slightest spark. These fires contribute to the serious impact on wildlife and the climate. According to the Forest Survey of India's (FSI) Real Time Forest Alert System, the number of forest fires rose from 4,225 between November 2018 and February 2019 to 14,107.

Table 1: Forest Cover of India

S. No	Forest Types	Area (sq km)	Percentage of Total Geographical Area
1.	Very Dense Forest	98158	2.99
2.	Moderate Dense Forest	308318	9.38
3.	Open Forest	301797	9.18
	Total Forest Cover	**708273**	**21.54**
4.	Scrub	45979	1.40
5.	Non-Forest	2533217	77.06
	Total Geographical Area	**3287469**	**100.00**

Source: India State of Forest Report, 2018

Causes

Environmental Causes

The environmental causes are largely related to climatic conditions such as temperature, wind speed and direction, moisture level in soil. Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) provide ideal starting conditions for a fire to start.

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Human Related Causes

A major cause of wildfires is human related factors arising from human activity as well as forest management practices, human carelessness. Fire happens when a source of fire such as naked flame, cigarette or bidi, electric spark or any ignition source comes into contact with flammable material.

Types of forest fire

Surface Fire

A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter (senescent leaves and twigs and dry grasses etc) on the forest floor and is swallowed by the spreading flames.

Crown Fire

A crown fire, often caused by a surface fire, is one in which the crown of trees and shrubs burn. In a coniferous forest a crown fire is particularly dangerous as resinous material given off burning logs burns furiously.

Underground Fire

Low intensity fires which consume the organic matter below and the forest floor surface litter are sub-grouped as underground fire. A thick mantle of organic matter is contained on top of the mineral soil in most dense forests. Typically these fires spread completely underground and burn beneath the surface for a few meters. This fire spreads very slowly and it becomes very difficult to detect and control these kinds of fires in most situations. They could continue burning for months and kill the soil's vegetative cover.

Ground Fire

Such fires are fires in organic fuels on the sub-surface, such as duff layers under forest stands, Arctic tundra or taiga, and marsh or bog organic soils. Sometimes the smoldering underground fires turn into Ground Fire. This fire kindles root and other material on or below the surface. These are more destructive than fires on the surface, since they can completely destroy the vegetation

Effect of Forest Fire

- Loss of valuable timber/wood products
- Loss of biodiversity
- Ozone layer depletion
- Loss of wildlife habitat
- Loss of forest cover
- Change in the microclimate
- The major cause of the forest fire is loss of livelihood for tribal people and the rural poor and also contributes to the diseases.
- The fauna and flora are both disturbed by forest fires.

Management

- Satellite remote sensing technology has become the primary source of data for predicting fire hazard ranking, fire monitoring.
- Satellite remote sensing techniques have potential as cost-effective tools in fire monitoring.

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- Digital technology can play a significant role in both preventing and fighting the spread of fires.

Precautions

- To keep the fire source or ignition source away from the combustible and flammable material.
- To keep watch and track of the source of fire.
- Do not allow fuel or flammable material to unnecessarily pile up and store as recommended for safe storage of such flammable or combustible material as per the procedure.
- In areas near forests to follow good practices viz. Factories, coal mines, oil shops, chemical plants and even in the kitchens of the family.
- To implement fire prevention methods and firefighting equipment

CONCLUSION

While humans are the main causes of wild fires scientifically, humans are endowed with forest fire management technology such as early warning and detection systems, remote technologies and digital communication help make wildfire fighting more likely and drive down prevention costs.

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Immune system in insects

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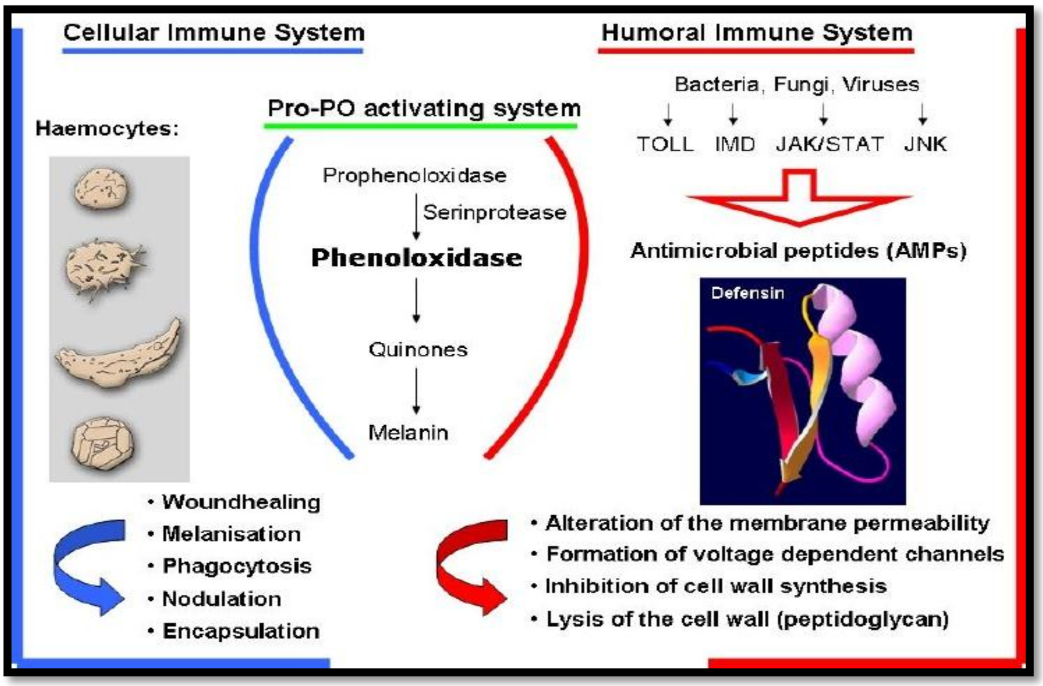
Ipsita Samal
PhD Scholar, Division of Entomology, Indian Agricultural Research Institute, New Delhi, 110012

INTRODUCTION

Insects are exposed to microorganisms (bacteria, viruses and fungi) and parasites on a regular basis. To survive in a world full of microorganisms and parasites, insects developed a potent defense mechanism that recognizes and removes microbial threats. Insects depend on innate immunity for their survival.



This innate immunity can be divided into two classes:

1. The cellular response

Much like we do, insects also have blood. But quit unlike us, insects do not have a circulatory system in which the hearth circulates the blood. Insects have a body cavity (the hemocoel) in which the blood resides (insect blood is called hemolymph) and a tube-like hearth which sucks the hemolymph from one side and pumps it back into the hemocoel on the other side. Generally insects do not use hemolymph (blood) to transport oxygen but it is very important in the immune response. The hemolymph consists of 3 cell types:

1) Plasmatocytes (comparable to our white bloodcells) 90-95% of the hemolymph
2) Crystal cells (storage of antimicrobial particles) 5% of the hemolymph
3) Lamellocytes (can handle larger microorganisms than plasmatocytes) very little

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The crystal cells contain particles that are lethal for microorganisms and are released upon infection. The plasmatocytes and lamellocytes are cells that eat microorganisms in a process which is called phagocytosis. The plasmatocyte surrounds for example a bacterium and consumes it. The bacterium will be on the inside of the plasmatocyte and will be broken down there.

2. **The systemic immune response**

Next to the cellular immune response, insects synthesize massive amounts of Anti Bicrobial Peptides (AMPs) in response to infection. The synthesis of AMPs in response to infection is called the systemic immune response. These AMPs can be produced in the liver (called fat body in insects). The liver produces large amounts of AMPs which it secretes into the hemolymph where the AMPs fight the infection. But to make these AMPs, first the infection needs to be recognized, the recognition of infection induces a chain reaction which will eventually lead to the production of AMPs. This chain reaction (or signal transduction) works because the different subunits of this chain are already present. First there are proteins in the hemolymph which recognize microorganisms. When they recognize a microbe these will active proteins (receptors) that are in the cell membrane of liver cells. This protein in turn will initiate a cascade of several different proteins which will eventually send a transcription factor (a protein that induces the production of other proteins trough DNA and RNA) into the cell nucleus and initiate the production of RNA. This RNA will be secreted into the cytoplasm and here it will be translated into protein. These proteins (AMPs) are secreted into the hemolymph (or other tissue depending were the infection is) and attack and kill the microorganisms (Lemaitre and Hoffmann, 2007).

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Types and advantages of green houses

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D. Srikanth
[1]Ph. D Scholar, Department of Vegetable Science, College of Horticulture, Dr. Y.S.R.H.U., West Godavari, Andhra Pradesh, 534101.

INTRODUCTION:

Green house technology: Green house is the framed or inflated structures cover with transient material large enough to grow crops under partially or fully controlled environmental conditions to get optimum growth and productivity. Greenhouse farming, which is cultivation of plants inside a building with glass walls and roof under controlled condition, has become necessary as temperature ideally required for flower cultivation is no longer available, not even during winter. Floriculturists say that the ideal day and night temperatures for flower cultivation are 28 and 18 degrees celsius respectively. However, they point out, the temperature in most parts of the country remained above this level even in the peak winter season. In the wake of the climate change, greenhouse farming is the only way to protect crops and manage a better yield than in normal condition. Farming under controlled condition, protects crops from wind, rain, radiation, and precipitation. Farmers in several states like Maharashtra, Gujarat, Himachal Pradesh, Karnataka and Andhra Pradesh adopted the greenhouse technology; the farmers in Orissa were yet to start on it. While over 1,30,000 hectares of area were under flower cultivation in the country, only 1,100 hectares now come under protected cultivation.

Protective Structures:

Net houses: These are used to reduce adverse effect of scorching sun and rains in vegetables, ornamentals and herbs.
Plastic low tunnels: These are used to raise early nurseries of vegetables and flowering annuals.
Green houses: These are framed structure covered with a transparent material in which crops could be grown under controlled environment.
Glasshouse: Glass is used as a Glazing material in the green house. Glass houses are fitted with the help of wooden or metal frame. The glass houses are constructed in all shapes and sizes and is quite effective for winter cultivation but due to increase in day temperature in summer, it becomes unfit for cultivation during summer. High initial cost, difficulty in construction and frequent damage of glass panels by strong winds have limited its use in both the regions.
Gable Type: A number of wooden structures, constructed gable type, uneven span type and even span type structures are used in Kashmir valley and are covered with 200 micron ultra violet stabilized polythene. Generally wooden structure fabricated gable type greenhouses are predominant in the valley with an average size of 40 sq. m (4 x 10m).
Gothic Type: Big size polyhouse is generally made of gothic type in Kashmir valley because the use of heavy iron structure which can sustain heavy snow load.
Walk in Tunnel: It is most popular type greenhouse which is small semi spherical structure frame made of materials like wood or plastic, iron , G.I. pipes and covered with polyethylene or fiber reinforced plastics. Department of Horticulture is providing these types of green houses to the farmers on subsidized rates. The various sizes of tunnel type green houses that were being utilized by the farmers and installed by different development departments are 40 sq. m (4 m x 10 m), 80 sq. m (5 m x 16 m) and 54 sq. m (9 m x 6 m).
Ladakhi Polyhouse: The most common green house in the Ladakh region is the Ladakhipolyhouse and is constructed by three side mud brick wall in place of polyethylene sheets which not only cuts down the installation cost but also

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reduces the adverse effects of strong winds and increases temperature retention in the green house. The polyhouse has three sides made of sun dried mud bricks. The polythene is supported on wooden poles and side walls.
Trench: This is a very simple, cheap and common green house structure. The various sizes of the trenches are (9 x 3 x 0.9 m) and (10 x 4 x 1 m) respectively. In this pit type of structure, wooden poles are used to hold UV stabilized polyethylene film. The polyethylene is also covered by an additional polyethylene film or woolen or cotton sheet during night to reduce heat loss in extreme winter.
FRP Greenhouse: The glazing material used in the green house is fiber reinforced polyester. The normal dimensions of the green house are (30 x 9 m) with an center height of 3.04 m and a side height of 1.82 m. The initial cost required for fabrication of the greenhouse is high but the comparative life of the green house is much more than other.
Double layered Polycarbonate Greenhouse: The glazing material used in the green house is double layer polycarbonate. The normal dimensions of the green house is 16.8 x 9.1 m with a center height of 3.3 m and a side height of 1.8 m. The variation in temperature between outside and inside conditions is 20º C.
Polyench Greenhouse: This type of green house combines the trench and green house technology for achieving more temperature inside green house during peak winter. The glazing material utilized in the green house is polyethylene, FRP, double layer and triple layer polycarbonate. The normal recommended dimensions of the green house are (18 m x 4.5 m x 0.8 m).
Solar Polyhouse Drier: Field Research Laboratory (DRDO), Leh has designed and developed a low cost non-conventional zero energy based solar polyhouse drier for scientific and hygienic dehydration of surplus fruits and vegetables like apricot, apple, cauliflower, cabbage, tomato, etc. when there is a glut in the market and to facilitate its availability during the snow bound winter. The drier works on the principle of greenhouse effect where it traps the solar radiation and maintains the temperature inside between 55-69o C. Provision has also been made for removal of hot and moist air from the chamber. It reduces drying period by 40 – 50 % as compared to sun drying.

Advantages of green house:

1. Crops can be grown all through the year
2. Higher yield
3. Quality produce
4. Plant moisture requirement optimized
5. Good control on pests and diseases
6. Less requirement of inter-cultivation practices

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Genome editing in crop improvement: current scenario and future prospects

Article id: 23431
Rajat Chaudhary
Division of Genetics, Indian Agricultural Research Institute, New Delhi-110012

Historical Prospects

Nature has been altering genomes for thousands of years, with natural selection enabling plants with certain genomic variants to survive. Moreover, humans have been using artificial selection to domesticate crops for more than 10,000 years. Genetic changes or variations are key to crop improvement, but our ancestors had to make do with naturally occurring mutations. In the twentieth century, once it was recognized that DNA and genes shape all life it became clear that altering DNA sequences induces phenotypic variations. A major advance in genetic modification was made with the discovery that *Agrobacterium tumefaciens*, is a natural genetic engineer that introduces a piece of its own DNA into the genome of a plant it infects, potentially carrying along a DNA sequence provided by a researcher. However, this approach has many drawbacks, including the random nature of the gene insertion, the possibility of disrupting functional genes, public concerns over genetically modified organisms (GMOs), and the failure to make use of the native genetic repertoire of the plant. There was therefore a pressing need for techniques to precisely change DNA sequences at the single-base level. Such technologies for adding, deleting, and editing existing DNA sequences to develop traits of interest are essential to crop bioengineering for various purposes, including improving crop performance to withstand the hotter and drier environments expected to arise under climate change.

In the 1980s, Mario Capecchi first established gene-targeting technology, along with the concept of harnessing double-strand breaks (DSBs) for genome editing. A later development was the ability to engineer genomes by generating site-specific DSBs. By generating more than one DSB, it becomes possible to produce even more types of changes, including chromosomal deletions, gene inversions and, with DSBs on two different chromosomes, chromosomal translocations. The big question was how to generate a site specific DSB. However, it is possible to program a DNA-binding domain to bind to any user-defined site-specific sequence. This domain can be fused with another domain that can cleave the DNA specifically where it binds. The genome-engineering toolbox has three major platforms: zinc-finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs), and CRISPR/Cas systems.

Mechanisms of Genome Editing Systems

Novel genome editing tools, also referred to as genome editing with engineered nuclease (GEEN) technologies, allow cleavage and rejoining of DNA molecules in specified site to successfully modify the hereditary material of cells. To this end, special enzymes such as restriction endonucleases and ligase can be used for cleaving and rejoining of DNA molecules in small genomes like bacterial and viral genomes. The first efforts to create methods for the editing of complex genomes were associated with the designing of "artificial enzymes" as oligonucleotides (short nucleotide sequences) that could selectively bind to specific sequences in the structure of the target DNA and have chemical groups capable of cleaving DNA. Targeted approach to address this challenge was the design of chimeric nucleases which are complex proteins

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containing one or two structural units, one of which catalyzes the cleavage of DNA, and the second is capable of selectively binding to specific nucleotide sequences of target molecule, providing the nuclease action to this site

1. Zinc Finger Nucleases (ZFNs).

ZFNs were the first generation of genome editing tools that use chimerically engineered nucleases which were developed after the discovery of the working principles of the functional Cys2-His2 zinc finger (ZF) domain. Each Cys2-His2 ZF domain consists of 30 amino acid residues, which are folded up to $\beta\beta\alpha$ configuration. Each ZF protein has the ability to recognize 3 tandem nucleotides in the DNA. Generalized ZFN monomer consists of two different functional domains: artificial ZF Cys2-His2 domain at the N-terminal region and a nonspecific *Fok*I DNA cleavage domain at the C-terminal region. Since the first report on zinc fingers in 1996, they have been successfully used in several organisms including plants. Examples include targeted inactivation of endogenous genes in Arabidopsis, high frequency modification of tobacco genes, and precise targeted addition of a herbicide-tolerance gene as well as insertional disruption of a target locus in maize. ZFNs have also been used for trait stacking in maize.

2. Transcription Activator-Like Effector Nucleases (TALENs)

The efficient and selective manipulation of target genomic DNA led to the identification of unique transcription activator-like effector (TALE) proteins that recognize and activate specific plant promoters through a set of tandem repeats that formed the basis for the creation of a new genome editing system consisting of chimeric nucleases called TALE nucleases (TALENs). TALE proteins consist of a central domain responsible for DNA binding, nuclear localization signal, and a domain that serves as activator of transcription of the target gene.

3. Oligonucleotide-Directed Mutagenesis (ODM)

The oligonucleotide- directed mutagenesis a tool for targeted mutagenesis, uses a specific 20- to 100-base long oligonucleotide, the sequence of which is identical to the target sequence in the genome except that it contains a single base pair change (intended mutation to be inserted in the genome) towards achieving site-directed editing of gene/sequence of interest. When these synthetic oligonucleotides or repair templates with homology to a specific region of the target gene are transiently exposed to the plant cells by using a variety of specific delivery methods, they bind to the targets and activate cell’s natural repair machinery which recognizes the single mismatch in the template and then copies that mismatch or mutation into the target sequence through repair process.

4. Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)

This is a method that utilizes adaptive bacterial and archaeal immune system, the mechanism of which relies on the presence of special sites in the bacterial genome called CRISPR loci. These loci are composed of operons encoding the Cas9 protein and a repeated array of repeat spacer sequences. The spacers in the repeat array are short fragments that are derived from foreign DNA (viral or plasmid) that have become integrated into bacterial genome following recombination. The guide (noncoding) RNA and DNA of the target site and the guide RNA and Cas protein complex has the nuclease activity for exact cleavage of double-stranded DNA using Cas9 endonuclease.

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5. Repair of Cleaved Genomic Sites

An important step in the genome editing process is the repair of the DNA break created by the nucleases. The ends of the cleaved DNA are joined together, often resulting in the insertion or deletion of nucleotides (indels) thereby shifting the gene reading frame, resulting in a gene “knockout”.

Improvement of Crop Traits

Although genome engineering is relatively new, the technology has been efficiently adapted to a wide range of crops as a means to improve yield, quality and nutritional value, herbicide resistance, and biotic and abiotic stress tolerance (Fig.1). Here, we provide highlights of key advances for improving crop traits using genome engineering and discuss the promise of these technologies for enhancing food security.

1. Improving Yield

Yield is one of the most important traits for crop plants. The most direct way of increasing yield is to knock out genes that negatively affect yield. In one recent case, three of the resulting knockout mutations, gn1a, dep1, and gs3, showed enhanced yield parameters in the T2 generation, resulting in improved grain number, dense, erect panicles, and larger grain size, respectively. Simultaneously knocked out three major rice negative regulators of grain weight (GW2, GW5, and TGW6) using a CRISPR/Cas9-mediated multiplex genome-editing system. The resulting mutants showed a significant increase in thousand grain weight.

2. Engineering Plant Disease Resistance

Plants are constantly infested by a variety of pathogens, including viruses, bacteria, and fungi, that can cause significant losses of crop quality and yield. For example, CRISPR/Cas9 and TALEN were successfully used to generate resistance to powdery mildew by simultaneously targeting the three homologs of the MILDEW RESISTANCE LOCUS (MLO), TaMLO-A, TaMLO-B, and TaMLO-D, in wheat. These examples demonstrate the great potential of genome-engineering technologies for producing plant immunity to various pathogens.

3. Enhancing Plant Abiotic Stress Tolerance

Abiotic stresses such as drought, salinity, and extreme temperature significantly limit crop yields worldwide by reducing plant growth and development (Fig.1). The conditions predicted to result from global climate change will worsen many of these stresses, potentially causing an enormous drop in global crop productivity. In one recent study, DuPont scientists successfully modified a gene encoding maize negative regulator of ethylene responses, ARGOS8, using CRISPR/Cas9. Resulted in drought-tolerant maize has better yield under water-deficit conditions.

4. Enhancing Plant Herbicide Resistance

Weeds compete with crop plants for resources such as water, nutrients, light, and space, causing considerable reductions in yield. Recently, scientists have begun to use genome editing to knock out endogenous genes, such as EPSPS and ALS, to produce herbicide-tolerant plants. ALS encodes acetolactate synthase, a key enzyme that catalyzes the first step in the biosynthesis of branched-chain amino acids such as valine, leucine, and isoleucine. Genome-editing-based gene replacement has been used to introduce precise alterations in the conserved region of ALS to prevent its inhibition by these herbicides. The resulting

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modified plants are able to grow in the presence of herbicide. The same gene has been targeted in several other crops, using TALENs and CRISPR/Cas9, to obtain herbicide-resistant potato, rice, maize, and soybean varieties.

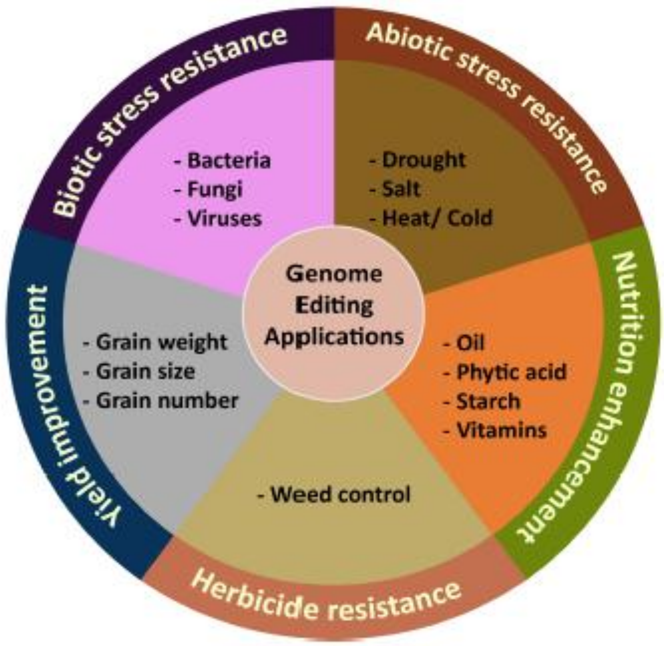

Fig: 1 Application of plant genome editing for targeted trait improvement

5. Improving Food Crop Quality

Genome editing can also enhance crop nutritional properties to produce healthier foods. For example, phytate, which exists in many crops, is usually regarded as an anti-nutrient due to its ability to form complexes with proteins and minerals, reducing their digestive availability. TALENs and CRISPR/Cas9 have both been used to reduce phytate content in maize by knocking out ZmIPK, a gene involved in phytate biosynthesis. The development of an improved waxy potato is another example of food quality improvement through genome editing. Genome editing has also been used to modify seed oil content to produce healthier food oils, as well as biofuels. This approach was made possible by increased knowledge of the metabolic pathways and the genes encoding enzymes related to fatty acid biosynthesis.

Future prospects

1. Multiplexing and trait stacking in crop breeding

In plants, cellular processes are often regulated by complex genetic networks. Therefore, molecular tools with the capability to manipulate multiple genes simultaneously are of great value in both basic research and practical applications. One of the advantages of CRISPR systems over other genome-editing methods is their potential for multiplexing, the simultaneous editing of multiple target sites. Using Golden Gate cloning or the Gibson Assembly method, several groups have assembled multiple sgRNAs into single Cas9/sgRNA expression vectors, in which multiple sgRNAs are driven by separate promoters. Multiple sgRNAs can also

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be used to target a single gene to improve rates of editing in crops that have low transformation or editing efficiencies.

2. High-throughput mutant libraries

Now that the complete genomes of many crops have been sequenced, the challenge of the post-genomic era is to analyze the functions of all crop genes systematically, as most of the genes sequenced to date have unknown functions and may control important agronomic traits. Gene knockout is a frequently used and effective strategy for identifying gene functions; hence, large-scale mutant libraries at the whole-genome level are of great value for functional genomics and for crop improvement. For example genome-wide mutant libraries in rice have been constructed by loss-of-function mutants because of its relatively small genome, rich genomic resources, and highly efficient transformation system. As techniques evolve, the construction of mutant libraries in other valued crop species should not be too long delayed.

3. Gene regulation

Gene regulation mainly involves the repression and activation of genes and is often achieved by fusing transcriptional repressors or activators to the DNA-binding domains of genome-editing constructs (such as zinc finger protein (ZFP), TALE, or dCas9), thereby targeting the regulatory regions of endogenous genes. In rapeseed, the VP16 transcriptional activation domain was fused to ZFP, which binds to the DNA sequence downstream of the transcription start site of KASII genes. Mutants in which KASII was activated displayed the desirable agronomic trait of decreased levels of palmitic acid and total saturated fatty acid. CRISPR/Cas9 can also be used to repress or activate the transcription of plant genes by combining catalytically inactive dCas9 with sgRNAs that target specific promoter sequences. This strategy provides a generalizable, efficient method for manipulating the translation of mRNAs, which can be applied to dissect biological mechanisms and improve crops.

CONCLUSION

Genome editing tools are becoming popular molecular tools of choice for functional genomics as well as crop improvement. Numerous novel genome editing systems have been introduced; these comprise zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs), and clustered regularly interspaced short palindromic repeats/Cas9 (CRISPR/Cas9). Genome editing technique is consistent for improving average yield to achieve the growing demands of the world's existing food famine and to launch a feasible and environmentally safe agriculture scheme, to more specific, productive, cost-effective and eco-friendly.

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GENE KNOCK-OUT

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Nandigam Swathirekha
Department of Genetics and Plant Breeding, Acharya N G Ranga Agricultural University, Agricultural College Bapatla, Andhra Pradesh.

INTRODUCTION:

A gene knockout is a genetic technique in which one of an organism's genes is made inoperative ("knocked out" of the organism). Knockout organisms or simply knockouts are used to study gene function, usually by investigating the effect of gene loss. Knocking out two genes simultaneously in an organism is known as a double knockout (DKO). Similarly the terms triple knockout (TKO) and quadruple knockouts (QKO) are also used to describe three or four knocked out genes, respectively.

Use- Knockouts are primarily used to understand the role of a specific gene or DNA region by comparing the knockout organism to a wild type with a similar genetic background. Knockout organisms are also used as screening tools in the development of drugs, to target specific biological processes or deficiencies by using a specific knockout.

Knockouts are accomplished through a variety of techniques:

- Homologous recombination
- Zinc-fingers
- TALENS
- CRISPR/Cas9

Homologous recombination:

Traditional & main method for causing a gene knockout. This method involves creating a DNA construct & involving a drug resistance marker. This was delivered to stem cells either through microinjection or electroporation. This method then relies on the cell's own repair mechanisms to recombine the DNA construct into the existing DNA. As a result sequence of gene was altered & if it is translated, it will result in a nonfunctional protein. However, this is an inefficient process, as it accounts for only 10^{-2} to 10^{-3} of DNA integrations.

ZFNS (Zinc Finger Nucleases)

- Zinc fingers were first discovered in African clawed tode (*Xenopus lewis*) in 1985. These were a class of DNA binding proteins. They facilitate targeted editing of the genome by creating ds breaks in DNA at specific sites.
- Zn – (+ve) ; DNA – (-ve) – helps the zinc finger in binding to DNA.
- **Zinc finger** – when Zn ion is inserted into tertiary structure, it is called Zn-finger & is present in transcription factors. Zn ion is needed for stability of tertiary structure. Finger – structural domain part of Zn finger.
- **Nucleases** – cleaves the DNA.

DNA binding domain - 9 to 18 bp. If domains perfectly recognize a 3 base pair DNA sequence, they can generate a 3-finger array that can recognize a 9 base pair target site [$(GNN)_N$].

DNA cleaving domain - FoK1 – *Flavobacterium okeanokoites* which recognizes the target DNA by the presence of a **spacer** between the 2 ZFNs which was about **5 to 7 bp.** It is type II restriction endonuclease. It functions as a dimer – so a set of 2 ZFNS are used to bind to targeted DNA.

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Zinc finger can be introduced into an organism by using:

a) Plasmids and attenuated viruses.
b) Agro-bacterium mediated transfer.
c) Particle bombardment method.

Applications:

a) Disabling an allele.
b) Allele editing.
c) Gene therapy
d) Treatment of HIV
e) Repairing mutations

Drawback of ZFNS - Off target site recognition & cleavage. In ZFNS, the DNA binding site may show impact to each other ie., they may get overlapped.

TALENS : Transcription Activator like Effector Nuclease

[TALE – DNA binding, NS – Cleaving]

- ✓ It came into light in 2011 – hence it was named as method of the year. TALEs are naturally occuring effectors released from plant pathogenic bacteria Xanthomonas. These effectors mimic the eukaryotic transcription factors & are also capable of binding with DNA.
- ✓ They are a type of restriction enzymes made by fusing-
    a) DNA binding domain (TAL effector)
    b) DNA cleavage domain (the catalytic domain RE FoK1).
- ✓ They will go & bind at specific sequences.

TALE protein structural domain - Central repeat domain – binds with DNA. Individual domain consists of tandem repeat of 34AA. Among these , 12,13 AA are needed specifically for binding with DNA & these are variable (remaining are conserved) . Hence they are called as Repeat variable di-residue.

Applications:

- ➢ Gene therapy.
- ➢ To correct the genetic errors that underlie a disease. Eg: BLB resistant.
- ➢ Used as a tool to harness the immune system to fight cancers.

<u>CRISPR/CAS 9</u>

CRISPR - Clustered Regularly Interspaced Short Palindromic Repeats.

CAS 9 – Nuclease responsible for clevage

- ✓ CRISPR is a part of plant immune system of bacteria and archea bacteria. It protects them against nucleic acids such as viruses by cleaving the foreign DNA.

CRISPR Components:

i. PAM (Proto Spacer Adjacent Motif)
ii. CRISPR RNA (cr RNA).
iii. Trans activating cr RNA (tracr RNA)

ii+iii – guide RNA - guides CAS 9 to cut DNA – 40 nucleotides long

PROCEDURE:

Step 1: Adaptation – DNA from an invading virus is processed into short segments that are inserted into the CRISPR sequence as new spacers.
Step 2: Production of CRISPR RNA – CRISPR repeats and spacers in the bacterial DNA undergo transcription, the process of copying DNA into RNA (ribonucleic acid). Unlike the double-chain helix structure of DNA, the resulting RNA is a single-chain molecule. This RNA chain is cut into short pieces called CRISPR RNAs.
Step 3: Targeting – CRISPR RNAs guide bacterial molecular machinery to destroy the viral material. Because CRISPR RNA sequences are copied from the viral DNA sequences acquired during adaptation, they are exact matches to the viral genome and thus serve as excellent guides.

APPLICATIONS:

- Gene knockout
- Gene repression
- Gene activation
- Genome wide screening

CONCLUSION

By using these techniques, we can knockout an organisms gene there by an unnecessary functioning of any mutated or deleterious gene can be stopped and we achieve our required organism with a required gene function.

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Correlation and Path analysis using OP Stat

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Duddukur Rajasekhar[1*], Ranjithkumar. G[2], Manjunath. P[3]
[1]School of Crop Improvement, [3]Department of Genetics and Plant Breeding, CoA(Imphal)
[1]College of Post Graduate Studies in Agricultural Sciences, Umiam, Meghalaya.
[1,3]Central Agricultural University, Imphal, Manipur.
[2]Departemnet of Genetics and Plant Breeding, JNKVV, Jabalpur, Madhya Pradesh

INTRODUCTION

Correlation coefficient is a statistical measure which is used to find out the degree of relationship between the two or more variables. In plant breeding, correlation coefficient analysis is widely used to measure the degree and direction of relationships between various traits including grain yield. The correlation coefficient, *r* ranges from -1 to +1. Plant breeders often calculate correlation coefficients to develop a selection strategy for better plant type.

The path coefficient analysis is defined as a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects. Path analysis was initially developed by Wright in 1921. This technique was first used for plant selection by Deway and Lu in 1959, the first component of path analysis is the direct effect of a predictor character upon its response character, while the second component is the indirect effect of a predictor character upon its response character through another predictor character(s). Path analysis is used in agriculture by plant breeders for identification of characters that can be used as selection criteria for improving grain yield.

Calculation using OP stat

Replicated data entry:

The character under study are laid down horizontal and replication within treatments are laid down vertical i.e. first replication of first treatment of all the characters must be entered in first line and the observations are separated by space or tabs, enter second replication of first treatment of all the characters in second line. Similarly enter all the replications of first treatment of all the characters in separate lines. Now take the second treatment and enter all the replications in sub sequent lines. (Figure 01)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
G_1R_1								
G_1R_2								
G_1R_3								
G_2R_1								
G_2R_2								
G_2R_3								
G_3R_1								
G_3R_2								
G_3R_3								
G_4R_1								
G_4R_2								
G_4R_3								
G_5R_1								
G_5R_2								
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G_6R_2								
G_6R_3								
G_7R_1								
G_7R_2								
G_7R_3								
G_8R_1								
G_8R_2								
G_8R_3								
G_9R_1								
G_9R_2								
G_9R_3								
$G_{10}R_1$								
$G_{10}R_2$								
$G_{10}R_3$								

Figure 01: Where C_1 C_2…. indicates characters or traits under study; R_1 R_2 R_3 indicates replication numbers.

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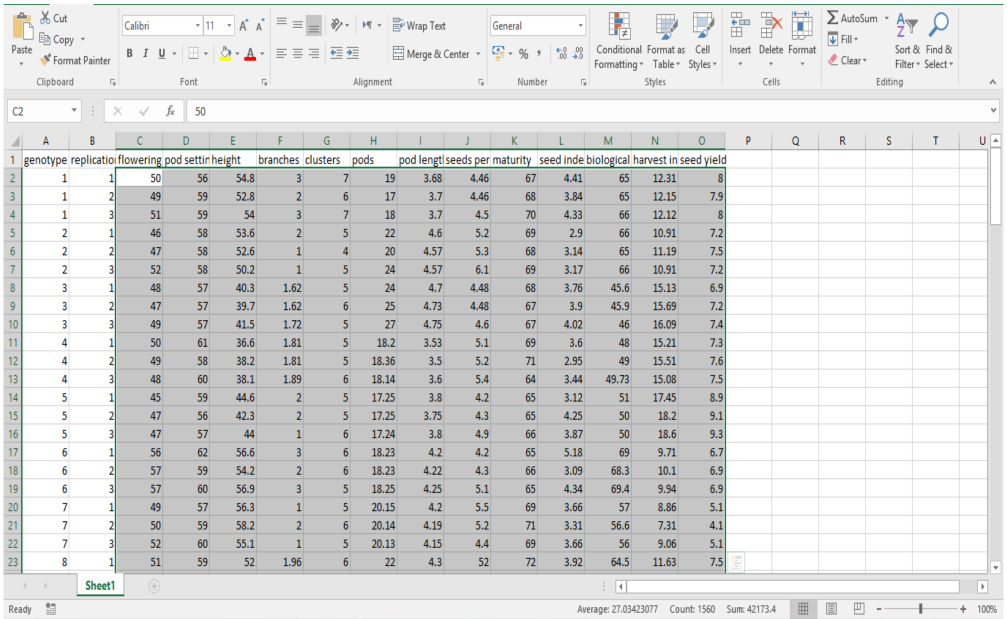
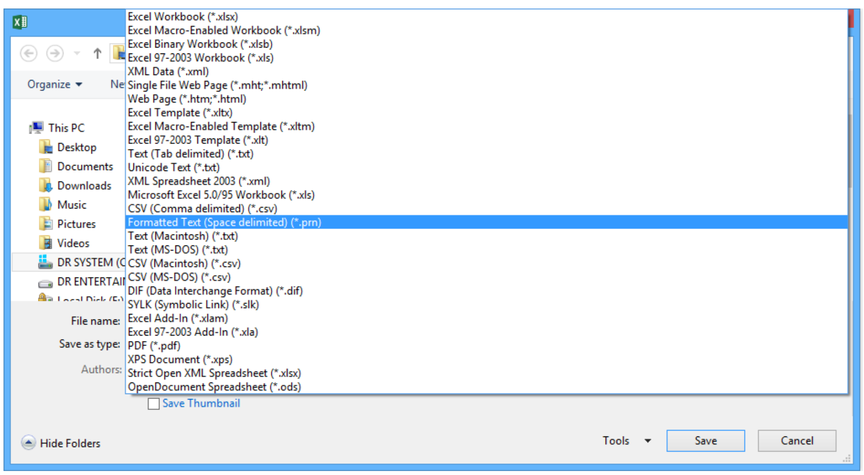


genotype	replicatio	flowering	pod settin	height	branches	clusters	pods	pod lengtl	seeds per	maturity	seed inde	biological	harvest in	seed yield
1	1	50	56	54.8	3	7	19	3.68	4.46	67	4.41	65	12.31	8
1	2	49	59	52.8	2	6	17	3.7	4.46	68	3.84	65	12.15	7.9
1	3	51	59	54	3	7	18	3.7	4.5	70	4.33	66	12.12	8
2	1	46	58	53.6	2	5	22	4.6	5.2	69	2.9	66	10.91	7.2
2	2	47	58	52.6	1	4	20	4.57	5.3	68	3.14	65	11.19	7.5
2	3	52	58	50.2	1	5	24	4.57	6.1	69	3.17	66	10.91	7.2
3	1	48	57	40.3	1.62	5	24	4.7	4.48	68	3.76	45.6	15.13	6.9
3	2	47	57	39.7	1.62	6	25	4.73	4.48	67	3.9	45.9	15.69	7.2
3	3	49	57	41.5	1.72	5	27	4.75	4.6	67	4.02	46	16.09	7.4
4	1	50	61	36.6	1.81	5	18.2	3.53	5.1	69	3.6	48	15.21	7.3
4	2	49	58	38.2	1.81	5	18.36	3.5	5.2	71	2.95	49	15.51	7.6
4	3	48	60	38.1	1.89	6	18.14	3.6	5.4	64	3.44	49.73	15.08	7.5
5	1	45	59	44.6	2	5	17.25	3.8	4.2	65	3.12	51	17.45	8.9
5	2	47	56	42.3	2	5	17.25	3.75	4.3	65	4.25	50	18.2	9.1
5	3	47	57	44	1	6	17.24	3.8	4.9	66	3.87	50	18.6	9.3
6	1	56	62	56.6	3	6	18.23	4.2	4.2	65	5.18	69	9.71	6.7
6	2	57	59	54.2	2	6	18.23	4.22	4.3	66	3.09	68.3	10.1	6.9
6	3	57	60	56.9	3	5	18.25	4.25	5.1	65	4.34	69.4	9.94	6.9
7	1	49	57	56.3	1	5	20.15	4.2	5.5	69	3.66	57	8.86	5.1
7	2	50	59	58.2	2	6	20.14	4.19	5.2	71	3.31	56.6	7.31	4.1
7	3	52	60	55.1	1	5	20.13	4.15	4.4	69	3.66	56	9.06	5.1
8	1	51	59	52	1.96	6	22	4.3	52	72	3.92	64.5	11.63	7.5

Step 1: Enter the data in above mentioned format in MS excel sheet and select only the data then copy it using Ctrl_C and then open the new excel workbook then paste the data.



Step 2: Then save as the file in space delimited format(.prn) in one of the device folder

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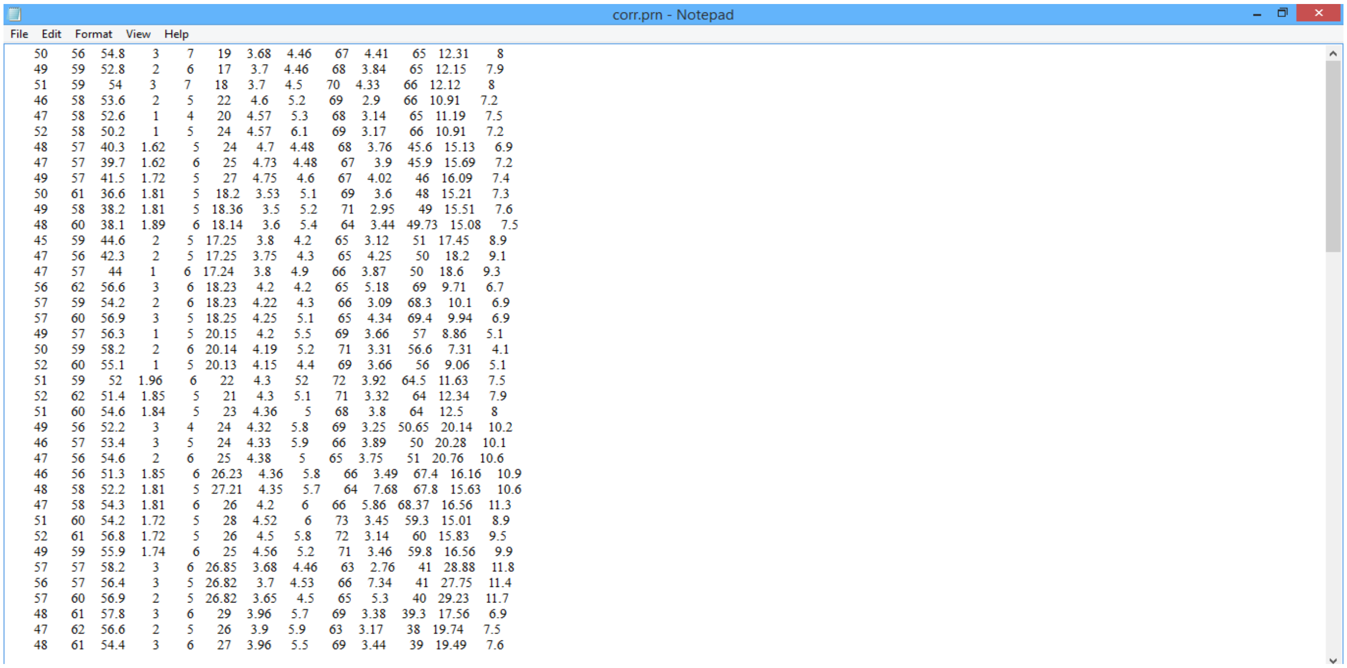

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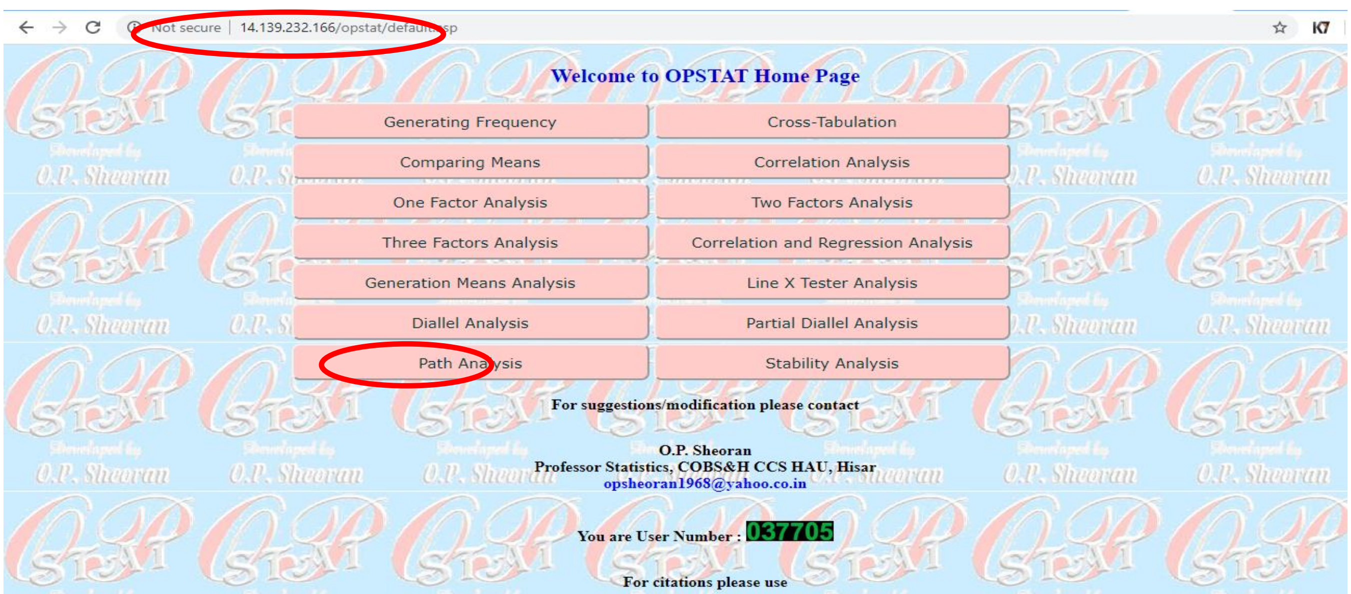
49	59	52.8	2	6	17	3.7	4.46	68	3.84	65	12.15	7.9
51	59	54	3	7	18	3.7	4.5	70	4.33	66	12.12	8
46	58	53.6	2	5	22	4.6	5.2	69	2.9	66	10.91	7.2
47	58	52.6	1	4	20	4.57	5.3	68	3.14	65	11.19	7.5
52	58	50.2	1	5	24	4.57	6.1	69	3.17	66	10.91	7.2
48	57	40.3	1.62	5	24	4.7	4.48	68	3.76	45.6	15.13	6.9
47	57	39.7	1.62	6	25	4.73	4.48	67	3.9	45.9	15.69	7.2
49	57	41.5	1.72	5	27	4.75	4.6	67	4.02	46	16.09	7.4
50	61	36.6	1.81	5	18.2	3.53	5.1	69	3.6	48	15.21	7.3
49	58	38.2	1.81	5	18.36	3.5	5.2	71	2.95	49	15.51	7.6
48	60	38.1	1.89	6	18.14	3.6	5.4	64	3.44	49.73	15.08	7.5
45	59	44.6	2	5	17.25	3.8	4.2	65	3.12	51	17.45	8.9
47	56	42.3	2	5	17.25	3.75	4.3	65	4.25	50	18.2	9.1
47	57	44	1	6	17.24	3.8	4.9	66	3.87	50	18.6	9.3
56	62	56.6	3	6	18.23	4.2	4.2	65	5.18	69	9.71	6.7
57	59	54.2	2	6	18.23	4.22	4.3	66	3.09	68.3	10.1	6.9
57	60	56.9	3	5	18.25	4.25	5.1	65	4.34	69.4	9.94	6.9
49	57	56.3	1	5	20.15	4.2	5.5	69	3.66	57	8.86	5.1
50	59	58.2	2	6	20.14	4.19	5.2	71	3.31	56.6	7.31	4.1
52	60	55.1	1	5	20.13	4.15	4.4	69	3.66	56	9.06	5.1
51	59	52	1.96	6	22	4.3	52	72	3.92	64.5	11.63	7.5
52	62	51.4	1.85	5	21	4.3	5.1	71	3.32	64	12.34	7.9
51	60	54.6	1.84	5	23	4.36	5	68	3.8	64	12.5	8
49	56	52.2	3	4	24	4.32	5.8	69	3.25	50.65	20.14	10.2
46	57	53.4	3	5	24	4.33	5.9	66	3.89	50	20.28	10.1
47	56	54.6	2	6	25	4.38	5	65	3.75	51	20.76	10.6
46	56	51.3	1.85	6	26.23	4.36	5.8	66	3.49	67.4	16.16	10.9
48	58	52.2	1.81	5	27.21	4.35	5.7	64	7.68	67.8	15.63	10.6
47	58	54.3	1.81	6	26	4.2	6	66	5.86	68.37	16.56	11.3
51	60	54.2	1.72	5	28	4.52	6	73	3.45	59.3	15.01	8.9
52	61	56.8	1.72	5	26	4.5	5.8	72	3.14	60	15.83	9.5
49	59	55.9	1.74	6	25	4.56	5.2	71	3.46	59.8	16.56	9.9
57	57	58.2	3	6	26.85	3.68	4.46	63	2.76	41	28.88	11.8
56	57	56.4	3	5	26.82	3.7	4.53	66	7.34	41	27.75	11.4
57	60	56.9	2	5	26.82	3.65	4.5	65	5.3	40	29.23	11.7
48	61	57.8	3	6	29	3.96	5.7	69	3.38	39.3	17.56	6.9
47	62	56.6	2	5	26	3.9	5.9	63	3.17	38	19.74	7.5
48	61	54.4	3	6	27	3.96	5.5	69	3.44	39	19.49	7.6

Step 3: Open the saved .prn file and copy the whole data



Step 4: Open the OP Stat page by using the URL http://14.139.232.166/opstat/default.asp and then click on the **Path analysis** option on the homepage.

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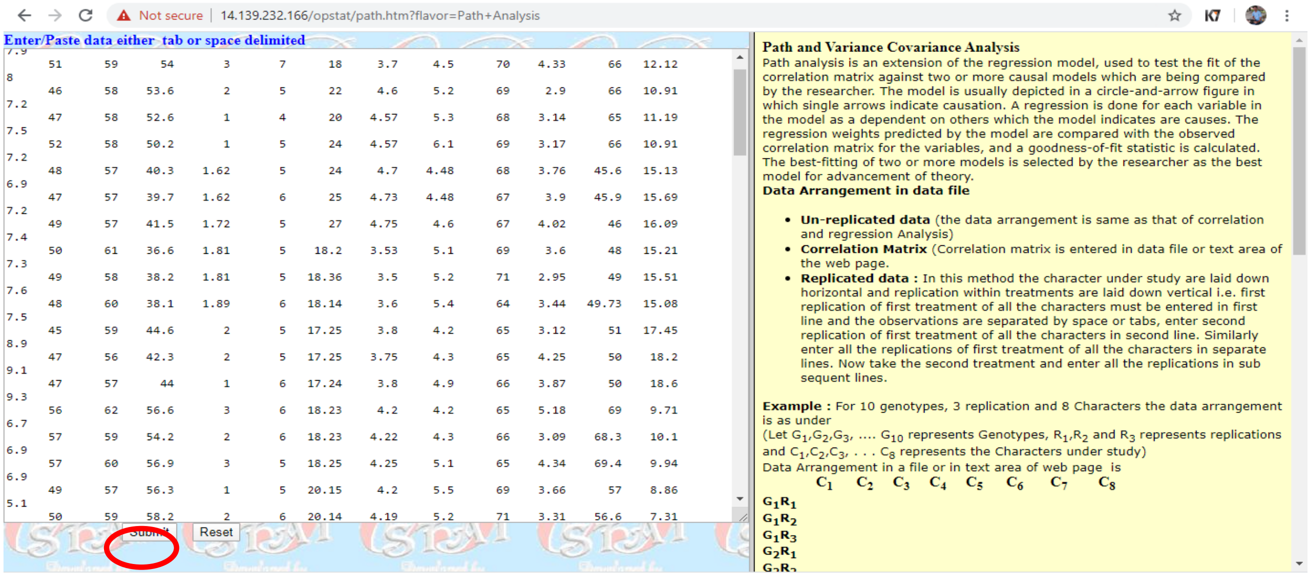
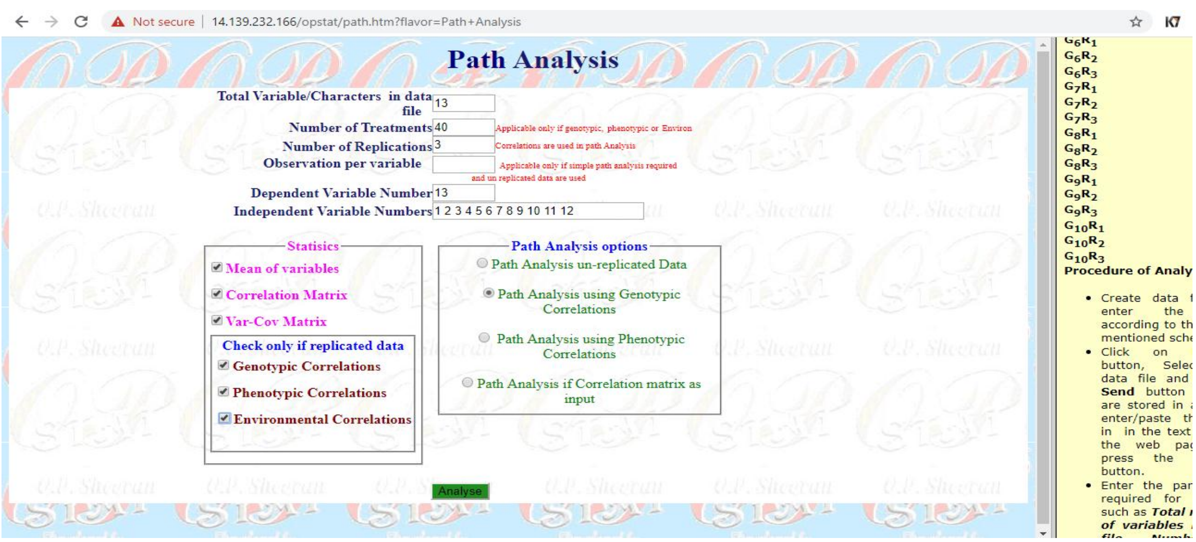


Step 5: Enter/Paste data either tab or space delimited in the place given and then click on submit.



Step 6: Enter the parameters required for analysis such as Total number of variables in data file, Number of treatments (This field is applicable only if genotypic, phenotypic or Environmental Correlations are used in path Analysis), Observations per variable (applicable only if un-replicated data are used), Dependent variable number (here you have to enter the column no which belongs to dependent variable) and Independent variable numbers (type the independent variables in the text box separated by space). Choose the Path analysis option using Genotypic or phenotypic correlatiuons. Select the statistics options. Press Analyse button to analyse your data.

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Economic potential of bamboo for rural livelihood

Article id: 23434

Atul Singh and Anil Kumar Kori
Department of Forestry,
Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur (MP) Pin no 482004

INTRODUCTION

Bamboo is called the poor man`s timber in china the friend of people in India and the brother in Vietnam (INBAR, 2003) around 75 genera and 1250 species of bamboo has traditionally been used for multiple purposes by various rural communities in several regions of Asian countries. Bamboo is an integral part of forestry and one of the major NTFPs in the tropical and sub-tropical forests in Asia and also in some private land. Various advantages such as a short rotation period, powerful regeneration ability, and properties for wide use, similar or even superior to those of wood, make bamboo a suitable substitute for wood. Combating degradation of mountain environment, ecosystem and natural resources. Bamboo use and trade have been growing rapidly in recent years.

Bamboo is one of the fastest growing plants on earth, gaining approximately 121 cm in 24 hrs (Adhikari, 2008). It has ability to grow on marginal and waste lands. Its rapid growth habit, low cost extraction, low cost processing and multifarious uses make them important for subsistence and income needs of rural communities, especially those with few alternative resources or employment opportunities. It is quickly changing its image from the poor man`s tree to a high-tech, industrial raw material and substitute for wood. Bamboo is also widely spread outside forests including farmlands, riverbank, roadsides and urban areas. It is an increasingly important economic asset in poverty reduction and economic and environment development.

Bamboo has a tremendous potential for economic and environment development and international trade. Its potential to raise living standards is being recognized, with several countries working to find ways to utilized bamboo resources for sustainable development. This would probably add greatly to the rural agriculture economy in general and act as poverty alleviator for the rural poor in particular through the processing and sale of bamboo goods (FAO, 2005; Souvanpheng et al., 2008). Bamboo has many small but important uses such as fishing rods, flutes, fishing traps, handicrafts, walking sticks, packing cases for tea and fruits, cages for poultry, pipes for water supply and irrigation, cradles, cart yokes, bullock carts, ladders, winnows and sieving for cleaning grains (DAS, 2002).

Bamboo plays a major role in the development of many countries with over 2.5 billion people globally depending on it for survival and livelihood (INBAR, 2014). in 2012 the domestic market for bamboo and rattan products in major producing countries was estimated at US$ 2.5 billion of international trade in bamboo and rattan products (INBAR, 2015). Global export of bamboo and rattan products reached its record high of US$ 2,557 million in 2008 but slumped sharply by about 25% in 2009 due to the financial crisis. In 2012, the world export of bamboo and rattan commodities was about US$ 1,881 million, of which 29% was industrialized bamboo products and 25% was bamboo woven products (INBAR, 2014; INBAR, 2015). The size of bamboo uses in Agarbatti industries itself in India has been estimated at RS. 135 crore and bamboo utilized in ice-cream industries, kites, crackers, lathies and fishing rods has been estimated to the tune of 10 lakh tones annually (Mehra & Mehra, 2007).

Wonder bamboo products

- **Bamboo pulp, paper and cloth**: several bamboo-producing countries, such as India and china, use bamboo in pulp, paper and more recently cloth. Bamboo paper has practically the same quality as paper made from wood. Its brightness and optical properties remain stable, while those of paper made from wood may deteriorate over time. The morphological characteristics of bamboo fibers yield paper with a high tear index, similar to that of

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hardwood paper. The tensile stiffness is somewhat lower compared with softwood paper while the strain strength is between that of hardwood and softwood papers. The quality of bamboo paper may be improved by quality of bamboo paper may be improved by refining the pulp (FAO, 2003).

- **Bamboo flooring:** bamboo flooring is a quality product that can be used widely and has a large, global consumer market. It has certain advantages over wooden floors due to its smoothness, brightness, stability, high resistance, insulation qualities and flexibility. Bamboo flooring has a soft natural luster and maintains the natural gloss and elegance of bamboo fiber. This flooring is attractive to the demanding markets in Europe, Japan and North America (Customs General Administration of china, 2004).
- **Bamboo homes**: From super-deluxe homes to affordable bamboo homes in flood affected areas, bamboo based architectures are creating wonders worldwide. Organization such as bamboo living are creating designs for making bamboo made homes which are eco-friendly to the environment and reduces carbon dioxide emission, conserves natural resources, improves air and water quality, cuts back waste and saves energy. It also stimulates architectural design and green construction that promotes sustainable and healthy living. It is estimated that globally, over one billion people live in traditional bamboo houses especially in south East Asia (FAO, 2005). New types of prefabricated houses made of engineered bamboo have certain advantages. For example, they can be packed flat and transport long distances at a reasonable cost. They are better designed and environmentally friendly and bamboo materials are widely available and can be cultivated at a low cost (FAO, 2005; INBAR, 2014).
- **Bamboo charcoal**: bamboo charcoal is made of bamboo by means of a pyrolysis process. According to the types of raw material, bamboo charcoal can be classified as raw bamboo charcoal and bamboo briquette charcoal. Raw bamboo charcoal is made of bamboo plant parts such as culms, branches, and roots. Bamboo briquette charcoal is made of bamboo residue, for example, bamboo dust, saw powder etc. Bamboo charcoal is traditionally used as a substitute for wood charcoal or mineral coal. It can serve as a fuel, absorbent and conductor. Bamboo charcoal is an excellent fuel for cooking and barbequing. Activated charcoal is used as a deodorant, purifier, disinfectant, medicine, agricultural chemical and absorbent of pollution and excessive moisture (FAO, 2005).
- **Bamboo crafts and furniture**: the bamboo weaving products are known for its durability and usefulness from the time immemorial. Many traditional bamboo weavers belonging to different ethnic groups of India are involved in making beautiful bamboo handicrafts. There are nearly 20 categories of wove bamboo products in Asia, including fruit baskets, trays, bottles, jars, boxes, cases, bowls, fans screens, curtains, cushion, lampshades and lanterns. New techniques of making bamboo furniture by laminating the bamboo product have increased the durability and efficiency of the product.
- **Bamboo shoots**: bamboo shoots are products of delicacy since ages. About 200 species of bamboo can provide edible and palatable bamboo shoots. Fresh bamboo shoots are delicious and healthy, with high fiber content. Cooked bamboo shoots can be stored in containers and shipped worldwide. It is also used as ethno medicine by many ethnic communities if India which helps to cure many disorders. The demand for bamboo shoots is India is about 4.8 crore and is expected to grow at the rate of 25% per annum each year (Mehra & Mehra, 2007).

CONCLUSION

Bamboo production is increasing in importance as an income generating alternative in importance as an income generating alternative for villagers and many local governments have drafted bamboo development progammes. Markets are growing and offer new opportunities for promotion of bamboo as alternative to wood as also other products. This is a golden opportunity for the farmer, entrepreneurs, industries, banks and also govt. agencies to tap the potential under the sector for economic, ecological and social gains. The involvement of villagers in growing bamboo products may serve as boon the economic development of he country. It will not only improve the rural livelihood but will also obliterate unemployment and hence will enhance the economy of the country.

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Tree - crop interactions in agroforestry

Article id: 23435

Atul Singh and Anil Kumar Kori
Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur (MP)

INTRODUCTION

It has been observed that the success of agroforestry depends on the exploitation of component interaction. These interactions are both ecological and economical in nature. The complexity of and lifespan of agroforestry system make investigation of mechanisms and process extremely difficult. Component interactions refer to the influence of one component of a system on the performance of other component as well as the system as a whole. When trees and crops are grown together on the same piece of land there will be interactions between the two components, which may have positive or negative results. Interaction is defined as the effect of one component of a system on the performance of another component and/or the overall system.

Types of interaction: In view of ecologically, based on the net effects of interactions, the following are the interactions.

- Commensalistic: Positive "+", effect on species one and on observable effect, "0" on species two. (Symbolically + and 0)
- Amesalistic: Negative "-", effect on species one and no observable effect, "0" on species two. (Symbolically – and 0).
- Monoplistic / predatory or parasitic: Positive "+", effects on species one and Negative "-", effects on species two.
- Inhibitory: Negative effects on both the crops (- and -).

To these, synergistic (+, +) could be added as an interaction where the net effects are positive for both species. These concepts of observable net effects can also be expressed as:

Complementary, Supplementary, Competitive and **Allelopathic** are used to describe economic interaction as well. Not all the tree crop association need be competitive or allelopathic. Under natural ecosystem, disparate groups spatial or temporal sharing of resources pools (utilizing different parts of it or utilizing it at different times) and through non-competitive adaptation. Such complimentary use of resources is called. Using a bioeconomic perspective, two positive plant associations of supplementarity and complementarity wherein environmental resources are portioned on maximized resulting in higher productivity.

1. COMPLEMENTARY INTERACTION: Exists if the presence of one crop increases production of another crop. An example of complementary in cropping is the positive effect of one crop on the other crop. *Cordia alliodora and several Erythrina* species are used as shade trees for coffee and cocoa. Trees moderate the intensity of sunlight and wind, and maintain higher humidity. Crops under or between the trees are protected from sudden changes in climate. Species of *Acacia, Leucaena, Gliricidia* and other legumes are often interplanted with crops in agroforestry systems, because the nitrogen fixed by these plants increases soil fertility and benefits the crop plants.

Interplanting trees and crops as in the *taungya* system often results in a mutual benefit. Weeding carried out by cultivators benefits both the crops and the trees in that it reduces competitions for nutrients and water. The cut weeds represent a source of readily available nutrients to the crops and trees, if used as mulch. The crops and weeds, and their litter when they are cut provide a mat over the soil which lessens erosion and reduces evaporation.

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2. SUPPLEMENTARY INTERACTION: This occurs if the presence of one crop does not influence the production of other crop(s). This is an independent relationship. This relationship occurs if the different crops draw on resources at different times of the year, or from different parts of the environment .e.g. different soil depth for nutrients. In *taungya*, crop plants occupy space between tree seedlings, and use light, nutrients and water that presumably otherwise would be wasted. During the first growing season, tree seedlings are so small that crops usually grow well despite their presence. The relationship between trees and crops during the first year of *taungya* appears in most cases to be supplementary.

3. COMPETITION: The component plants in a mixed system vie for essential resources. Although agroforestry is envisaged as a system of plant species that benefit each other mutually or unilaterally, it is too optimistic to assume that all types of competition can be eliminated in these systems, especially in areas with poor soils and scanty rainfall. Agroforestry systems lose some of the assimilated nutrients in the form of grain, wood, fodder, etc, at each harvest, thus reducing reserves, unlike natural forests where recycling of nutrients occurs.

Ideally, the relationship between crops and trees should be of a 'complementary' nature. However, this is not always the case. In many situations where trees and crops are grown together, they may compete for water, nutrients and solar energy. The situation is obvious when the canopies of trees begin to close over the tops of crops such as upland rice.

In Indonesian *taungya* (Tumpangsan) teak is often interplanted with giant *Leucaena leucocephala* and with cassava as a cash crop. The *Leucaena leucocephala* is beneficial in that it Produces shade and green manure. The side-shading results in good form for the teak. However, competition can be deleterious when teak is enclosed by two rows of *Leucaena leucocephala*. Competition between trees and crops is a long-term problem in plantations when the crop species is a perennial.

4. ALLELOPATHY: Allelopathy is an interaction between plants or between plants and microorganisms in which substances (allelochemicals) produced by one organism affect the growth of another (usually adversely).

The term allelopathy was coined in 1937 by Molisch to refer to biochemical interactions between all types of plants including micro-organisms. Allelopathy means plant-plant biochemical interactions that have detrimental effects, i.e. certain plants release into the environment toxic chemicals that are injurious to other plant(s) in their vicinity. Such toxic chemicals may be injurious to microbes and even to the seedlings of those plants releasing them.

Recent studies have shown that the organic compounds released this way are often phytotoxins which are released into the environment as leaf leachates or root exudates by certain plants. The effects of the chemicals may result in complete inhibition of growth or in stunted or retarded growth. When complete inhibition occurs; this may be noticed in the form of bare areas around the trees which exude the chemicals. When the toxic exudates of the adult trees of a particular species suppress and eventually kill their seedlings; then the phenomenon is called autoallelopathy. Allelopathic situation has been found around *Callitris intratropica* in Northern Australia. Grevillea's poor performance in Australian tree plantations may be due to autoallelopathy. Researchers have shown that water-soluble extracts from roots of adult trees suppress and eventually kill their seedlings. This could prevent trees from growing well when closely space in pure stands. Allelopathic compounds (allelopathic chemicals or allelochems) may be released into the environment by:

1. Volatilizations,
2. Leaching from living or dead tissues,
3. Exudation from roots and decay of plant tissues

Allelopathic interactions between trees and crops have been investigated in *taungya* plantations. Some Southeast Asian scientist (Susech and Vinaya Rai) in 1987 reported on effects upon Sorghum, Cowpea and Sunflower by

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Eucalyptus tereticornis, *Casuarina equisetifolia* and *Leucaena leucocephala.* The crops, grown in topsoil taken from beneath the trees, had decreased seed germination rate, decreased root growth and decreased dry matter production compared with crops grown in control soils.

Presently, most of the allelochems known fall into FIVE chemical classes:
1. Phenolic compounds,
2. Aldehydes,
3. Coumarins,
4. Glucosides and
5. Terpenes.

Mechanisms of action of allelochemicals

The mechanisms of action of allelochems are diverse and include:

- Inhibition of cell division and elongation;
- Inhibition of gibberellins – or indoleacetic acid induced growth;
- Reduction of mineral uptake;
- Retardation of photosynthesis;
- Inhibition or stimulation of respiration;
- Inhibition or stimulation of stomatal opening;
- Inhibition of protein synthesis and changes in lipid and organic acid metabolism.

Positive interaction (beneficial and production enhancing)

The major types of positive or complimentary interactions at the tree crop interface are those relating to microclimate amelioration and nutrient balance. In agroforestry microclimate amelioration involves soil moisture and temperature results from the use of tree for shade, live supports, fence, windbreaks or shelterbelts. Temperature humidity and movement of air as well as temperature and moisture of soil directly affects the photosynthesis, transpiration and energy balance of associated crop and thus the net effects of which may translate into increased yield.

Negative interaction (production decreasing)

All members of plant community utilize the resources for growth such as light, nutrients; water and thus negative interaction often through competition are likely to occur in every plant association. The major yield decreasing effects at the TCI arise from competition for light, water and nutrients as well as from interaction via allelopathy.

Above ground competition: Importance of light, multiple AF system, Photosynthetic activity and yields. Low light intensity: paddy yields were low because of low intensity of light and wheat tillering grain production will also be less. Low light intensity is one of the important constraints for higher yield in agroforestry. The degree of shading to annual crops increase with the increases in the proportion of land occupied by in agroforestry system and size of the trees. Light transmission ration (LTR) was maximum in teak and minimum in sissoo.

Many tree crops are inefficient in interaction of radiant energy in their early years since full canopy formation in trees may take many years. Under such circumstances, solar radiations falling on bare soil is wasted and promotes only weed growth. Intercropping of ground cover crops with the trees in their early years will therefore help in better utilization of the resources. Reduction in crop yield from second year of tree growth under agroforestry system has

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been reported. The shade effects caused by full canopy of a13 year old unlopped *Acacia tortilis* were considerable. Compared to open field, the total and net radiation beneath the tree canopy were only 24% and 16% respectively. Under limitation of light, there is an inevitable depression in the intersown crop yield. Establishment and growth of *Cenchrus ciliaris* was poor under 13 year's old unlopped acacia tortilis. Forage yield of pollarding due to shading caused by newly sprouted shoots.

Below ground competition:

1. **Moisture:** underground competition is relatively more for moisture and nutrients. The lateral spread of roots was found to have more effect on utilization of moisture which deepens upon density tree. In agroforestry studies, subabul recorded maximum soil moisture percentage followed by sissoo, casurainas and eucalyptus and higher depletion was under bamboo and teak.
2. **Nutrient:** trees required lesser quantity of nutrients for their growth as compared to annual crop. Trees pump nutrients from the deeper layer to the surface through absorption and litter fall. However, release of nutrients through litter fall depends upon the density of trees, nature of species, season etc. litter fall may varies from 0.5 to 6.5 tones / ha / years. On basis of dry weight, leaf litter contains 0.5 to 1.5 percent N, 0.05 to 0.15 percent of P and 0.25 to 0.75 percent of K, 0.25 to 1.00 percent Ca and 0.10 to 0.2 percent of Mg. growing of trees, markedly decreased the pH and EC and increased organic carbon, available phosphorous and potassium.

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Types of metamorphosis in insects

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Ipsita Samal
PhD Scholar, Division of Entomology, Indian Agricultural Research Institute, New Delhi, 110012

INTRODUCTION

Growth is an important part of an individual's ontogeny, the developmental history of that organism from egg to adult. Equally significant are the changes, both subtle and dramatic, that take place in body form as insects molt and grow larger. Changes in form (morphology) during ontogeny affect both external structures and internal organs, but only the external changes are apparent at each molt. Three broad patterns of developmental morphological change during ontogeny, based on the degree of external alteration that occurs in the postembryonic phases of development.

AMETABOLY

The primitive developmental pattern, ametaboly, is for the hatchling to emerge from the egg in a form essentially resembling a miniature adult, lacking only genitalia. This pattern is retained by the primitively wingless orders, the silverfish (Zygentoma) and bristletails (Archaeognatha) , whose adults continue to molt after sexual maturity. In contrast, all pterygote insects undergo a more or less marked change in form, a metamorphosis, between the immature phase of development and the winged or secondarily wingless (apterous) adult or imaginal phase. These insects can be subdivided according to two broad patterns of development, hemimetaboly (partial or incomplete metamorphosis) and holometaboly (complete metamorphosis).

HEMIMETABOLOUS DEVELOPMENT

Developing wings are visible in external sheaths on the dorsal surface of nymphs of hemimetabolous insects except in the youngest immature instars. The term exopterygote has been applied to this type of "external" wing growth. In the past, insect orders with hemimetabolous and exopterygote development were grouped into "Hemimetabola" (also called Exopterygota), but this group is recognized now as applying to a grade of organization rather than to a monophyletic phylogenetic unit. In contrast, pterygote orders displaying holometabolous development share the unique evolutionary innovation of a resting stage or pupal instar in which development of the major structural differences between immature (larval) and adult stages is concentrated. The orders that share this unique, derived pattern of development represent a clade called the Endopterygota or Holometabola. In the early branching Holometabola, expression of all adult features is retarded until the pupal stage; however, in more derived taxa including Drosophila, uniquely adult structures including wings may be present internally in larvae as groups of undifferentiated cells called imaginal discs (or buds), although they are scarcely visible until the pupal instar. Such wing development is called endopterygote because the wings develop from primordia in invaginated pockets of the integument and are everted only at the larval—pupal molt.

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HOLOMETABOLOUS DEVELOPMENT

The evolution of holometaboly allows the immature and adult stages of an insect to specialize in different resources, contributing to the successful radiation of the group (Roller *et al.,* 1967). Most insects undergo complete metamorphosis over the course of a lifetime. Each stage of the life cycle—egg, larva, pupa, and adult—is marked by a distinctly different appearance. Entomologists call insects that undergo complete metamorphosis "holometabolous," from "holo," meaning "total." The larvae of holometabolous insects bear no resemblance to their adult counterparts. Their habitats and food sources may be entirely different from the adults as well. Larvae grow and molt, usually multiple times. Some insect orders have unique names for their larval forms: butterfly and moth larvae are caterpillars; fly larvae are maggots, and beetle larvae are grubs. When the larva molts for the final time, it transforms into a pupa. The pupal stage is usually considered a resting phase, although many active changes are occurring internally, hidden from view. The larval tissues and organs break down entirely, then reorganize into the adult form. After the reorganization is complete, the pupa molts to reveal a mature adult with functional wings. Most of the world's insect species-including butterflies, moths, true flies, ants, bees, and beetles-are holometabolous (Reynolds, 2019).

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Greenhouse gas mitigation technologies for climate smart agriculture

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Tulasi Lakshmi Thentu*

SMS (Crop Production), Krishi Vigyan Kendra- Nellore, Acharya N. G. Ranga Agricultural University, AP-524004

A number of methods and practices were adopted to address these challenges. For example, production systems adapted by altering cropping patterns, planting dates and farm management techniques. The embankments built to protect rice farms from floods and new drought and submergence tolerant varieties of rice were produced and distributed by the government institutions and the private sector.

Beside farmers were diversifying their production systems, growing other cereals, vegetables and rearing fishes and animals (such as pigs and chickens). The residues and waste from each system were converted into composted and used as manure, thereby reducing the need for external inputs. This diversification enhanced incomes, improved nutrition, built resilience to shocks and minimized financial risks. The development of advanced modelling techniques, mapping the effect of climate change on rice growing regions and providing crop insurance were other examples of managing risks and reducing vulnerability. Research on rice cultivation identified that emissions mainly occur in the few months of the year when the ground was waterlogged. A more integrated approach to rice paddy irrigation and fertilizer application was found to substantially reduce emissions.

Rice is fundamental for food security with approximately 3 billion people, about half of the world population, eating rice every day. Approximately 144 million ha of land is cultivated under rice each year. The water logged and warm soils of rice paddies make this production system a large emitter of methane (CH_4). Rice production will be affected by changes in climate. Irregular rainfall pattern, drier spells in the wet season (damaging young plants), drought and floods showed adverse effect on yields. This has also caused outbreaks of pest and diseases, with large losses of crops and harvested products. Peng *et al.* (2004) analysed 6 years of data from 227 irrigated rice farms in six major rice-growing countries in Asia, which produced more than 90% of the world's rice. They found that rising temperatures especially in night had a severe effect on yields causing losses of 10 to 20% of harvests in some locations. Globally agriculture accounts for 50% and 60 % of totally anthropogenic CH_4 and N_2O emissions respectively. Within agriculture, intensified rice production system is one of the major anthropogenic sources of atmosphere CH_4 and N_2O. emissions are predicted to increase by 35 to 60% by 2030 as result of the increasing application of chemical fertilizers (FAO, 2003).

(a) Azolla, green manure application technology to mitigate greenhouse gas emission: green manures are widely used in rice production and may influence methane (CH_4) efflux. Influence of application of *Azolla (A. Caroliniana)*, a widely used biofertilizer for rice (*Oryza saliva* L.) on CH_4 efflux from a flooded alluvial soil planted to rice and select soil and plant variables were investigated in a field experiment at cuttack, India. Azolla was either incorporated as green manure at the beginning of the experiment or grown as a dual crop in the standing water along with the rice crop. Dual cropping of Azolla in conjunction with urea considerably reduced CH_4 efflux without affecting the rice yields and can be used as a practical mitigation option for

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minimizing CH_4 flux from flooded paddy. The study showed that dual cropping of Azolla reduced CH_4 flux and yet increased grain yield similar to that of urea application. The decrease in CH_4 efflux in plots with a dual crop of Azolla could be related to the release of oxygen in the standing water by the growing Azolla dual cropping for sustaining the environment by minimizing the CH_4 flux from flooded rice paddies.

(b) Water management strategies to mitigate greenhouse gas emission from paddies: Both soil types and water regimes play important roles in the process of methanogenesis and methane emission from rice soils. In view of wide spatial and seasonal variability and the importance of moisture on the process of methane emission, it is pertinent to evaluate the role of soil type and moisture interaction on methane efflux from soils planted to rice.

(c) Use of Agrochemicals to mitigate greenhouse gas emission from rice paddy ecosystem: Agrochemicals including pesticides were widely used as agronomix practices to enhance crop productivity, however, their influence on soil microbial mediated greenhouse gas emmion are not well understood. Pesticides like Tridemorph even at field application rate could influence CH_4 production while the herbicide butachlor inhibits CH_4 production and emission by 20% from paddy ecosystem. Thus, use of such agrochemicals enhanced crop growth and productivity simultaneously mitigated greenhouse gas emission from paddy studied.

(d) Biochar accounting and emission trading for climate smart agriculture: It is possible to combat greenhouse gases emission and reinvigorate rural and agricultural communities simultaneously through the use of biochar, (name given to charcoal produced for agronomic and other ecosystem applications). Besides, stably sequestering the carbon in the biochar for periods of time estimated to be estimated to be several hundred to several thousand years biochars can be applied to crop land to increase crop yields, decrease runoff, decrease fertilizer and lime use, increase soil fertility and minimize nitrous oxide and methane emissions, which are also potent greenhouse gas. Biochar acted as an absorber of NH_3 and water soluble NH_4 + and might, therefore, reduce losses of N during composting of manure. Biochar's porous structure allowed oxygen (O_4) to move through the material, and maintaining these air passageways enhanced microbial activity and provides for a faster and odor-free decomposition. Studies showed a significant reduction in N-P-K loss during the decomposition process as nutrients and minerals bond to the biochar. In using biochar, commercial composters find the reduction in greenhouse gas emissions and ability to sell their compost as an enhanced N-P-K fertilizer quite significant.

CONCLUSION:

The climate smart agriculture aims to improve food security, help communities adapt to climate change and also contributes to mitigation of climate change effects by adopting enabling policies and institutions and mobilizing needed finances. Climate smart agriculture helped to overcome as well as cope-up with climatic vulnerabilities such as drought, prolonged dry-spell, water logging, floods ect. The climate-smart agriculture related interventions helped farmers to face the climate vulnerability more 'smartly, swiftly and successfully' in minimize losses due to climate aberration.

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Impact of FDI on Agricultural Sector

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Subham Paul
M.Sc. Horticulture, BCKV

Agriculture is taken into account as the backbone of rural India and accounts for 14.39% share of Agriculture & allied sectors is Gross Value Added (GVA) in 2018-19 at 2011-12 prices. It's been observed that the share of agriculture exports in total exports of the country is 12.28% and share of agriculture imports in total imports is 4.09%. Contribution of Agriculture sector in Indian economy is way above world's average (6.4%). Indian agriculture sector accounts for 15.4% of India's Gross Domestic Product (GDP) and also provides employment to 42% of our nation's workforce, hence the steady growth of agriculture sector for Indian economy is of utmost importance. Since the initiation of economic reforms in 1991, Government of India has initiated several programs to draw in and incorporate FDI inflows, to enhance the status of our nation's economy. The concept of Foreign Direct Investment (FDI) has constantly been evolving since its conception and has since undergone several changes over time. However an effort has been made to harmonize the differing concepts of FDI, the OECD and the IMF thereby concurred the following definition which states that Foreign direct investment reflects the objective of obtaining a lasting interest by resident entity in one economy ("direct investor") in an entity resident in another economy which is far away from that investor ("direct investment enterprise"). In simple terms a foreign direct investment (FDI) is an investment made by a firm or individual in one country into business interests that are located in another country or region. In India, agriculture is a crucial sector of the Indian economy and accounts for nearly 7.39% of India's total global agriculture output only second to china in world ranking. However, unlike developed nations the agricultural sector in India exists at the subsistence level. Therefore, to boost the quality of living of the people and to enable them to use the advantages of scientific and technological, modern advances in agriculture, industry, transport, communication, education, health services and other fields, it's utmost essential that the capital formation should happen at a better rate than before, so that income receives an honest escalation. This paper endeavors to know the impact of FDI in Agriculture sector existing in the rural scenario of India.

INTRODUCTION: When investments made by a company into another company that are located in another country these are called Foreign direct investments (FDI). They are commonly categorized as being Horizontal, Vertical or Conglomerate. A horizontal direct investment refers to the investor that establishes operation in a foreign country as it operates in its own country, for instance, McDonald's opening restaurants in India would be considered as horizontal FDI. A vertical investment is slightly different in the aspect that it's within the domain of the investor's main business but acquires an interest in a foreign company and moves to different level of the supply chain by supplying raw materials required by the manufacturing company for its products. Using an equivalent example, McDonald's could purchase a large-scale farm in a foreign nation to supply meat for its restaurants in that country. A conglomerate sort of FDI is one where a corporation or individual makes a foreign investment in a business that's unrelated to its existing business in its home country. Since this sort of investment involves entering an industry in which the investor has no previous experience, it often takes the shape of a venture with a foreign company already operating within the industry. Thus, we can say, that FDI inflows comprises of capital which is provided by foreign investors, directly or indirectly to enterprises in another economy with an expectation of obtaining profits derived from the capital participation or capital investment within the enterprise. It's seen that the FDI equity inflows during the five years 2005-06 to 2009-10 showed a huge increase of 'seven (7)' times than those of the previous year's 1991-92 to 1999-00 and 2000-01 to 2004-05. The rural Agriculture sector in India is very fragmented and unorganized. It's said if the war on poverty is to be won, developing countries need to place more emphasis on the agricultural sector (Mangisoni, 2006). Farmers are still kept ion tenterhook, not knowing the way to manage their economy, except to play it by years (Gupta, 2005). If production is sweet then there's glut and costs fall. When there's surplus production farmers hardly get any compensation in terms of higher price. For example, West Bengal is a densely populated eastern province of India where paddy is the principal crop involving many rural people for their livelihood. Profitability in paddy cultivation gradually decreased to only 13% in 2007 and has further come right down to 10% in 2011 as per the report of the Commission for Agricultural Costs and Prices (Choudhury S, 2011). This case has been observed throughout the Agricultural sector of India. Farmers toil hard to sustain their mere livelihood. Newspapers are rampant with the news of farmers' suicides across the state. It's this scenario of the destitute condition of rural people belonging to the vulnerable agricultural sector that invokes the role of FDI within the Indian Agricultural Sector.

V. Balasubramanian discusses the negative and positive benefits of India as it's member through his paper "WTO and Indian agriculture insight, implications and imperatives". He indicated some problems of Indian farmers, remarking that the governments of developed countries spend huge amounts on agricultural subsidies. This has resulted in the decline of costs of agricultural commodities within the world market. However, in Indian context the trade liberalization policies of the Indian government have compelled the farmers to compete with cheaper foreign agricultural commodities where the fact is our farmers already spend more and more for ever increasing cost of agricultural inputs like seeds, fertilizers, pesticides, electricity, etc. Increasing cost of inputs, decline in growth rates and lower prices of outputs have adversely affected the farmers and this has accelerated the indebtedness, desperation, deplorable condition of majority of rural people particularly the small and marginal farmers and tenant cultivators. He concludes that factors such as import liberalization which has contributed in a big way for the reduction in prices of agricultural products resulting in downfall of Indian agriculture as it is often difficult for the Indian Farmers to compete with the subsidized agricultural products of the foreign countries which has flooded the markets due to the trade liberalization. As the farmers do not get remunerative prices for their products, many farmers have curtailed their farm operations which successively have increased unemployment among the rural sectors. This highlights the necessity of Indian policy makers to take initiatives to safeguard the interests of weaker sections of the not so developed Indian economy against the stiff competition from highly subsidized agricultural commodities of the greater equipped, efficient and highly developed signatories of WTO. Herein comes the role of FDI which will invest within the agriculture Services which will incorporate positive growth in various sectors of rural economy like Food processing industry, Irrigation roads, Water system, Electrification, Telecommunication connectivity, fertilizers industry creating several job opportunities within the rural areas and also click on the untapped potential of this sector and harness huge profits both for the investing companies besides securing higher income for the farmers. For instance, Frito Lay in India that's involved in the business of Potato-Chips gets its supply of graded potatoes from the small and marginal farmers. The service network that Frito lay has organized for its suppliers contributes to reducing the risks faced by farmers. The potato farmers under contract with Frito lay have a higher margin of profit as compared to farmers selling their potatoes to the normal market. Agricultural inputs are provided by these foreign corporate companies.

The NORMS of FDI in agricultural sectors as of present Indian context states that the FDI inflows to Agriculture Services are allowed up to 100% and allowed through the automated route covering horticulture, floriculture, development of seeds, farming, pisciculture, aqua culture, cultivation of vegetables, mushroom and Services related to Agriculture. No FDI is allowed within the Indian Agriculture sector except only in Tea sector where 100% FDI is allowed, however this needs Government of India approvals. 100% FDI is allowed in Agriculture Services.

FDI inflows in various Agriculture Scenario:

1. ***FDI inflows to food processing industries***: Food processing industry may be a predominant segment within the food industry in India and accounts for 32 percent shares within the industry. The food processing industry

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comprises of 2 percent of fruits and vegetables and 15 percent of processed milk. The food processing industry contributes to 6.3 percent of the Gross Domestic Product (GDP) of India, 19 percent to the Indian industry, and 13 percent to the export production. The food processing industry is predicted to witness a growth of 10 percent within the recent years and active measures are being taken by the Govt to ameliorate the food processing units in infrastructure, research and development and human resource.

- One Hundred (100) percent FDI has been permitted in most the food processing units only with the exception of alcohol.
- Enactment of the Food Safety and Standards bill 2005 has introduced an effective administration and new regulations for the food processing sector. This legislation has also allowed a One hundred percent tax write-off in profits for five years and 25 percent for subsequent five years especially for the upcoming agro-processing industries.

2. ***FDI inflows to agriculture Services:*** The FDI Inflows to agriculture services are permitted to 100% and allowed through the automated route covering horticulture, floriculture, development of seeds, farming, pisciculture, aqua culture, cultivation of vegetables, mushroom and Services associated with agriculture and allied areas. Only in Tea sector, 100% FDI is allowed, including, plantations of tea but needs approval from the Govt of India. FDI inflows to agriculture services have also facilitated growth of other allied areas like Irrigation, Roads, Housing, Water system, Electrification and Telecommunication connectivity.

3. ***FDI inflows to agricultural machinery***: The Agrarian sector and rural sector in India have received a positive impact on account of FDI inflows to agricultural machinery. The FDI inflows has resulted in the subsequent development of the Indian agricultural sector. The entire quantum of foreign direct investment within the Indian agricultural machinery was above US$ 185.50 million in the amount from August 1991 to December 2010. This farm mechanization has brought about higher yields and subsequently higher returns to farmers

4. ***FDI inflows to fertilizers industry***: Foreign Direct Investment (FDI) in fertilizers in India is allowed up to 100% under the automated route in India, the entire amount of FDI inflows to Fertilizers industry in India was US$ 78.22 million between August 1991 and December 2005 and the entire percentage of FDI inflows to fertilizers industry in India stood at 0.26% out of the entire foreign direct investment within the country during August 1991 to December 2010.

CONCLUSION

Indian economy has been heavily geared towards the service sector that contributes 56% of your GDP. The Service Sector's contribution to the rise in GDP over the last 5 years has been 63.9%. Having high contribution from Services is an attribute that's characteristic of developed economies. In India, manufacturing contributes a mere 23.1% of the GDP. If India has to grow at 8 to 10% economic rate than our agricultural sector has got to expand. For that to happen there is a requirement for reforms in our agricultural sector. The positive outcomes of FDI are summarized below:

1. The minimum investment limit has been set at US$ 100 million for foreign companies, out of which a minimum of 50 per cent must be incorporated in areas comprising of transportation, distribution, storage, and packaging facilities, and develop farm infrastructure, this would increase the connectivity of the Agrarian sectors of rural India.
2. The various advantages that merged due to FDI inflows to fertilizers industry in India are growth and expansion of fertilizer industry in India and use of improved technology within the fertilizer industry which has resulted in improving the quality of fertilizers significantly.

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3. Often farmers are forced to sell their produce at considerably lower prices due to lack of adequate infrastructure facilities and lack of proper storage facility which sometimes cannot even cover their cost of production, this could be overcome by influx of FDI as they might strengthen the marketing channels removing the role of middle-men and promote higher returns to the farmers throughout the year by efficient storage facilities.
4. It is predicted that permitting foreign investment in agricultural retailing is probably going to ensure adequate inflow of capital into rural economy which will likely promote the welfare of all sections of society, particularly farmers and consumers.
5. The job opportunities in sectors like transportation, packaging, agriculture processing is expected to flourish. According the Govt of India, FDI in retail sector is capable of generating approximately 4 million direct jobs and around 5 to 6 million indirect jobs within a span of 10 years.

The Department of Commercial Policy and Promotion (DIPP) has issued a circular whereby farming pisciculture, aquaculture “under controlled conditions” and services associated with agriculture and allied sectors have also been given 100 per cent FDI along with tea sector. The implementation of the new rules has been from April 1, 2011. As per the defined term the “under controlled conditions’’ for the categories of floriculture, horticulture, cultivation of vegetables and mushrooms is that the practice of cultivation wherein rainfall, temperature, radiation, air humidity and medium are controlled artificially. Control of these parameters could also be carried out through protected cultivation under green houses, net houses, poly houses or the other improved infrastructure facilities wherein microclimatic conditions are regulated manually. The microclimate of poultry breeding farms and hatcheries is being controlled through advanced technologies like incubators, ventilation systems. The pisciculture and aquaculture includes aquariums hatcheries where eggs are artificially fertilized and are hatched and incubated in an indoor environment with artificial climate control. FDI plays a big role in increasing productivity by offsetting the investment and technological gap. However, in recent years, India is losing its attraction as FDI destination. From an edge of 8th rank in 2009 India has fallen to 14th position in recent years in the scale of countries attracting largest FDI, consistent with “World investment report 2011” by United Nations Conference on Trade and Development (UNCTAD). Diverse studies and reports highlight the weakness of India as falling in FDI destination. Thus, Indian policy makers should revamp their efforts to magnetize FDI in agricultural sector improving the conditions of the Agrarian economy.

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Insect innate immunity

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Ipsita Samal
Ph.D. Scholar, Division of Entomology, Indian Agricultural Research Institute, New Delhi, 110012

INTRODUCTION

The innate immune system in insects is composed of a large variety of specific and nonspecific responses that are activated in response to the presence of foreign agents (Santoyo & Aguilar, 2011). innate immunity can be categorised into humoral and cell mediated responses. In humoral response antimicrobial peptides (AMPs) are involved that produce intermediate reactive oxygen & nitrogen species, and by doing so they regulates melanisation of haemolymph and coagulation process. Cellular response includes haemocyte mediated actions such as phagocytosis, encapsulation & nodule formation.

Components of insect innate immunity

Insect innate immune system contains different types of Peptidoglycan recognition proteins (PGRPs). Insect PGRPs are of two types. The first type are amidase enzymes, which directly lyse the infectious foreign microorganisms and reduces its inflammatory activity. The second type of PGRPs evoke signal to activate proteolytic cascades and signal transduction pathways that generate antimicrobial products, induce phagocytosis, hydrolyse peptidoglycan (Dziarski and Gupta, 2006). Like human adaptive immunity, this second type of insect PGRPs have recognition, signalling, and effector functions, all of which are crucial for enhancing antimicrobial innate immunity (Dziarski and Gupta, 2006). But insect PGRPs are able to recognise only a limited number of foreign microorganisms.The recognition of infectious microorganisms in innate immunity is done by the detection of pathogen-associated molecular patterns (PAMPs), which includes lipopolysaccharide (LPS), peptidoglycan (PGN), flagellin and nucleic acids from bacteria, fungi and viruses, which are essential for the microbial survival, but are not found in higher eukaryotes (Yano & Kurata, 2011).

Insects have nineteen types of PGRPs, which protect insects against microbial infections. The first PGRP was discovered in silkworm as a protein that induces prophenol oxidase cascade leading to melanisation and interferes with the bacterial PGN (Dziarski & Gupta, 2006). On the basis of size insect PGRPs are categorised as short PGRPs (PGRP-S) having smaller transcripts and are extracellular proteins, while other are long PGRPs (PGRP-L), which have longer transcripts and are intracellular, extracellular, or membrane-spanning proteins (Dziarski & Gupta, 2006). Thus S & L stands for short transcript and long transcript respectively and A, D, C are different isoforms e.g., PGRP-LC stands for C isoform of long transcript PGRP.

Antibacterial immunity: role of antimicrobial peptides (AMPS)

Antibacterial activity in insects was first observed in the bacteria-immunized pupae of the giant silk moths *Samia cynthia* and *Hyalophora cecropia* and later on in the bacteria-induced *Drosophila melanogaster* adult flies. The first insect AMP (Cecropin) was purified from the larvae of giant silk moth (*Hyalophora cecropia)* in 1980, and since then over 150 insect AMPs have been identified (Yi *et al*, 2014). AMPs play a vital role in antibacterial immunity. Antimicrobial peptides (AMPs) are short cationic molecules that can be classified into three families on the basis of their protein structures and/ or amino acid compositions (Viljakainen, 2015).

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Molecular mechanism of synthesis of AMPS: During microbial infection, Toll like receptor (TLR) and Immuno deficiency (IMD) mediated pathway regulates the synthesis of AMPs. These two pathways exhibit striking similarities with the Toll like receptor (TLR) and Tumor Necrosis Factor-R (TNF-R) of the vertebrates that regulate NF-kB activity during the immune response, thereby suggesting common evolutionary lineage in respect of innate immunity (Tembhare, 2016).

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Glandular trichomes as defense in plants against herbivores

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Kuldeep Sharma[1*] and GN Niranjana[2]
[1]Department of Entomology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan
[2]Division of Entomology, Indian Agricultural Research Institute, New Delhi

INTRODUCTION: Plants employ diverse strategies to resist or evade arthropod herbivores. The plant epidermal surface represents the first barrier for arthropod herbivores and disease-causing pathogens, and these plant surfaces are said to be pubescent bearing trichomes which contribute to plant defense in different ways. This defense may be constitutively expressing or may be induced following attack by the herbivorous arthropods. Trichomes are hair-like epidermal structures present on the aerial parts of a plant. The term deriving from the Greek word “trichos”, which means hair-are, in most cases, not connected to the vascular system of the plant, but instead are extensions of the epidermis from which they originate. Trichomes range in size from a few microns to several centimetres and they exhibit a tremendous species-specific diversity in shape, and, therefore, they are often used as diagnostic characteristics for the identification of plant species. Trichomes are mainly found on leaves and stems, but they can also occur, depending on the species, on petals, petioles, peduncles and seeds. Trichomes can be single-celled or multicellular, but the criterion that is mostly used to classify them is whether they are glandular or non-glandular. Glandular trichomes are usually multicellular, consisting of differentiated basal, stalk and apical cells and can be found on approximately 30% of all vascular plants. Glandular trichomes have in common the capacity to produce, store and secrete large amounts of different classes of secondary metabolites (Fahn, 2000). Non-glandular trichomes are present on most angiosperms, but also on some gymnosperms and bryophytes. On the model plant *Arabidopsis*, only non-glandular trichomes can be found, which are unicellular and can be either unbranched, or have two to five branches. These trichomes are polyploid and have been extensively studied with respect to their development. Many of the specialized metabolites that can be found in glandular trichomes have become commercially important as natural pesticides, but also have found use as food additives or pharmaceuticals. For instance, plants of the Lamiaceae, comprising species such as mint (*Mentha x piperita*), basil (*Ocimum basilicum*), lavender (*Lavandula spica*), oregano (*Origanum vulgare*) and thyme (*Thymus vulgaris*), are cultivated for their glandular trichome which produces essential oils. Moreover, artemisinin, a sesquiterpene lactone that is produced in the glandular trichomes of annual wormwood (*Artemisia annua*), is used for the treatment of malaria. In addition, gossypol and related compounds, which are dimeric di-sesquiterpenes produced by cotton (*Gossypium hirsutum*) trichomes, have strong antifungal and are having potential pesticidal properties. Likewise, the acyl sugars present in tobacco glandular trichomes functions as a dangerous lollipop that tags caterpillars with a distinctive odour that gives the information for predators in locating host (Weinhold and Baldwin, 2011). The presence of methyl-ketones in glandular trichomes of tomato showed resistance to *Heliothis zea* (Dimock and Kennedy, 1983). Apart from these, the presence of phenolics in glandular trichomes of tomato inhibited the larval growth of *Heliothis zea* (Duffey and Isman, 1981).

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Types of Glandular Trichomes:

1) Capitate trichomes: Typically consist of one basal cell, one to several stalk cells, and one or a few secretory cells at the tip of the Stalk. They predominantly produce non-volatile or poorly volatile compounds that are directly exuded onto the surface of the trichomes.

2) Peltate trichomes: Commonly found in mint and basil, consist of a basal cell, one (short) stalk cell, and a head consisting of several secretory cells, which is surmounted by a large sub-cuticular storage cavity. This cavity is formed by separation of the cuticle from the cell wall of the secretory cells and it is filled with the products of the secretory cells, thereby giving these trichomes a characteristic "bulb-like" shape.

Biosynthesis and role of glandular trichome produced compounds: The plant epidermal surface represents the first barrier for pathogens and arthropod herbivores to overcome after arrival on a plant. Therefore, it may not come as a surprise that trichomes density is one of the main factors correlating with resistance to herbivory. The presence of trichomes is however, not always beneficial for the plant, since trichomes may interfere with indirect defense by disturbing natural enemies of herbivores. Trichomes can contribute to plant defense in different ways (Glas *et al.,* 2012)**.** The arthropods may become entrapped in sticky and/or toxic exudates, such as acyl sugars or polyphenols, produced by glandular trichomes. Such polyphenols are quickly formed via oxidation when the contents from the glandular trichome heads are released as a result of insect-mediated rupturing of the glandular cuticle. The entrapped herbivores usually die as a result of starvation or of ingested toxins or, in the case of small herbivores, of suffocation. Alternatively, in some cases trichome-produced toxic compounds are found to be transported via the stalk to distal plant tissues, thereby increasing resistance of these tissues against plant attackers. Glandular trichomes, thus, function as important chemical barriers for plant parasites. The main classes of secondary chemicals that have been found to be produced in trichomes include terpenoids, phenylpropenes and flavonoids, methyl ketones, acyl sugars and defensive proteins. Although all of these compounds play a role in plant defense, both glandular and non-glandular trichomes may have many other functions as well, including attraction of pollinators, protection against UV due the presence of flavonoids and other UV-absorbing compounds in trichomes, temperature regulation and reduction of water loss.

Trichomes as defense in plants against herbivores: Glandular trichomes possess several kinds of defensive product against herbivores such as hormonal regulation of induced defenses in trichomes, terpenes, phenylpropenes, flavonoids, methyl ketones, acyl sugars and defensive proteins are described here.

1. **Hormonal regulation of induced defenses in trichomes:** There are two forms of defense, first is the constitutive defenses, *i.e.*, those defenses that are always present (such as trichomes), and the second are the induced defenses, which are activated or increased upon attack by herbivores or pathogens (such as some parts of the trichome metabolism).Typically, wounding and/or herbivore infestation activates the octadecanoid pathway, resulting in increasing levels of jasmonic acid which triggers the expression of defense genes, such as protease inhibitors (PIs), as well as the accumulation of secondary metabolites, like terpenoids. Besides regulating herbivore-induced defense responses, jasmonic acid is also linked with trichome formation, since jasmonic acid

biosynthesis and reception mutants in the cultivated tomato were shown to have less glandular trichomes while, in addition, herbivore feeding as well as jasmonic acid treatment can give rise to increased trichome densities on newly formed leaves.

2. **Terpenes:** Terpenoids are major components of herbivore-induced volatile blends and they play an important role in the attraction of predators and parasitoids to herbivore-infested plants, a phenomenon known as indirect plant defense. Indirect defenses mediated by plant volatiles have been reported from plant species with glandular trichomes.
3. **Flavonoids:** Flavonoid are similar to terpenes and plays an important role herbivore induced plant protection. These related phenolic compounds are known to inhibit the growth of lepidopteran larvae.
4. **Acyl sugars:** Sugar esters, also called acyl sugars, are nonvolatile metabolites, produced and stored in glandular trichomes of many Solanaceae, including *Solanum, Nicotiana*, *Datura* and *Petunia* species. Acyl sugars may be directly toxic to herbivores, but they are also excellent emulsifiers and surfactants and may easily stick to arthropod cuticles thereby immobilizing or suffocating arthropods. The native tobacco, *Nicotiana attenuata*, known to produces glandular trichomes on both adaxial and abaxial leaf surfaces. These trichomes contain as a minor constituent, nicotine, a secondary metabolite known to inhibit growth even of adapted larvae. O-acyl sugars (AS), viscous liquids that consist of aliphatic acids of different chain lengths esterified to sucrose, are the most abundant secondary metabolites in the glandular trichomes of Solanaceous plants.
5. **Methyl ketones:** It has been found that presence of methyl ketones on trichomes was lethal to several herbivorous arthropods. Major methyl ketones found in plants are 2- heptanone, 2-nonanone, 2-undecanone, 2-tridecanone and 2-pentadecanone. 2- tridecanone have identified as major constituents of type VI trichomes of the wild tomato *Solanum habrochaites* which is lethal to several herbivorous arthropods.
6. **Defensive proteins:** Trichomes produce significant amounts of proteins with defensive functions, such as proteinase inhibitors (PIs), polyphenol oxidases (PPOs) and phylloplanins. PIs can be either constitutively expressed in flowers or induced upon wounding or herbivory in leaves and their trichomes and induced PIs slow down the growth of herbivores upon ingestion probably via inhibition of digestive proteinases in the herbivore gut. PPOs are stored in leucoplasts whereas their phenolic substrates are present in the vacuoles. When the tissue is damaged, for instance by walking herbivores, the PPOs will mix with vacuolar content of the head cell and rapidly oxidize *o*-dihydroxyphenolics to the corresponding *O*-quinones. These quinones, in turn, are highly reactive molecules that covalently bind to nucleophilic -NH2 and –SH groups of molecules such as amino acids and proteins, thereby reducing the availability of essential amino acids to the herbivores and/or the digestibility of proteins. Glandular trichomes may also actively secrete proteins, as shown in cultivated tobacco, where proteins can be deposited on the leaf surface through pores that are present in the cuticle of short glandular trichomes which are reminiscent of tomato type VII trichomes.

CONCLUSION: Glandular trichomes act as a first line of defense against herbivorous insects and pathogens. The tremendous progress in the availability of genomic data has allowed for the discovery of genes in various biosynthetic pathways involved in trichome associated lethal compounds. However, the potentiality of trichome has not been exploited due to complexity in plant secondary metabolism. Furthermore, the future study can be focused on identification of the genes and enhancement of expression of those genes that control the synthesis of these glandular trichomes chemicals. Thus, the glandular trichomes may soon prove to be the ideal vehicles for targeted modification of the versatile secondary metabolism of many plant species to enhance biocide-based protection of crops.

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Agricultural Knowledge and Information System (AKIS): A knowledge and information network for agricultural development

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Ereneus K Marbaniang[1] and Pynbianglang Kharumnuid[2]
[1]SMS (Extension), KVK, West Khasi Hills, Nongshillong, Meghalaya
[2]Scientist, ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh

INTRODUCTION

In today's world, technology plays an important component in our everyday life and is much useful for fulfilling our daily needs and requirements, say smartphone, TV, washing machine, oven, suction pump cleaner, AC, etc. Technology is very much useful and becomes a boon even in educational institutions using audio-visual aids for higher learning and also in various service and manufacturing sector, so similarly as in the case of agriculture which is being used by the farming community in different farm operations from seed technology, farm machineries, post-harvest techniques to market artificial intelligence, etc. But if we see the widespread of agricultural technologies to the farming community as compared to other technologies, the technology adoption rate of the farmers is very low. The government over the years through their line department, research institutes and different extension institutes have played a tremendous effort in transfer of farm technologies using the different extension methods, extension approach but still the growth in adoption rate is very low. The possible few reasons for low adoption rate may be researchers and others have not invested enough time and energy in developing and marketing their ideas, concentrating activities in areas that are not a priority for producers. Producers on the whole are too traditional and conservative to adopt new ideas and symptoms of a deeper problem which is that producers have not been sufficiently involved in the research and development process. A time has come that we need to sensitize the real problem regarding adoption of technologies by the farmers which could be possibly solved through the cooperation and participation of various stakeholders using latest information technology. The AKIS concept is developed and popularized during the 1980s by Roling. The concept of AKIS is that research and extension should not be seen as separate institutions but must have a linkage with one another for the betterment of the farmers.

Need for AKIS:

The AKIS concept has gained popularity from the mid 90's and in recent years. AKIS combines agricultural research, extension and education in one system to form a knowledge triangle so that these three components could generate new knowledge and information for farmers. The emphasis in this model is very much on the linkages between the different components.

Definition of AKIS:

Röling (1986) defined AKIS 'as a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in such processes as the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergically to support decision-making, problem solving and innovation in a given country's agriculture'.

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According to FAO/World Bank (2000), AKIS links people and institutions to promote mutual learning and generate, share and utilise agriculture-related technology, knowledge and information. The system integrates farmers, agricultural educators, researchers and extension personnel to harness knowledge and information from various sources for better farming and improved livelihoods.

An AKIS can be defined in three different ways:

i. As sets of organizations and people engaged in knowledge and information processes; ii. sets of coherent cognitions that have evolved among members of organizations, communities or societies; and iii. a computer-based ‘intelligent’ software (for example, expert systems, artificial intelligence). (Anandajayasekeram *et.al*.,2008)

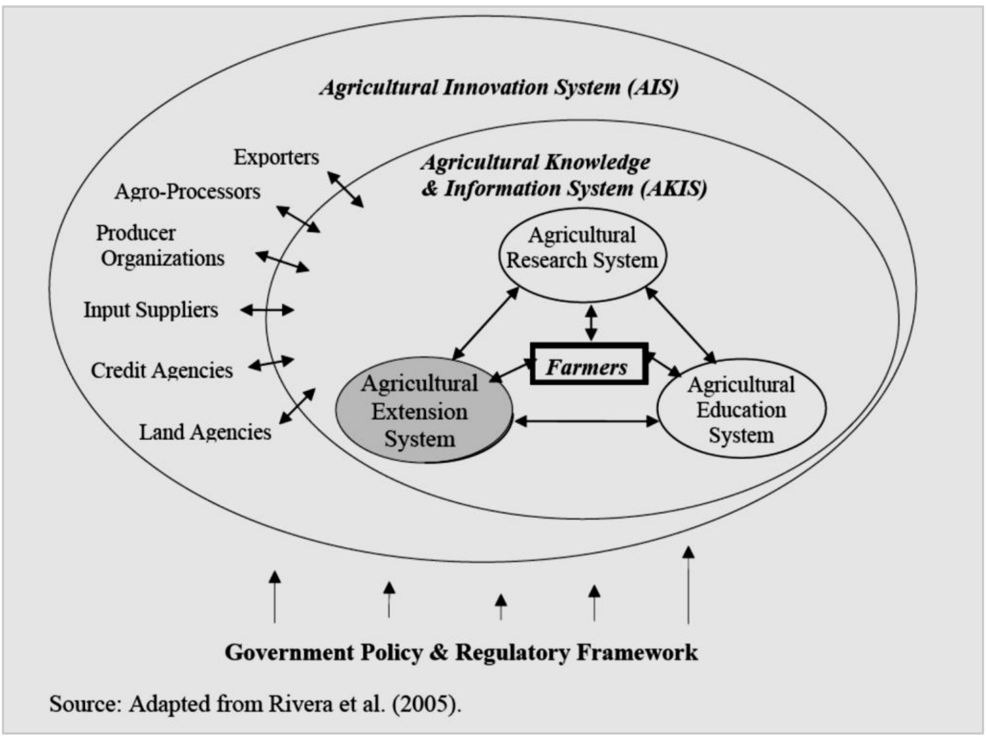

Figure 1: Agricultural extension as component of an agricultural knowledge and innovation system.

Importance of AKIS:

Knowledge generation appears to be more effective when carried out in groups than when attempted by individuals. AKIS knowledge processes helps in decision making and problem solving.

Figure 2: AKIS knowledge processes

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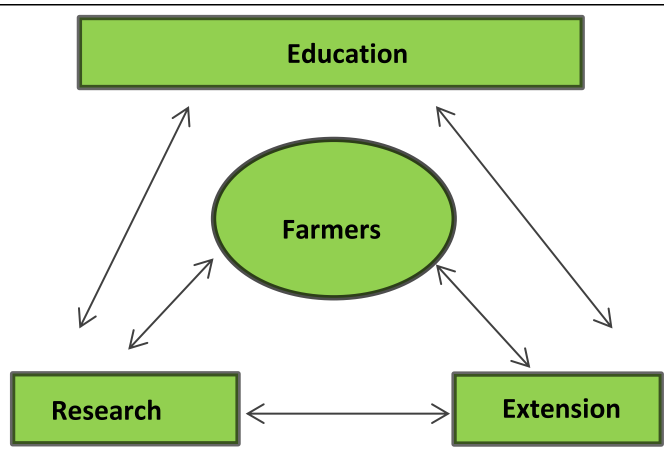
The transformations taking place within an AKIS are as follows:

1. From information on local farming systems to research problems
2. From research problems to research findings
3. From research findings to tentative solutions to problems (technologies)
4. From technologies to prototype recommendations for testing in farmers' fields
5. From recommendations to observations of farmer behaviour (male, female, children)
6. From technical recommendations to information affecting service (inputs and marketing) behaviour
7. From adapted recommendations to information dissemination by extension
8. From extension information to farmer knowledge. (Anandajayasekeram *et.al*.,2008)

AKIS model:

When modelling the AKIS, it is important to bear in mind that the system takes its place in a larger context, from which it is not separate (see Figure 3). Agricultural knowledge and information processes must be examined at a national level against the backdrop of: (1) the policy environment, which formulates the laws and incentives that influence agricultural performance; (2) structural conditions, such as markets, inputs, the resource base, infrastructure and the structure of farming; (3) the governance structure through which interest groups influence the system; and (4) the external sector, comprising donor agencies, international agricultural research centres (IARCs) and/or commercial firms (Elliott 1987).

<table>
<tr><td></td><td>Policy environment
Laws
Incentives</td><td></td></tr>
<tr><td>Governance structure</td><td>
</td><td>External sector

International agricultural research centres

Commercial firms

Donor agencies</td></tr>
<tr><td></td><td>Structural conditions
Markets
Inputs/outputs
Resource base
Infrastructure</td><td></td></tr>
</table>

Figure 3: The AKIS as part of a larger system. (Elliott, 1987)

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CONCLUSION

An effective AKIS requires the input of information, sharing of information among the partners. The healthy organisational climate is of much importance which is free from personal ego with the organizational motives. There must a linkage, convergence programmes among different components to understand each other's strengths and weakness and also their defined roles.

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Farm Automation; The future of Modern farming

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Hema . P
Assistant Professor, Dept. of Agricultural Extension, Imayam institute of Agriculture and Technology, Affiliated to TNAU, Thuraiyur, Trichy – 621206.

INTRODUCTION

The development of agriculture was a watershed moment in humanity. Humans ability to engineer the environment to generate enough food to sustain massive population growth was the first profound change in the relationship between fully-modern humans and the environment. The advent of agriculture kick started a wider range of advancements from the use of fire and prepared food to self-driving machinery. With a global population projection of 9.7 billion people by 2050, agricultural production will need to increase by at least 70% from current levels to serve nutritional trends.

Agriculture has moved us forward us so far in 12,000 years, but we are now at a turning point. And with a global population projection of 9.7 billion people by 2050, agricultural production will need to increase by at least 70% from current levels to serve nutritional trends. Now more than ever, the pressure on farmers to produce nutritious products is putting our planet's health under even more stress.

New advancements in technologies ranging from robotics and drones to computer vision software have completely transformed modern agriculture. Farmers now have access to tools that will help them meet the demands of our world's ever-increasing population.

What is farm automation?

Farm automation, often associated with "smart farming", is technology that makes farms more efficient and automates the crop or livestock production cycle. An increasing number of companies are working on robotics innovation to develop drones, autonomous tractors, robotic harvesters, automatic watering, and seeding robots. Although these technologies are fairly new, the industry has seen an increasing number of traditional agriculture companies adopt farm automation into their processes.

What technologies are being used in farm automation?

The primary goal of farm automation technology is to cover easier, mundane tasks. Here are some major technologies that are most commonly being utilized by farms.

Cropping Sensors

Almost centuries Indian farmers follow a set of prescribed manual or guideless during fertilizer application and spraying. The local agri university or research agencies give farmers information on the dosage and method of application which is common to all farms and farmers.The evolution of crop sensors is going to change this scenario.

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Sensors tomorrow are going to provide site-specific information on the exact amount of nutrient required for a farm. This will save a lot of fertilizers and also conserve the precious soil resources.

Farming Vertically

Skyscrapers in agriculture are going to be the future in increasing farm output per area. With depleting soil fertility levels and increasing urbanization, land for farming tomorrow is going to be costlier than before. This means that food is going to be costlier and not affordable to common people.To avoid this situation, the vertically farming technique using soil-less medium and using artificial lights are the future. This technique will reduce cost, produce more, protect crops from bad weather and ultimately produce food which is safe and healthier.

Agri Robots

Soil preparation, weeding, inter-cultivation, fruit harvesting are soon going to be auto. The agri robots are going to replace the manual labors and will automate agricultural processes.

Robotic Swarms

Just imagine hundreds of agri robots embedded with sensors collecting real-time information on farms. The data collected are shared to cloud and automatic reports are generated in terms of excess moisture, nutrient deficiency and many more insights of the farm.

Automatic Tractors

Self-driving tractors which are GPS enabled will help reducing human errors in farming which are very relevant today. In Indian context where more than 90% of the farms are small and scattered driving a tractor requires certain skillset. With increasing urbanization, the demand for tractor driver is extraordinary in rural India. Self-driving tractors can solve this problem and farmers can navigate them remotely. All major tractor companies like New Holland, John Deere and Mahindra are investing in this technology. Who knows soon Indian farmers might be using remote controlled tractors in the farms.

Fitness trackers for cows

Fit bits have revolutionized human fitness, in the same path a start-up in India (StellApps) has introduced fit bits for cows. This technology used the IoT features in tracking a cow’s sleeping time, eating and lameness period in helping farmers to take informed decisions.

Big data in farming

Collection of huge chunks of farming data, interpretation of the data and taking real time decisions will enable faster growth in agriculture. Data analytics and informed decision making will ensure greater levels of consistency, reliability, and accuracy.

Information such as plant height and correlation with plant lifetime can provide insightful information in terms of an amount of care it needs to be taken to a particular farm.

Advantages of farm automation

Farm automation technology addresses major issues like a rising global population, farm labor shortages, and changing consumer preferences. The benefits of automating traditional farming processes are monumental.

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Consumer Benefit

Consumers' preferences are shifting towards organic and sustainably-produced products. With automation technology, produce reaches consumers faster, fresher, and more sustainably. Increase in productivity from automation increases the yield and rate of production, therefore reducing costs for consumers.

Labor Efficiency

Labor is over 50% of the cost to grow a farm and 55% of farmers say they are impacted by labor shortages. Because of this, 31% of farmers are moving to less labor-intensive crops. However, there is huge potential with harvest robots. Routine tasks can be automated with robotics technology, reducing labor costs and manpower needed amidst a labor shortage in the agriculture industry. A single strawberry robot harvester has the potential to pick a 25-acre area in 3 days and replace 30 farm workers.

Reduced Environmental Footprint

Farm automation practices can make agriculture more profitable while also reducing the ecological footprint of farming at the same time. Site-specific application software can reduce the amount of pesticides and fertilizer used while also reducing greenhouse gas emissions.

Challenges of farm automation

Still, there are challenges of farm automation that must be overcome. High costs to adopt robotic technologies present a huge barrier to entry for farmers, especially in developing countries. For example, robotic planters must carry water or pesticides with significant weight; the hardware must be built differently, which results in higher costs to make it a larger size. Technical issues and breakdown of equipment also present high costs to fix for such specialized equipment. In order to fully utilize farm automation, farmers will need to combine their knowledge and experience with these new technologies.

CONCLUSION

We are only at the early stages of farm automation technology, but it will be able to transform agriculture. It offers a path towards sustainable and more efficient agriculture by advancements of technologies, production systems, and software. Every year, automation technology becomes more sophisticated, and what was cutting-edge just a few years ago will become commonplace and cost-effective soon. The human element will always be a fundamental aspect of managing a farm, but fully autonomous vehicles and farm equipment are coming.

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Role of green manuring in sustainable agriculture

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***V. Hariharasudhan[1]**
[1]Teaching Assistant (Agronomy), Institute of Agriculture, Kumulur, Trichy- 621712.

The beneficial effect of green manuring in crop production has been known since ancient time. Green manure mainly for soil ameliorating in recent years because of high cost of chemical fertilizers, increased risk of environmental pollution, and need of sustainable cropping systems. This practices improve soil physical, chemical, and biological properties and consequently crop yields. Green manuring reduced nitrate leaching risk and lower fertilizer N requirements for succeeding crops. Green manuring is best alternatives toimprove soil health and meet the nutritional need of succeeding crop. Addition of organic matter is essential for replenish the loss of nutrients, which is necessary for keeping the soilhealth in good condition by enhancing the supply of nitrogen and by promoting the growth ofmicroorganisms. Green manuring possibly will best serve this purpose with number of advantages.

Green Manuring

Green manuring is the plough and turning into the soil undecomposed green plant tissue for the purpose of improving soil fertility and productivity. It increases the soil fertility bythe direct addition of nitrogen and also improves the soil structure, water holding capacity andmicrobial population of soil by the addition of humus or organic matter. The crop generally used for green manuring is dhaincha though the cultivation of sun-hemp and guar. Leguminous crops should be preferred as a green manure crop since it adds a lot of nitrogen into soil due to *Rhizobium* symbiosis. The incorporation leguminous crops producing 8 to 25 tonnes of green matter per ha will add up about 60 to 90 kg of nitrogen/ha, thatis equivalent to an application of three to ten tones of farmyard manure on the basis of organicmatter and it's nitrogen contribution. *Rhizobium* fix the nitrogen in association with leguminous plants which result in meeting the nitrogen demand of the crop. *Rhizobium* culture ensure adequate nitrogen supply for legumes (cowpea, green gram, black gram, pea, chickpea, groundnut, soybean, berseem, subabul) in place of N fertilizer and observed that *Rhizobium* can fix 50-300 kg N/ha.

Characteristics of an ideal green manure crop

Green manure crops should have following characteristics

- Deep rooting system, facilitating nutrient mining from subsurface soil.
- Lower water requirement.
- Fast growing to produce abundant biomass.
- The biomass produced should have low fibrous material to facilitate quick decomposition.
- High capacity to fix atmospheric nitrogen.

Commonly used crops for green manuring in our country are Sunn hemp (*crotolaraiajuncea*), Dhaincha (*Sesbania aculeate*), senji (*Melilotus parviflora*), berseem (*Trifolium alexandrinum*) etc. Sunhemp is is well suited in almost all parts of the India; it also fits in well with the sugarcane, potato and the second season paddy in southern states of India and irrigated wheat in Indo Gangetic Plains. Dhaincha crop is grown well in the waterlogged and alkaline soils.

Sowing and Fertilization of Green Manure Crop

Green manure crop can be sown in May to June and incorporated in July. Wheat fields in the north India can be green manured with sunhemp, dhaincha, cowpea, green gram, black gram, etc. Normally higher seed rate is recommended for green manuring. Fertilization of green manures with phosphatic fertilizers can be done by broadcast, because it

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improves theavailability of phosphorus to the succeeding crop as compared to phosphorus applied to succeeding crop.

Age of Incorporation

Green manure crop should be incorporated into soil at proper time of age to get maximum benefit. It should be turned into soil at before flowering stage, which is about 7-8 weeks after sowing. Dhaincha attain maximum growth is 7-8 weeks after sowing, while sunnhemp crop flower around 8-10 weeks after sowing. Eight week old green manure crop is succulent enough to be turned into soil for best response in paddy. Various reports conclude that a green manure crop should be turned under at 7 to 8 week, which coincides with flowering and maximum growth stage for most of the green manure crops.

Time Interval between Burial of Green Manure Crop And Sowing of Next Crop

The time interval between the ploughing down of green manure crop and the sowing of the next crop depends on (i) Weather conditions and (ii) Nature of the buried green material. The warm and humid conditions favor rapid decomposition of plant material. If the green manure crop issucculent, then paddy transplanting can be done immediately after turning over of the greenmanure crop. In case of the woody plant material, sufficient time interval should be allowed forproper decomposition of green plant material before paddy transplanting, e.g. when succulent green manure crop of around 8 weeks to be buried then paddy can be planted immediatelywithout having any adverse effect on the yield. But when dhaincha become woody (12 weeks), it is necessary to bury it about 6 to 8 weeks first before transplanting paddy for its proper decomposition.

Advantages of Green Manuring

- They absorb nutrient from the deep depth of soil.
- The green plant material buried stimulates the activity of the micro-organisms inhabitant to the soil.
- They respire and decompose the organic matter CO_2, which help in producing carbonic acid. The carbonic acid decomposes the soil minerals to release plant nutrients bind in them green material on decomposition also produces certain organic acids which enhance the availability of certain plant nutrients like P_2O_5, Ca, K_2O, Mg and Fe.
- It absorbs nutrients from the soil and protects them against leaching.
- It improves the soil structure, moisture holding capacity and infiltration of water, thusdecreasing the runoff and erosion.
- Green manuring with leguminous plants, like sun hemp, dhaincha, barseem, etc fixatmospheric nitrogen to the soil that becomes available to the succeeding crop.

CONCLUSION

Green manuring technology is an importance due to increasing emphasis on soil health,minimize environmental pollution and cut down the use of chemical in agriculture and restores soil fertility. Therefore,it is an eco-friendly low cost technology to conserve the natural resources besides maintaining environmental quality in a sustainable manner.

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Study of Soil Biological Activity by Estimation of Soil Microbial Biomass Nitrogen by Fumigation Extraction method

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Arti R. Gabhane, Sagar N. Ingle Chetna S. Kumbhar, and V. H. Jadhav
Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi vidyapeeth Akola

As soil microorganisms play an important role in the retention and release of nutrients and energy any attempt to assess nutrient and energy flow in soil systems must take into account the role of soil microbial biomass. To ascertain the same through direct observation methods like colony counting method have certain disadvantages like: time consuming, data difficult to interpret as variation is large and often erratic, distinction between live and dead organisms is often difficult. Uncertainly that all organisms actually present have been counted.

Principle: A more easily applicable, non-subjective and replicable method is described here for total microbial biomass nitrogen determination in soil samples at a particular point of time. In the fumigation-extraction method, a direct measurement of N and other nutrients contained therein in microbial biomass is carried out. Overnight fumigation with chloroform is carried out to kill all the organisms in soil samples. The microbial biomass constituents released by $CHCl_3$ fumigation treatment can be extracted directly through chemical extractants. The readily oxidizable C contained in the extractant can be measured through standard chemical procedures.

The methods are based on some underlying assumptions as follows:

- Nitrogen in dead organisms is more rapidly mineralized than in the living organisms
- Fumigation leads to a complete kill.
- Death of organisms in the non-fumigated soil is negligible compared to that in fumigated SOIL.
- The only effect of soil fumigation is to kill the living biomass.
- The fraction of dead biomass N mineralized over a given time period does not differ in different soils.

Materials:

- Moisture box, glassware and Whatman No. 1 filter paper

Reagents:

- Distilled chloroform
- Standard H_2SO_4 (0.02 N)
- Boric acid solution (2%)
- Mixed indicator (bromocresol green 99 mg +methyl red 66mg in 100ml ethanol
- Strong NaOH(40%) 40 g NaOH in 100 ml distilled water

Instruments:

- Vacuum desiccator/ Vacuum pump
- Nitrogen digestion and distillation unit

Procedure:

- Put soil sample after collection in plastic bag to prevent drying due to evaporation. Do not dry the sample. Analyze soil samples the same day they are received in the laboratory.
- Weigh five sets of 10 g soil for each sample. keep one set in the moisture box after taking weight of the empty box. Keep the box in the oven at 100 ^{0}C for 24 h or until constant over dry weight is achieved. Weigh the dry soil along with the box after cooling it in desiccator and calculate the gravimetric moisture content of the soil.

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- Out of the remaining four sets of the soil, keep two sets in 50 mL beakers for fumigation. Remaining two sets are packed and kept in refrigerator for extraction next day.
- Keep the required volume of ethanol free chloroform in 100mL beakers. Do not keep more than 40 mL in each beaker to avoid splash while boiling.
- Line the inner surface of the desiccator with moistened filter paper above it chloroform containing beaker above it vacuum sheet and then soil sample beaker place it . Do not use plastic desiccator. Use high-density silicon vacuum grease at the lid-joint to ensure proper sealing. Use a rubber tube to direct the exhaust through water.
- Put on the vacuum pump and keep it on until the chloroform boils for about five minutes. Close the outlet and put the desiccator in dark for 24 h
- After 24 h release the vacuum, take out the beakers containing chloroform and the inner paper lining. Perform back suction for five to six times to ensure removal of any excess chloroform vapors.
- Take the non- fumigated soil sample from fridge and thaw it.
- Transfer both the fumigated and non-fumigated soils in digestion tube.
- Pipette out 10 ml of boric acid solution into 100 ml beaker containing mixed indicator, place the beaker below the condenser so that the tip of the condenser dip in the solution.
- Pipette an aliquot (usually 10 ml) of digested acid extract into a distillation apparatus, funnel is washed with 2-3 ml of distilled water and add 10 ml of 40 % NaOH solution and carry out the distillation.
- When all the ammonia is evolved stop distillation and titrate the distillation with standard H_2SO_4 till the colour changes from green to red.

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Soil solarisation and weed management

Article id: 23445

Prayasi Nayak[1] Somanath Nayak[2]
1. PhD scholar, Deptt. Of Agronomy, GBPUAT, Pant nagar
2. PhD scholar, Division Of Agronomy, IARI, New Delhi

INTRODUCTION

Weeds have become one of the major deterrents in the development of sustainable intensive agriculture systems. Weed menace in agricultural field is ever increasing in spite of constant efforts to get rid of it. Weeds by their manifold harmful effects on the growing crop plants and interference with land uses, ranked prime enemies in crop production. The annual global loss due to weeds has been estimated to be 1980 crore rupees and accounts for 33 per cent yield loss (Gautam and Mishra, 1995). Dormancy and longevity of weed seeds are natural mechanisms for the perpetuation of weed species on account of which it is impossible to deplete the soil weed seeds completely. There is a tendency to regard weeds as an unavoidable problem in the farming.

Weed control by mechanical and cultural means have some limitations as they are laborious, time consuming and expensive. Besides, these methods are employed only after the crop attained certain stage of growth, by this time the weed would have also grown sufficiently to cause damage to the crop plants by depriving them of nutrients, moisture and space. Chemical weed control although is one of the effective methods, there has been a growing apprehension among ecologists about the use of chemicals which have plagued with problems such as pollution of environment, development of weed resistance and above all is depend on fossil fuel. Hence, there is a need for developing eco-friendly alternate methods of weed control. Consequently, researchers in their search for new methods also took interest in some of the traditional practices with a hope of evolving a much efficient tool of weed management. The time demands that the new method besides, being efficient, economically viable, ecologically sound and acceptable to the users and environmental friendly. In this direction soil disinfection through soil solarization offers greater potentialities.

The possible mechanisms of weed control by soil solarization are direct killing of weed seeds by solar heat, indirect microbial killing of weed seeds weakened by sub-lethal heating, killing of seeds stimulated to germinate in the moist mulched soil and killing of germinating seeds whose dormancy is broken. Basically, all these are caused due to raising of soil temperature to lethal levels. Soil solarization being a integrated system aiming mainly for weed management besides, it also targets soil borne disease control and also serves as a novel means to obtain higher yields with enhanced quality through better input use efficiency towards sustainable agriculture. Various terms used to describe the method of solarization are solar heating, plastic or polyethylene tarping, plastic or polyethylene mulching and solar pasteurization. Solarization is a technique, wherein the control of weeds is made through the use of tarps for capturing solar energy by transparent polyethylene sheets. The use of plastic materials proved promising both on experimental and commercial basis. Hence, soil solarization, a preventive measure could be an efficient and non-hazardous option. '**Soil Solarization**' is a "method of heating the surface soil by using plastic sheets placed on moist soil to trap solar radiation and there by increase the soil temperature". This method is nonhazardous to the user and the environment can be kept cleaner as it is dependent on renewable source of energy. "Soil solarization is a method of heating the surface soil by using plastic sheets placed on moist soil to trap solar radiation and there by increase the soil temperature"

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Solarization Material

- ✓ **Transparent polyethylene films are more efficient in trapping solar radiation than black polyethylene**
  - ❖ Low cost
  - ❖ High strength
  - ❖ Maximum transmittances of solar radiation
- ✓ **Thinner films are more effective for solar heating than thicker films**
  - ❖ Less expensive
  - ❖ Better radiation transmittance

How soil solarization controls weeds ?

- o Direct killing of weeds by solar heat
- o Indirect microbial killing of weakened weed seeds
- o Killing of seeds stimulated to germinate in the moist mulched soil
- o Killing of germinating seeds whose dormancy is broken

How soil solarization is done ?

- ❖ Field should be properly ploughed
- ❖ Good seed bed is prepared
- ❖ Irrigate the field and bring to field capacity
- ❖ Cover seed bed with thin transparent
- ❖ Polyethylene sheetsmaintain minimum space between the sheet and soil
- ❖ Good insulation to avoid the escape of heat generated inside

Solarization Technique: Soil solarization is recommended to be done for 4-6 weeks during warm months of the year. The soil to be solarized must be worked up to good seed-bed condition by cultivating the soil until it is loose and friable with no large clods or other debris in the soil surface as they create air pockets, which, reduces heating of the soil and keep the tarp from fitting tightly over the soil surface. A clean, flat surface will also prevent the accidental puncturing of the thin plastic mulch by debris. Adequate moisture level (up to field capacity) for working the soil before laying the plastic tarp is essential. If the soil is dry, irrigating the areas to be solarized is required before covering the sheet, since most weeds are more sensitive to high temperatures in wet soil than in dry soil. Results of the experiment conducted at UAS, Bangalore indicated that soil moisture upto FC was essential for achieving higher soil temperature and reduced weed infestation followed by irrigation upto 50 % FC. Then dig a shallow trenches all around the bed or plot at 6-8 inches deep. When the soil bed is ready for tarping two edges of polyethylene sheets of thickness 100-200 gauge or 0.025-0.05 mm should be inserted into the furrows and covered and tarped air tightly by maintaining minimum gap between polyethylene sheet and the soil surface. Soil solarization in nursery beds can be done manually. In the fields, soil solarization can be done either manually or by using improved machinery. Any damage to polyethylene sheets should be sealed at the earliest. Entry into plots covered with polyethylene sheet should be avoided to the extent possible. If entry is necessary, such as for sealing leaks, bare feet or smooth-soled shoes are preferable.

Mechanized mulching can be done either by separated beds (strip mulching) or by Continuous mulching. Most machines used for strip mulching operate on similar principles. Two discs (or flippers) open two trenches on either side of the strips. The plastic film is unrolled behind the machine, and its edges are deposited into the trenches

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by two guiding wheels. Which are also used to stretch the film outward and covering discs returns the soil to the trench.

A whole field mulching requires a continuous mulching machine which is designed to unroll narrow film strips, each of which is anchored to the soil at one side and the other side connected to another plastic sheet laid on the previous pass. While traveling, a new sheet is unrolled. One edge of the newly unrolled sheet is embedded in the soil, while its other edge is glued or fused to the previously laid one. (Reddy 1998)

Solarization in orchards create discontinuities in the field so that application of continuous mulch can be done only manually. The procedure is to cut the sheet to surround the tree trunks or the poles. The film is held in place, where overlapped, with soil wind rows that are applied manually. An improved technique, without cutting the film, is also used. A trench is opened along the line of obstructions. One plastic sheet is unrolled to one side of the trees and a second sheet is placed from the opposite side, around the obstructions. One edge of each sheet is buried and the upper sheet is then opened.

Effect on weed emergence : Due to elevated temperature in soil following solarization treatment it results in reduction in the population of weeds. The response to solarization in weeds varies with weed species. Soil solarization was most effective at controlling broad-leaved weeds than sedges and grasses.

Types of weeds controlled : The first sign of an effective soil solarization treatment could be seen by the amount of weeds grown in the treated plots. Soil solarization is effective in controlling most of the annual weeds however, the perennials, such as *Cynodon dactylon*, *Cyperus rotundus*, and *Convolvulus arvensis*, gradually recovered. Several studies over many years have revealed that many rainy and winter season annuals are susceptible to soil solarization. The dominant weeds viz, *Trianthema monogyna, Dactyloctenium aegyptium, Acrachne racemose, Digera arvensis, Echinochloa colona, Eleusine indica,* and *Commelina* spp. in rainy season and *Avena ludoviciana, Phalaris minor, Chenopodium album, Rumex dentatus Fumaria indica,* etc. of winter season were highly sensitive to solarization treatment. However, *Cyperus rotundus, Melilotus indica* and *Convolvulus arvensis,* were tolerant; though the seed-borne sedges were highly susceptible. The survival of *Cyperus rotundus* tubers in the soil has been attributed to heat resistance of the tubers Soil solarization controlled *Orobanche* by 90 % in Israel (Jacobsohn *et al.,* 1980).

The overall effect is best in crops, which form quick canopy cover. Otherwise, slow growth of crop plants may give way for weed seeds, which have escaped solarization treatment. Although the density of weeds is substantially reduced due to solarization, their increased biomass may seriously interfere with crop growth and yield. Under such circumstances, a low-energy input manual weeding or chemical would prove highly beneficial and cost-effective (Yaduraju, 1993).

Effect on weed seed bank : The reserves of dormant weeds in agricultural soils provide a source of seeds for persistent weed problems that often require repeated control measures. A reduction in the number of dormant weed seeds in the soil should also correspondingly reduce weed persistence and weed control requirements. Hence, soil solarization would be desirable as a means of reducing the dormant weed seed reserves in the soil. However, solarization was not effective in eliminating dormant weed seeds from the germination zone. The treatments killed non-dormant seeds and greatly reduced the number of weed seedlings that otherwise would have emerged (Egley, 1983).

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CONCLUSION

Innovative approaches to control the pests including weeds are in great demand around the world, particularly those which are cost effective and less harmful to environment. The search for such new control methods which are effective and economic and have minimal undesirable side effect is a continuous process. In recent years, with increased concern regarding the hazards of chemicals to the environment, interest in nonchemical approaches, which aim to reduce pesticide usage is growing. In this light harvesting of solar energy through soil solarization for controlling soil-borne pests including weeds, pathogens and nematodes will be the key preposition to reduce the dependency on chemicals, besides large number of side effects for improving the use efficiency of different input and reducing the labour drudgery and machineries.

Soil solarization is certainly not the "magic bullet" for which farmers have been hoping. However, it is a useful non-chemical and eco-friendly tool that can be integrated into the pest management program. Various researchers have recommended soil solarization for weed control besides improving the efficiencies of different inputs of crop production.

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Important diseases of citrus and their management

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Samir B. Zade
Assistant Professor, Department of Plant Pathology,
CSMSS, College of Agriculture, Kanchanwadi, Aurangabad (MS) – 431011

INTRODUCTION:

Citrus is important fruit crop in india. In citrus there are number of diseases are their.There are varoius diseases cause by fungus , bacteria and viruses and other pathogens are attacks on citrus plant, due to this pathogen the total yiled of crop also reduces. So in this topic we are discusing the varoius diseases of citrus tree there symptoms and there management. Following are the diseases of citrus and there management.

1. *Phytophthora parasitica, P. palmivora, P. citrophthora*

Disease symptoms:

- The symptoms appear as yellowing of leaves, followed by cracking of bark and profuse gumming on the surface.
- The main source of infection is infected planting material. As a result of severe gumming, the bark becomes completely rotten and the tree dries owing to girdling effect.
- Prior to death, the plant usually blossoms heavily and dies before the fruits mature. In such cases, the disease is called foot rot or collar-rot.

Pathogen

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

Favourable conditions

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

Mode of spread and survival

Soil inhabitants, Sporangia spread by splashing rain water, irrigation water and wind.

Management

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

2. Scab/Verucosis : *Elsinoe fawcetti*

Symptoms

- The lesions in early stages appear on the underside of the leaves as small semi-translucent dots, which finally become sharply defined pustular elevations.
- In later stages, leaves often become distorted, wrinkled, stunted and deformed. On the fruit, lesions consist of corky projections, which often break into scabs.

- The opposite surface corresponding to the warty growth shows a circular depression with a pink to red center.

Pathogen

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

Mode of Spread and Survival

The pathogen survive in off season as ascospores and spreads through Conidia.

Management

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

3. Canker : *Xanthomonas campestris* pv *citri*

Symptoms

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

Pathogen

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

Favourable conditions

Free moisture for 20 minutes, 20-30°C.

Mode of survival and spread

Wind and rain splashes. Survives in infected leaves for 6 months.
Injury caused by leaf miner helps the entry of the bacterium.

Management

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

4. Tristeza or quick decline : *Citrus tristeza virus* (CTV)

Symptoms

- Lime is susceptible both as seedling or buddling on any root stock.
- But mandarin and sweet orange seedlings or on rough lemon, trifoliate orange, citrange; Rangpur lime root stocks tolerant; susceptible root stocks are grapefruit and sour orange.
- In sweet orange or mandarin on susceptible root stocks, leaves develop deficiency symptoms and absise.
- Roots decay, twigs die back. Fruit set diminishes; only skeleton remains.
- Fine pitting of inner face of bark of sour orange stock.

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- Grapefruit and acid lime are susceptible irrespective of root stock. Acid lime leaves show large number of vein flecks (elongated translucent area).
- Tree stunted and dies yield very much reduced.
- Fruits are small in size. Use of infected bud wood and *Toxoptera citricida* (aphid) is the important vector.

Pathogen

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

Mode of spread

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

Management

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

5. Exocortis of scaly butt: *Viroid*

Symptoms

- Affects only Rangpur lime, trifoliate orange and citrange root stocks.
- Vertical cracking and scaling of bark in the entire, root stock.
- Extreme stunting of plant.

Pathogen

Viroid is free RTVA without protein coat.

Mode of Spread and Survival

Transmission normally occurs through infected bud, wood, and contaminated tools. Not through vector and seed.

Management

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

6. Greening: *Liberobactor asiaticum* (Phloem limited bacteria)

Symptoms

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

Pathogen

Rickettsia like organisam

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Mode of spread

Infected budwood; psyllid vector-*Diaphorina citri*

Management

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

CONCLUSION:

By using different methods of disease control we can control the total yield losses in citrus crop.

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Diseases of wheat and their management

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Samir B. Zade
Assistant Professor, Department of Plant Pathology,
CSMSS, College of Agriculture, Kanchanwadi, Aurangabad (MS) – 431011

INTRODUCTION

Wheat is an important food grain crop. There are number of pathogens are infects the wheat plant. Following diseases are mostly found on wheat crop which causes heavy losses in yield of the crop.

1. Black or stem rust - *Puccinia graminis tritici*

Symptoms

- Symptoms are produced on almost all aerial parts of the wheat plant but are most common on stem, leaf sheaths and upper and lower leaf surfaces.
- Uredial pustules (or sori) are oval to spindle shaped and dark reddish brown (rust) in color. They erupt through the epidermis of the host and are surrounded by tattered host tissue.
- The pustules are dusty in appearance due to the vast number of spores produced.
- The color of the pustule changes from rust color to black as teliospore production progresses.
- If a large number of pustules are produced, stems become weakened and lodge. The pathogen attacks other host (barberry) to complete its life cycle. Symptoms are very different on this woody host.

2. Brown or leaf rust - *Puccinia triticina (P. recondita)*

Symptoms

- The most common site for symptoms is on leaf blades, however, sheaths, glumes and awns may occasionally become infected and exhibit symptoms.
- Uredia are seen as small, circular orange blisters or pustules on the upper surface of leaves.
- Orange spores are easily dislodged and may cover clothing, hands or implements.
- When the infection is severe leaves dry out and die. Since inoculum is blown into a given area, symptoms are often seen on upper leaves first.
- As plants mature, the orange urediospores are replaced by black teliospores. Pustules containing these spores are black and shiny since the epidermis does not rupture.
- Yield loss often occurs as a result of infection by *Puccinia recondite* f. sp. *tritici.*
- Heavy infection which extends to the flag leaf results in a shorter period of grain fill and small kernels.

3. Yellow or stripe rust - *Puccinia striiformis*

Symptoms

- Mainly occur on leaves than the leaf sheaths and stem.
- Bright yellow pustules (Uredia) appear on leaves at early stage of crop and pustules are arranged in linear rows as stripes.
- The stripes are yellow to orange yellow. The teliospores are also arranged in long stripes and are dull black in color.

Pathogen

The uredospores of rust pathogen are almost round or oval in shape and bright orange in colour. The teliospores are bright organge to dark brown, two celled and flattened at the top.

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Sterile paraphyses are also present at the end of sorus.

Disease Cycle

In India, all these rusts appear in wheat growing belt during Rabi crop season. Uredosori turn into teliosori as summer approaches. The inoculum survives in the form of uredospores /teliospores in the hills during off season on self sown crop or volunteer hosts, which provide an excellent source of inoculum. In India, role of alternate host (Barberis) is not there in completing the life cycle. The fungus is inhibited by temperatures over 20°C although strains tolerant of high temperatures do exist. The complete cycle from infection to the production of new spores can take as little as 7 days during ideal conditions. The disease cycle may therefore be repeated many

times in one season. During late summer, the dark teliospores may be produced. These can germinate to produce yet another spore type, the basidiospore, but no alternate host has been found. Although the teliospores seem to have no function in the disease cycle they may contribute to the development of new races through sexual recombination.

Favourable Conditions

- Low temperature (15-20°C) and high humidity during November – December favour

black and brown rusts.

- Temperature less < 10o favours yellow rusts.

Disease cycle

Uredospores and dormant mycelium survive on stubbles and straws and also on weed hosts and self sown wheat crops. Wind borne uredospores from hills are lifted due to cyclonic winds and infect the crop in the plains during crop season.

Management

- Mixed cropping with suitable crops.
- Avoid excess dose of nitrogenous fertilizers.
- Spray Zineb at 2.5 kg/ha or Propioconazole @ 0.1 %.
- Grow resistant varieties like PBW 343, PBW 550, PBW 17.

4. Loose smut - *Ustilago nuda tritici* (*Ustilago tritici*)

Symptoms

- It is very difficult to detect infected plants in the field until heading.
- At this time, infected heads emerge earlier than normal heads.
- The entire inflorescence is commonly affected and appears as a mass of olive-black spores, initially covered by a thin gray membrane. Once the membrane ruptures, the head appears powdery.
- Spores are dislodged, leaving only the rachis intact.
- In some cases remnants of glumes and awns may be present on the exposed rachis.
- Smutted heads are shorter than healthy heads due to a reduction in the length of the rachis and peduncle.
- All or a portion of the heads on an infected plant may exhibit these symptoms. While infected heads are shorter, the rest of the plant is slightly taller than healthy plants.
- Prior to heading affected plants have dark green erect leaves. Chlorotic streaks may also be visible on the leaves.

Disease Cycle

Ears of infected plants emerge early. The spores released from the infected heads land on the later emerging florets and infect the developing seed. Infection during flowering is favored

Symptoms

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by frequent rain showers, high humidity and temperature. The disease is internally seed borne, where pathogen infects the embryo in the seed.

Management

- Treat the seed with Vitavax @ 2g/kg seed before sowing.
- Burry the infected ear heads in the soil, so that secondary spread is avoided.

5. Flag smut - *Urocystis tritici*

Symptoms

- The symptoms can be seen on stem, clum and leaves from late seedling stage to maturity.
- The seedling infection leads to twisting and drooping of leaves followed by withering.
- Grey to grayish black sori occurs on leaf blade and sheath.
- The sorus contains black powdery mass of spores.

Pathogen

Aggregated spore balls, consisting 1-6 bright globose, brown smoth walled spores surrounded by a layer of flat sterile cells.

Favourable Conditions

- Temperature of 18-24°C.
- Relative humidity 65% and above.

Disease cycle

Seed and soil borne. Smut spores are viable for more than 10 years.

Management

- Treat the seeds with carboxin at 2g /kg.
- Grow resistant varieties like Pusa 44 and WG 377.

6. Hill bunt or Stinking smut - *Tilletia caries* / *T.foetida*

Symptoms

The fungus attacks seedling of 8-10 days old and become systemic and grows along the tip of shoot. At the time of flowering hyphae concentrate in the inflorescence and spikelet's and transforming the ovary into smut sorus of dark green color with masses of chlamydospores. The diseased plants mature earlier and all the spikelets are affected.

Pathogen

Reticulate, globose and rough walled. No resting period. Germinate to produce primary sporidia which unite to form 'H' shaped structure.

Life cycle

The spores on the seed surface germinate along with the seed. Each produces a short fungal thread terminating in a cluster of elongated cells. These then produce secondary spores which infect the coleoptiles of the young seedlings before the emergence of the first true leaves. The mycelium grows internally within the shoot infecting the developing ear. Affected plants develop apparently normally until the ear emerges when it can be seen that grain sites have been replaced by bunt balls. In India disease occurs only in Northern hills, where wheat is grown.

Favourable Conditions

- Temperature of 18-20°C.
- High soil moisture.

Disease cycle

Externally seed borne

Management

- Treat the seeds with carboxin or carbendazim at 2g/kg.

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- Grow the crop during high temperature period.
- Adopt shallow sowing.
- Grow resistant varieties like Kalyan sona, S227, PV18, HD2021, HD4513 and HD4519.

7. Karnal bunt - *Neovassia indica*

Symptoms

- Symptoms of Karnal bunt are often difficult to distinguish in the field due to the fact that incidence of infected kernels on a given head is low. There may be some spreading of the glumes due to sorus production but it is not as extensive as that observed with common bunt. Symptoms are most readily detected on seed after harvest.
- The black sorus, containing dusty spores is evident on part of the seed, commonly occurring along the groove. Heavily infected seed is fragile and the pericarp ruptures easily.
- The foul, fishy odor associated with common bunt is also found with karnal bunt. The odor is caused by the production of trimethylamine by the fungus. Seed that is not extensively infected may germinate and produce healthy plants.

8. Foot rot - *Pythium graminicolum* and *P. arrhenomanes*

Symptoms

- The disease mainly occurs in seedlings and roots and rootlets become brown in colour.
- Seedlings become pale green and have stunted growth.
- Fungus produces sporangia and zoospores and oospores.

Favourable Conditions

Wet weather and high rainfall.

Disease cycle

Through soil and irrigation water.

Management

- Follow crop rotation.
- Treat the seeds with Carboxin or Carbendazim at 2g/kg.

9. Powdery mildew - *Erysiphe graminis var. tritici*

Symptoms

- Greyish white powdery growth appears on the leaf, sheath, stem and floral parts.
- Powdery growth later become black lesion and cause drying of leaves and other parts.

Pathogen

Fungus produces septate, superficial, hyaline mycelium on leaf surface with short conidiophores. The conidia are elliptical, hyaline, single celled, thin walled and produced in chains. Dark globose cleistothecia containing 9-30 asci develop with oblong, hyaline and thin walled ascospores.

Disease cycle

Fungus remains in infected plant debris as dormant mycelium and asci. Primary spread is by the ascospores and secondary spread through airborne conidia.

Favourable Conditions

Temperature of 20-21°C.

Management

- Spray Wettable Sulphur 0.2% or Carbendazim @ 500 g/ha

10. Leaf blight - *Alternaria triticina* / *Bipolaris sorokiniana*

Symptoms

Reddish brown oval spots appear on young seedlings with bright yellow margin. In severe cases, several spots coalesce to cause drying of leaves. It is a complex disease, having association of *A.triticina, B.sorokiniana* and *A. alternaa..*

Disease cycle

Primary spread is by externally seed-borne and soil borne conidia. Secondary spread by air borne conidia.

Favourable Conditions

- Temperature of 25°C and high relative humidity.

Management

- Spray the crop with Mancozeb or Zineb at 2 kg/ha.

CONCLUSION

By using different methods of disease control we can control the total yield losses in wheat crop.

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Watermelon: Integrated Pests and Diseases Management

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Chhabil A. Dudhabale, Assistant Professor, Agril. Entomology Section
Rupeshkumar J. Choudhari, Assistant Professor, Plant Pathology Section
Kewalramji Harde College of Agriculture, Chamorshi Dist. Gadchiroli(M.S.)-442603

INTRODUCTION:

Watermelon (*Citrullus lanatus*) is a tropical fruit, belongs to family Cucurbitaceae is a flowering plant originally from South Africa. It is a fruit, which is a special kind reffered by botanists as a pepo, a berry that has thick rind (exocarp) and flesh mesocarp and endocarp. Watermelon contains about 6% sugar and 92% water by its weight. It is a good source of vitamin C. Various pests and diseases attacked on crops viz. Red Pumpkin Beetle, Fruit Fly, Serpentine Leaf Miner, Thrips, White fly, For obtaining maximum yield, this is important to keep pest level below economic injury level. Hence, for maintaining ecological balance, pests and diseases controls by integrated pest and diseases management is beneficial which also promotes to conserve natural enemies.

Nutritional value of watermelon fruit per 100 gm:

Sr. No.	Composition	Quantity(gm)
1.	Energy(K.Cal.)	30
2.	Water(gm)	91.45
3.	Carbohydrates(gm)	7.55
4.	Proteins(gm)	0.61
5.	Iron(mg)	0.24
6.	Magnesium(mg)	10
7.	Potassium(mg)	112
8.	Fats(gm)	0.15

Major pests and their management:

1. **Red Pumpkin Beetle(*Aulacophora faveicollis/ Aulacophora intermedia*) :**

Life history:

Eggs: Brownish yellow color, elongated eggs laid singly or in batches by mature adult female in moist soil near rhizospere. After completion of 5-8 days incubation period newly hatch larvae enters into the soil.

Larvae: Grubs feed on the debris and roots and stem of plants. Larval period lasts for 18-25 days which mostly spend in the soil. Full grown grub measures upto 10-12 mm in length.

Pupa: Pupation takes place in a waterproof cocoon at a depth of 25 cm.

Adult: 4-7 mm long reddish active beetles fly from plant to plant and feed on leaves.

Nature of damage:

Feeding by larvae causes rotting and withering of the roots and stems. Adults may completely destroy seedlings by feeding. Adults make holes on older plant leaves or defoliate completely. The surface of young fruits may show damage marks caused by adults and undersurface of fruits where they touch the soil surface may have indication of larval tunnels.

Control measures:

- Release predators viz. Ground Beetles, Spiders, Earwigs, *Pennsylvania* leathewig beetle, etc.
- Release parasitoids viz. Braconid Wasp, *Celatoria cetosa*(Tachinid fly)
- Spray 4% NSKE
- Hand picking of beetles if incidence is less.

2. Fruit Fly (*Dacus cucurbitae*/*Dacus zonatus*):

Life history:

Eggs: Female adult fly lays 2 mm long, elliptical, pure white, almost flatten eggs in the rind of fruits.

Larvae: The maggot is cylindrical cigar shaped. It has anterior mouth hooks, ventral fusiform area and a flattened caudal end.

Pupa: A full grown maggot goes in the soil for pupation and makes about 5-6 mm long puparium of dull red or brownish yellow to dull white in color.

Adult: The adult melon fly is 6-8 mm in length. The head is yellowish with black spots, thorax is reddish yellow with yellow markings. Total life cycle completes in 14-35 days.

Nature of damage:

Newly hatch maggot bore into the fruit pulp by forming serpentine galleries and contaminate the fruit by releasing its frossy excreta which invites bacterial and fungal infections that results into rotting of fruits. Due to sever infestation, Fruits dropped prematurely which become unfit for consumption.

Control measures:

- Release predators viz. Dragon Fly, Ants, Spiders, Robber fly, etc.
- Regular monitoring of fruit flies using fly traps.
- For effective management, spray Malathion (0.25%) and jaggeri @ 15 gms/lit. at 15 days interval.

3. Serpentine Leaf Miner(*Liriomyza trifolia*):

Life history:

Eggs: Eggs are minute and orange yellow in color which hatches in 3-5 days.

Larvae: Full grown maggot measures about 3 mm in length. Larval period is about 7-10 days.

Pupa: Pupation takes place inside a thin loose mesh of silken cocoon in soil or sometimes on leaves. Pupal period is about 5-7 days.

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Adult: An adult is 1.5 mm in length and yellowish in color. Total life cycle completes in 20-21 days.

Nature of damage:
Maggots feed on chlorophyll mining in between epidermal layers which produce silvery serpentine mines in leaves. In severe infestation, leaves become dry and dropped prematurely.

Control measures:
- Foliar spray with Neem oil @ 10-20 ml./lit. or 5% NSKE.
- Release predators viz. Lacewings, lady Bird Beetles, Praying Mantid, dragon Fly, etc.

4. Thrips(*Thrips tabaci*):
Life history:

Eggs: A microscopic and white or yellow eggs laid one by one by female below the upper epidermis of leaves. Adults prefer to lay their eggs in leaf, cotyledon or sometimes flower tissues.
Nymphs: Nymphs are similar to adults except wings, smaller in size and pale yellow to brownish in color.
Adult: The adults are slender, pale yellow to dark brown in color and measures about 105-2 mm in length. They have fringed wings.

Nature of damage:
At the time of feeding, at first, they rasp the leaf surface with their mouth parts and release some liquids to make cell sap dilute then suck the plant juice. Hence, leaves losses more water than normal through damaged tissues. Besides, plant pathogens enter easily through injured plant cells easily.

Control measures:
- Release predators viz. Mirid Bug, Predatory Mite, Predatory Thrips in the field.
- Keep plants well irrigated, avoid excess application of nitrogenous fertilizers.
- Soil application of Neem cake followed by 4 % NSKE with stickers(0.5 ml/lit. of water) at 10-15 days interval.
- Eradication of weeds viz. *Cassia tora* and other cucurbitaceous weeds.

5. White fly(*Bemisia tabaci*):
Life history:
Eggs: Eggs are stalked, sub-eliptical and yellow brown in color lays singly on underside of leaves.
Nymphs: Nymphs are pale yellow and clustered together underside of leaves.

Adults: Adults are winged, yellowish in color and body covered with white waxy powder. Several overlapping generations are completed in a year.

Nature of damage: Both the nymphs and adults suck the cell sap from tender plant parts which results into yellowing, downward curling and drying of leaves.

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Besides sucking the cell sap, they also secretes honey dew like substance on which black sooty mould growth that affects the photosynthesis rate.

Control measures:

- Release predators viz. Lacewings, Lady Bird Beetles, *Dicyphus hespercus*.

Major Diseases and their management:

1. Downey mildew: This disease caused by fungus *Pseudoperonospora cubensis*

Disease symptoms: yellow, angular spots restricted by veins resembling mosaic mottling appear on upper surface of the leaves.

- The corresponding lower surface of the pots shows a purplish downy growth in moist weather.
- The spot turn necrotic with age.
- The diseased leaves become yellow and fall down.
- Diseased plant gets stunted and dies. Fruit produce may not mature and have poor taste.

Host range: Musk melon, watermelon, sponge gourd and bitter gourd etc.

Survival and spread: The pathogen survives in disease plant debris.

- Primary spread occurs by mean of oospores in soil and sporangia from perennial collateral weed hosts in the vicinity.
- Secondary spread occurs by wind and rain splashes.

Favorable condition: relative humidity ≥85%, high soil moisture, frequent rains.

Management: Cultural control: Trellising(provide support systems) watermelon. Control alternate weed host(Wild cucumber, Golden creeper and volunteer cucumbers) in neighboring fence rows and field edges. Bower system of cropping reduces the disease incidence. Seed production should be preferably carried out in summer season because summer crop is often free from diseases.

2. Powdery mildew: This disease caused by fungus *Podosphaera xanthii*

Disease symptoms: Whitish powdery growth on upper foliage, stems and young parts.

- The superficial growth ultimately covers the entire leaf area.
- The diseased areas turn brown and dry leading to premature defoliation and death.
- Fruit remain underdeveloped and are deformed.

Host range: Pumpkins, watermelon, bottle gourd, coccinia, cucumber, ridge gourd, bitter gourd.

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Survival and spread: The fungus overwinters in dormant buds or plant pert.

- Primary infection occurs by dormant mycelium or cleistothecia in infected plant debris or conidia from collateral host.
- Secondary infection occurs by means of wind borne conidia.

Favorable condition: Morning relative humidity ≥ 50%, cool and dry weather.

Management: Cultural control: Bower system(Maintain gapping) of cropping reduces the disease incidence.

3. Fusarium wilts: This disease caused by fungus *Fusarium oxysporum F. sp. melonis*

Disease symptoms: The first symptom appears has chlorosis of leaves. Wilting of leaves from bottom to top occurs. Brown vascular discoloration inside infected stage or root leads to death of plant.

Survival and spread: Pathogen survives in soil in form of clamadospore (resting spore) for many years and primary infection occurs through inoculums present in the soil.

Favorable condition: Relatively high soil moisture and soil temperature are favorable for infection.

Management: Seed treatment: Seed treated with *Trichoderma harzanium* and *T. viridae* @ 4-8 gms/kg seed.Cultural control: uproots and burn the infected plant.

4. Bud necrosis: This disease caused by virus TSWV(Tomato spotted wilt virus)

Disease symptoms: Chlorotic rings, mottling, crinkling on leaves are seen, on stunted plant. This spot turn brownish black and leaves become brown and distorted. The surface of the fruits having ring spot which later turn to tan, necrotic or scab like lesion. Transmission and favorable condition: Thrips are the main vector for the transmitting the virus. Dry and hot periods when thrips population increased rapidly favours the spread of the disease.

Management: cultural control: Maintaining a clean buffer zone free of weeds of at least 25 m between a virus source and susceptible crop can considerably reduced virus levels. Control the thrips as given above in thrips management.

5. Cucumber mosaic virus: This disease caused by virus CMV(Cucumber mosaic virus)

Disease symptoms: Symptoms of mosaic appear on the youngest leaves when infection occurs at 6 to 8 leaves stage. Leaves curl downwards and become mottled, distorted, wrinkled and the reduced the size. Veins appear bunchy because of shortening of internodes. Fruit set is very less if infection occurs early in crop growth. Fruits are often misshapen, mottled, warty, and reduced in size.

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Wide Host range: Cucumber, pumpkins, gourds, cowpea, tomato, chilli, etc.
Cucuma virus with spherical partials having ssRNA, Banana, Clover, Corn, Passion fruit, safflower, spinach, sugar beet, Wield cucumber, *Commelina communis, Commelina diffusa, Commelina nudiflora, Solanum elaegnifolium, Phytolacca sp. Periwinkle gladiolus, And phlox.*

Survival and spread: Primary - virus particle on collateral and other weeds, ornamentals or crops. Secondary - virus particles transmitted by aphids(*Aphis craccivora, Myzus persicae*) and Spotted and stripped cucumber beetles.

Management: cultural control: Raise four row of barrier crop such as maize, sorghum, bajara. Avoid planting tomatoes next to cucurbits , spinach or other vegetables and flower susceptible to this diseases. Control of aphids vector as given in aphids management.

CONCLUSION

- Application of Neem seed cake at the seedling stages greatly helps in reducing the population of both Red Pumpkin Beetle and Serpentine Leaf Miner.
- Indiscriminate use of pesticides eliminates various natural enemies. Hence, there is need to conserve them.
- Application of Neem seed powder or Neem cake at the time of planting followed by 5% NSKE at the time of flowering can keep most of the pests below economic threshold level(ETL).
- Conservation of natural enemies in field, help to minimize the pest population and maintain ecological balance.
- The activity of pollinators is very essential in Watermelon. Therefore, to avoid damage to pollinators, spraying should be done at early morning or at evening hours.
- Seed treatment with biofungicides greatly avoids the entry of pathogens on crops.

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Water hyacinth- A Unique Sustainable Material

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Naresh Chaudhari
Department of Agronomy, Main Sugarcane Research Station
Navsari Agricultural University, Navsari-386 450 (Gujarat), India

Pollution of soil is a major environmental problem in field and day by day its increase due to over use of fertilizer in farm land. Most conventional remediation approaches do not provide acceptable solution to pollution problem. Eichhornia crassipes, commonly known as (common) water hyacinth, is an aquatic plant native to the Amazon basin, and is often a highly problematic invasive species outside its native range. Day by day growth of water hyacinth is increased in maximum amount and it is a big challenge to control it. As per observation, it is clear that actual application of water hyacinth is useful in a number of the sector but no one can study its adverse effect on the environment. There are no. of research was carried out on that still it is not stated that how it will effect in the environment. The solution is water hyacinth is use as dry organic manure and liquid fertilizers in field crop. So avoid use of chemical.

In brief, It is the free floating aquatic plant and grow on river, tank or any other place where water is stagnated. It has highest growth in short time, higher percent of nitrogen content and higher percent of protein, Also contain palmitic acid and stigmastereol. It have lost of Medicinal properties.

Whenever use, its 100% natural, free from artificial chemical, non toxic, environmental friendly and ecologically compatible. It does not have harmful residue and does not cause problem of pollution. Supply macro and micro nutrients to the plant. It helps in improving soil structure like physical and chemical condition of the soil and improves soil fertility. And one other use is Phytoremediation- to clean the pollution in water and improve the water quality. It has been tool for treatment of the municipal waste. Its absorb the heavy metal, its add some acid to increase decomposition process in river.

Water hyacinth is best source of nitrogen, phosphorus and potassium, organic carbon and other amino acid, humic acid, falvic acid. Its very usefully to plant growth (Nesic and Jovanovic, 1996).

Water hyacinth has been used in aquatic systems for wastewater purification for many years worldwide. The role of water hyacinth (*Eichhornia crassipes*) species in polishing nitrate and phosphorus concentration from municipal wastewater treatment plant effluent by phytoremediation method was evaluated. The objective is to determine the removal efficiency of water hyacinth in polishing nitrate and phosphorus, as well as chemical oxygen demand (COD) and ammonia. Water hyacinth is considered as the most efficient aquatic plant used in removing a vast range of pollutants such as organic matters, nutrients, and heavy metals (R. M. Kutty. *et al*, 2009).

Jayaweera and Kasturiarachchi (2004) Water hyacinth (*Eichhornia crassipes*) is an aquatic biomass species that exhibits prolific growth in many parts of the world. It has been suggested as a strong candidate for the production of methane because of high biomass yield potential and also those biomass use in agriculture sector for organic fertilizers, not environment pollution and supply macro or micro nutrient to plant.

CONCLUSION

As per above discussion, it is clear that there is a number of application of water hyacinth used for a different area. As water hyacinth is used for water purification process and removal of heavy metals from waste water. Sometimes ut is also clear that phytoremediation techniques are reported to be cost effective compared to other methods. Various contaminants like total suspended solids, dissolved solids, electrical conductivity, hardness, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, nitrogen, phosphorous, heavy metals, and other contaminants have been minimized using water hyacinth.

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UZHAVAN APP

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V. Keerthana
Assistant Professor, Imayam Institute of Agriculture and Technology, Thuraiyur – 621 206
Affiliated to Tamil Nadu Agricultural University, Coimbatore.

INTRODUCTION

Tamil Nadu government has released UZHAVAN APP to support farmers. The application provides complete real-time agricultural information. It provides 15 important services such as weather updates and the current crop rates. The app is introduced by the chief minister of Tamil Nadu, Edappadi K. Palaniswami. The app supports two Tamil and English languages. The UZHAVAN APP is available and downloadable on android.

Objective

UZHAVAN APP's objective is to empower farmers with accuracy so that they can take appropriate decisions. The Mobile App will help the farmers by providing information in real time and encouraging farmers to take up farming activities at the right time. It is a boon particularly for Tamil Nadu farmers to reduce their risks.

UZHAVAN APP Services

This APP provides information on 15 services namely,

- Information on farm subsidies.
- Farmers can book farm equipments.
- Details about crop insurance and services.
- Weather forecast for next 4days.
- Market price
- Information on fertilizer stock.
- Details on organic products.
- Information on seed stock position.
- Asst. Agri / horti officer visit.
- Information on reservoir levels.
- Details on FPO products.
- Agriculture news.
- Feedback mechanism.
- Farm guide.
- Benefit registration.

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Key Facts

The app is available for download from Google Play Store. Farmers may use it to obtain information about farm subsidies, book farm equipment and the relevant infrastructure. It will also help them get details about their crop insurance, in addition to receiving weather forecast for the next 4 days. It will also provide information on the seed and fertilizer stocks available in local government and private stores. This Mobile Seva would certainly thrash out the problems that arise from seasonal adversities, timely input non-availability, farm machinery non-availability and natural calamities.

Benefits

- It generates awareness of many crop enhancement and development schemes and subsidies.
- It inspires other youngsters to participate in farming.
- It saves farmers time and costs.
- They can easily get farming inputs and equipment.

CONCLUSION

Tamil Nadu Government has established a technology for farmers to get all schemes and subsidies. So each and every farmer needs to be smarter to reap the benefits of UZHAVAN APP and our country needs more young people to get interested in agriculture.

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Urban Agriculture: The Saviour of Rapid Urbanization

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Kishor Prabhakar Panzade
ICAR-Indian Agriculture Research Institute, New Delhi.

INTRODUCTION

Urban agriculture is the way of cultivation and marketing of food products in and around urban area. It also comprises horticulture, beekeeping, animal husbandry and aquaculture. As per the prediction of FAO, by 2030, around 60 % of the people from developing nations will possibly live in urban areas. This speedy increasing of urban population in the developing nations is expecting huge burden on urban food supply chains owing to shortages of food during the time of crisis. To conquer this crisis, urban agriculture is the best solution. The minimum land accessible in heavily populated concrete jungles can be employed for crops cultivation. The highly perishable leafy vegetables are mainly cultivated to meet the daily demands of a small community or family and surplus is sold in local markets. The major aim of urban agriculture is to have easy access to locally grown food and gain basic knowledge of crop husbandry. The understanding of what food and how food grows, seasonally and regionally, how it is processed after harvest and how it transported to other places in a food route before reach to final consumer are all important lessons of urban agriculture. Urban agriculture supply fresh food, recycles urban wastes, generates employment, creates greenbelts and supports cities resilience to climate change. Presently, urban agriculture practiced as a hobby and few urban farms are created for training and education purpose. Many are created to obtain healthy food or to maintain cultivation of traditional culinary and few are created to get economic benefits. The urban agriculture also has important role in environmental resilience as well improving health of peoples.

Types of urban agriculture

Urban agriculture can be categorised into many types according to type, area of commodity produced, medium used for cultivation.

The following are common types of urban agriculture

a. **Kitchen gardening**: Cultivation of herbs and vegetables in and around the house area to meets the daily kitchen needs. It is a very small scale cultivation there is no surplus produce for sale. Its aim to become less dependent on the market availability.
b. **Terrace gardening**: Cultivation of herbs and vegetables on the terrace of a house by group or single families to satisfy the daily needs of a kitchen use or a community. The focus here is to exploit existing empty space on the terrace and decrease dependence on the markets.
c. **Vertical farming:** Crops cultivation in vertically stacked sheet. The major benefit is the more crop yield/unit area used. It can be employed on walls, tall apartments.
d. **Street landscaping:** Cultivation of vegetables, in available empty place the along roads can be used.
e. **Green house gardening**: The empty areas in and near the city can be used for greenhouse creation for cultivation of crops. It can be supervised by an commercial owners or community or individual.
f. **Container gardening**: Use of waste materials produced in the urban areas for cultivation of crops. The major focus here is to recycle, reuse and decrease the waste materials may cause of pollution in the city.
g. **Peri-urban farming**: Crops cultivation in the city boundary is peri-urban farming. Individual can follow large scale production by building up polyhouses etc. This system is largely employed in India. The cost of transportation almost zero in this system. Suitable for highly perishable leafy and seasonally available vegetables and fruits are cultivated.

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Advantages of urban agriculture:

a. **Nutritional and quality food**: The time lapse for storage, packing, processing and transportation is almost nothing in urban agriculture, thus providing good quality and fresh produce at door steps.
b. **Health benefits:** The cultivated crops in terrace or gardens are least exposed to heavy metals, insecticides, pesticides so, the food contamination is less.
c. **Environmental justice:** Urban agriculture has many environmental benefits like, reduction in plastic pollution due to recycling and reuse of waste
d. **Efficient utilization of time:** People can make agriculture as a hobby. Children can also be educated and encouraged to take up farming as a hobby and continue our age old tradition of farming.
e. **Efficient utilization of land and resources**: The abandoned and vacant lands in urban areas can be used. The urban waste can be utilized as manure, waste water from kitchen may used for irrigation, biodegradable waste can be used for composting etc.,
f. **Economic benefits:** Provides incomes and employment for disadvantaged groups. Urban women can earn some money to support economically to their families.
g. **Environmental** resilient**:** It reduces air pollution and water pollution etc..

Success stories of urban agriculture

Mumbai, India: Method of city gardening by Dr. Doshi is popular in Mumbai, to produce pure organic food by waste recycling. Nearby available agriculture and kitchen wastes like polyethylene bags, cylinders, sugarcane waste, tires containers, and soil are used for crop cultivation.

Hyderabad, India: In Hyderabad, >4,000 families are self dependent for the vegetable needs of family. The government is promoting urban farming through providing subsidy kit worth 360 Rs to interested peoples.

Delhi, India: In Delhi the farmers living on the banks of Yamuna River are cultivating vegetables from many generations and selling in the markets.

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Underutilized arid fruits for nutrition

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Vikas Mandloi, Ph.D. (Hort.), Deptt. Of Horticulture
Praveen Kumar Singh Gurjar, Scientist (Hort.), KVK Gwalior
Rajmata Vijayaraje Scindia Krishi Vishwavidhyalaya, Gwalior (M.P.) 474002

INTRODUCTION

Underutilized crops could be considered in these areas for integration in existing farming system as these crops require less inputs and can sustain the harsh climatic conditions. There are around 30 plant species in arid zone known for their edible uses out of which some 20 plant species are known for their edible fruits or as vegetables viz., kair (*Capparis decidua*), lasora (*Cordia myxa*), jhar ber (*Ziziphus nummularia*), pilu (*Salvadora oleoides*), khejri (*Prosopis cineraria*), phalsa (*Grewia subinaequalis*), bael (*Aegle marmelos*), karonda (*Carissa carandas*), fig (*Ficus carica*) and prickly pear (*Opuntia ficus-indica*) etc. These underutilized fruits have many advantages in terms of ease in growing, hardy nature and good yield even under extreme weather conditions. These crops have their own history of consumption because, local people are well aware about their nutritional and medicinal values. Thus, these crops have the potential to provide great nutritional and social benefits and it is increasingly advised that they are identified, researched and promoted in the way similar to the other commercial fruit crops.

Underutilized fruit plants that have some special adaptive features like deep tap root systems, leaf shedding in summer, water binding mechanism, wax coating, hairiness, sunken and covered stomata in leaves, tolerance capacity to salinity and alkalinity, synchronization of flowering and fruiting during rainy season or at maximum water availability offer scope in arid regions. Underutilized crops are defined as ‘species’ with under-exploited potential for contributing to food security, health (nutritional/medicinal), income generation and environmental services (Mitra *et al.,* 2011).

Kair

Kair is a shrub of family Capparaceae. The immature fruits are rich in carbohydrates, protein and mineral elements (Chouhan *et al.,* 1986). The fruits were also found to be rich in dietary fibre (Agarwal and Chouhan, 1988). Nutritional value of Kair is Protein (8.6%), Carbohydrate (21%), Fiber (12.3%), Vitamin C (7.81mg/100g), Ca (154 mg/100g FW), P (57 mg/100g) and Energy (41.6 kcal/g) (Duhan *et al.,* 1992).

Lasora

Locally known as Gonda/Lasora/lehsua (*Cordia myxa* L.), belongs to family Boraginaceae and is grown all over India except high hills. It has great capacity to tolerate drought and hence quite widespread in arid and semi-arid regions of north India. The fruits and other plant parts are used in curing various ailments viz. skin diseases, dropsy, dysentery, dyspepsia, cholera and headache etc. Nutritional value of lasoda is Protein (2%), Carbohydrate (12%), Fat (2%), Fiber (2%), Ca (55 mg/100g), P (275 mg/100g), Fe (6 mg/100g), and Energy (394/g) (Duhan *et al.,* 1992).

Karonda

Karonda (*Carissa carandas* L.) is an evergreen spiny shrub or a small tree which belongs to the family Apocyanaceae. which are edible and rich in iron, calcium, magnesium, phosphorus and vitamin C. Nutritional value of karonda is Energy (364 k cals), Moisture (18 gm), Protein (2 gm), Fat (10gm), Mineral (3gm), Fiber (1.5gm), Carbohydrates (67gm), Calcium (21mg), Phosphorous (60 mg), Iron (39.1 mg), Vitamin A (1619IU), and Ascorbic Acid (1.6-17.9 mg) (Kumar and Singh, 1993).

Khejri

Khejri (*Prosopis cineraria* L. Druce) is an important component of arid farming system which plays significant role in the economy of people of Indian Thar desert. The immature pods of khejri are edible and rich in crude protein, carbohydrates and minerals such as phosphorus , calcium and iron. Nutritional value of khejri is Protein (23.2%), Carbohydrate (56%), Fat (2%), Fiber (20%), Vitamin C (523mg/100g), Ca (414mg/100g), P (400mg/100g), Fe(19mg/100g), and Energy (334.8 kcal/g) (Rathore and mala, 2004).

Bael

Bael (*Aegle marmelos* L.) wich is belong to family rutaceae. Various chemical contituents like alkaloids, coumarins and steroids have been isolated from different parts of tree such as fruits, leaves, wood, root and bark etc. Nutritional value of bael is Carbohydrate (31.8 %), Fat (0.3 %), Proteins (1.8 %), Vitamin A (0.055 mg/100 g), Vitamin B1 (Thiamine) (0.13 mg/100 g), Vitamin B2 (Riboflavin) (1.19 mg/100 g), Vitamin B3 (Niacin) (1.1 mg/100g), Carotene (55 mg/100 g), Calcium (85 mg/ 100 g), Phosphorus (31.8 mg/100 g), Iron (0.6 mg/100 g), Fiber (2.9 %), and Energy (137 k.cal/g) (Parichha,2004).

Jhar ber

Jhar ber (*Ziziphus nummularia*) wich is belong to family Rymneceae. The fruits contain considerable amount of soluble carbohydrates. The dried fruits are grounded (fruits with the stone) and sieved. The sieved powder consumed after meal as mouth freshner is very rich in sugar and ascorbic acid. Nutritional value of jhar ber is Ca (19 g/kg), P (3.1 g/ kg), Crude protein (11.5 %), Crude fiber (33.8 %) and Polyphenols (4.15mg/g).

Peelu

Peelu (*Salvadora oleoides Decne*)The fresh fruits contain about 70% juice. The seeds are rich in fat (40-50%) which is not edible but have industrial value for preparation of soaps and candle. After extraction of oil the cake is also useful as manure. Nutritional value of peelu is Protein (6%), Carbohydrate (76%), Fat (2%), Fat in seed (45.5%), Fiber (2%), Fiber in seed (6%), Ca (630 mg/100 g FW), P (76%), Fe (8%) and Energy (346 kcal/g) (Duhan et al., 1992).

Phalsa

Phalsa is an indigenous short duration crop of immense potential but it has not attained much commercial importance due to perishable nature of fruits due to which it can not be transported to distant markets.

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Nutritional value of phalsa is Carbohydrate (15%), Digestive fiber (1.5%), ca (130 mg/100 g FW), Vitamin A (800 IU) and Polyphenols (3.77mg/g FW).

Common fig

Fig (Ficus carica L.) is one of the oldest known fruit trees in the world. Nutritional value of fig is Moisture content (80.20%),Crude Fiber (0.50%), Total carbohydrate(15.84 gm), Calcium (30.5 mg), Iron (315 mg), Sodium (329 mg), Potassium (49.3 mg), Protein (28.12 mg), Fat (1 mg), Mineral (2 mg), Carotene (200 mg), Ascorbic acid (5.3 mg) and Phosphorus (103 mg).

Wealth of antioxidants

The health benefits of fruits are attributed mainly to the presence of some Phytochemicals such as polyphenols, flavanoids, flavanols, anthocyanins etc., which are usually referred as antioxidants.

Fruits	Polyphenols (mg/g) FW
• Bordi	3.90
• Jharber	4.15
• Lasoda	5.31 (at green immature stage)
• Ker	0.91-1.85 (pulp), 0.15-0.46 (seeds)
• Pilu	2.94 (red), 2.42 (green)
• Phalsa	3.77
• Karonda	9.70
• Bael cv. NB-9	6.40

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Synthetic Seed

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Prayasi Nayak[1] Somanath Nayak[2]
1. PhD scholar, Deptt. Of Agronomy, GBPUAT, Pant nagar
2. PhD scholar, Division Of Agronomy, IARI, New Delhi

INTRODUCTION

Synthetic seeds are defined as artificially encapsulated somatic embryos, shoot buds, cell aggregates, or any other tissue that can be used for sowing as a seed and that possess the ability to convert into a plant under in vitro or ex vitro conditions. In simple words synthetic seed contains an embryo produced by somatic embryogenesis enclosed within an artificial medium that supplies nutrients and is encased in an artificial seed covering.

Why Synthetic Seeds?

In some of the crops seeds propagation is not successful due to;

- Heterozygosity of seeds particularly in cross pollinated crops
- Minute seed size eg; orchids
- Presence of reduced endosperm
- Some seeds require mycorrhizal fungi association for germination eg: orchids
- No seeds are formed

Characteristics of Synthetic Seeds

1. High volume. Large scale propagation method
2. Maintains genetic uniformity of plants
3. Direct delivery of propagules to the field, thus eliminating transplants
4. Lower cost per plant let
5. Rapid multiplication of plants

Advantages of Synthetic Seeds Over Somatic Embryos For Propagation

1. Ease of handling while in storage
2. Easy to transport
3. Has potential for long term storage without losing viability
4. Maintains the clonal nature of the resulting plants
5. Serves as a channel for new plant lines produced through biotechnological advances to be delivered directly to the green house or field
6. Allows economical mass propagation of elite plant varieties

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Types of synthetic seed (Based on technology established)

1. Desiccated: The desiccated synthetic seeds are produced from somatic embryos either naked or encapsulated in polyoxyethylene glycol (Polyoxr) followed by their desiccation. Desiccation can be achieved either slowly over a period of one or two weeks sequentially using chambers of decreasing relative humidity, or rapidly by unsealing the petri dishes and leaving them on the bench overnight to dry. Such types of synseeds are produced only in plant species whose somatic embryos are desiccation tolerant.

2. Hydrated: Hydrated synthetic seeds are produced in those plant species where the somatic embryos are recalcitrant and sensitive to desiccation. Hydrated synthetic seeds are produced by encapsulating the somatic embryos in hydrogel capsules.

Procedure for Synthetic Seed Production: The somatic embryos for synthetic seeds are produced in the lab through culturing of somatic cells and treating with different hormones to produce root and shoot. The following are the different steps involved in artificial seeds production;

1. Establish somatic embryogenesis
2. Mature somatic embryos
3. Synchronize and singulate somatic embryos
4. Mass production of embryos
5. Encapsulation of matured somatic embryos
6. Desiccation
7. Field planting

Somatic Embryos and somatic embryogenesis

Somatic embryos are bipolar structure with both apical and basal meristematic regions which are capable of forming shoot and root, respectively. Somatic embryogenesis is the development of embryos form vegetative cells with in vitro systems. Specific tissues have a capacity for somatic embryogenesis in cultural systems.

Zygotic Embryos V/S Somatic Embryos

Zygotic embryos	**Somatic embryos**
Is the result of a sexual process	Produced as a result of asexual process
involve fusion of male and female gametes	Does not involve male and female
Produced form sexual cells	Produced from vegetative cells
contains genetic constituent from both parents	contains genetic constituent from single parent
Genetic recombination takes place	No genetic recombination will take
Contains embryo, endosperm and seed coat	Contains only embryo and endosperm and seed coat are absent

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Procedure of Somatic Embryogeneis:

1. Petiole explants plants are surface sterilized and cultured on SH medium (Schenk and Hildebrandt, 1972) containing 2, 4-D, kinetin and many other nutrients. 2, 4-D activates the cell cycle of many cells in the petiole - those in the vascular cambium develop into a callus, whereas some sub-epidermal cells develop into a somatic embryo.
2. The initial somatic embryos are embedded in a callus mass of non-differentiated cells.
3. To liberate these proembryonic structures, and to stimulate the formation of more embryos, the callus is dispersed in a liquid medium to form a suspension culture containing 2,4-D but not kinetin
4. After 7 days, the suspension is sieved and transferred to solid medium lacking 2,4-D On this medium the embryos develop through morphological stages that appear to be globular, heart and torpedo.
5. **Maturation Phase 1:** Once the majority of embryos reach the torpedo stage (7-10 days after sieving) they are transferred to an enriched medium containing a high level of sucrose, nitrogen and sulphur to prevent precocious germination and to enable deposition of storage reserves. The embryos rapidly accumulate fresh and dry weight, reaching 1-2 mg dry weight per embryo
6. **Maturation Phase II:** To induce the acquisition of desiccation tolerance, the somatic embryos are placed on a modified medium containing abscisic acid (ABA) for 3 days. Then they are removed from the medium, washed to remove sugar and other nutrients, and dried.

Encapsulation of Matured Somatic Embryos

The somatic embryos are mixed with sodium alginate (2 %) and the suspension is dropped into the calcium salts solution (200mM). The principle involved is when sodium alginate dropped into the calcium salt solutions it from round firm beads due to the ion exchange between Na+ in sodium alginate and Ca2+ in calcium salt solutions and sodium alginate form calcium alginate in 20-30 minutes. Since somatic embryos lack seed coat and endosperm the matrix of encapsulation can be added with nutrients and growth regulator, which will serves as an artificial endosperm. This will increase the efficiency of germination and viability of seeds. Addition to these nutrients other useful materials fungicides, pesticides, antibiotics and microorganism can also be incorporated.

Application of Synthetic Seeds

1. Multiplication of non-seed producing plants, ornamental hybrids or polyploids plant
2. Propagation of male or female sterile plants for hybrid seed production
3. Germplasm conservation of recalcitrant species
4. Multiplication of transgenic

Limitations

1. Limited production of viable micropropagules that are useful in synthetic seed producer
2. Asynchronous development of somatic embryos
3. Improper maturation of somatic embryos that makes them inefficient for germination and conversion in to normal plants
4. Lack of dormancy and stress tolerance in somatic embryos that limit the storage of synthetic seeds
5. Somaclonal variations which may alter the genetic constituent of the embryos

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SPACE MUTATION BREEDING

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Gayatri Kumawat
Research Scholar, Department of Plant Breeding and Genetics,
Sri Karan Narendra Agriculture University, Jobner, Rajasthan.

Space breeding is a cutting edge science that combines astronautics with agricultural and forestry sciences. Space breeding refers to the technique of sending crop seeds or microorganisms into space (200-400km away from earth) on a recoverable satellite or in other recoverable spacecraft. When spacecraft returning to earth, mutant crop seeds will be selected and planted to breed strains with high desirable traits.

Main factors of space environment affecting plant mutation

- High-energy ion radiation
- Microgravity
- Space magnetic field
- Ultra vacuum
- Other physical stresses

The Chinese scientist Jiang Xingcun, with the Chinese Academy of Sciences, discovered that spaceflight can increase mutation rates by hundreds of times that experienced on Earth. Twelve percent of seeds sent to spaceflight in satellites manifested mutations of some kind in such experiments. Since then, China has sent more than 400 plant seed species to spaceflight (Wen *et al.*, 2004). "Breeding seeds in space is expected to become a strong driving force behind Chinese agriculture in the 21st century since it can bring about high-yield and high-quality crops that are hard for ordinary breeding methods to obtain."

Goals of this space Expedition:- higher yield, disease resistant plant varieties, abiotic stress resistant plant varieties, biotic stress resistant plant varieties, several other desirable traits.

Photo taken on August 27, 2015 shows ripe pumpkins growing from space breeding seeds at a space breeding base in Tianshui, northwest China's Gansu Province. The average weight of such a pumpkin is more than 100 kilograms, and the maximum weight can reach 175 kilograms. Space breeding is a technology using the space to have seeds mutated in order to have better yields. (Xinhua/Wang Heng)

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Biological effects of space induced factors on plant seeds

- Seed germination potential, germination index, seedling height and seedling vigor index of wheat, barley and triticale were all significantly higher
- Japonica rice carried by a high altitude balloon, all the 11 investigated characters which were plant height, growth period duration, spike length, grain husk color and light sensitivity, etc. segregated greatly.

Mechanism of Space mutagenesis:

- Space radiation
- HZE particles
- Frequency rate more- root meristem and hypocotyle was hit.
- Higher duration- frequency rate increased.
- Both cosmic radiation and microgravity combined.
- Strong vibration and blast force at the time of launch and landing- chromosomal aberrations.

Mutant Varieties developed by space breeding

Crop	Varieties
Rice	Hangyu1, Huahang1,Eryouhang1, Teyouhang1, Yuehang1, Zhe101, Yuyou1, Teyou175 and Huaxiang7, etc.
Wheat	Taikong5, Taikong6, Longfumai15, Hangmai96, Longfumai17 and Luyuan301.
Cotton	Zhongmiansuo42 and Zhongmiansuo52
Sesame	Zhongzhi11 and Zhongzhi13
Pepper	Yujiao1, Yujiao2, Yujiao3, Yujiao4 and Longjiao9
Tomato	Yufan1 and Yufan2
Alfalfa	Longjing1

China is using recoverable spacecraft to conduct various microgravity experiments and nearly 405,000 hectares of rice fields planted with space seeds and 8,100 hectares of space vegetable growing (Liu *et al.*, 2007).

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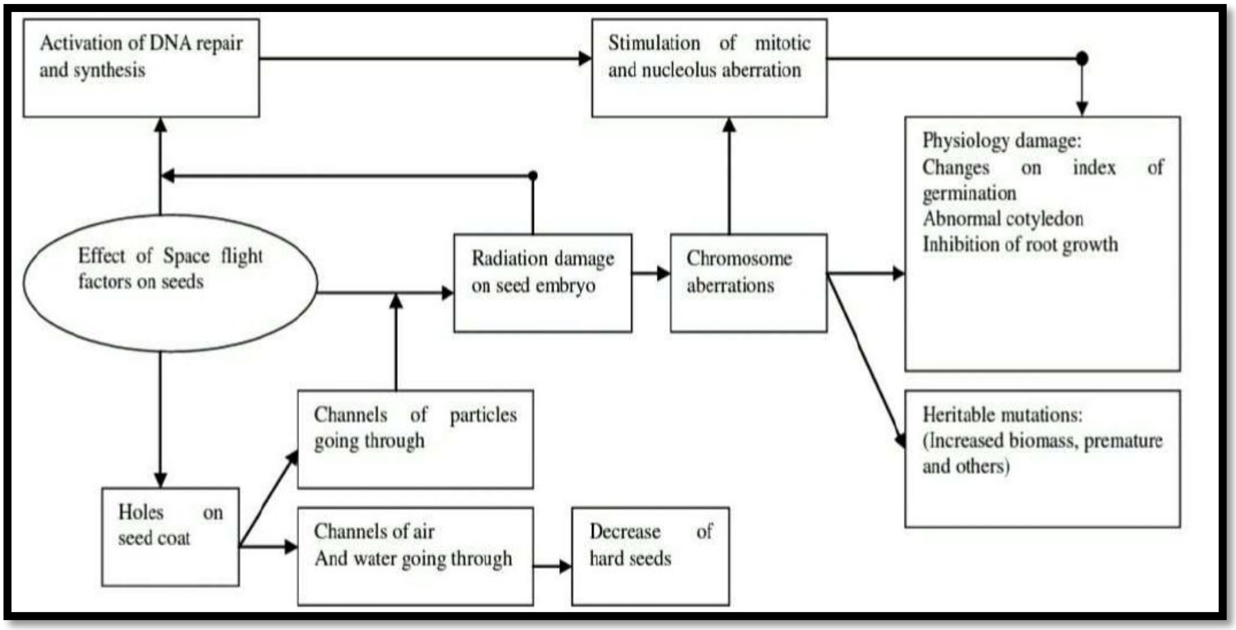

Fig. Speculated function model of mutation effect induced by space light factors

Screening of the mutant varieties: Numerous molecular markers, such as AFLP and RAPD have been used to mark plant materials, but SSR marker highly reproducible molecular marker, has become one of the most effective markers for population genetic analysis. Thus SSRs are used in the study of space bred mutant varieties.
Presently other nations involved in space-breeding are primarily interested in investigating how plants grow in space and producing food for the orbiting astronauts.

CONCLUSION

Space-induced mutation technique is an effectively new way not only to develop new crop variety, but also possible to obtain rare mutants that may make a great breakthrough in important economic characters of crop, such as yield and quality, which are difficult to get using the other breeding methods on ground. The research on applied basis of space-induced mutation technique needs to be strengthened. Because of the big investment and good technological support, this method is limited but is important to make ground simulation on space environment factors.

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Breeding for Quality Improvement in Cereals

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Basu Sudhakar Reddy[1], Deepayan Roy [2], Babita Bhatt [3] and Kuldeep Nagar [4]
[1] Department of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar 263145 (Uttarakhand), INDIA.
[2]Department of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar 263145 (Uttarakhand), INDIA.
[3] Department of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar 263145 (Uttarakhand), INDIA.
[4]Division of Plant Breeding and Genetics, Rajasthan Agricultural Research Institute, Durgapura 302018 (Jaipur), INDIA.

INTRODUCTION

Increased yield, better adaptation to local environmental conditions and better resistance to the major pests and diseases have been among the priority goals of crop improvement programmes. Yielding ability and stability undoubtedly deserve high priority but enough attention also needed to improve the quality characteristics of the plant produce for their maximum utilization. High yielding varieties developed by plant breeders has resulted in green revolution and the next goal of plant breeders is to improve the quality of produce in crop plants. The growing sophistication in the instrumentation methods aids to the development of biochemical procedures for quality analysis in crop plants. The molecular plant breeding methods also help to identify the high quality plants easily, quickly and at different stages of the crop. New avenues are opening up with the globalization of international trade for getting premium price to the high quality products. Increased emphasis on better nutritive and processing quality will improve the commercial value of a particular crop. In this context, the quality traits in the crops like long slender aromatic Basmati rice with desirable amylose content, better quality durum wheat *etc*. will have good export potential.

The quality traits are varied based on the crop and most of these characters are controlled by few genes. In the crops like rice, wheat, few of the traits are controlled by oligogenes while others are controlled by polygenes indicating different breeding strategies for their improvement. There are attempts to incorporate high levels of nutritional factors in the major crops to make them preferential sources for dietary consumption regularly. High amylose content in rice is found to be incompletely dominant over low amylose content and controlled by one major gene with several modifiers. The high gelatinization temperature (GT) is dominant to low GT. Hard gel consistency is conditioned by single dominant gene. Grain elongation in Basmati rice has been reported to be of polygenically controlled trait and is difficult to transfer. Protein content has significant correlation with GT, gel consistency and cooked rice hardiness.

Important physico-chemical properties of rice and their range are presented below,

Quality traits	Range
Hulling %	75 – 80
Milling %	70 – 75
Head rice recovery %	30 – 60

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Kernel length (mm)	3.0 – 8.0
Kernel breadth (mm)	2.0 – 3.0
L/B ratio	1.5 – 3.5
Amylose (%)	1.0 – 32.0
Alkali value (GT)	2.0 – 7.0
Gel consistency (mm)	27 – 100
Kernel colour	Black – Red – Brown – white
Transparency	Translucent – chalky
White belly	Present occasionally present – Absent
Classification	Fine – Medium – Bold

Amarawathi *et al.* (2007) mapped number of QTLs, including three for grain length, two for grain breadth, two for length to breadth ratio, three for aroma and one each for amylose content and alkali spreading value on seven different chromosomes. Ge *et al.* (2005) identified QTLs which include three for cooked rice grain length elongation, six for width expansion and two for water absorption. While, Myint Yi *et al.* (2009) improved fragrance and intermediate amylose content (AC) by using marker assisted backcrossing (MAB) in Manawthukha rice to introgress the Basmati alleles of genes conferring fragrance and intermediate AC into Manawthukha by using Basmati 370 as a donor parent. All improved lines had intermediate AC and fragrance similar to the donor parent Basmati, whereas their agronomic performances were the same as the original Manawthukha. Maize is the world's most widely grown cereal crop, which has a higher level of industrial utilization. It is one of the principal sources of carbohydrates and proteins. Even though maize is considered as an important source of protein and is deficient in two essential amino acids i.e lysine and tryptophan which leads to poor net utilization and low biological value.

To overcome this, high quality protein mutant opaque-2 was identified using this opaque-2 mutant, quality protein maize was developed which contains twice the amount of lysine and tryptophan than the normal maize. The QPM varieties released in India are, hybrid shaktiman-1 and shaktiman-2 and composite shakti-1. In future this QPM will contribute to food security and also it aids in eradicating the protein calories malnutrition. Thus the new era of QPM with its improved nutritional quality is a new feather added to the cap of maize research. Babu *et al.* (2005) used two generation marker-based backcross breeding program for incorporation of the opaque2 gene along with phenotypic selection for kernel modification in the background of an early maturing normal maize inbred line, V25. James Nelson *et al.* (2006) using a set of 114 recombinant inbred lines (RILs) generated from a synthetic-hexaploid (W7985) × bread wheat (Opata 85) cross studied milling and baking quality traits in wheat by QTL analysis in the ITMI population. Hence, quality improvement is very essential component of crop breeding programmes.

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Nanopesticides and Nanoregulations

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Kailash Pati Tripathi[1]*, Sameer Ranjan Misra[1], Jagadish Jena[2]
[1]Division of Agricultural Chemicals, ICAR-IARI, New Delhi-110012, India.
[2]Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh

Nanotechnology: It is the scientific approach to control & manipulate matters in the range of nanoscale (1nm-100 nm) in order to use the size and structure dependent properties and phenomena as distinct from those associated with individual atoms or molecules or with bulk or normal size materials (ISO, 2010).

Nano pesticide: It involves either very small particles of pesticide active ingredient or other small engineered structures with useful pesticide properties.

Nanomaterial: Material with any one of the external dimensions in the nanoscale, or having internal structure or surface structure in the nano scale.

Nanostructure: Composition of interrelated constituent parts in which one or more of those parts is in a nanoscale region.

Potential application of Nanotechnology in the pesticide sector

Factors making the implementation of effective regulatory schemes complex are

- Broad spectrum applications of variety of nano materials
- The limited knowledge on the toxic effects of nanomaterials in living systems and their transport in living and environmental systems
- Making access to information related to new generation nanomaterials becomes a tedious job
- The lack of harmonized standards or guidance
- The potential inadequacy of statutory authorities

Authorities taking responsibilities for worldwide control and regulation of nano-materials:

Function	How can this be achieved	Current examples
Enhanced apparent solubility	Nano and micro emulsions	BANNER MAXX of Syngenta
Faster decomposition in soil and/or plant	Nano catalyst conjugated ai in microcapsules	SDS modified TiO_2 conjugated with imidacloprid
Controlled release	Nanocapsules	Polymeric stabilized bifenthrin
Targeted delivery	Nanocapsules	Nanoencapsulated glyphosate
Protection against premature degradation	Nano capsules with catalyst ai conjugate	Porous hollow Si encaged validamycin
Enhanced toxicity to targeted organism	Nanodispersions	Nano dispersed triclosan
Nanoparticle as ai	Nanometals and nano clays	Registered Nano-Ag biocide, Nano-Si

US-EPA

The EPA strategy on nanomaterials is described in the EPA Nanotechnology White Paper
Four main research themes identified

1. Identifying sources, fate, transport, and exposure;
2. Understanding human & ecological risks and their assessments

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3. Developing risk assessment approaches;
4. Preventing and mitigating risks

For evaluation following acts are responsible:

- Toxic Substances Control Act (TSCA)
- Federal Insecticide, Fungicide and rodenticide Act (FIFRA)
- Pesticide Clean Air Act (CAA),
- Clean Water Act (CWA),
- Safe Drinking Water Act (SDWA)

EUROPIAN UNION:

REACH-ECA: Registration, Evaluation, Authorization and Restriction of Chemicals - European Chemicals Agency

- Established in 1st June 2007
- Based on the principle that manufacturers, importers and downstream users have to ensure that their activities do not adversely affect human health or the environment
- A specific working group within REACH, named the Competent Authorities Sub Group on Nano materials established in March 2008
- They, governs issues on substance identification, registration of Nano materials, chemicals safety assessment and risk management, communication in supply chain and information on Nano materials

Country wise nanomaterial regulations and their authorities:

Austria

Agency responsible for nanomaterial regulation:

Federal ministry of agriculture, forestry, environment and water management (BMFLUW)
Provides a careful analysis of risks and opportunities, focused in areas considered relevant to nanotechnology in social and health terms, environment, business, science, research and development. Based on this analysis, a set of recommendations for specific actions and measures are to be taken at national, European and international level, with an indicative time frame for their adoption (1 to 3 years)

FRANCE

French Agency for Environmental and Occupational Health Safety (AFSSET),
The French Food Safety Agency (AFSSA)
Monitoring drugs, medical devices and cosmetics (AFSSAPS),
In France the regulation and registration procedures are followed as indicated in REACH

A legislation is followed which includes:

1. Requirements for declaration to authorities of the manufacturing
2. Importing or the placing on the market of nanoparticle substances
3. Including information about their identity, quantity and uses
4. Reporting, upon request of the authority, of hazard and
5. Exposure information regarding these substances

GERMANY

Agency responsible for nanomaterial regulation:

- Federal Institute for Occupational Safety and Health

- In Germany, the regulation and registration procedures are followed as indicated in REACH

UNITED KINGDOM

Agency responsible for nanomaterial regulation:

- UK Food Standards Agency
- Natural Environment Research Council
- Department for Environment, Food and Rural Affairs
- The United Kingdom offers its agreeance towards EU initiatives and regulatory aspects
- They are promoting a 'case-by-case' approach to assess the risk and suitable use of individual nanomaterials in food and food contact materials.

USA

Agency responsible for nanomaterial regulation:

- National Institute for Standards and Technology (NIST)
- National Institutes of Health (NIH)
- Environmental Protection Agency (EPA)
- National Institute for Occupational Safety and Health (NIOSH)
- Food and Drug Administration (FDA) and EPA

INDIA

Agency responsible for nanomaterial regulation:

- Department of Science and Technology
- Ministry of Environment and Forests
- Ministry of Chemicals and Fertilizers
- Ministry of Health and Family welfare

No regulation specific to nanotechnology

BIS is the Indian member to ISO to support international standardization in nanotechnologies

CONCLUSION

In spite of the interest across the nanotechnology, Nano-specific regulation for Nano-related products are still rare. Lacking specific guidelines and provisions, the adoption of a precautionary approach with increased self-reliance on manufacturers regarding nanotechnologies are taken. Nano regulation requires a dynamic approach, it must adapt to the evolution of scientific knowledge, to the increase in applications, to the concern and attitude of stakeholders.

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HYDROPONICS: Practice of soilless farming in vegetable production

Article id: 23457
Priyanshu Singh[1*], Tejbal Singh[2], Archit Singh[1]
[1]Research scholar in Department of Horticulture, Institute of Agriculture Science, Banaras Hindu University, Varanasi- 221005
[2] Research scholar in Department of Agronomy, Institute of Agriculture Science, Banaras Hindu University, Varanasi- 221005

Soilless cultivation represents a valid opportunity for the agricultural production sector, especially in areas characterized by severe soil degradation and limited water availability. Furthermore, this agronomic practice embodies a favorable response toward an environment-friendly agriculture and a promising tool in the mitigation of a general challenge in terms of food security. This review aims therefore at unraveling limitations and opportunities of hydroponic solutions used in soilless cropping systems focusing on the plant mineral nutrition process. In particular, this review provides information

(1) On the processes and mechanisms occurring in the hydroponic solutions that ensure an adequate nutrient concentration and thus an optimal nutrient acquisition without leading to nutritional disorders influencing ultimately also crop quality (e.g. solubilization/precipitation of nutrients/elements in the hydroponic solution, substrate specificity in the nutrient uptake process, nutrient competition/antagonism and interactions among nutrients);

(2) On new emerging technologies that might improve the management of soilless cropping systems such as the use of nanoparticles and beneficial microorganism like plant growth-promoting rhizobacteria (PGPRs);

(3) On tools (multi-element sensors and interpretation algorithms based on machine learning logics to analyze such data) that might be exploited in a smart agriculture approach to monitor the availability of nutrients/elements in the hydroponic solution and to modify its composition in real time. These aspects are discussed considering what has been recently demonstrated at the scientific level and applied in the industrial context.

Growing Food without Soil

Those two subcategories are:

1. Systems using a soilless media or substrate to grow the crop, and

2. Systems using only a nutrient solution to grow the crop with no media or substrate other than to grow the transplant plug.

Products sold as "hydroponic" in stores may use either a soilless media or nutrient solution type of production system. In no case would a crop be considered to be grown hydroponically if grown in a native soil.

Why use soilless systems?

While soil supports many areas of our lives (food, clothing, housing), there are challenges in managing crops in soils. Soil may have poor physical structure, poor drainage or low nutrition, all of which limit plant growth. Soils may harbor plant pathogens, insects or nematodes that can infect or feed on

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plants. Soils may have been contaminated with other materials or chemicals that can reduce growth and yield or present safety hazards for humans. Additionally, there are many urban and suburban areas where soil is not even accessible or land is so valuable that gardening or agriculture cannot realistically be practiced. Plants grown in soil are generally outdoors where low or high ambient temperatures, low or excess moisture, pests and pathogens can negatively impact crop growth and quality. All of these potentially negative factors can be condensed into three key reasons why soilless production may be a solution:

•Soilless production can tailor the physical, chemical and even biological aspects of the growing substrate and environment to exact crop needs to enhance growth and productivity.

•Soilless production can be practiced more easily in controlled environments, such as greenhouses or even indoors with proper lighting, to enable the most efficient use of these high capital production areas.

•Soilless production in controlled environments can enable exclusion and efficient management of damaging pests and pathogens as well as environmental challenges.

Types of soilless cultures

There are two main types of soilless culture;

1. **Closed soilless culture type:** In closed soilless frameworks the dissolved supplements are recycled and the supplement concentrations are observed and balanced in like manner. Keeping the supplement adjust in such hydroponic frameworks is a test and the dissolved supplements must be examined and dissected in any event once every week. The dissolved supplements must be balanced by results. If there is not oversaw appropriately, the dissolved supplements may escape of the balance. Closed soilless frameworks incorporate both basic and advanced soilless culture frameworks.
2. **Open soilless culture type**: In open soilless frameworks a new dissolved supplements is involved for every irrigation cycle. The dissolved supplements are normally conveyed to the plants utilizing the dripping framework. In open soilless frameworks a sufficient keep run-off must be kept up with a specific end goal to keep supplement adjust in the root zone. Every soilless culture utilizes just the substrates and dribble frameworks are has a place with open soilless culture. However, there is a drip system used as closed system in case of use reservoir for re-circulating the nutrient solution.

Need for Soilless Farming

Soilless farming has been discovered to proffer solution to the problems being faced by tradition soil farming. The major advantage with such a system is the absence of weeds and other soil borne pests, no toxic pesticide residue, better use of water, better control over nutrient and oxygen, increased crop quality and yields [9].

i. Higher productivity: in line with the need for food production to rise faster than population growth to ensure food security and nutrition improvement, crops grown under soilless farming techniques have been studied and observed to better and faster as they

Expend energy in leave and fruit development rather than in the development of roots systems in search for nutrients in the soil as in the case of geoponics.

ii. Reduced labour requirement: the labour requirement in soilless farming is lesser as there are no soil to till, plough or ridge, no weeding to be done, no watering and requires less for pest control especially in greenhouses.
iii. Not season-bound: plants grown in soilless farming are not affected by the season as they are constantly fed with the required nutrient and water to grow.
iv. Low management cost: cost of running the systems is usually low especially for the NFT system because these are kept running almost entirely automatic and each input is expected to last for years.
v. No weed competing: since soil is not used, with all seeds carefully selected, soilless farming has no weed or weeding problem. This saves cost on herbicide and spraying

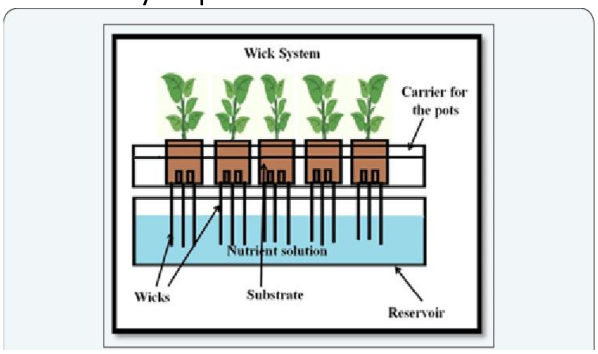
Closed Soilless culture system which is used in vegetable farming
HYDROPONICS
What is hydroponics?
Translated directly, hydroponics means plants working (growing) in water.
The word 'hydroponics' is derived from two Greek words: '***hydro***' – meaning water, and '***ponos***' – meaning labour.

A modern definition of hydroponics: A system where plants are grown in growth media other than natural soil. All the nutrients are dissolved in the irrigation water and are supplied at a regular basis to plants.

In South Africa, hydroponic vegetable production is almost always done under protection. Hydroponics (*i.e.,* "water working") is simply the growing of plants without soil. Plants don't need soil, but they do need the vitamins and minerals that soil can provide for them. Plants also need light, water, carbon dioxide and oxygen at the root zone. In hydroponics, plants are grown in an inert medium such as rocks or coco coir fiber, and they are fed a solution containing a perfected mix of primary, secondary and micro-nutrients. Almost any kind of plant can be grown hydroponically, including veggies, herbs, fruits and flowers. Hydroponics is world widely used by farmers and growers.


The plants grown are significantly larger because of so many available nutrients and not to have time to waste for growing extensive root systems. This makes the yield bigger. The nutrient solution also keeps the same amount of nutrients available all the time, whereas soil tends to "wear out" as the nutrients are taken up. The combination of all these things makes hydroponics plants more productive than soil growing plants. Many farmers at different locations are beginning to switch over to hydroponics production system. The concern about water use is also big reason hydroponics is becoming more popular- it significantly conserves water over the usual growing methods.

There is following Figures from 1 to 5 show some of the kinds of hydroponics mainly used, but any person can put his own design according to his need and the kind of plants according to the main target and the aim of hydroponics function.



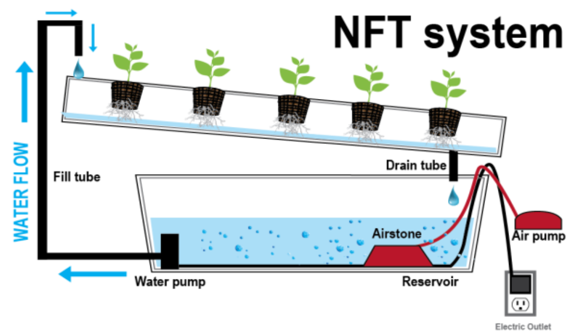


Figure 1 & 2: Wick system and nutrient film technique (NFT) of hydroponics

Wick system: The wick system (Figure1) is the simplest of all types of hydroponic systems. That's because traditionally it doesn't have any moving parts, thus it doesn't use any pumps or electricity. However, the wick is the connecting part between the potted plant and food solution in the existing reservoir. Because it doesn't need electricity to work, it's also quite useful in places where electricity can't be use, or is unreliable. The wick system is an easy type of system to build when first learning about hydroponics, and/or you just want to get your feet wet first. This type of hydroponic system is also often used by teachers in classrooms as experiments for kids. In wick system the plants are cultivated in substrate.

Nutrient film technique (NFT): The nutrient film technique (Figure 2) is re-circulated design to run highly oxygenated dissolved nutrients continuously over the roots of plants through a set of channels, typically grown in baskets hanging in a PVC pipe. The solution is pumped from a holding tank, through irrigators at the top of every sloping pipe and the run-off from the bottom of the channels is returned to the tank. Thus, the nutrient solution is continuously recycled. It is possible to make the angle of the pipe smaller and add an overflow pipe similar to what's in, off and flow system. This would serve to provide a reservoir of nutrients that would remain in the event of a power or pump failure. Because of the confined space of a PVC pipe and the requirement for nutrients to continuously flow over the roots, the nutrient film technique is particularly well suited to plants that have small root balls such as lettuce, strawberries, and herbs.

Water culture or deep-water culture (DWC): Water culture or deep-water culture (Figure 3) is the straightforward form of hydroponics systems. Plants are floating by float platform on a bath of hydroponic nutrient solution. Oxygen is supplied by an air pump that runs continuously. A water culture system can easily be set up in glass basins, fish ponds, plastic boxes, ice boxes, Concrete basins or in engraved basins covered with polypropylene sheets. Since the plants are floating and continuously in contact with the nutrient solution, there is no risk of damage to plants in the event of a power outage or stop the air pump.

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The most convenient plants in this system are Lettuce, strawberries, and herbs grow particularly well in this system.

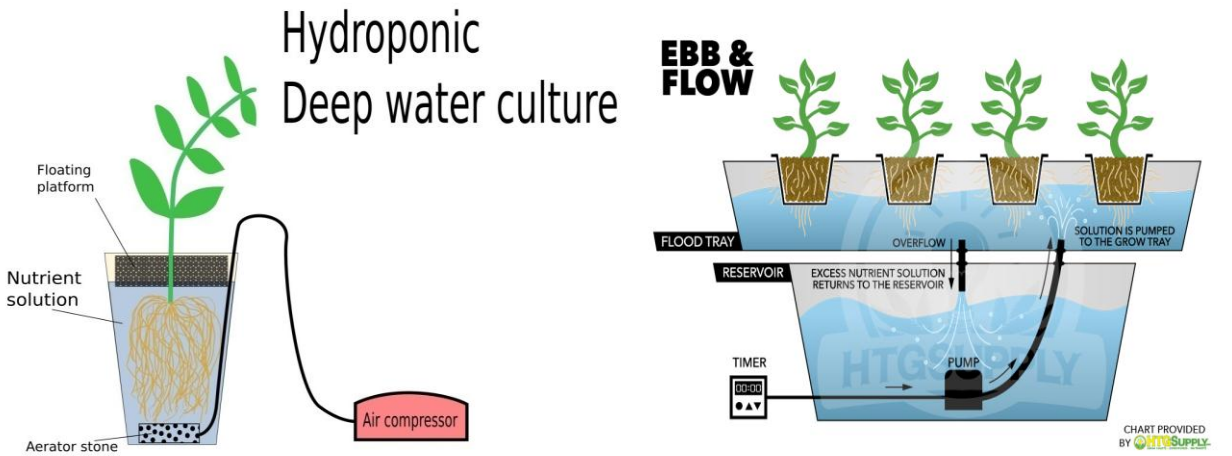

Figure 3& 4: Water culture or deep-water culture (DWC) and Ebb and flow systems

Ebb and flow systems: Ebb and flow system (Figure 4) is another inexpensive type of hydroponic setup. The setup is very similar to the drip system, where there are two containers, the one on top containing the plants in pots with substrate, and the one on the bottom containing the nutrient solution. Rather than the nutrient solution being passed slowly to drippers at the stem of each plant, the nutrients are pumped in large volumes into the top container, flooding the container. An overflow pipe determines the height of the nutrients, typically to where the roots begin at the base of the stem, with excess liquid being re-circulated through the overflow pipe back to the bottom container. With ebb and flow system, the pump is switched on and off intermittently (perhaps 30 mins on, 15 mins off), to flood the grow tray periodically. When the pump is switched off, all of the nutrients are siphoned out of the grow tray via the pump line. The emptying period allows for oxygen to reach the roots, and for this reason an air stone is not absolutely required for ebb and flow systems. As with drip systems, almost any plant will grow well with this type of system. Plants with large root balls are also particularly suited to off and flow systems.

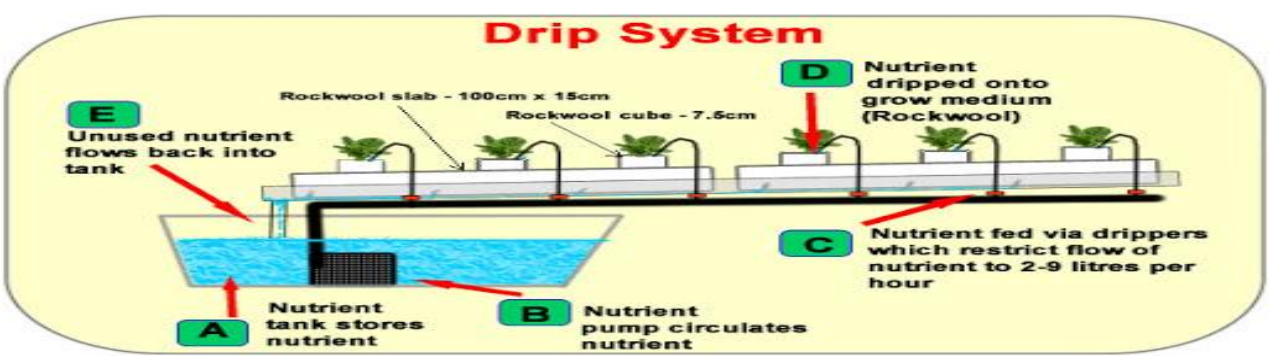

Figure 5: Drip system of hydroponics

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Drip system: Drip hydroponic systems (Figure 5) have at least two containers, one on top or higher than the other. Plants are located in the top container, while the nutrient solution is in the bottom container. The nutrient solution is pumped up to drippers located by the stem of each plant with a water pump, and an aquarium air stone is used to oxygenate the water. The nutrients filter down to the plant roots and are passed back to the bottom container. Typically, both the water and air pumps run continuously with this type of system. A crop of almost any plant will grow well with this system. Plants with large root balls are particularly suited to drip systems. However, the plants are grown in supportive mediators.

Advantages of hydroponic vegetable production

- Hydroponically produced vegetables can be of high quality and need little washing.
- Soil preparation and weeding is reduced or eliminated.
- 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 are available at all times.
- One does not need good soil to grow vegetables.
- Water is used efficiently.
- Pollution of soil with unused nutrients is greatly reduced
- Can overcome temporal (seasonal) and spatial (agro climatic) problems of crops.
- Uses much less water, no percolation and runoff.
- High density cropping. (i.e. more number of plants in small area)
- Faster growth, early harvest/ fruiting and with extended duration or some crops can be grown round the year.
- Bigger yield with better quality and shelf life.
- Less number of field operations for successful crop production.
- Clean hygienic environment.
- Efficient nutrient utilization.
- Can be grown by landless people on their rooftops/ in windowsills/inside houses or backyard

Potential Drawbacks

1. High cost (i.e. initial capital cost, cost to run, energy)
2. High maintenance (i.e. constant supervision) and management.
3. Requires specialized knowledge and equipment.
4. Pollination is another problem in enclosures for which extra steps by planting attractive flowers around or by the use of some growth regulators.
5. Epidemics and infestations can explode into total losses overnight on plant grown in confinement.

Classified hydroponics into five namely:

1. Deep Water Culture (DWC): this technique allows plant to be grown in bucket containing nutrient solution covered with a lid and the plants, contained in net pots, suspended from the center of the cover. This system is aerated using an air pump as the covering of the bucket limits air-water exchange.

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2. Float Hydroponics (FH): in this technique, floating materials such as polystyrene or Styrofoam are placed on a trough containing nutrient solution. These floating materials are used to support each plant in net pot which are placed in holes made on the material. Most float systems are long, rectangular reservoirs built out of cement or wood and lined with a durable polylines.

3. Nutrient Film Technique (NFT): in this technique, thin layer of nutrient solution is made to flow through an elevated channel (trough) within which the root of the plant lie. Thin layer of the nutrient solution allows the upper part of the plant root to be adequately oxygenated while the elevation of the channel is to allow nutrient solution to reach plants at the lower end. The nutrient solution may be delivered continuously in a 24-hour cycle, or intermittent (alternating watering and dry periods to increase root system oxygenation) or continuous recirculation during daylight hours and automated switching off at night.

4. Deep Flow Technique (DFT): similar to some other aforementioned techniques, the root of plants are continuously exposed to moving nutrient solution by supporting them with floating materials but the channel here usually contains solution of a depth of 50–150 mm and width of about 1m. Control of the nutrient solution is simplified by the large water volume and this buffers the temperature, making it suitable for regions where fluctuation in temperature of nutrient solution can be an issue.

5. Aeroponics: this has to do with growing plants with their roots suspended while fine mist of nutrient solution are continuously or intermittently applied. In some parts of Bangladesh most affected by flood and waterlogging, farmers are using methods similar to hydroponic know as floating agriculture. In this method, plants are grown on the water in a bio-land or floating bed made of water hyacinth, or other plant residues [19]. This method of farming is not only practiced in Bangladesh but in some other part of the world faced with similar challenge and this makes it recommendable for regions in Nigeria having such issue of flooding or waterlogging or little land but much water resources.

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Easy work of home by the ergonomic principles

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Neetu Kumari & Aradhana Kushwaha
M.Sc. first year student & PDF fellow
Dr. Rajendra Prasad Central Agricultural University Pusa, Samastipur, Bihar-848125 & C.S.A University of Agriculture & Technology, Kanpur

Ergonomics is the sciencetific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system. Ergonomics is the art of using furniture, workplace tools and the environment in a way that reduces the risk of discomfort or injury. Read on to learn more about how ergonomics can help you in your home.

Basics of Ergonomics in the Home Basically speaking, ergonomic in the home encompasses the following components:

I. Designing equipment and systems so that they are as easy to use as possible and less likely to cause damage to the homeowner when used.
II. Designing equipment and organizing the layout of the home so that the body's posture is improved and the loads on the body are reduced.
III. Designing the environment so that lighting and temperature are at optimal levels.

Ergonomics in the Kitchen: The kitchen is the most important area of the home as it is the area where most of the work is done. In fact, the kitchen work triangle is the most researched and applied of all the ergonomic principles. A good kitchen work triangle will have the three most used work sites the most efficient distance from one another and minimize traffic through the work zone. The three main sites are the refrigerator, the sink, and the stove/oven. Placed too far apart, you will waste a lot of steps, while placed too close together, you will feel cramped. The best height for the kitchen cabinet is 36 inches or 3 feet. It may not be the best height for a specific task but it is the best overall compromise for all of the tasks performed in the kitchen. The toe kick may be the second most important component of kitchen ergonomics. It is vital for any cabinet that sits on the floor. Many ergonomic kitchen utensils are designed with longer, larger handles so that the pressure is distributed over a wider area of the hand and the wrist is kept straight. Many kitchenware brands have ergonomic varieties of many common tools used in the kitchen.

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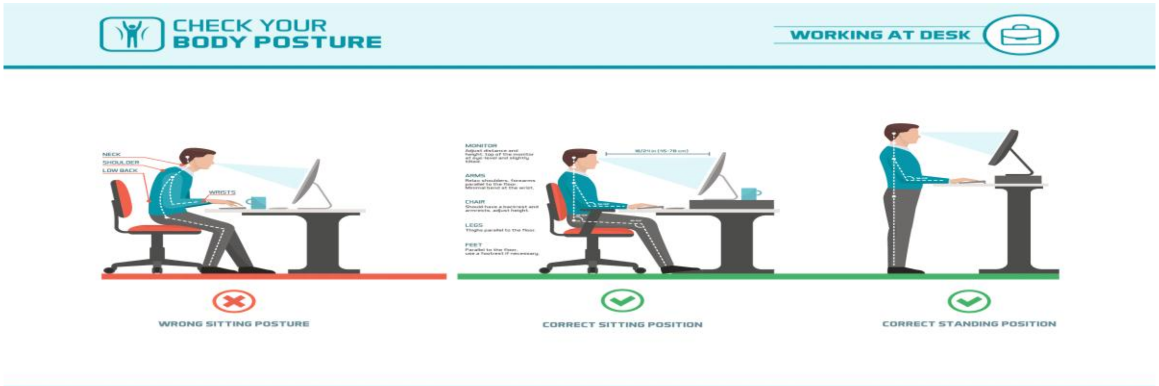
Benefits of a Workplace Ergonomics Process



1. Ergonomics reduces costs

By systematically reducing ergonomic risk factors, you can prevent costly MSDs(Musculoskeletal Disorders). With approximately $1 out of every $3 in workers compensation costs attributed to MSDs, this represents an opportunity for significant cost savings. Also, don't forget that indirect costs can be up to twenty times the direct cost of an injury.

2. Ergonomics improves productivity

The best ergonomic solutions will often improve productivity. By designing a job to allow for good posture, less exertion, fewer motions and better heights and reaches, the workstation becomes more efficient.

3. Ergonomics improves quality

Poor ergonomics leads to frustrated and fatigued workers that don't do their best work. When the job task is too physically taxing on the worker, they may not perform their job like they were trained. For example, an employee might not fasten a screw tight enough due to a high force requirement which could create a product quality issue.

4. Ergonomics improves employee engagement

Employees notice when the company is putting forth their best efforts to ensure their health and safety. If an employee does not experience fatigue and discomfort during their workday, it can reduce turnover, decrease absenteeism, improve morale and increase employee involvement.

5. Ergonomics creates a better safety culture

Ergonomics shows your company's commitment to safety and health as a core value. The cumulative effect of the previous four benefits of ergonomics is a stronger safety culture for your company. Healthy employees are your most valuable asset; creating and fostering the safety & health culture at your company will lead to better human performance for your organization.

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Mechanism and mass production of Biocontrol agents

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Rupeshkumar J. Choudhari
Assistant professor, Department of Plant Pathology
Kewalramji Harde College of agriculture, Chamorshi, Gadchiroli (MS)-442603.

INTRODUCTION

A biological agent that reduces the number or diseases producing activities of the pathogen is called as antagonists or biocontrol agent. Biological agent as the reduction of inoculum density of disease producing activities of a pathogen or parasite in its active or dormant state by one or more organisms, accomplished naturally or through manipulation of the environment, host or antagonist or by mass introduction of one or more antagonsits (Baker and Cook 91974). The important biocontrol agents used in plant disease management includes fungi, bacteria, actinomyces, virus, protozoa etc. Among them fungal and bacterial antagonists especially species of *Trichoderma, Pseudomonas* and *Bacillus* are most widely used against plant disease.

List of bio-control agents and plant pathogens

Sr. No.	Antagonist	Plant pathogen controlled
		Fungal antagonistics
1.	*Trichoderma harzianum*	*Pythium spp., Fusarium spp. Rhizoctonia solani Sclerotium rolfsii*
2.	*T. viride*	*Phytophthora spp, Armillaria mellea, Botrytis cinerea Pythium spp.,Rhizoctonia solani, Sclerotium rolfsii, Fusarium spp*
3.	*Verticillium lecanii*	*Puccinia arachidis, Uromyces appendiculatus*
		Bacterial bioagents
1.	*Agrobacterium rediobacter*	*Agrobacterium tumefaciens*
2.	*Azotobacter chroococum*	*Rhizoctonia solani*
3.	*Bacillus subtilis*	*Fusarium spp.,Pythium spp. Rhizoctonia spp., Sclerotium rolfsii , Streptomyces scabies Verticillium spp.*
4.	*Bacillus thuringiensis*	*Alternaria alternata,Hemileia vastatrix*
5.	*Erwinia herbocola pv. herbicola*	*Erwinia amylovora*
6.	*Pseudomonas fluorescens*	*Fusarium spp., Acrophobia phaseolina, Pyricularia oryzae,Pythium spp. , Rahizoctonia solani*
7.	*Streptomyces diastaticus*	*Pythium aphanidermatum*
8.	*S. griseoviridis*	*Alternaria brassicola, Rhizoctonia solani,*

Ideal characteristics of biocontrol agents

- ✓ It should not be pathogenic to plants, human beings, animal and beneficial microorganisms.
- ✓ It should have broad spectrum of activity in controlling many types of diseases and must be genetically stable.
- ✓ It should have fast growth and sporulation.
- ✓ It must be cultured under artificial media.
- ✓ It should have long shelf life.
- ✓ It must be effective under different environmental conditions.

- ✓ It should be compatible with biofertilizers.

Mechanism of bio-control agents

- Understanding the mechanisms by which biocontrol agents suppress the plant pathogens is essential for improvement and wider use of biological methods.
- Biological control is principally achieved through antagonism which involves

1. Competition:

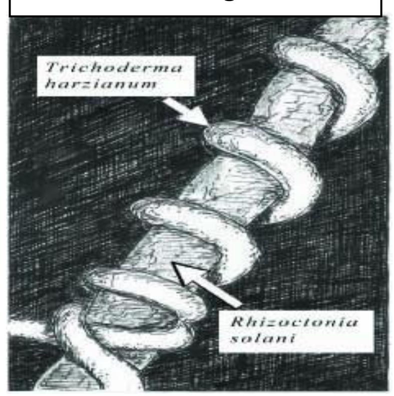
- Microorganisms compete for space, minerals and organic nutrients to proliferate and survive in their natural habitats.
- This has been reported in both rhizosphere as well as phyllospere.
- Elements for which microorganisms generally compete are carbon, nitrogen and iron, which are essential for germination and penetration of host tissue by pathogens.
- Competition has been suggested to play a role in the biocontrol of *Fusarium* and *Pythium* and some strains of *flurorescent pseudomonas*. Those fungi which highest numbers of propagules or the greatest mass of mycelial growth (Biomass) have the greatest competitive advantage.

2. Myco-parasitism:

- ✓ One of the most salient characteristics of *Trichoderma* group is their ability to parasite other fungi. *Trichoderma* attached to host hyphae via coiling, hooks and approsorium like body and penetrate the host cell wall by secreting hydrolytic enzymes, subsequently dissolve the host cytoplasm.
- ✓ Mycoparasitism is the phenomenon of one fungus being parasitic on another fungus. Mycoparasitism commonly occurs in nature.
- ✓ Antagonistic has capability to secrete cell wall degrading enzymes, it can penetrate the cell wall of host hyphae and enter in lumen of the cells.
- ✓ Mycoparasitism occurs when the antagonistst invaded the pathogen by secreting enzymes such as chitinases, cellulases, glucanases and other lytic enzymes. Several cell wall degrading enzymes , such as cellulase, B-1,3-glucanase, chitinase, proteases etc have been reported. Eg. Plant pathogen :*Rhizoctonia solani.*
- ✓ This may be hyphal interaction or destruction of propagules. As a result of inter fungus interaction i. e. fungus-fungus interaction, which lead to predation viz. coiling, penetration, branching and sporulation, resting body production, barrier formation and lysis.

Penetration

Coiling



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3. Antibiosis

Antibiosis defined as antagonism mediated by specific or non- specific metabolites of microbial origin by lytic agents, enzymes, volatile compounds or other toxic substances. Antibiosis play an important role in biological control.

- ✓ Antibiotics are generally considered to be organic compounds of low molecular weight produced by microbes and at low concentrations they are deleterious to the growth or other metabolic activities of other microorganisms. Antibiotic production as mechanism of biological control has largely been demonstrated for the biocontrol agents used against soil borne plant pathogens. The fungi are known to produce a wide variety of toxic substances. Colonization of pea seeds by *T. viride* resulted in the accumulation of significant amount of the antibiotics, gliotoxin, viridian, gliovirin , viridiol, trichodermin and volate compounds like lactines, alcohols, terpenes in the seeds and thus Trichoderma as seed –coat inoculants controlled *Pythium ultimum.*
- ✓ Antibiotic production by some strains of fluorescent pseudomonas is now recognized as an important mechanism in disease control.

4. Induced Systemic Resistance (ISR)

- Induced systemic resistance is the ability of an agent (fungus, bacterium, virus, chemical, etc.) to induce plant defense mechanisms that lead to systemic resistance to a number of pathogens.
- Inoculation of plants with weak pathogens or non-pathogens leads to induced systemic plant resistance against subsequent challenge by pathogens.
- Many rhizobacteria produce hydrogen cyanide and this has been shown to play direct as well as indirect role in biological control of plant disease and increasing the yields. Some *Pseudomonas fluorescens* themselves produced HCN and are able to suppress black root rot of tobacco caused by *Thielaviopsis basicola*

5. Plant growth promoters

Trichoderma strains solubilized phosphate and micronutrients. The application of Trichoderma with plants increases the number of deep roots, thereby increasing the plants ability to resist drought. (Prem Kishor and Ghosh, 2009). The ability of these fungi to increase the rate of plant growth and development, including, especially, their ability to cause the production of more robust roots has been known.

Mass multiplication of bio-control agents

- For successful biological control, technologies including the production, formulation and delivery system of antagonists play an important role. In addition, these aspects must be implemented to be compatible with industrial and commercial development methods and field application. With the increasing interest in developing alternatives to chemicals fungicides, mass production of biocontrol agents for use as bioprotectant has become a focus of industrial research and development.
- The following are the methods generally employed for the mass production of biocontrol agents. They are
- Mass multiplication in solid substrates- Solid state fermentation
- Mass multiplication in Liquid media- Liquid state fermentation

Mass multiplication in solid substrates

- This method is followed only for fungal biocontrol agents. Solid-state fermentation is a very common method of mass production of antagonists in laboratory experimentation. The antagonistic fungus us grown in Petri plates, spores and others propagates are then harvested and formulated. In this methods are use of various cheap agriculture waste and by-products for mass production of biological control agents. Various substrates being used in solid state fermentation are sorghum grain, coconut coir pith, gobar gas slurry, well decomposed pressmud, wheat bran, rice bran sugarcane biogases, wheat straw, sheep manure , poultry manure etc.

- Solid fermentation is very common method for mass production of Trichoderma spp. Various cheap cereal grains like, sorghum, millets, ragi are used as substrates. The grains are soaked in water overnight and water is decanted in the morning. The soaked grains are taken in heat resistant bags and sterilized for 30 minutes in an autoclave or pressure cooker. The sterilized grains are inoculated with Trichoderma spore suspension and incubated for 10-15 days. Coating on the grains. These grains can be powdered finely and used as seed

1. Solid Fermentation

Improved selective solid media are used for multiplication of *Trichoderma spp.*

1. Wheat straw
2. Saw dust
3. Sorghum grains
4. Manures

Multiplication of *Trichoderma* on sorghum grain

The sorghum grains are soaked in water overnight in a vessel and the water is decanted from the grains in the morning.Five hundred gram of soaked sorghum grains are taken in polypropylene bags (25cmX35cm). Autoclaved bags to be inoculated with two ml suspension of *Trichoderma* and mixed thoroughly. Inoculated bags to be incubated in a BOD incubator at 28 $\pm$ 1^0C for 15 days. (Project Directorate of Biological Control -Bangalore)

Culture of *Trichoderma harzianum* :

Mass multiplication in liquid media

Biocontrol agents can be grown in any one of the liquid media under stationary/ shaker/fermentor culture conditions. In statonary culture conditions, it will take about 10 days for full spore production, in shaker, it may take 7 days and in fermentor, peak production occurs after 3 days.

Liquid media are used for multiplication of *Trichoderma.*

1. Potato dextrose medium

The *Trichoderma* selective strain is grown on PDA for seven days. Spores are removed from agar surface by scraping with sterile spatula after adding 10 ml of sterile water. One ml of this inoculums or 5g mycelial bit is added to 100 ml of liquid medium. Inoculated media are grown under stationary/ shaker/ fermentor condition. In stationary condition it will take about 10 day for full spore production, in shaker, it may take 7 days and in fermentor peak production occur after 3 days.

Talc based formulation of Trichoderma

Trichoderma is grown in any one of the media for obtaining biomass. Full-grown *Trichoderma* is mixed with talc powder and dried to 8 per cent moisture under shade. After drying and breaking clots, the formulation is packed in milky white polythene bags. (Project Directorate of Biological Control -Bangalore)

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Advantages of Biocontrol agents

- They help to reduce the use of chemical-based fungicides.
- They help to reduce the risk of developing pathogen resistant to traditional chemicals.
- In most cases they are safer to use and In most cases they are less phytotoxic.
- They tend to be more stable than chemical pesticides if stored properly.

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New Technologies and Old Problems: Insect Taxonomic Research in 21st Century

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C. Sowmiya[1] E. Sankarganesh[2] and F.D.Prisca seeli[3]
[1]*Ph.D. Scholar, Department of Agricultural Entomology, TNAU, Coimbatore*
[2]*Ph.D. Scholar, Department of Agricultural Entomology, BCKV, West Bengal*
[3]*Ph.D. Scholar, Department of Genetics and Plant Breeding, TNAU, Coimbatore*

Taxonomy is the science of classification, deals with the naming and classifying organisms based on the similarities and dissimilarities. About 10 million insect species have been existing in the world. But the identified insect fauna are restricted to 1 million. At present there is huge taxonomic crisis and only 15%, approximately 6000 taxonomists in the world. If they supposed to describe a new species every 6 months once, then only they can complete their task. Moreover, they need to spend 1000 years to describe all unknown species and it is difficult to even imagine. It is the right time to speed up the taxonomic research by using advanced technologies.

Old problems

Traditional taxonomic identification solely depended on morphological characters. The taxonomic keys were not available for all the life stages and some are highly gender-specific. Also, while identifying aquatic insects, immature identification is quite important which is consider as bio-indicator. But for the exact identification the keys were not available and have several difficulties in the field of identification. The problems like lack of taxonomists, time consumption, difficulty in the insect taxonomy, cryptic species issue and lack of modern keys for the revised taxa were encountered.

New technologies as solutions

To ratify these problems DNA barcoding, Automatic insect identification and Integrative taxonomy can be the fruitful solution.

- **DNA barcoding**

DNA barcoding is a technique that uses mitochondrial COI gene from the small fragment of the genome to identify a species. For barcoding of the particular species, DNA extraction is the preliminary step (using standard protocol) followed by PCR amplification and sequencing. Finally, the analysed sequence has to BLAST in the NCBI portal for the identification. Databases like BOLD (Barcode of Life Data systems), IBOL (International Barcode of Life) and MODII (Moth Databases on Indian Insects) can be used for identification purposes. Cryptic species are the closely related organisms that are morphologically similar but reproductively isolated. This is one of the major problems in traditional taxonomic identification. The issues like lack of taxonomists, time consumption will be ratified using this DNA barcoding technology. But mitochondrial DNA is maternally inherited, sometimes the presence of pseudogenes will have certain limitations.

- **Automatic insect identification**

The advanced one is the automatic insect identification. Steps involved in the automation are characteristics of insects, principles, colour histogram, GLCM, pattern recognition, extension theory, stacked spatial pyramid kernel, ontology-based insect recognition, KNN spectral recognition and hybrid approach. Characteristics like wings, legs, body shape will be taken for individual species identification. Image acquisition will be done for the initial step and then the background will be converted into a single colour to avoid noise in imaging. For image processing, the acquired image will be converted to greyscale then to a binary image (black and white) to get the perfect outline. Patterns, dots and markings like features will be extracted under the feature extraction process. Then colour histograms produced to covert a normal red-green-blue image to hue-saturated image for improving the accuracy.

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Artificial or convolutional or kernel neural networks also used to get high pixel quality images. Finally, all features will be max pooled and hybrid image with more quality will be produced. Modern taxonomic keys, difficulty in the insect taxonomy, time consumption and lack of taxonomist problems were solved by using automation. On the other hand, there is possibilities of some misidentifications. Insects like water strider were mistakenly identified as Scutellarid bug, hoppers identified as cicadas and some ants identified as wasps.

- **Integrative taxonomy**

Next to the above technologies the important approach is integrative taxonomy. It means in addition to morphological and molecular techniques, other disciplines have been utilized in systematics. Other disciplines like Ecology (habitat, ecological niches, pathogen, symbiont, host/ food plant), Behaviour (mating-related, social/ interspecific behaviour) and Reproductive compatibility will be chosen for identification. Crosskey in 1984 described the integrative taxonomy for the first time by using cytomorphological, biochemical & zoogeography in identifying sibling species of *Simulium damnosum* complex. This type of integration will be useful to improve the overall accuracy.

Advantage: The development of powerful and affordable computers and new statistical tools to analyse these data.
Disadvantage: Integration by cumulation is a risk of overestimation of species as divergence in a single character may not lead to reproductive isolation.

The points will be appropriate while making taxonomic decisions

1) Multiple disciplines should be incorporated to improve rigour.
2) Morphology is the basic of taxonomic investigation and molecular genetic information has to be included along with this.
3) If there is any mismatch, importance should be given to the evolutionary traits of the species.
4) Conventional taxonomists should be trained with additional methods to improve accuracy and speed.

CONCLUSION

The recent advancements and integrated taxonomy does not replace traditional taxonomy as whole. It compresses the slow classical taxonomic routine into one procedure by coordinating the findings of different disciplines under the procedure. The comphrenshive information are certainly helpful for the pest management experts.

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NUTRACEUTICAL FOOD: VEGETABLES

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Nidhi Joshi
Ph.D. Scholar, Dept. Food and Nutrition, College of Home Science,
G.B.P.U.A. & T., Pantnagar, U.S. Nagar, Uttarakhand- 263145

INTRODUCTION

Vegetables and fruits are described as nutraceutical foods because of their health benefits. They are essential constituents of the human diet supplying the body with vitamins, minerals and certain hormone precursors along with small amounts of energy and protein (Akindahunsi and Salawu 2005). In addition to vitamins and provitamins, these nutraceutical foods also contain phytochemicals that possess great potential for the prevention of chronic diseases (Chu *et al* 2002). A constant supply of phytochemical-containing plants is essential to furnish the defensive mechanism to reduce the risk of chronic diseases in humans (Liu 2002). Polyphenols, phenols, terpenes, flavonoids, tannins, glucosinolates in vegetables and fruits and specific components like green tea polyphenols and lycopene in tomatoes prevent degenerative diseases and reduce oxidative stress (Karthiga and Jaganathan 2013). Phenolic and flavonoid compounds have been associated with color and flavor characteristics of vegetables and fruits and they have been reported to have multiple biological effects.

Antioxidant profile of vegetables

Crude extracts of plant materials rich in phenolics are increasing of interest in the food industry because of their retarding effect on lipid oxidation and thereby improving the nutritional value and quality of food (Javanmardi *et al* 2003). It is recognized that diet rich in vegetables has a protective role against various diseases like cancer and coronary heart diseases (Melo *et al* 2006). Diets with a higher proportion of vegetables and fruits are useful for combating the rising prevalence of obesity as vegetables are good sources of fiber, phytonutrients, provitamins, polyphenols, and minerals (Gueco *et al* 2003). To obtain optimal health benefits from dietary phytochemicals, it is suggested that humans should consume a balanced diet with a variety of phytochemical sources from whole foods, such as vegetables, fruits, and grains as part of whole meals (Liu 2002). Despite the association of fruits and vegetables in preventing disease, the intake of fruits and vegetables is generally less than the recommended levels (Yadav and Krishnan 2008).

Vegetables though contribute towards the vitamin and mineral content of the human diet; they also contain significant levels of biologically active components that impart health benefits beyond basic nutrition through their antioxidant properties (Peter and Hazra 2012). The protection that the green vegetables provide against diseases including cancer and cardiovascular and cerebrovascular diseases is not only attributed to the presence of nutritional antioxidants such as vitamins A, C, E and β-carotene but also due to the presence of greater quantity of non-nutritional antioxidants such as flavones, flavonoids and polyphenol compounds (Wang *et al* 2003). In nutshell, the richness of antioxidants in vegetables has catapulted their significance in human health. The projected long life of vegetarians is not only due to the fact that vegetables provide much-needed minerals, vitamins, and other nutrients but also contain antioxidants.

The antioxidant potential of a wide variety of vegetables including spinach, cauliflower, cabbage, carrot, leaf lettuce, cucumber, garlic, onion, potato, and legumes was analyzed on a fresh weight basis (Cao *et al* 1996). It was found that garlic had the highest antioxidant activity (μmol of Trolox equivalent/g) against peroxy radicals (19.4) followed by spinach (12.6), onion (9.8 to 3.9), cauliflower, potato, cabbage, leaf lettuce, carrot and cucumber (3.8 to 0.5). Kaur and Kapoor (2002) evaluated the antioxidant activity of extracts of thirty-six vegetables. The antioxidant activity expressed as percent inhibition of oxidation ranged from a high of 92% in turmeric extracts to a low of 12.8% in long melon. Other vegetables like ginger, fenugreek, mint, beetroot, broccoli, brussels sprouts, yam, tomato, lotus stem, and coriander were found to have antioxidant activity more than 70%. Antioxidant and antiproliferative activity of 10 common vegetables were studied by Chu *et al* (2002). The results showed that broccoli possessed the highest total phenolic content (101.6 mg/100 g of sample) followed by spinach, yellow onion, red pepper, carrot, cabbage, potato, lettuce, celery, and cucumber. Red

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pepper had the highest total antioxidant activity (46.95 µmol of vitamin C equivalent/g of sample) followed by broccoli, carrot, spinach, cabbage, yellow onion, celery, potato, lettuce, and cucumber. Doss and Dhanabalan (2009) evaluated the antioxidant activity of onion, chilly, coriander, garlic, tomato, and cucumber. The results showed that all vegetable juices exhibited increased antioxidant activity with an increase in juice concentration, coriander having the highest antioxidant activity and radical scavenging power. Aberoumand and Deokule (2008) studied total phenolic compounds in a wide range of vegetables consumed in India and Iran. The results showed that the total phenolic content of *Momordica dioicia Roxb* (396 mg/100 g) and of *Cordia myxa Roxb* (402 mg/100 g) was comparable with total phenolic content of mint vegetables (399.8 mg/100 g) and the amounts were more than total phenolic content of other vegetables.

Green leafy vegetables

Green leafy vegetables are micronutrient dense nature's gift to mankind that provide more vitamins than any other food and constitute a vital part of a balanced diet. Green leafy vegetables are incredibly healthy and have been considered as 'nature's anti-aging wonders' (Gupta *et al* 2005). They are inexpensive sources of micronutrients such as ascorbic acid, vitamin A, β-carotene, folic acid, riboflavin, tocopherols, calcium, iron, phosphorus, magnesium, phytochemicals, antioxidants and essential fatty acids (Gupta and Prakash 2011). They provide adequate roughage required in the daily diet. These are some of the most valued components of Indian diets for their appetizing color, flavor, taste, and health-promoting effects. Green leafy vegetables possess the enormous nutritive potential and can be used in the prevention of radical-induced diseases. The presence of antioxidants in vegetables acts as a remedy for radicals. The antioxidant activity and nutraceutical value of green vegetables have been in limelight and an important area of nutritional and phytotherapeutic research (Ansari *et al* 2005). The average intake of green leafy vegetables in the Indian population is much less than the recommended levels.

Dark green leafy vegetables had large amounts of micronutrients that play a vital role in nutrient metabolism and retard degenerative diseases (Chu *et al* 2002). These constitute a major part of a balanced diet and are rich in bioactive compounds such as polyphenols, carotenoids, flavonoids, flavones, isoflavones, catechins, lignans and isocatechins (Sonawane and Arya 2013). Phytochemical analysis of *Basella alba* leaves by Tongco *et al* (2015) revealed that total phenols were found to be 93.89 and 85.13 mg gallic acid equivalent (GAE)/g extract for ethanol and aqueous extracts, respectively and 100.18 and 90.80 mg quercetin equivalents (QE)/g extract for ethanol and aqueous extracts, respectively. Rajeshwari *et al* (2006) evaluated the antioxidant effect of Indian Dill leaves (*Anthem sowa*). Water extract of *Anthem sowa* exhibited maximum antioxidant activity (74.5%) followed by methanol, chloroform and hexane extracts that showed antioxidant activity of 54.4, 43.4 and 40.1%, respectively. Biochemical and nutritional constituents of lettuce, cabbage, parsley, spinach, and arugula were estimated. Among five green leafy vegetables, the lettuce was found to have the highest content of ascorbic acid while the least was found in arugula (Settaluri *et al* 2015).

Phytochemical characters and *in vitro* antioxidant activity of Indian mustard (*Brassica juncea*) leaves was studied by Kumar *et al* (2010). It was revealed that total phenols, total glucosinolates, crude fiber, flavonoids, and β-carotenes ranged from 4.3 to 8.3 ppm (gallic acid equivalent); 19.9 to 32.7 µmoles/g; 9.5 to 11.8%; 0.8 to 2.3 ppm (quercetin equivalent) and 37.7 to 42.2 ppm, respectively. Gupta and Prakash (2009) studied the antioxidant activity of *Amaranthus sp., Centella asiatica, Murraya koenigii* and *Trigonella foenum graecum.* The ascorbic acid, total carotene, β-carotene and total phenolic content (tannic acid equivalents) of the green leafy vegetables ranged between 15.18 to 101.36; 34.78 to 64.51; 4.23 to 8.84 and 150 to 387.5 mg/100 g, respectively. Subhasree *et a*l (2009) analyzed free radical-scavenging activity in four plant species, namely *Trigonella foenum graecum, Centella asiatica, Sauropus androgynus,* and *Pisonia alba.* Correlation and regression analysis established a positive correlation between some of these antioxidants and *in vitro* free radical-scavenging activity of the plant extracts. The study revealed that these plants may play a crucial role in several therapeutic formulations. Dasgupta and De (2007) analyzed the antioxidant activity of eleven edible leafy vegetables namely, *Asteracantha longifolia, Bacopa monnieri, Bauhinia racemosa, Centella asiatica, Chenopodium album, Enhydra fluctuans, Ipomea reptans, Moringa olifera, Nyctanthes arbortristis, Paederia foetida, and Trigonella foenum graecum.* The results revealed that *Ipomea reptans* possessed the highest antioxidant activity while the lowest activity was found in *Nyctanthes arbortristis*. Bajpai *et a*l (2005) evaluated free radical scavenging activity of some leafy vegetables and it was

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reported that the aerial parts of *Coriandum sativum, Spinacia oleracea, Trigonella corniculata, and Trigonella foenum graecum* showed lower inhibitory concentration values (4.1 to 7.9 mg/ml), efficiency concentration values (178 to 321 mg/ml DPPH) and higher values of anti-radical power (0.31 to 0.51) as compared with their seeds.

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Major problems and constraints for organic farming in India

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Dropati Saran[1] and Sunaina Varma[2]
Ph.D. Scholar, [1]Department of Agricultural Economics, [2]Department of Plant Pathology, COA, SKRAU, Bikaner – 334 006

India is basically an agricultural oriented country and for meeting food demand under limited arable area and toxin-free agricultural produce have become an important forcing factor for countries like ours to explore possibilities for opting 'conventional agriculture', Organic farming emerged as a potential alternative for meeting food demand, maintaining soil fertility and increasing soil carbon pool. Organic farming system emphasis on the use of organic matter for enhancing soil properties, minimizing food chain associated health hazards and attaining closed nutrient cycles, the key factors for sustainable agriculture. Organic farms although yield on an average 10-15% less than conventional farms, the lower yields are balanced by lower input costs and higher margins. However, Indian organic farming industry is almost entirely export oriented, running as contract farming under financial agreement with contracting firms, The objective of this article is to assess the status and potential of organic farming and the constraints therein impeding the adoption of this sustainable agricultural practice in India.

Lack of Awareness:

The most important constraint felt in the progress of organic farming is the inability of the government policy making level to take a firm decision to promote organic agriculture. Unless such a clear and unambiguous direction is available in terms of both financial and technical supports, from the Centre to the Panchayat levels, mere regulation making will amount to nothing. Many farmers in the country have only vague ideas about organic farming and its advantages as against the conventional farming methods.

Use of bio-fertilizers and bio pesticides requires awareness and willingness on the part of the farming community. Knowledge about the availability and usefulness of supplementary nutrients to enrich the soil is also vital to increase productivity. Attention on the application of composts/organic manure is also lacking. The organic matter is spread during the months when the right moisture level is absent on the soil. The whole manure turns into wastes in the process. The required operation is of course labour intensive and costly, but it is necessary to obtain the desired results.

Output Marketing Problems:

It is found that before the beginning of the cultivation of organic crops, their marketability and that too at a premium over the conventional produce has to be assured. Inability to obtain a premium price, at least during the period required to achieve the productivity levels of the conventional crop will be a setback.

Shortage of Bio-mass:

Many experts and well informed farmers are not sure whether all the nutrients with the required quantities can be made available by the organic materials. Even if this problem can be surmounted, they are of the view that the available organic matter is not simply enough to meet the requirements.

Inadequate Supporting Infrastructure:

In spite of the adoption of the NPOP during 2000, the state governments are yet to formulate policies and a credible mechanism to implement them. There are only four agencies for accreditation and their expertise is limited to fruits and vegetables, tea, coffee and spices. The certifying agencies are inadequate.

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High Input Costs:

The small and marginal farmers in India have been practicing a sort of organic farming in the form of the traditional farming system. They use local or own farm renewable resources and carry on the agricultural practices in an ecologically friendly environment. However, now the costs of the organic inputs are higher than those of industrially produced chemical fertilizers and pesticides including other inputs used in the conventional farming system.

Marketing Problems of Organic Inputs:

Bio-fertilizers and bio-pesticides are yet to become popular in the country. There is a lack of marketing and distribution network for them because the retailers are not interested to deal in these products, as the demand is low. The erratic supplies and the low level of awareness of the cultivators also add to the problem. Higher margins of profit for chemical fertilizers and pesticides for retailing, heavy advertisement campaigns by the manufacturers and dealers are other major problems affecting the markets for organic inputs in India.

Low Yields:

In many cases the farmers experience some loss in yields on discarding synthetic inputs on conversion of their farming method from conventional to organic. Restoration of full biological activity in terms of growth of beneficial insect populations, nitrogen fixation from legumes, pest suppression and fertility problems will take some time and the reduction in the yield rates is the result in the interregnum. It may also be possible that it will take years to make organic production possible on the farm.

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Problematic Soils and their management practices

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Prabhoo Singh[1], Ramesh Chand Bana[2] and Vikas Kumar[3]
[1]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, SKN Agriculture University, Jobner303329 (Rajasthan)
[2]Ph.D. Scholar, Department of Agronomy, SKN Agriculture University, Jobner-303329 (Rajasthan)
[3]Ph.D. Scholar, Department of Extension Education, SKN Agriculture University, Jobner-303329 (Rajasthan)

INTRODUCTION

The soils, especially in humid regions, were acidic before they were ever farmed. Leaching of bases from soils and the acids produced during organic matter decomposition combined to make these soils naturally acidic. As soils were brought into production and organic matter was decomposed (mineralized), more acids were formed. The total global area of salt-affected soils including saline and sodic soils was 831 M ha (Martinez-Beltran & Manzur, 2005. Soil sodicity is characterized by high pH, high water soluble and exchangeable sodium, low biological activity, poor physical properties and deficiency of many essential nutrients.

Major Types of Problematic Soils

This article throws light upon the three major types of problematic soils. The types are:

1. Acid Soils:

The soils with pH less than 6.5 and which respond to liming may be considered as acidic soils.

Characteristics:

- pH is less than 6.5
- These soils are open textured with high massive Structure.
- Low in Ca, Mg with negligible amount of soluble salts.
- These soils appear as brown or reddish brown, sandy loams or sands.

Injury to Crops:

- Plant root system does not grow normally due to toxic hydrogen ions.
- Permeability of plant membranes are adversely affected due to soil acidity.
- Enzyme actions may be altered, since they are sensitive to pH changes.
- Deficiency of Ca and Mg occur by leaching.
- Al, Mn and Fe available in toxic amounts.

Amelioration:

- Lime as reclaiming agent
- Basic slag obtained from Iron and steel industry can be substituted for lime.
- Ammonium sulphate and Ammonium chloride should not be applied to acid soils buturea can be applied.
- Calcium Ammonium Nitrate (CAN) is suitable to acidic soils.
- Any citrate soluble phosphate fertilizer is good source of phosphorous for acidic soils.

2. Alkaline Soils:

Alkali soils are formed due to concentration of exchangeable sodium and high pH. Because of high alkalinity resulting from sodium carbonate the surface soil is discoloured to black; hence the term black alkali is used.

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Characteristics:
- Saline soil has soil pH of more than 8.5.
- EC is less than 4.0 m.mhos/cm
- ESP (exchangeable sodium per cent) is more than 15.
- It has black colour that why it is also called as Black alkali

Injury to Crops:
- High exchangeable sodium decreases the availability of calcium, magnesium to plants.
- Toxicity due to excess hydroxyl and carbonate ions.
- Growth of plant gets affected mainly due to nutritional imbalance.
- Restricted root system and delay in flowering in sensitive varieties.
- Typical leaf burn in annuals and woody plants due to excess of chloride and sodium.
- Bronzing of leaves in citrus.
- It affects the solubility of zinc (Zn).

(e) Amelioration:
- Gypsum
- Use of Pyrites (FeS_2).
- Sulphur present in pyrites causes decrease in pH of soil due to formation of H_2SO_4.
- Application of sulphur.
- Application of molasses.
- Drainage channels must be arranged around the field.
- Growing the green manure crops and incorporates in the field.

3. Saline Soils:
The saline soils contain toxic concentration of soluble salts in the root zone. Soluble salts consist of chlorides and sulphates of sodium, calcium, magnesium. Because of the white encrustation formed due to salts, the saline soils are also called white alkali soils.

Characteristics:
- Saline soil has soil pH of less than 8.5
- EC is more than 4.0 m.mhos/cm
- ESP (exchangeable sodium per cent) is less than 15
- Dominated by sulphate and chloride ions and low in exchangeable sodium
- Flocculation due to excess soluble salts.
- High osmotic pressure of soil solution
- Presence of white crust

Injury to Crops:
- High osmotic pressure.
- As a result of retarded growth rate, leaves and stems of affected plants are stunted.
- Development of thicker layer of surface wax imparts bluish green tinge on leaves during to high EC germination per cent of seeds is reduced.

Amelioration:
- The required area is to be made into smaller plots and each plot should be bounded to hold irrigation water.
- Separate irrigation and drainage channels are to be provided for each plot.
- Plots are to be flooded with good quality water up to 15 – 20 cms and puddled.

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- Thus, soluble salts will be dissolved in the water.
- The excess water with dissolved salts is to be removed into the drainage channels.
- Flooding and drainage are to be repeated 5 or 6 times, till the soluble salts are leached from the soil to a safer limit
- Green manure crops like Daincha can be grown up to flowering stage and incorporated into the soil. Paddy straw can also be used.

Table: 1. Combination between Saline and Alkaline Soil

Particular	Saline soil	Alkaline soil
Known as	Solan chalk	Solanetz
Soluble salt	>0.1 %	<0.1 %
Colour	White coloured so also called white alkali	Black coloured so also called black alkali
Ions persence	Cl^- and SO_4^{2-} ions of Na^+	CO_3^{2-} of Na^+

Table: 2. Comparison between Saline, Saline Alkaline and Alkaline Soil

Particular	EC (dS m^{-1}) at 25^0 C	ESP	pH
Saline soil	>4	<15	<8.5
Saline alkaline soil	>4	>15	<8.5
Alkaline soil	<4	>15	8.5-10.0

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Challenges in the Industrial Production and Implication of Bioactive Peptides

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[1]Sonu K. S.* and [2]Basavaprabhu H. N.
Doctoral fellows
[1] Dairy chemistry Division
[2] Dairy Microbiology Division
ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India

INTRODUCTION

Bioactive peptides are gaining popularity in these modern days due to their better nutraceutical properties. Bioactive peptides are the specific fragments of proteins usually containing amino acid residues of 2-20, generally encrypted in the native protein. Unless until bioactive peptides encrypted in the native protein get hydrolyzed, they do not show any bioactivity. Bioactive peptides are generated from various sources such as plant proteins and animal proteins. Bioactive peptides are produced either by *in vitro* enzymatic hydrolysis, microbial fermentation or gastrointestinal digestion. Routinely *in vitro* enzymatic hydrolysis method is largely exploited for their production using the proteolytic enzymes like pepsin, trypsin, papain, alcalase, pancreatin, chymotrypsin, thermolysin, flavourzyme, neutrase, and protamex, while fermentation method of production is carried out by using suitable microbial strain that is having GRAS status, e.g. lactic acid bacteria (Chalamaiah, Yu, & Wu, 2018). Recently, food protein-derived bioactive peptides have been reported to have biological activities like anti-microbial, antioxidant, antihypertensive, immunomodulatory, anti-inflammatory, intestine-modulatory, anti-cancer, anti-diabetic, opioid, hypocholesterolemic, and metal chelating properties (Chalamaiah*et al*., 2018; Daliri, Oh, & Lee, 2017; Rizzello*et al*., 2016;). Bioactivity of peptides is influenced by various factors like the number of amino acids, type of amino acids, hydrophobicity, and charge of peptides.

Food protein-derived bioactive peptides have a great potential for application as functional foods/natural health products/health foods/nutraceuticals. Recently, the commercial interest has been increased to produce health-promoting products with bioactive peptides. Although a large number of peptides have been produced and isolated from different sources, only a handful of them have been commercialized, especially of milk and fish source. Stability, safety aspects, and lack of *in vitro* and *in vivo* trials are the constraints for their commercialization.

Hurdles for the production of bioactive peptides for the functional foods.

1. The development of a suitable and efficient method for commercial production of bioactive peptides
2. Difficulty in the production of peptides with bioactivity and consumer acceptable taste
3. Stability of peptides during the manufacturing process and storage
4. Isolation and characterization of new bioactive peptides
5. Action of mechanism of bioactive peptides against demonstrated bioactivity
6. Lack/insufficient *in vitro* and *in vivo* studies on the safety aspects of bioactive peptides
7. The lacuna in the meta-analysis of scientific evidence regarding health benefits
8. Lack of scientific data on the recommended dosage level

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9. Lack of evidence on the side effects of excessive consumption of bioactive peptides
10. Lack of evidence on long term effect of usage of bioactive peptides on human health
11. Lack of scientific evidence on the absorption, distribution, metabolism, and excretion of bioactive peptides
12. Lack of scientific data in relation to the interaction of peptides with the drugs or other food components in the body

CONCLUSION

Although a lot of bioactive peptides are demonstrated to have health benefits, lack of clinical trials limit their application for human use. A large number of clinical trials need to be conducted to generate scientific evidence on the safety and recommended dosage level of bioactive peptides to commercialize the production to achieve in the field of bioactive functional foods.

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Yelllow Mosaic Virus of Mungbean and Their Management

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Krishna Kumar [1], Akshay Kumar[2] and Ankit[3]
[1]Ph.D. Scholar, Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India
[2]Ph.D. Scholar, Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India
[3]M.Sc. (Ag.), Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.) India

INTRODUCTION

Mungbean *(Vigna radiata* L.) belongs to the family Fabaceae and sub-family Papilonaceae, is a good source of protein, carbohydrate and vitamin. Being an important short-duration Kharif grain legume, mungbean is grown extensively in major tropical and sub-tropical countries of the world. *Vigna radiata* (L.) Wilczek, generally called as green gram or mungbean which is native to India or the Indo Burma region. It is well adapted to large number of cropping systems and creates an important source of cereal based diet worldwide, grown in more than six million hectares. Presently about 90% of world's mungbean is produced in Asia alone. India accounts for about 65% of world's acreage and 54% of its global production and it is the world's largest mungbean producer. In India, mungbean is grown on an area of 3.42 lakh ha and production of 1.03lakh tonnes with productivity 302 kg/ha. Important mungbean growing states are Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, Odisha, Tamil Nadu and Uttar Pradesh. Nutritional status of crop mainly consists of carbohydrate (51%), protein (24-26%), minerals (4%) and vitamins (3%). It also has the capacity to fix good amount of atmospheric nitrogen and thus, enhances soil fertility. The standard worldwide yield of mungbean is very low (384 kg/ha) and besides many efforts its production has not considerably increased. The major reason for the low yield is the sensitivity of the crop to insects; weeds and diseases caused by fungi, virus and bacteria.

Bean Yellow Mosaic Virus

Yellow Mosaic is a most destructive and widely distributed. This disease was first reported from New Delhi (1960) in India. The disease has been reported from several countries *viz.,* India, Pakistan, Bangladesh, Sri Lanka, and Thailand. In India, this is major limiting factor in mungbean (*Vigna radiata* L.) and urdbean cultivation in Uttar Pradesh, Uttarakhand, Madhya Pradesh, Bihar, Delhi, Punjab, Haryana, Rajasthan and Andhra Pradesh. The yield losses may be more than 60 %, when infection occurs within 25 days after sowing. The per plant reduction yield varies from 22.3 to61.7 %.

Symptoms

Symptoms of the disease start as scattered small specks or yellow rounded spots on the leaf surface. These spots diffuse and extend rapidly resulting in yellow areas with green ones. The green areas now turn to yellowish giving irregular pattern indistinct light and dark areas on the leaf. The yellow mottled leaf gradually changes to whitish and ultimately becomes necrotic. Because of the severe infection the chlorophyll content of the leaves is lost and pods reduce in size. The pods are produced on disease plants and they gradually deform containing shrivelled seeds.

Causal Organism

The disease is caused by Mungbaen Yellow Mosaic Virus (MYMV), a white fly transmitted virus which are restricted to dicotyledonous plant and are assigned and belongs to the Begomovirus within the family Geminiviruses.

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The virus is a isometric particle occurring mainly in pairs measuring 18-20nm in diameter. The nucleic acid is a single-stranded DNA (ssDNA), the genome consists of single stranded circular DNA of length ranging from 2500-3000 nucleotides and the replication of genomic DNA is through a double stranded intermediated in a rolling circle fashion, mediated by replication associated proteins encoded by the virus.

Transmission

Mungbaen Yellow Mosaic Virus is transmitted by white fly (*Bemisia tabaci* Genn.) in a persistent and circulative manner. Indian subcontinent isolates of MYMV are not sap transmissible, however, a mungbean isolates from Thailand is sap transmissible. Female adults more efficient vector than males. Maximum spread of the disease occurs when 10-20 female adults feed per plant and at 8-10 weeks after sowing. Whiteflies prefer drier climate for multiplication as its population is on peaks during the end of May to last of July.

Disease Cycle

The causal virus survive family on the main host as well as other leguminous plants like *Phaseolus vulgaris, Glycine max* and *Cajanus cajan* etc. *Macrotyloma uniforum* are infected and produce systemic mosaic and yellowing. These plants serve as source of primary inoculums. Pigeon pea being a long duration crop, harbours the virus and its vector from June to March get infected with MYMV as the viruliferous whiteflies migrate from pigeon pea to these crops. Secondary spread of the disease depends on white fly population gradually increases under the environmental conditions favourable for multiplication of whiteflies as well as expression of the symptoms in mungbean.

Management

1. Select see from healthy crops.
2. Uprooted the infected plants and burn it.
3. Use resistant varieties *viz*., Pant 1, 2, 3, T-1, T-44, MH 303, ML 5, ML 131, ML 613, ML 134, ML 818, ML 353 and ML 408.
4. Spray Metasystox @ 1ml/ litre water, two to three times at 10-15 days intervals.

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Marker free transgenic: Selectable marker genes (SMGs)

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Pawankumar S. Kharate & Prakriti Meshram
Indira Gandhi Krishi Viswavidyalaya, Raipur (C.G.) 492012

Selectable marker genes (SMGs), such as antibiotic or herbicide resistance genes, are used in nearly every plant transformation protocol to efficiently distinguish transformed from non-transformed cells. However, once a transgenic event has been selected, marker genes are generally of no use. On the contrary, the continued presence of marker genes in transgenic plants may raise public and regulatory concerns and may have technological disadvantages.

The main perceived risk is horizontal gene transfer of antibiotic resistance genes to pathogenic organisms or the transfer of herbicide resistance genes to weeds. Regulatory agencies may thus advice or require the absence of certain marker genes in commercialized transgenic plants.

Fears concerning SMGs center around the presence of antibiotic resistance genes in transgenic crops or its products that might reduce the efficacy of a clinically important antibiotic. A lot of attention has been spent on risk assessment concerning the transfer of antibiotic resistance genes from genetically modified (GM) plants to soil- and plant-related micro-organisms by horizontal gene transfer. For example, the transformation of bacteria in the food chain where free DNA persists in some materials for weeks, and moreover, some bacteria develop natural/chemical competence to take up DNA from the environment. In addition, in the gastrointestinal tract of humans and farm animals, DNA may remain stable for some time, particularly in the colon. However, degradation already begins before the DNA or the material containing the DNA arrives at the critical sites for horizontal gene transfer, which are generally believed to be the lower part of the small intestine, caecum, and the colon. In the case that DNA can arrive to this part, it will be mostly fractionated in pieces smaller than a gene sequence. Thus, breakdown of DNA in the gut, combined with the breakdown of the DNA due to food processing, strongly reduces the risk of dissemination. Moreover, the antibiotic resistance genes that are commonly used as selectable marker genes in transgenic plants actually have a bacterial origin. Indeed bacteria have developed very sophisticated mechanisms to eliminate competitors and guarantee their own survival producing antibiotics and genes to confer resistance to these antibiotics. Thus, the contribution of horizontal transfer of antibiotic resistance genes between transgenic plants and microorganism is most likely insignificant compared to the existing exchange of such genes between bacteria.

On the other hand the escape of herbicide resistance genes to wild relatives is also a concern. Many crops are sexually compatible with wild and/or weedy relatives, then if the plants grow close one to another, crop-to-weed or crop-to-wild relative gene flow could result. The success of the introgression of a transgene in a wild relative has many barriers. Firstly, both have to grow in close proximity; secondly, both have to be flowering in overlapping time frames; thirdly, the progeny must be sufficiently fertile to propagate; and fourthly, a selective pressure should be applied (herbicide). There will only be a selective advantage for the wild relative if the herbicide is used in the habitat where the relative grows. For example, it is well known that cultivated rice is sexually compatible with perennial wild red rice (*Oryza rufipogon* Griff.), considered a harmful weed. It grows in many of the same regions, often has overlapping flowering times, and thus is a prime candidate for gene flow with cultivated rice. Indeed, Chen *et* al. showed that the gene flow rate was 0.01% under natural conditions. This and other studies showed the risk of the transfer of transgene(s) to the wild relative or weeds. Thus precautions should be taken into account to prevent gene flow and introgression. A possible way consists in containing transgenic pollen by growing barrier crops in adjacent areas or by alternating transgenic cultivars carrying different herbicide resistance genes. Other strategies consists in the creation of biological containment, to limit the transfer of pollen to plants in the surrounding area, e.g. by

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engineering male sterility or by delaying and/or decreasing flowering. Alternatively, complete removal of the marker gene should alleviate concerns regarding effects on human health and the environment.

In some specific cases, selectable marker genes are needed after selection, for example in propagation of lines with nuclear male sterility. However, generally SMGs are not needed after the selection of the transgene event. On the contrary, their presence may have some technological drawbacks. It has been reported that some genes (selectable markers included) may induce pleiotropic effects under certain conditions. In fact, a transcriptome analysis of three Arabidopsis transgenic lines containing pCAMBIA3300 vector (35S-bar-35S) showed that they differ from their WT counterparts by expression of 7, 18 and 32 genes respectively. However, only four genes were found to be significantly different in all three lines compared with the wild type plant in glufosinate untreated plants. Thereafter, 81 genes were found to be differentially expressed in the presence of glufosinate in transgenic plants, in contrast to the 3762 differentially expressed genes in WT plants. From these 81 genes 29 were specific to transgenic plants. These results suggested to the authors that glufosinate or a metabolic derivative of glufosinate activates unique detoxification pathways to offset any effects on plant growth and development. Nevertheless, in the above mentioned work, no indication or study of the position effect and/or effect of transgene regulatory sequences was reported. Indeed the regulatory sequences (promoters and terminators) can influence the activity of some genes in the same T-DNA or even endogenous genes that are close to the insertion site. Furthermore, in systems where the number of efficient SMGs is limited, the re-transformation with the same SMG is precluded by its presence. This is problematic as most transformation protocols are indeed based on one or a few selectable marker genes only. Miki and McHugh reported that more than 90 % of the scientific publications that use transgenic plants were based on three selection systems: the antibiotics kanamycin or hygromycin and the herbicide phosphinothricin. These outcomes provide an extra motivation to remove SMGs and other unnecessary sequences as soon as possible after selection of transgenic plants.

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Socioeconomics of Integrated Pest Management

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Kishor[1], Shivakumara M N[2*] & Ponnusamy N[2]
[1]Department of Agricultural Economics, OUAT, Bhubaneswar - 751003
[2]Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125

INTRODUCTION

Integrated Pest Management is a decision supporting system for selection and use of pest control tactics singly or harmoniously. This system has coordinated into a management strategy based on cost/benefits analysis that takes into account the interest of an impact on producers' society and the environment. IPM strategy that focuses on long term prevention of pests through a different combination of techniques such as cultural, physical, mechanical, botanical, biological and chemical control methods etc. There are several socioeconomic factors and constraints like social status, social expectations from farmers, economic security, work experience of an individuals or family economic status, number of family labor, farm size, income structure, diversity of farmer's production activities, education status of farmers and occupation of farmer's influences in implementation of IPM.

Socioeconomic characteristics of the farmers which influences adoption of IPM

- **Family size of farmers:** Mostly, large families can adopt IPM practices rather than small, medium families because larger families may be joint families.
- **Educational status of farmers:** Usually Illiterate farmers have less knowledge regarding IPM than primary, secondary and higher secondary farmers. Most of the young farmers are showing interest in adopt IPM rather than middle and old age farmers.
- **Occupational status of farmers:** It is mainly required for management farm activities. It may be from different activities like agriculture, Livestock, Fisheries petty business, day-labor etc.
- **Training:** Training should be needed for farmers to understand the timely management practices, new technology related to pest management like field scouting for identification of infestation level to take control measures.
- **Innovativeness:** Progressive farmers usually adopted new innovative technologies developed by different institution and it depends on their education status, economic status, interest and land holding.

Socio Economic constraints faced by the farmers in using IPM practice

There are several constraints influences for adoption of IPM like attitudes of farmers, technical knowledge about agro ecosystem analysis, monitoring of pest management, decision making criteria applied in pest management, defender population dynamics and different components of IPM make doubt about its effectiveness and also thought that it is laborious practices and burden for other works, so willingness of the farmers to participate in IPM is less.

Positive Implication of Socio Economics of IPM

IPM practices in the social, economical, and environmental point of view play a important role in increases the farm profits by reducing farm input cost and by discourages the use of chemicals it minimizes negative impacts on agricultural commodity, human and non-target organism in crop ecosystem so it is closer to organic agriculture therefore increases the consumer confidence in safety, quality of food and farm produce. It creates less cases of anti resistance and slows the development of insect resistance to pesticides, pest resurgence and secondary pest outbreaks due to their different pest management practices.

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Negative Implications of Socio Economics IPM

IPM practice is labor intensive than conventional pest control due to regular monitoring of field, also it requires more up front resources and creates more production cost. Usually IPM needs to be educated farmers for proper planning for farm. IPM is time and energy consuming therefore expected results of intervention may take long time to be achieved. Due to lack of financial support from the government and policies for implementation of IPM and there is no national certification for growers using IPM so farmer thought there is no difference in cost for farm produce produced from both IPM and conventional methods.

CONCLUSION: Extension activities should be carried out to educate farmers and provide information, regarding management of insect pest, benefits of IPM and also learning agricultural information from media sources and farm training events such as field days, krishi mela (kisan mela), and field tour significantly increase the likelihood of IPM adoption effectively by farming community.

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Reactivity of phosphate rocks for direct and residual application

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Samanyita Mohanty[1*] and Shreya Das[1]
Ph.D. Research Scholar, Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, 741252

INTRODUCTION

The reactivity of Phosphate Rocks (PR) can be defined as a measure of the rate of dissolution of PRs under standard laboratory conditions or in a given soil and field conditions. It excludes the changes in the rate of dissolution caused by varying soil properties and by plant effects. The reactivity of PRs is determined by its chemical composition and particle size. PRs of sedimentary origin are generally most reactive and, therefore, more suitable for direct application than residual application. The chemical properties that influence the reactivity of PRs are phosphate crystal (apatite) structure and the presence of accessory materials, especially calcium carbonate. Increasing the substitution of carbonate to phosphate in the crystal structure generally increases its reactivity. Calcium carbonate is the most abundant accessory mineral in PRs. As calcium carbonate is more soluble than the most chemically reactive phosphate mineral, its dissolution enhances the calcium (Ca) concentration and pH at the phosphate mineral surface. Thus, it can be easily said that accessory calcium carbonate can reduce the rate of PR dissolution in some soils. However, under field conditions, leaching and plant uptake may remove Ca ions. The magnitude of the removal by leaching varies according to soil and climatic conditions and also with the mode of PR application. For surface applied fertilizer, the calcium carbonate effect can be minimal even if its content is maximum. On the other hand, for incorporated PR, more than 15 percent of free calcium carbonate can lessen the effectiveness of PR in a limed alkaline soil.

Factors influencing dissolution of PR:

1. Particle size

As PRs are relatively insoluble materials, their particle size has an important bearing on their rate of dissolution in soil. The finer the particle size, the greater is the degree of contact between PR and soil and, therefore, the higher is the rate of PR dissolution. Moreover, the increase in the number of PR particles per unit weight of PR applied increases the chances of root hairs intercepting PR particles. Thus, application of PR as finely ground materials (usually less than 0.15 mm) enhances both the rate of dissolution of PRs and the uptake of PR-phosphorus in a given soil. On the negative side, because of their dusty nature, the application of finely ground materials is fraught with practical difficulties.

2. Soil properties

For a given PR to be agronomically effective, the PR should not only dissolve, but the dissolved PR should also be available to plants. The soil properties that favour the dissolution of PR are low pH (less than 5.5), low solution concentration of Ca ions, low P fertility levels and high organic-matter content.

3. Soil acidity

The dissolution of PR may be expressed by the equation;

$$Ca_{10}(PO_4)6F_2 + 12H_2O \rightarrow 10Ca2^+ + 6H_2PO_4^- + 2F^- + 12OH^-$$

(Phosphate rock) (Water) (Dissociation products)

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Although the above reaction is for a fluorapatite PR, it applies to other members of the apatite minerals including reactive PRs (RPRs). As indicated in the above equation, the dissolution of PR results in the release of hydroxyl ions into solution. Neutralization of the hydroxyl ions released by soil acidity enables the PR dissolution process to continue. In the case of PRs where phosphate has been substituted with carbonate ions, hydrogen ions may also be needed to neutralize hydroxyl ions formed on the release of carbonate ions into solution. Each carbonate ion joins with two hydrogen ions and forms one water molecule and carbon dioxide gas. Thus, an adequate supply of hydrogen ions is of primary importance for the continued dissolution of PR. Indicators of hydrogen ion supply are soil pH and titratable acidity. Soil pH shows the magnitude of hydrogen ion supply at a given time, whereas titratable acidity indicates the supply of hydrogen ions in the longer term.

4. *Cation exchange capacity, and exchangeable calcium and magnesium*

For continual dissolution of PR, it is important that the other major reaction product, the Ca ion, be removed or that its concentration in soil solution be maintained at a lower level than that in the film surrounding the dissolving PR particle. It is possible to achieve these outcomes if there are adequate soil cation exchange sites available to adsorb the Ca ions released from the PR, or if Ca is leached away from the site of PR dissolution. A measure of the cation exchange sites available for Ca adsorption is the difference between the cation exchange capacity of soils and the exchangeable Ca. Recent studies suggest that high exchangeable magnesium (Mg) in soils may enhance PR Dissolution. Theory would suggest that, as Mg is held by soils more strongly than Ca, the presence of Mg on the soil exchange sites can block adsorption of Ca released on dissolution of PR and thereby facilitate its removal from the soil-fertilizer system. This will have the effect of enhanced PR dissolution. The cation exchange capacity of soils is also related closely to soil texture. Sandy soils usually have a low cation exchange capacity and, therefore, do not provide an adequate sink for Ca released from PR. This would lead to a reduction in PR dissolution and in agronomic effectiveness. The other two scenarios occur in areas of sufficient rainfall. The first is where the released Ca may be removed from near the PR particles, with a positive effect on PR dissolution and on agronomic effectiveness. The second is where excess rainfall may lead to leaching of P below the rooting zone of crops and reduce the agronomic effectiveness of PRs. However, because of their slow-release nature, PRs are likely to be more beneficial under such circumstances than water-soluble fertilizers.

5. *Soil solution P concentration and P retention capacity*

As the P concentration in soil solutions is usually very low (0.05–0.5 mg/litre), it has little influence on the dissolution of PR. Nevertheless, there have been reports that the greater the P sorption capacity of soils, which results in depletion of soil solution P, the greater the dissolution of PR. It is not P adsorption capacity per se that affects PR dissolution but the number of sites available to adsorb the P released from PR and, therefore, maintain a lower P concentration in solution near PR particles. When considering a large number of soils, the variation in the rate of PR dissolution in soils can be better explained by taking into account the P sorption capacity of soils in addition to the titratable acidity. Although increased P sorption capacity may favour PR dissolution, its availability will depend on soil P status and the amount of PR added.

6. *Soil organic matter*

Another soil property that increases PR dissolution and its availability to plants is soil organic matter. This seems to arise from: (i) the high cation exchange capacity of organic matter; (ii) the formation of Ca-organic-matter complexes; and (iii) organic acids dissolving PR and blocking soil P sorption sites.The cation exchange capacity of organic matter is greater than that for clay minerals. Depending on their clay content, the cation exchange capacity of mineral soils may range from a few to 60 cmol/kg, whereas that of organic matter may exceed 200 cmol/kg. The high cation exchange capacity of organic matter means increased Ca retention capacity of soils, which leads to enhanced PR

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dissolution. Humic and fulvic fractions of organic matter form complexes with Ca,which can also reduce Ca concentration in solution, so leading to enhanced PR dissolution. The organic matter content of tropical soils is generally less than 2 percent. When arable crops are harvested, a large proportion of the root residues and in some cases part of the above-ground portions is left behind in the soil. The decomposition of plant residues in soil results in the production of numerous organic acids, such as oxalic, citric and tartaric acids. These acids can be expected to dissolve PR by supplying the hydrogen ions needed to neutralize the hydroxyl ions produced when PR dissolves and by forming complexes with cations, especially the Ca from PRs. The organic ions and humus can also reduce the P sorption capacity of soils by blocking P sorption sites and by forming complexes with iron and aluminium hydrous oxides, leading to increased P concentration in solution. Logic would dictate that incorporation of PR during cultivation between crops would benefit the farmers most. Such a practice would allow the decomposing plant residues, and any animal litter that might have been applied, to enhance the release of PR. The early application of PR would also allow time for the reaction of PR with the soil and the release of some P before the next crop is established.

7. Climate conditions

Rainfall is the most important climate factor that influences PR dissolution and its agronomic effectiveness. Increased soil water brought about by rainfall or irrigation increases PR dissolution. The process is affected by speedy neutralization of the hydroxyl ions released and removal of Ca and other reaction products from the area adjacent to PR particles. Adequate water supply will encourage plant growth and P uptake by plants, so leading to the increased agronomic effectiveness of PRs. However, the rainfall requirement does depend on soil properties. Chien *et al.* (1980b) reported that temperature has negligible or no influence on the solubility of PRs within a range of 5–35°C and, therefore, on its agronomic effectiveness.

8. Crop species

Plant species differ in their P uptake demand and pattern as well as in their ability to absorb soil solution P. Moreover, plant species show differences in their ability to access sparingly forms of P that are unavailable to other plants. Among these, some plants can dissolve and take up the products from PR dissolution. For example, perennial pastures, tree crops and plantation crops require a steady supply of P over an extended time span. Because PRs in soil dissolve gradually and supply P at a steady rate, increasing amounts of PRs are being applied as phosphate fertilizers for the above-mentioned crops. The high agronomic effectiveness of PRs realized with these crops reflects partly the acidic nature of the soils and the high root density. High root density facilitates the intensive exploration of a large soil volume for P because of the presence of a large number of fine roots per unit of soil volume. Legumes are particularly suited for the use of PRs. They are effective in dissolving PR and in absorbing its dissolution products because of their demand for Ca and the acidifying effect of nitrogen (N) fixation in the soil near the root system (rhizosphere). This effect can be utilized to improve the P nutrition of a companion crop (intercropping) or that of the subsequent crop in a rotation. Some plant species (e.g. rapeseed, lupines and pigeon pea) have been studied because of their ability to secrete organic acids that result in an enhanced dissolution of PR. Crops that possess high Ca uptake capacity are more suited for PR use. In this respect, finger millet is most suited for PR use, followed by pearl millet and maize.

Management practices

Four important management practices that can influence the agronomic effectiveness of PRs are: the placement of PR material in relation to the plants; the rate of application; the timing of application; and lime application.

1. PR placement

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In order to achieve the maximum agronomic effectiveness from PRs, the material should preferably be broadcast and incorporated uniformly into the surface soil to the required depth. The depth of incorporation for seasonal crops may be of the order of 100–150 mm. Incorporation facilitates greater dissolution of PR by increasing contact between the soil and PR particles. It also enhances plant absorption of P by providing a greater volume of P-enriched soil. In addition, there is a greater likelihood that a root will encounter a dissolving PR particle.

2. Rate of PR application

The decision on the rate of PR application needs to be based on the soil P status as indicated by soil testing, and the expected rate of dissolution of PR and its availability to plants. The soil testing method to be used would depend on whether the phosphate fertilizer applied previously was a water-soluble form or a PR. Some general guidelines are:
PR application is likely to be beneficial in soils of medium P status. In such soils, the minimum rate of application should be such that the expected amount of P dissolved from PR is no less than the amount of P removed from the site as farm produce plus the amount of phosphate retained by soils in a form that is not available to crops under near maximum production levels. This is often called the 'maintenance P application' rate. In terms of absolute amounts, soils with high P retention capacities will require greater rates of P fertilizer application than soils of lower P retention. This allows for the P retained by soils in a form that is 'not available' to plants. In soils of low P status there are two choices: (i) bring the fertility level to medium P status by applying water-soluble fertilizers and follow this by the application of PR; (ii) incorporate large applications of PR (500–1000 kg/ha) followed by a regular maintenance application of P.

3. Timing of PR application

In very acid soils (pH less than 5.5) with a high P retention capacity, the incorporation of PR close to planting time is recommended in order to minimize conversion of dissolved P to plant 'unavailable' forms. However, in less acid soils (pH of about 5.5–6) with a low P retention capacity, incorporation of PR 4–8 weeks ahead of planting is preferred. This allows time for some dissolution of PR and its subsequent availability to plants. The use of PR for flooded rice requires special attention because soil pH generally increases upon flooding. For this reason, it is advisable to apply PR to the soil about two weeks before flooding.

4. Lime application

Incorporating lime has an adverse effect on PR dissolution in soil because it increases the Ca concentration in solution and reduces soil acidity. However, liming may increase the availability to crops of dissolved P by increasing soil pH and reducing aluminium (Al) toxicity. In view of the above effects, where liming is to be done in order to raise soil pH values to 5.5, it can be applied at the same time as the PR application, but preferably not as an admixture with PR. This can eliminate Al toxicity while still encouraging PR dissolution. Where the soil pH is to be raised above pH 5.5, liming should preferably be done about six months after the incorporation of PR so that PR dissolution is not reduced drastically.

CONCLUSION

Effective dissolution of Phosphate rocks either of igneous or sedimentary origin is the basic principle for its application to different soil conditions. Reactivity of PR mainly depends on its chemical composition and particle size. Various climatic, soil, plant and management practices affect the rate of dissolution of rock phosphate thereby directly or indirectly influencing its reactivity and agronomic effectiveness.

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Stored grain pests and their management

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Sucharu Singh*[1], Shalendra Pratap Singh[2]
[*1,2] Ph.D Scholar ,Department of Entomology, CSA University of Agriculture and Technology, Kanpur-208002 (U.P.)

INTRODUCTION

Storage depends on various factors such as crop or variety, initial seed quality, storage conditions, seed moisture content, insect pests, bacteria and fungi (Amruta *et al.,* 2015). Losses due to insect pests is about 26% (Anonymous, 2015) and food grain accounts for 20-25% damage by storage insect pests (Rajashekar *et al.,* 2010) which is really a brainstorming matter.

Storage insect pests are categorized into two types viz.

• Primary storage pests: Internal feeders

1. Rice weevil: *Sitophilus oryzae* (Curculionidae: Coleoptera)
Full grown larva is plumpy, legless creature. Adult reddish brown beetle with a cylindrical body and a long, slender, curved rostrum. Its elytra bear four light reddish or yellowish spots. Both the adults and the grubs cause damage. The developing larva lives and feeds inside the grain causing irregular holes.

2. Lesser grain borer: *Rhyzopertha dominica* (Bostrychidae: Coleoptera)
The larva is dirty white, with light-brown head and a constricted elongated body. Pupa remain inside the seeds or either outside the seeds. The adult is a small cylindrical beetle. It is shining dark brown with a deflexed head, covered by a crenulated hood-shaped pronotum. Both the adults and the grubs cause damage.

3. Angoumois grain moth: *Sitotroga cerealella* (Gelechiidae: Lepidoptera)
A full grown larva is a white body and yellow brown head. The adult is a buff, grey yellow, brown or straw coloured moth. In pupa stage, larva remain inside the cocoon. The characteristic feature is the presence of the narrow pointed wings fringed with long hair. Only the larvae cause damage by feeding on the grain kernels before harvest and also in store.

4. Pulse beetle: *Callosobruchus maculatus* (*chinensis*) (Bruchidae: Coleoptera)
Larva is whitish with a light-brown head. Pupa remain inside the seeds.The adult beetle is oval, reddish brown in colour and has long serrated antennae, truncate elytra, not covering the pygidium. The adult and grub feed on the grain by making a small hole. Infested stored seed can be recognized by the white eggs on the seed surface and the round exit holes with the 'flap' of seed coat.

5. Cigarette beetle: *Lasioderma serricorne* (Anobiidae: Coleoptera)
Adult light brown round beetle with its thorax and head bent downwards. The elytra have minute hairs on them.The creamy white oval eggs are laid on the surface of stored material. Both the adults and the grubs cause damage.

6. Drug store beetle: *Stegobium paniceum* (Anobiidae: Coleoptera)
It lays the eggs in batches. Grub is not hairy but is pale white. Adult reddish brown small beetle has striated elytra.

8. Sweet potato weevil: *Cylas formicarius* (Apionidae: Coleoptera)

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Pupation takes place in the feeding tunnel.Whitish apodous with brown head. Adult is slender ant like with a long snout and shiny black with reddish brown thorax and legs. Grubs and adults bore into the tubers. Damage occurs both in field and storage.

9. Potato tuber moth: *Phthorimoea operculella* (Gelechiidae: Lepidoptera)
Larva is pale greenish.Pupation occurs within a cocoon. Adult is small with narrow fringed wings; forewings grey brown with dark spots and hindwings dirty white. Damage occurs both in field and storage.

External feeders

1. Red flour beetle: *Tribolium castaneum* (Tenebrionidae: Coleoptera)
The young larva is yellowish white and it matures, it turns reddish yellow. Pupation takes place in the flour. The pupa is yellowish and hairy. Both the larvae and adults cause damage. In severe infestation, the flour turns greyish and mouldy, and has a pungent smell.

2. Indian meal moth: *Plodia interpunctella* (Phycitidae: Lepidoptera)
Larva is white, often tinged with green or pink, a light-brown head. Pupation takes place away from the infested materials. Only the larva causes damage. Crawling caterpillars completely web over the surface of a heap of grains with silken threads. The adults fly from one bin to another and spread the infestation.

3. Almond Moth / Fig moth: *Ephestia cautella* (Pyralidae:Lepidoptera)
The full-grown larva is white with pinkish tinge. The larvae pupate inside the cocoons.The adult moth has greyish wings with transverse stripes on the outer region. The female lays whitish eggs indiscriminately in cracks and crevices of the receptacles or on the food stuff. The caterpillars make tunnels in the food materials.

4. Rice moth: *Corcyra cephalonica* (Pyralidae: Lepidoptera)
The larvae alone damage the grains of rice and maize by feeding under silken webs.Pupa webs silken shelter before pupation. Adults are pale buff brown in colour. When infestation is high, the entire stock of grains may be converted into a webbed mass. Ultimately, a characteristic foul odour develops.

5. Khapra beetle: *Trogoderma granarium* (Dermestidae: Coleoptera)
Female begins to lay white translucent eggs on the grains, singly or sometimes in clusters. Pupa inside the seeds. Fresh yellowish-white larva grows and turns brown. The grubs eat the grain near the embryo or at any other weak point and from there proceed inwards. Adults are oval in shape.

• Secondary storage pests

1. Saw toothed grain beetle: *Oryzaephilus surinamensis* (Cucujidae: Coleoptera)
It is slender, dark, narrow, flattened beetle. The larva is slender, pale cream in colour with to slightly darken patches on each segment. It pupates in a protective cocoon like covering with sticky secretion. It feed on grains, dried fruits etc by scarving of grain surface or burrowing holes in them.

2. Long headed flour beetle: *Latheticus oryzae* (Tenebrionidae: Coloeptera)
The beetle is light brown in colour with longated body. Pupa is naked. Both grubs and adult beetles feed on the milled products.

3. Flat grain beetle: *Cryptolestes minutus* (Cucujidae: Coleoptera)

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The larva is cigar like yellowish white with two reddish brown spots at anal segment. It is light to dark reddish brown beetle. It lays white eggs loosely in flour, grain or crevices. Both grubs and adults feed on broken grains or on milled products. In case of heavy infestation it cause heating in grain and flour.

Management of stored grain pests

1. Near mature crops treated with safer insecticide like malathion to prevent the transport of infestation (eggs) from field to stores.
2. Threshing yards clean and away from stores.
3. Gunny bags new and insect free.
4. Grain dried to have less than 10% moisture, before filling in bags.
5. Before storing, cracks and crevices on walls, floor closed.
6. Dirt, rubbish, sweepings removed and white washed.
7. For cover fumigation or air tight containers - 3 tablets of 3g each/ tonnes of grain. In case of cover fumigation, mud plastering and sand snakes to be used for preventing leakage of toxic gas.
8. For shed fumigation – 21 tablets each weighing 3g / 28 m^3
9. Spray malathion 50 EC 10 ml/ L with @ 3 L of spray fluid / 100 m2 over the bags.
10. Disinfestation of stores by treating walls, dunnage, ceilings of empty godown with malathion 50 EC 1: 100 or DDVP 100EC 1: 300 @ 3 liters / 100 m^2 (DDVP is a constant and fumigant)
11. Diatomaceous earth (DE), a silica product is used as an insecticide against a variety of pests.

CONCLUSION: Effective control of stored-grain pests with minimal pesticide use requires an IPM approach combining sanitation, monitoring, and other preventive practices. Proper identification of pests is essential for effective control.

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Strigolactone: A novel carotenoid derived plant hormone

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Nitin Sharma
Division of Plant Physiology
ICAR- Indian Agricultural Research Institute, New Delhi - 110012

INTRODUCTION

Strigolactones are carotenoid-derived plant metabolites that function as signaling molecules, both endogenously as phytohormones and exogenously in the rhizosphere. It promotes growth of symbiotic arbuscular mycorrhizal fungi in soil and branching in plants. Its name has been derived from root parasite. It was first identified as chemical signal that stimulate *Striga lutea* seed germination. Striga lutea and other members of Striga genus and Orobanchaceae family are plant parasitic weeds that use strigolactone released from the roots of host plants as germination signal so as to ensure their germination in close proximity to their host.

Basic structure: Strigolactone has basic structural unit of tricyclic lactone made up of three eings that are connected to a D-ring butenolide group via an enol-ether bridge. Its biological activity resides in enol-ether bridge. Example of naturally occurring strigolactone: Orobanchol, Sorgolactone, Strigol, 5-deoxy-strigol, Alectril. Example of synthetic analogue of strigolactone: GR6, GR7, GR24

Biosynthesis: Site of its biosynthesis is plastid and cytosol. Its biosynthesis begins in plastid with the conversion of trans-β-carotene to (Z)-(R)-carlactone (CL) involving three intermediate steps catalyzed by trans/9-cys-β-carotene Isomerase, CCD7, and CCD8, respectively. Carlactone is then transported to cytosol where Cytochrome P450 monooxygenase (MAX1) and several other unidentified enzymes it is further converted to different other strigolactones.

Perception and signaling: Strigolactone are recognized by its receptors D14/DAD2. Receptor hydrolyses strigolactone resulting in change of confirmation in D14/DAD2 proteins. Receptor with altered confirmation then binds to F-box protein from SCF complex and strigolactone repressor D53. Repressor is then degraded by ubiquitin proteasome pathway. Hence downstream gene involved in strigolactone response gets activated.

Physiological functions:

- Play a role in attracting mycorrhizal fungi to the root.
- Suppress lateral shoot branching and promotes apical dominance.
- Involved in promoting germination of root-parasitic plants of the genera like *Striga*, *Orobanche*, *Alectra*, and *Phelipanche*

CONCLUSION: Still there are many lacunas in our understanding of its synthesis, transport, perception and signaling of strigolactone. It will be interesting to know how strigolactones are involved in cross talk with other hormones in controlling plant architecture and its role in various biotic and abiotic stress.

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Processing of cashew nuts - A boon for employability of rural population

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S. Velmurugan
Regional Research Station, TNAU, Vridhachalam, India

INTRODUCTION

Processing of nuts is the recovery of kernels from raw nuts by manual or mechanical means. India has been a pioneer in cashew processing. The growing demand for kernels in the world market and the availability of cheap labour mainly of women possessing the requisite skills are the favourable factors for the rapid growth of processing industry in the country and it has a monopoly over the manual processing of cashew. Though mechanization is introduced in cashew processing, the availability of skilled and cheap labour in India and better quality of kernels under manual processing, limits the scope for extensive mechanization. Factories in general have mechanization in roasting/ boiling and packing. Predominance of manual labour continues in the processes like shelling, peeling and grading. In India processing mostly consist of moisture conditioning, roasting, shelling, kernel drying, peeling, grading and packing. Grading of raw nuts before processing reduces broken kernel. Nuts are conditioned by sprinkling water and allowed to remain moist for 24-48 hours (Nagaraj, 1998).

Cleaning

All raw nuts carry foreign matter, consisting of sand, stones, dried apple etc. The presence of foreign matter in the roasting operation can be avoided by cleaning the nuts. The raw nuts can be sieved by hand using a ¾ inch mesh sieve.

Soaking

The next stage is to soak the nuts in water to avoid scorching them during the roasting operation. This can be done by placing the nuts in a 40-45 gallon drum or vat and filling it with water until all the nuts are covered. After being left to stand for about ten minutes, the water should be drained off through a plug near the base of the drum. The nuts should then be left for periods of not less than four hours in order to allow the water left on the surface of the nuts to be absorbed. The process of covering the nuts with water, draining and standing should be repeated with the same nuts about three times until a moisture content of 9% is reached.

Roasting

Roasting makes the shells brittle, besides making the extraction of kernels easier. A slight under roasting or over roasting adversely affects the quality of and recovery of kernels. In the open pan roasting method, one kilogram of nuts are kept in shallow iron pans or earthen pots and are heated over an open fire. The nuts are rapidly turned to prevent charring. During the process of roasting, large quantities of shell liquid and smoke would come off and cause an irritation and injurious effect on the skin of personnel engaged in the operation. The roasted nuts are then removed from the pan and thrown on the floor. They are quickly covered with earth which would absorb shell oil adhering to the roasting nuts and also cool

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them. The nuts are then subjected to subsequent operations. The cashew nuts are also roasted by drying under sun for two to three days when they lose much of the moisture contents and become brittle enough for shelling. The other improved methods of roasting cashew nuts are drum roasting, oil bath roasting and steam boiling (Balasubramanian,1998).

- **Drum roasting**

In drum roasting, the nuts are fed into an inclined rotating drum that is heated initially to such an extent that exuding the oil ignites and burns, thus charring shell. Drum maintains its temperature due to burning of CNSL oozing out of nuts. Roasting takes 3-5 minutes. Roasted nuts which are still burning are covered with ash to absorb oil on surface. Shell becomes brittle and out turn of whole kernels is reported the highest in the method.

- **Oil bath roasting**

Oil bath roasting is a traditional method followed in a few processing factories of Kerala and Karnataka. In this method, raw nuts are passed for 1-3 minutes through a bath of CNSL maintained at a temperature of 190-200^0 C by means of a screw or belt conveyor. Roasting equipment consists of a rectangular vessel 60-90 cm deep with a flat bottom. Whole assembly is embedded in brickwork furnace which uses spent cashew shell as fuel.

- **Steam roasting**

The steam roasting process, commonly known as 'cooking process' consists of a baby boiler followed by a steam cooker where the cashew nuts are cooked with steam. Steam boiling is adopted in factories where hand-and-leg-operated shelling machines are used. Nuts after conditioning are given a mild roasting in a closed vessel for 20-25 minutes at 100-120 PSI to loosen kernels from shell and make its removal easy.

- **Baby Boiler**

The baby boiler is a hand stoked fire tube boiler, which produces steam at 7.0-8.5 kg/cm. The roasted cashew shell or de-oiled cake are fed manually (about 2-3 kg fuel once in 15 to 20 minutes) at the bottom of the boiler. The combustion air is drawn through the grate by natural draft stack at the top of the boiler. The flue gases from the boiler are discharged into atmosphere through the stack 12-15m high.

- **Cashew nut cooker**

A cylindrical steam cooker with provision of cashew nut feeding at the top and discharging of cooked nuts from the side near bottom, has a capacity of holding 4 bags (80 kg each) of cashew nut in a batch. Once the cashew nut is loaded, steam from a boiler is introduced into cooker at a pressure of 7.0-8.5 kg/cm. The cashew nuts in the cooker are steam cooked and when all the nuts are sufficiently cooked, the excess steam starts releasing near the bottom outlet. The steam is injected into the cooker till the steam starts escaping from the outlet mouth of the cooker. This process takes about 10-20 minutes time. Then the steam injection into the cooker is stopped and the condensed water at the bottom of the cooker is discharged in to a container and disposed on ground through septic tank. In cashew nut cooking process in Kerala have different process in steam injection quantity. The steam is injected for about 15 minutes even after the steam starts escaping from the outlet mouth of the cooker. This method consumes more steam.
The cooked cashew nut are removed from the bottom of the cooker and spread on the floor for cooling.
The cooled nuts are sent for cutting section to cut open and collect the kernel. The total batch time is about 40-45 minutes. Usually, the units are provided with a baby boiler and minimum two cookers, while one

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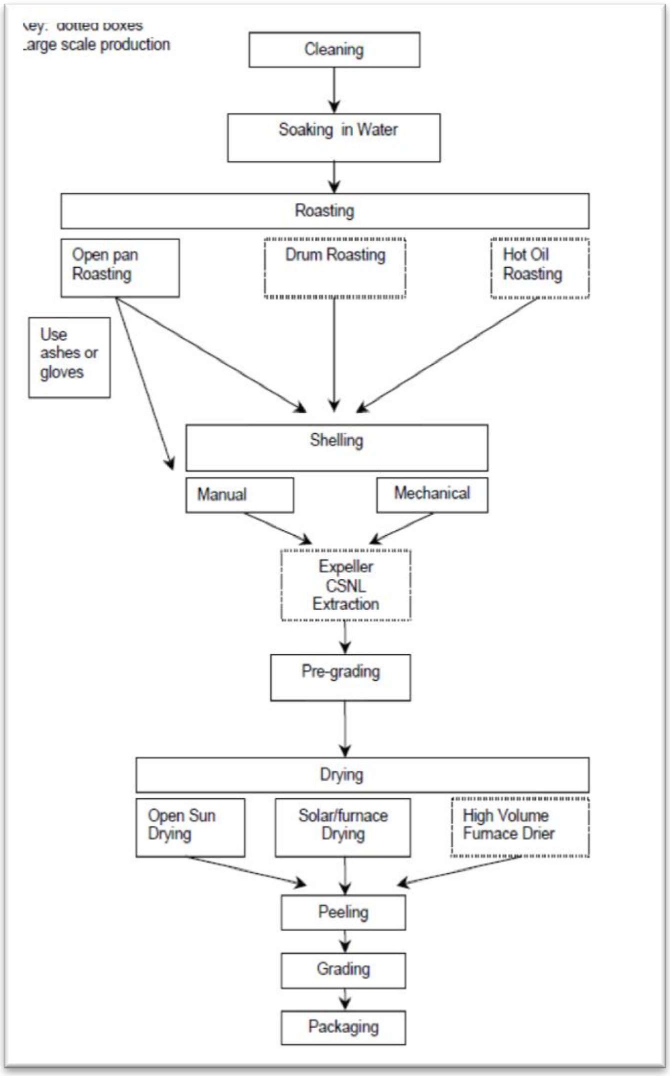
cooker is in cooking operation, the other cooker is in unloading and loading operation. Normally the cooking operation is carried out for 2-4 hrs in a day, cooking 5 to 10 batches of nuts, depending on the production capacity of the units.



Process flow chart for cashew nut processing

Shelling

The objective of shelling is to produce clean, whole kernels, which are free of cracks. Shelling has always been manually performed in India. Other countries have difficulty in competing with the great skill of Indian workers. India has therefore enjoyed a virtual monopoly of cashew processing for a long time. Shelling is a manual process that entails putting the nut against one sharp blade and bringing another blade, which is on a foot powered lever, through the outer shell. The blade on the foot lever is raised by an enthusiastic stomp allowing the outer shell to separate from the nut. The nut inside is carefully picked out of the shell using a nutpick. After shelling, shell pieces and kernels are separated, and the unshelled nuts are returned to shelling operation. Output is 15-20 kg kernels in 8 hours with 90% whole kernels. Mechanical shelling can

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also be done where shell is cut and kernel is scooped out using a sharp needle. Output of a worker is 14-22 kg of kernels. Main disadvantage is that kernels are contaminated by CNSL from mildly roasted nuts. Varying size of nuts requires careful manipulation during cutting to avoid injury to hands.

Separation

After shelling, shell pieces and kernels are separated and the unshelled nuts are returned to the shelling operation. Usually blowers and shakers are used to separate the lighter shell pieces from the kernels. The greatest problem is to recover small pieces of kernel sticking to the shell. This is usually done manually from a conveyor belt used to carry all the sorted semi-shelled nuts.

Pre-grading

Pre-grading can be done before or after drying the kernels and may greatly reduce the final grading work. For large-scale processors pre-grading can be done mechanically, separating mainly the whole from the broken kernels and sometimes separating the different size groups of whole kernels.

Drying

The shelled kernel is covered with the testa, the removal of which is facilitated by drying the shelled kernel, to produce the blackened kernel. Drying helps to reduce the moisture content 2-4 % in kernels. Drying causes shrinkage of the kernel, thereby allowing the testa to be easily removed either mechanically, or by hand with a knife. Drying also protects the kernel from pest and fungal attack at this vulnerable stage. Drying usually takes 6-8 hours, at a temperature of around 70-75^{0}C. A uniform temperature throughout the drier is essential to avoid under - drying or scorching. A tray dryer is used, for drying cashew kernels. The dryer contains a series of mesh-bottom trays that are slotted into the drying cabinet. The trays are of a size that can be lifted when full. Hot air circulates over the trays and is exhausted through the chimney. Cashew oil cakes are burned to provide the heat source.

Kernel Drying (Borma)

The kernel coming from the shelling section (Roasting Process) as well as cutting section (Cooking process) contains a brown cover, known as 'testa', over it. To remove testa over the kernel and also control the moisture content in the kernels, they are exposed to prolonged and controlled heating with hot air at 80 - 90^{0}C for about 6-7 hrs in the chamber. About 5 - 8% of moisture is removed from the kernels in the process. This process is known as 'Borma'. The Borma Ovens are fired with cashew shell (from roasting process) or de-oiled cashew cake (from cooking process) for about 4 - 6 hrs depending on the quantity of kernels to be dried. In Kerala and Maharashtra, most of the small scale units carried out the Borma operation by electric heaters which consume large electricity and the process will be dependent on power supply.

Peeling

At this stage, the testa is loosely attached to the kernel, although a few kernels may have already lost the testa during prior operations. Those parts still attached to the kernel, can be removed by scraping of the testa with a blunt knife, which is the most effective way of removing it. It is essential that the testa is

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removed with minimum pieces. It is also essential that the entire testa is removed with a blunt knife and removed. Average peeling capacity is 7-10 kg/head.

At the end of the day, the removed testa is winnowed and all cashew pieces removed. The dust and very fine pieces that cannot be peeled, together with the diseased pieces, are classified as refuse. The brown kernels, which are not been separated out during the shelling operation, are removed and discarded. All workers follow basic codes of hygiene. The peeled kernels are vulnerable to insect infestation and mould growth, and hence require proper storage.

Grading

In order to safeguard and guarantee quality, producers and exporters have introduced quality standards which must be met by cashew exporters. Kernels are graded based on size and colour according to specifications prescribed by Government of India under Export Act 1963. Cashew kernels are selected on the basis of the number per unit weight, in accordance with the weight of the kernels. They are also classified either as wholes, chips, splits, butts or baby bits, in accordance with the integrity of the kernel. White or ivory kernels are preferred over brown ones. There is a maximum permitted moisture level (both for raw cashews and cashew kernels) and the product must be free from insects, mould, rancidity and extraneous materials. The highest price is paid for better quality kernels of the W180 and W210 grades which are the largest and heaviest grades. These are roughly divided into three groups: white whole, white pieces and scorched grades.

White wholes (W180, W210, W240, W280, W320, W450)
White pieces (Butts, Splits, Pieces, Small pieces, Baby pits)
Scorched grades (Wholes, Butts, Splits, Pieces)

CONCLUSION

Quality has emerged, ahead of price, as the most vital criterion for any item if it is seeking entry into the global market. Quality aspects include safety, reliability, durability and acceptability of the product to the consumer. Small-scale processors have to match the standards set by importers, consumers and standards agencies. India has therefore enjoyed a virtual monopoly of cashew processing for a long time due to the great skill of Indian workers in cashew growing areas.

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Precision farming

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Prayasi Nayak[1] Somanath Nayak[2]
1. PhD scholar, Deptt. Of Agronomy, GBPUAT, Pant nagar
2. PhD scholar, Division Of Agronomy, IARI, New Delhi

INTRODUCTION

Precision agriculture is an integrated information and production based farming system that is designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment sustainability and protection of the land resource by minimizing the production costs. Increasing environmental consciousness of the general public is necessitating us to modify agricultural management practices for sustainable conservation of natural resources such as water, air and soil quality, while staying economically profitable. The use of inputs (i.e. chemical fertilizers and pesticides) based on the right quantity, at the right time, and in the right place. This type of management is commonly known as "Site-Specific Nutrient Management". The productivity gain in global food supply have increasingly relied on expansion of irrigation schemes over recent decades, agricultural products is challenging economic viability of the traditional agricultural systems, and requires the development of new and dynamic production systems.

Components of Precision Farming

1. Geographic Information Systems (GIS)

This system comprises hardware, software and procedures designed to support the compilation, storage, retrieval and analysis of feature attributes and location data to produce maps. Computerized GIS maps are different from conventional maps and contain various layers of information (e.g. yield, soil survey maps, rainfall, crops, soil nutrient levels and pests). GIS is a Precision farming containing kind of computerized map, but its real role is using statistics and spatial methods to analyses characters and geography.

2. Global Positioning Systems (GPS)

GPS is a navigation system based on a network of satellites that helps users to record positional information (latitude, longitude and elevation) with an accuracy of between 100 and 0.01 m GPS allows farmers to locate the exact position of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions. There is an automatic controlling system, with light or sound guiding panel (DGPS), antenna and receiver. The system allows farmers to reliably identify field locations so that inputs (seeds, fertilizers, pesticides, herbicides and irrigation water) can be applied to an individual field, based on performance criteria and previous input applications.

3. Variable Rate Technology (VRT)

Variable-rate technologies (VRT) are automatic and may be applied to numerous farming operations. VRT systems set the rate of delivery of farm inputs depending on the soil type noted in a soil map. Information extrapolated from the GIS can control processes, such as seeding, fertilizer and pesticide application,

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herbicide selection and application at a variable rate in the right place at the right time. VRT is perhaps the most widely used PFS technology in the United States.

4. Yield Monitor

Yield monitors are a combination of several components. They typically include several different sensors and other components, including a data storage device, user interface (display and key pad), and a task computer located in the combine cab, which controls the integration and interaction of these components. The sensors measure the mass or the volume of grain flow (grain flow sensors) in the case of grain, yield is continuously recorded by measuring the force of the grain flow. A recent development of a mass flow sensor works on the principle of transmitting beams of microwave energy and measuring the portion of that energy that bounces back after hitting the stream of seeds flowing through the chutes. In all yield monitors, GPS receivers are used to record the location of yield data and create yield maps.

5. Remote Sensing

"The term Remote Sensing means the sensing of the Earth's surface from space by making use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensor**.**

6. Site-Specific Nutrient Management (SSNM)

Optimizes the supply of soil nutrients over space and time to match crop requirements SSNM increases crop productivity efficiency of fertilizer u through four key principles the principles, called the “4 Rs”.

- **Right product**

Match the fertilizer product or nutrient source to crop needs and soil type to ensure balanced supply of nutrients.

- **Right rate**

Match the quantity of fertilizer applied to crop needs, taking into account the current supply of nutrients in the soil. Too much fertilizer leads to environmental losses, including runoff, leaching and gaseous emissions, as well as wasting money. Too little fertilizer exhausts soils, leading to soil degradation.

- **Right time**

Ensure nutrients are available when crops need them by assessing crop nutrient dynamics. This may mean using split applications of mineral fertilizers or combining organic and mineral nutrient sources to provide slow-releasing sources of nutrients**.**

- **Right place**

Placing and keeping nutrients at the optimal distance from the crop and soil depth so that crops can use them is key to minimizing nutrient losses. Generally, incorporating nutrients into the soil is recommended over applying them to the surface. The ideal method depends on characteristics of the soil, crop, tillage regime and type of fertilizer

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Benefits of site specific nutrient management

1. Higher profits

SSNM can increase and maintain yields by optimizing the balance between supply and demand of nutrients and providing more balanced plant nutrition (Wang *et al.* 2007). In general, it improves nutrient-use efficiency and provides greater returns on investments in fertilizer.

2. Reduced nitrous oxide emissions

Agriculture contributes 70-90% of nitrous oxide (N_2O) emissions, mostly from N fertilizer. SSNM reduces N2O emissions by reducing total N application and/or timing applications to crop needs, thus avoiding N losses to volatilization, leaching and runoff.

3. Improved disease resistance

The more balanced NPK nutrition that comes with site specific nutrient management may lead to improved resistance to plant diseases (Pasuquin *et al.* 2014).

4. Variable economic benefit: For SSNM to increase farmers' profits, site specific nutrient management must deliver savings from reduced fertilizer use without a reduction in yields,) yield increases that are valued higher than the costs of acquiring and using SSNM technology.

Precision farming How does SSNM help adapt to and increase resilience to climate change impacts?

Most of the research on SSNM has been focused on increasing productivity and incomes, and mitigation. However, good nutrient management in general should increase yields and resilience of crops (Thornton and Herrero 2014). In addition, if optimization of fertilizer inputs is based on attainable yield.

How does SSNM mitigate greenhouse gas emissions?

As a greenhouse gas mitigation strategy, SSNM is most applicable to farming systems in which N fertilizers are currently used, and especially "SSNM" reduces the quantity of N applied, thus reducing total reactive N (NH3, NH4+, NO3-, NO2-, NO, N2O) losses to the environment (through leaching or volatilization, for example) and N2O emissions. In one Study, implementation of "Site Specific Nutrient Management" practices resulted in a 30% reduction of fertilizer use in rice (Wang *et al.* 2007).

How does SSNM increase productivity, farm livelihoods and food security?

SSNM generally maintains or increases crop yields. Study of 13 sites in Southeast Asia, "Site Specific Nutrient Management "lead to grain yield increases of 13% over a three-year period, although yields declined slightly in the first year (Pasuquin et al. 2014). In recent studies across large numbers of locations in wheat systems in South Asia, "Site Specific Nutrient Management". Lead to 18-27% increases in grain yield of wheat, when compared to farmers' standard fertilizer practices (Jat and Satyanarayana 2013).

Why is Precision Nutrient Management Important?

1. Nutrient variability within a field can be very high, affecting optimum fertilizer rates.
2. Yield potential and grain protein can also vary greatly even within one field, affecting fertilizer Requirements.
3. Increasing fertilizer use efficiency will become more important with increasing fertilizer costs and environmental concerns

Why is Need for Precision Farming in India?

1. Increased Land degradation. (In India, out of 329 million ha of total geographical area 182 million ha of area is affected by land degradation due to water erosion, wind erosion, water logging and chemical deterioration.)
2. Socio economic need for enhanced productivity / unit of land, water and time.
3. Environment Pollution because of increased and indiscriminate use of fertilizers and chemicals
4. Precision Farming is essential in order to address poverty alleviation, enhance quality of life and food security.

CONCLUSION

Precision agriculture has target to increase the crops productivity reducing performance differences in the production area, and it can be implemented through different ways. It is a very particular topic which interests the entire agricultural sector, in order to find out even more precise and reliable methods to recognize the variability.

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Precision Agriculture - Concept Scope and Indian Agriculture

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Roshan Jadhav[1], Manisha Apraj[2]
[1]Ph. D. Scholar, Department of plant physiology
[2]Ph. D. Scholar, Department of soil science and agricultural chemistry
PGI, MPKV, Rahuri, Dist- Ahmednagar (413 722)

Precision agriculture (**PA**), **satellite farming** or **site specific crop management** (**SSCM**) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. The goal of precision agriculture research is to define a decision support system (DSS) for whole farm management with the goal of optimizing returns on inputs while preserving resources. Among these many approaches is a phytogeomorphological approach which ties multi-year crop growth stability/characteristics to topological terrain attributes. The interest in the phytogeomorphological approach stems from the fact that the geomorphology component typically dictates the hydrology of the farm field.

The practice of precision agriculture has been enabled by the advent of GPS and GNSS. The farmer's and/or researcher's ability to locate their precise position in a field allows for the creation of maps of the spatial variability of as many variables as can be measured (e.g. crop yield, terrain features/topography, organic matter content, moisture levels, nitrogen levels, pH, EC, Mg, K, and others). Similar data is collected by sensor arrays mounted on GPS-equipped combine harvesters. These arrays consist of real-time sensors that measure everything from chlorophyll levels to plant water status, along with multispectral imagery. This data is used in conjunction with satellite imagery by variable rate technology (VRT) including seeders, sprayers, etc. to optimally distribute resources. However, recent technological advances have enabled the use of real-time sensors directly in soil, which can wirelessly transmit data without the need of human presence.

Precision agriculture has also been enabled by unmanned aerial vehicles like the DJI Phantom which are relatively inexpensive and can be operated by novice pilots. These agricultural drones can be equipped with hyperspectral or RGB cameras to capture many images of a field that can be processed using photogrammetric methods to create orthophotos and NDVI maps.[11] These drones are capable of capturing imagery for a variety of purposes and with several metrics such as elevation and Vegetative Index (with NDVI as an example). This imagery is then turned into maps which can be used to optimize crop inputs such as water, fertilizer or chemicals such as herbicides and growth regulators through variable rate applications.

Precision agriculture aims to optimize field-level management with regard to:

- crop science: by matching farming practices more closely to crop needs (e.g. fertilizer inputs);
- Environmental protection: by reducing environmental risks and footprint of farming (e.g. limiting leaching of nitrogen);
- Economics: by boosting competitiveness through more efficient practices (e.g. management of fertilizer usage and other inputs).

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Precision agriculture also provides farmers with a wealth of information to:

- build up a record of their farm
- improve decision-making
- foster greater traceability
- enhance marketing of farm products
- improve lease arrangements and relationship with landlords
- enhance the inherent quality of farm products (e.g. protein level in bread-flour wheat)

Prescriptive planting

Prescriptive planting is a type of farming system that delivers data-driven planting advice that can determine variable planting rates to accommodate varying conditions across a single field, in order to maximize yield. It has been described as "Big Data on the farm." Monsanto, DuPont and others are launching this technology in the US.

Data collection:

Geolocating a field enables the farmer to overlay information gathered from analysis of soils and residual nitrogen, and information on previous crops and soil resistivity. Geolocation is done in two ways:

- The field is delineated using an in-vehicle GPS receiver as the farmer drives a tractor around the field.
- The field is delineated on a basemap derived from aerial or satellite imagery. The base images must have the right level of resolution and geometric quality to ensure that geolocation is sufficiently accurate.

Variables:

Intra and inter-field variability may result from a number of factors. These include climatic conditions (hail, drought, rain, etc.), soils (texture, depth, nitrogen levels), cropping practices (no-till farming), weeds and disease. Permanent indicators-chiefly soil indicators-provide farmers with information about the main environmental constants. Point indicators allow them to track a crop's status, i.e., to see whether diseases are developing, if the crop is suffering from water stress, nitrogen stress, or lodging, whether it has been damaged by ice and so on. This information may come from weather stations and other sensors (soil electrical resistivity, detection with the naked eye, satellite imagery, etc.). Soil resistivity measurements combined with soil analysis make it possible to measure moisture content. Soil resistivity is also a relatively simple and cheap measurement.

Economic and environmental impacts:

Precision agriculture, as the name implies, means application of precise and correct amount of inputs like water, fertilizer, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields. Precision agriculture management practices can significantly reduce the amount of nutrient and other crop inputs used while boosting yields. Farmers thus obtain a return on their investment by saving on water, pesticide, and fertilizer costs.

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The second, larger-scale benefit of targeting inputs concerns environmental impacts. Applying the right amount of chemicals in the right place and at the right time benefits crops, soils and groundwater, and thus the entire crop cycle. Consequently, precision agriculture has become a cornerstone of sustainable agriculture, since it respects crops, soils and farmers. Sustainable agriculture seeks to assure a continued supply of food within the ecological, economic and social limits required to sustain production in the long term.

Precision agriculture reduces the pressure on agriculture for the environment by increasing the efficiency of machinery and putting it into use. For example, the use of remote management devices such as GPS reduces fuel consumption for agriculture, while variable rate application of nutrients or pesticides can potentially reduce the use of these inputs, thereby saving costs and reducing harmful runoff into the waterways

Emerging technologies

Precision agriculture is an application of breakthrough digital farming technologies. Over $4.6 billion has been invested in agriculture tech companies-sometimes called agtech.

Robots:

Self-steering tractors have existed for some time now, as John Deere equipment works like a plane on autopilot. The tractor does most of the work, with the farmer stepping in for emergencies. Technology is advancing towards driverless machinery programmed by GPS to spread fertilizer or plow land. Other innovations include a solar powered machine that identifies weeds and precisely kills them with a dose of herbicide or lasers. Agricultural robots, also known as AgBots, already exist, but advanced harvesting robots are being developed to identify ripe fruits, adjust to their shape and size, and carefully pluck them from branches.

Drones and satellite imagery:

Drone and satellite technology are used in precision farming. This often occurs when drones take high quality images while satellites capture the bigger picture. Light aircraft pilots can combine aerial photography with data from satellite records to predict future yields based on the current level of field biomass. Aggregated images can create contour maps to track where water flows, determine variable rate seeding, and create yield maps of areas that were more or less productive.

The Internet of things:

The Internet of things is the network of physical objects outfitted with electronics that enable data collection and aggregation. IoT comes into play with the development of sensors and farm management software. For example, farmers can spectroscopically measure nitrogen, phosphorus, and potassium in liquid manure, which is notoriously inconsistent. They can then scan the ground to see where cows have already urinated and apply fertilizer to only the spots that need it. This cuts fertilizer use by up to 30%. Moisture sensors in the soil determine the best times to remotely water plants. The irrigation systems can be programmed to switch which side of tree trunk they water based on the plant's need and rainfall.

Smartphone Applications:

Smartphone and tablet applications are becoming increasingly popular in precision agriculture. Smartphones come with many useful applications already installed, including the camera, microphone, GPS, and accelerometer. There are also applications made dedicated to various agriculture applications

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such as field mapping, tracking animals, obtaining weather and crop information, and more. They are easily portable, affordable, and have a high computing power.

Machine Learning:

Machine learning is commonly used in conjunction with drones, robots, and internet of things devices. It allows for the input of data from each of these sources. The computer then processes this information and sends the appropriate actions back to these devices. This allows for robots to deliver the perfect amount of fertilizer or for IoT devices to provide the perfect quantity of water directly to the soil. The future of agriculture moves more toward a machine learning architecture every year. It has allowed for more efficient and precise farming with less human manpower.

Scope and Adoption of Precision Farming in India

PA for small farms can use small farm machinery and robots which will not compact the soil and may also run on renewable fuels like bio oil, compressed biogas and electricity produced on farms by agricultural residues. For small farms, precision agriculture may include sub-surface drip irrigation for precise water and fertilizer application, weed removal, harvesting and other cultural operations. Some of these robots are already being used on small farms in the US and Europe and it is expected that they may be deployed in large scale in the near future. For small farms, precision agriculture may help in sub-surface drip irrigation for precise water and fertilizer application and robots for weed control, harvesting and other operations. Similarly, drones have also been introduced in Japan and the U.S. for mapping the farms, identifying diseases and so on. Most robotic machines and drones are compact and thus suitable for small farms. India's small farms, therefore, are ideal for the large-scale application of precision agriculture.

The way forward

The most important component in taking PA forward will be in creating a huge resource of engineers, scientists and agriculturists to develop various components of the technology. Without excellent manpower and consequently good R & D, PA will not succeed. Unfortunately, most good students want to get into engineering and medical streams and ignorantly, agriculture becomes an afterthought. There is also a need for excellent engineers from institutions like IITs, NITs, etc. to design machinery like robots and drones for PA. This can be facilitated by establishing a new branch of engineering called agricultural mechanotrics or robotics where faculty and students from ICAR institutes, IITs, industries and farmers work together, interact and collaborate to develop smart systems for PA. Industries have to take charge since they will develop the machinery and set up the leasing agencies resulting in jobs creation in PA system and better students will pursue a career in agriculture.

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Diseases of Banana and their management

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M.D. Navale and A.C. Patil
Ph.D. Scholar, Department of Plant Pathology, VNMKV, Parbhani- 431 402 (M.S.)

1. Panama disease : *Fusarium oxysporum* f. *spcubense*

The first major disease which attacked banana was called Panama disease from the area where it first became serious. Banana wilt is a soil-borne fungal disease and gets entry in the plant body through roots and wounds caused by nematodes.

Symptoms

- Yellowing of the lower most leaves starting from margin to midrib of the leaves.
- Yellowing extends upwards and finally heart leaf alone remains green for some time and it is also affected.
- The leaves break near the base and hang down around pseudostem. Longitudinal splitting of pseudostem. Discolouration of vascular vessels as red or brown streaks.
- The fungus spreads through use of infected rhizomes Continuous cultivation results in buildup of inoculum.
- The pathogen is soil borne. It survives in soil as chlamydospores for longer periods. The primary spread of the disease is through infected rhizomes and secondary spread is through irrigation water.

Management-

- ✓ Avoid growing of susceptible cultivars *viz*., Rasthali, Monthan, Red banana and Virupakshi.
- ✓ Grow resistant cultivar Poovan.
- ✓ Corm injection of 3 ml of 2% Carbendezim injected in the corm by making a hole to a depth of 10cm with 45^0 angle on 5 th and 7 th month as mentioned earlier.

2. **Moko disease :** *Pseudomonas solanacearum / Burkholderia solanacearum*

Symptoms

- Leaves become yellow and progress upwards.
- Petiole breaks and leaves hang.
- When it is cut open discolouration in vascular region with pale yellow to dark brown colour.
- The discolouration is in the central portion of the corm. Internal rot of fruits with dark brown discoloration. When the pseudostem is cut transversely bacterial ooze can be seen.

Pathogen is soil borne, it survives in susceptible hosts like banana and Heliconia spp.

Management-

- ✓ Eradicate infected plant.
- ✓ Expose soil to direct sunlight.
- ✓ Use disease free planting material.
- ✓ Crop rotation is advisable.
- ✓ Disinfection of pruning of tools.
- ✓ Providing good drainage.

3. Sigatoka disease : *Mycosphaerella musicola* (*Cercospora musae*)

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Symptoms-

- On leaves small light yellow or brownish green narrow streaks appear. They enlarge in size becomes linear, oblong, brown to black spots with dark brown brand and yellow halo.
- Black specks of fungal fruitification appear in the affected leaves.
- Rapid drying and defoliation of the leaves.

Management-

- ✓ Removal and destruction of the affected leaves.
- ✓ Spray Propiconazole + Carbendazim 0.1% or Chlorothalonil 0.25%. Add wetting agent such as teepol or sandovit added @ 1ml/lit of water.

4. Cigar end Rot (*Verticillium theobromae, Trachsphaera fructigena* and *Gloeosporium musarum*)

Symptoms

- A black necrosis spread from the perianth into the tip of immature fingers. The rotted portion of the banana finger is dry and tends to adhere to fruits (appears similar to the ash of a cigar).

Control:

- ✓ Removal of pistil and perianth by hand 8-10 days after bunch formation and spraying the bunch with Dithane M -45 (0.1%) or Topsin M (0.1%) controls the disease effectively.
- ✓ Minimising bruising; prompt cooling to 14°C; proper sanitation of handling facilities reduce the incidence in the cold storage.

5. Anthracnose: *Gloeosporium gloeosporioides*

Symptoms

- The skin at the distal ends of the fingers turn black shrivels.
- The fungus produces masses of conidia which form a pinkish coat.
- The entire fruit and bunch is affected in severe cases.
- Sometimes main stalk of bunch diseased.
- The bunch becomes black and rotten.
- Acervuli produces cylindrical conidiophores, hyaline, septate, branched. Conidia hyaline, non-septate, oval to elliptical.

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The spread of the disease is by air borne conidia and numerous insects which frequently visit banana flowers also spread the disease.

Management-

- ✓ Post harvest dipping of fruits in Carbendazim 400 ppm, or Benomyl 1000 ppm, or Aureofunginsol 100 ppm.

6. Banana bunchy top: *Banana bunchy top virus*

The disease is covered by domestic quarantine regulations. Losses were estimated to be Rs.4 crores every year and 100% loss occurs if infected suckers are planted.

Symptoms

- Subsequent leaving show the same symptoms and are dwarfed.
- Dark broken bands of green tissues on the veins, leaves and petioles.
- Plants are extremely stunted. Leaves are reduced in size marginal chlorosis and curling. Leaves upright and become brittle. Many leaves are crowded at the top. Branches size will very small.
- If infected earlier no bunch will be produced. The disease is transmitted primarily by infected suckers.

Management-

- ✓ Select suckers from disease free areas.
- ✓ Control vector by spraying methyl demoton 1 ml/lit. or Monocrotophos, 2 ml/l. or Phosphomidon 1 ml / lit. or Injection of Monocrotophos 1 ml / plant (1 ml diluted in 4 ml).
- ✓ Infected plants are destroyed using 4ml of 2, 4, D (50g in 400 ml of water).

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Availability of nitrogen in soils under conservation agriculture (CA)

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Siddhartha Mukherjee[1*], Dibyendu Sarkar[1]
[1]Department of Agricultural Chemistry and Soil Science, B.C.K.V.
Mohanpur-741252, Nadia, West Bengal, India

Why CA is our concern?

Food grain production in India increased effectively with green revolution which was mainly guided by genetic improvement of crops along with higher application of external inputs (fertilizers, pesticides, water, etc). Over the past 50 years, nitrogenous fertilizer application has increased 20-fold, and its application is projected to extend to 180 million tons by 2030 (Verhulst *et. al.,* 2014). As a consequence, some recent studies have shown that intensive ploughing of the soil along with indiscriminate use of chemical fertilizers exposes soil organic matter (SOM) to the atmosphere for rapid oxidation and ultimately reduces soil fertility, destroys soil structure-aggregates, and deteriorates aeration as well as moisture status. Moreover, degradation of natural resources due to global climate change is posing a major threat to future food security. The conservation agriculture (CA) based crop management technologies are gaining more attention in recent years with the rising concern over degradation of natural resources, mainly soil and water, and to minimise the cost of production (Ladha *et. al.,* 2009).

According to FAO (2012), CA is an approach to manage agro-ecosystems for sustained productivity, considerable profits and food security and characterised by three linked principles, namely: 1) continuous no or minimal mechanical soil disturbance (zero-tillage or reduced tillage); 2) permanent soil cover or residue retention (retaining crop biomass, rootstocks and stubbles); and 3) diversification of crops (by adopting a cropping system with crops in rotations, including a balanced mixture of legume and non-legume crops). As CA has been found to alter the physical, chemical and biological properties of soils as compared to conventional agricultural practices, it is likely to be that CA features a different effect on N dynamics in soils.

Influence of CA on different transforming processes of N in soils:

Mineralization and immobilization: The transforming processes related soil N cycle are immensely affected by mineralization, the transformation of organic N in SOM into inorganic N by microbial activity. Mineralization is mainly influenced by warm and wet climatic conditions and maximized in well-aerated soils with a soil pH ranges from 7 to 9 (optimum pH 8.5). Whereas, immobilization is just the opposite phenomenon of mineralization where removal of inorganic N from the soil by microorganisms takes place to form protein for their structural development. These microorganisms fulfil their energy needs by utilizing the residue carbon components by breaking down crop residues. Thus, C/N ratio of >30 in crop residues leads to net N immobilization by providing huge amount of carbonaceous compounds in soils.

In CA, crop residues are left on the soil surface. The residue layer may reduce the availability of N to crops as well as grain yields over a short period because of its negative effects of immobilization of surface-applied N in early years of adoption (Dordas, 2015). Inorganic N can be immobilized during SOM decomposition especially when organic material with a large C/N ratio is applied to the soils (Yadvinder-Singh *et. al.,* 2005).

N stock: Comparatively higher immobilization in CA than conventional tillage (CT) can influence the conservation of soil and fertilizer N in the long-term. The build-up of readily mineralizable organic N pools leads to less requirements of N fertilizers over time in CA though having a higher initial N fertilizer needs. Soil N-stocks can be increased at 0-15 cm soil depth after 2.5 years (at the end of seven crops) by 11% in strip planting with higher residue retention as compared to conventional tillage with lower residue (Islam *et. al.,*2016).

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Leaching: In CA systems, residue retention promoted the formation of more stable macro-aggregates compared to CT (Singh *et. al.,* 2016) which features higher infiltration rates. This may enhance leaching losses of N. Moreover, CA systems especially zero tilled (ZT) soils may have increased number of earthworm biopores than intensively tilled soils and may facilitate more leaching losses. On the other hand, slower mineralization in ZT system during fallow periods could reduce the potential for NO_3 leaching from soil system.

Volatilization: CA systems are reported to have higher volatilization losses of N due to inappropriate fertilizer management. When urea is broadcast under CA systems, the potential for volatilization is greater as compared to CT. Volatilization from urea can also be greatly minimized by the activities that move fertilizers into the soils so that ammonium formed from urea hydrolysis can be arrested by soil particles (Jat *et. al.,* 2016).

Denitrification: Residue retention of CA often increases the soil water and SOM content compared to conventionally tilled systems. On the one hand, ZT systems can conserve more soil moisture by reducing evaporation from soil surface than intensively tilled soils. This leads to reduced microbial activity and mineralization of crop residues. Thus, ZT has more population of anaerobic bacteria, particularly in the upper soil layers compared to CT and more prone to loss via denitrification (Dordas, 2015). Conversely, less soil temperature and improved aggregate stability may enhance aeration which means less anaerobic conditions and ultimately can minimize N_2O emissions from soils under CA.

Options for better management of N in CA

Option 1: Use of finer crop residue

In the long term, CA increases SOM and hence soil microbial biomass which play an important role in N availability in soils. However, the problem of the lower N mineralization in CA systems can be tackled. Use of fine crop residues so that it can be decomposed quickly by microbes as here the substrate surface is increased.

Option 2: Fertilizer management

a) **Rescheduling of N fertilizer doses:** As CA can provide a higher amount of easily mineralizable carbonaceous material than CT to avoid the initial temporary losses of N from soils due to immobilization, 25% N fertilizers can be applied more than recommended at the time of land preparation.
b) **Precision N management:** Sensor-based N management with spatial technologies such as GPS, remote sensing and GIS to adjust fertilizer application by monitoring crop growth to improve NUE and crop yield is a good option. NDVI (normalized difference vegetation index) based Green-seeker or LCC (leaf colour chart) can be used in this regard. In combination with a well-fertilized reference crop, the NDVI sensor can be useful to provide precise information about crop N demand and helps farmers to reduce fertilizer costs as well as to minimize the cascading effect of excess N towards our environment.
c) **Site-specific nutrient management (SSNM):**
Site-specific application of fertilizer has been reported to improve nutrient use efficiency without compromising grain yield of crops across the world under CA. The SSNM can reduce N fertilizer application by 32% and increase grain yield by 5% compared with farmers' N fertilization practices in the field experiments for rice (Shaobing *et. al.,* 2010).

CONCLUSION

Conservation agriculture offers a new paradigm for agricultural research. To get a sustainable agricultural production system by performing C sequestration, minimising the effect of global warming by curbing CO_2 emission from soils, obtaining profitable yield in cost-effective way, CA is the only option in the present scenario. But, information on impact of CA with different nutrient management and crop rotations on N availability in soils in initial years of adoption is very limited and more research is needed to obtain an ultimate conclusion.

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Doubling Farmers' incomes through Machine Learning

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Shubhi Chaurasia
Scholar, Banaras Hindu University, Varanasi

India's agriculture needs have changed. And a new India needs new agriculture solution for its growing population. Now India needs smart farming. With precise and resource efficient approaches .By utilizing AI, IoT, Big Data, sensors, GPS, Robotics in agriculture. Farmers can be future ready.

India is a developing country where Majority of its population (more than 56%) depends on agriculture and allied activities for their livelihood. With depletion of natural resources, shrinking land sizes and increase in cost of input , along with the uncertainty of various factors like weather, market prices etc, agriculture becomes a risky profession .Being world's 2nd largest populated country, it is a matter of great challenge to achieve zero hunger and meet the needs of the people . .So uses of latest technology in agriculture sector are required. Now it is necessity to adopt Precision farming or smart farming. As it will enable the farmers to maximize their production and minimize the cost of input. One way to do so is through machine learning.

Machine learning is an active application of artificial intelligence based idea, evolving along with big data and becoming most trending technology of modern agriculture.Machine learning is the branch of computer science which runs through algorithms having a self-learning property. In a layman's language, we can say Machine learning is nothing but a scientific method which allows the machine to learn without programming the device regularly. Human mind use to learn from their past experiences and based upon the past data, it take decision for future. So, for becoming intelligent like a human being, machines have to learn first from their previous experiences. Once the learning process is completed, then the machine can be used to make assumptions. By making use of technologies and deep learning algorithms, the data related to weather , soil ,crops etc are collected from the fields through satellite image survey, drones ,field based sensors and other software to monitor the crops and to take quick and fast result oriented decision.

There are three types of learning and algorithms in machine learning:

A. Supervised Learning

The algorithm is given some training examples on the basis of which it can study the inputs and their corresponding outputs. If the output variables are provided, the learning becomes supervised. For example, Clicking picture of different disease plants from mobile app and also feeding the name of the disease in the mobile app. Popular supervised learning algorithms are Artificial neural networks, Decision trees, K-means clustering, Support vector machines, Bayesian networks etc.

B. Unsupervised Learning

When the algorithm is not provided with any outputs, the learning is said to be unsupervised**.** For example, if we watch a movie in Korean language that we don't know, we don't understand anything, but if we keep on watching we will identify certain patterns and slowly start understanding**.** Popular unsupervised learning algorithms Self organized feature maps, COBWEB, DBSCAN etc.

C. Reinforcement Learning

This type of learning works on the principle of feedback. Every action has its impact on the system which is then reported back to the algorithm. The algorithm modifies its behavior according to the feedback received. Popular algorithms are Genetic algorithms, Markov decision algorithms etc.

Uses:

1. Artificial neural networks is used in the selection of the crops and varieties depends upon the topography, types of soil, climate, ecology, natural calamities. A crop selection method called CSM are used in decision making like which crop, under which weather condition will produce the best yield and give the highest returns.
2. Smart irrigation system: ML studied evaporation loss, soil moisture content and soil temperature, hydrological, climatological and agricultural water status. Daily, weekly monthly evapotranspiration and allow the effective use of irrigation with the help of field based sensors.
3. The nutrient content of soil can also be recorded using the soil scanning and sensors as it able to predict the nutritional requirements of the soil and based upon that soil fertility status can be maintained.
4. Identification of Disease and Pest: ML also help in identification of pest and disease as the drone or sensor click the picture of the insect or disease from the field and provide the data to the technician to corrective measures..
5. Apart from disease ,weed also effect the yield of crop , and the biggest difficulty is to detect and discriminate weed from the crops ML algorithms and computer vision using pattern recognition improve in detection of weed from crops at very low cost without causing any environmental issue.
6. Just Like crop ML are used in Livestock also: Eg : Monitor the location of livestock, well being and health of their cattle, with this information ,they can identified their sick animals. Tracking animals by weight predicting system, prior to slaughter day, can allow farmers to improve the diet and condition of ruminants.
7. **Robotics**: Robots are specially designed to perform essential task related to agriculture, including harvesting, intercultural operations. IoT based solution, Automatic spray machines and tools are also designed for pest and disease management are some of the examples of machine learning.

CONCLUSION: By making the use of Machine Learning, Artificial Intelligence, farmers will be able to get location specific data which can be utilized in crop production and reduces the cost of input .Farmers can monitor the growth of their crops, protect them from weeds, pest and diseases, fulfill the requirements of nutrients and irrigation based upon their own location and topography. This precision can help in reducing the chemical expenditure, sustain the environment. So we can say from placing the seeds in soil, to disease and pest management and and to picking up by the robots, Machine Learning is everywhere from sowing to harvesting.

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Use of jute in home decoration

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Neetu kumari, M.Sc. student (Department of FRM)
Dr. Rajendra Prasad Central Agriculture University, Pusa, Samastipur, Bihar, 848125

Jute is one of the finest parts of unique Indian Handicraft. Jute is a natural fiber with golden and silky shine & is used to make sacks bags, yarn, and fabric. In rugs Jute items are always appreciated as they are fancy and long lasting. But with the growth in creativity of artisans and interior designers of our decoration industry, there is a huge demand for Jute decorative items.

Market is completely flooded with the Eco-friendly Jute decorative items for interiors. Hence, it's your turn now to give a unique & gorgeous look to your Interiors.

Many Indian handicraft are focusing on manufacturing such home decorative items to transform your home like never before. In fact, our artisans believe that not only home lovers, even the corporate organizations are demanding for Jute decorative items.

Jute Furniture for Cozy Look

If you are looking for some contemporary look for your living space, then Jute sofa sets, chairs, stools & center table will add sleek look to the interiors. Earlier, Jute was only used for rugs or bags, but now as they are eco-friendly, people are using these jute decorative items for home decoration purpose.

You can even renovate your old furniture with the help of these jute ropes & soft jute fabrics. Jute strands can be woven for back seat of sofa set or for side holders. There is no issue of colors. Moreover, Jute is

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available in all the shades of cream & brown. So now, give a cozy look to the home interiors with these sleek & sophisticated jute designs. Plus, usage of jute in furniture makes them more durable.

Jute Hanging Lamps for Chic Look

Captivate the eyes the people on the ceilings of your home interior with these lovely jute lamps. Now you can find the collection of attractive jute lamps not only as table lamps, but also as hanging lamps.

Give royal look to the balcony or living area with these eye catchy jute lamps. When light will pass through these designer hanging lamps, it will fill your home with artistic effects. Trust me guys! Add these hanging lamps in your home decoration & let others utter 'WOW' & give salute to your choice.

Designer Jute Rugs & Curtains

Friends, home decoration is incomplete without furnishing the floor. A dull & lifeless floor can overlook the charm of your home interior. Now add some fascinating look to the floor with these designer jute rugs. As they are available in different shapes & sizes, fits perfectly in the home decor. Simple rugs can be used to adorn the look of sofa, whereas designer netted rugs all over the home will outspread their beauty in home decoration.

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Want to give modern accent to the home decoration .Artistic creation of jute curtains allows you to intensify the accent of the interiors. Instead of soft jute fabric, artisans are using hard jute to cover up the windows. Jute blends are very popular nowadays to enhance the beauty of the home interior.

Cushion Covers for High-Toned look

Bed, sofa or any other sitting space looks cursory without cushion covers. If you can't afford other jute decorative items, but wish to get high toned look, then usage of jute cushion covers is the smart choice. Use of Jute fabrics in the cushion covers gives alluring look to the sitting space.

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Mechanism of organic matter clay interaction

Article id: 23478

Payal Mahadule[1] and Reshma Sale[2]

[1,2]Department .of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. (413722)

It is frequently expected that a great part of the humified material in soil is solidly bound to colloidal mineral surfaces. Proof originates from the finding that sediment and earth related OM is more seasoned and has a more drawn out turnover time than OM related with the sand part. Soil clay minerals can sorb an assortment of natural mixes by various instruments, the fundamental ones being (a) ligand exchange, (b) polyvalent cation bridging, (c) electrostatic attraction, and (d) hydrophobic weak interactions including H-holding and van der Waals powers.

Ligand Exchange

Arrangement of covalent bonds between hydroxyl (– OH) bunches on mineral surfaces and carboxyl gatherings and phenolic OH gatherings of the natural atoms is a significant system for the development of solid organomineral associations (Mikutta *et al*., 2007). OM association with mineral surfaces via ligand exchange increases with decreasing pH and maximum complexation occurs between pH 4.3 and 4.7, corresponding to the pKa values of the dominant carboxylic acids in soils (Gu et al., 1994)

Polyvalent Cation Bridging

Negatively charged mineral surfaces repulse natural anions, yet the nearness of polyvalent cations on the trade complex favors official between them. In nonpartisan and soluble soils, Ca^{2+} and Mg^{2+} are the significant cations, while hydroxypolycations of Fe^{3+} and Al^{3+} are predominant in corrosive soils. These positively charged particles become adsorbed on contrarily charged mineral surfaces and encourage the adsorption of adversely charged long-chain natural atoms through cation bridging. As a rule, OC adsorption on clay minerals followed the request: oxides–hydroxides>2:1 clay minerals>1:1 clay minerals, and this pattern was constrained by the Specific surface area and CEC of the particular minerals.

Electrostatic Attraction

Electrostatic bonding between soil mineral surfaces and organic molecules can occur through cation exchange. The reaction occurs when positively charged organic molecules such as protonated amines replace inorganic cations on the exchange complex (Wang and Lee, 1993). The positive charge density of weakly basic organic molecules is strongly pH dependent. Hence, adsorption by this interaction is controlled by both the basic nature of the organic molecules and the pH of the soil. Further, the chain length of the organic molecules and the type of cations on the exchange sites also govern the strength of bonding. This type of exchange may also occur on interlayer surfaces of expandable 2:1 phyllosilicates resulting in the penetration of organic molecules into the interlayer spaces, known as intercalation (Sarkar *et al*., 2013).

Van der Waals Force, H-Bonding, and Hydrophobic Interaction

Basically, these powers can happen between particles or nonpolar atoms because of a briefly fluctuating dipole moment of one atom which produces a dipole in its neighbour; this is referred to as an incited dipole interaction. On account of hydrogen bonds, a partial positively charged hydrogen atom interacts with an adjacent, partially negatively charged N or O atom. Uncharged polysaccharides and extracellular chemicals or other protein atoms build up linkages by means of van der Waals powers or hydrogen bonds because of the nearness of hydroxyl and other polar gatherings in the particles (Quiquampoix *et al*., 1995).

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Aquamimicry: A revolutionary concept for shrimp farming

Article id: 24379

M.Vignesh[1], B.Naveen Rajeshwer[1], Gorashiva Prasad[1], Shiv Mohan Singh[2*], Perla Sruthi[3]
[1]Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata,
[2]College of Fishery Science, Jabalpur,
[3]College of Fisheries Sciences, Muthukur.

INTRODUCTION

- In the past, the shrimp farming industry in some Asian countries has suffered from environmental issues and collapsed almost all in virtually & practically and no ways found to sustainable ever in the 1990s.
- Shrimpfarming can be a highly lucrative business around the world but has increasingly been characterized by intensification, with greater inputs of feed. Intensification can increase the risk of disease outbreak and the operational cost of shrimp farming.
- Very high stock density within the ponds, up from 300,000 to 1,000,000 pieces of aquaculture shrimp post larvae per hectare (30-100 pieces/sqm) could produce several tons of organic wastes within one crop.
- When organic wastes accumulated within shrimp ponds environment, much organic wastes material in their bodies are in the form of organic wastes compounds and those organic wastes cannot be utilized by the phytoplankton through photosynthesis. Oxidation of these organic wastes compounds depletes the dissolved oxygen deep in the bottom soils, and formation of toxic metabolites such as hydrogen sulfide, methane, ammonia, and nitrite, thus contributing greatly to the mortality rates.
- So recently there has been a new technology of shrimp farming that mimics the aquatic natural inhabitation of shrimps, this system can provide a sustainable revival to the shrimp farming industry. Aquamimicry is the intersection of aquatic biology and aquaculture technology (synbiotics) synergistically in mimicking the nature of aquatic ecosystems to create living organisms for the well-being development of aquatic animals.

ORIGIN AND CURRENT STATUS:

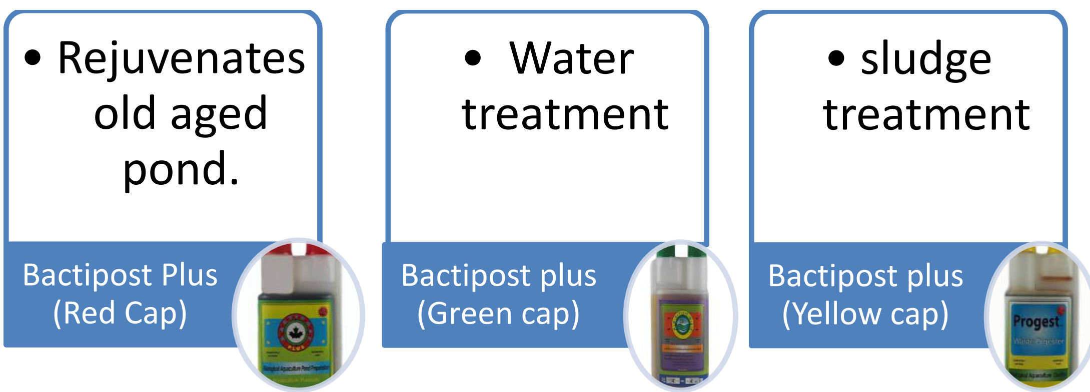
- Aquamimicry farming has been first developed in Thailand during the disease outbreaks in the 1990s. it has been noticed that in some extensiveshrimp culture ponds the shrimp were growing disease-free, despite being near infected ponds. The interesting thing is no formulated feeds were given, as the farmer had limited resources. They were only fed with rice bran, and it was thought to be one of the potential reasons for the better performance of shrimps in extensive ponds.
- After extensive trial and errors, over time a protocol slowly developed. After some years this farming technique was introduced outside Thailand. This new technology has been researched and field-tested by the Thai Organic Shrimp Group lead by its key advocator, Mr. Veerasun Prayotamornkul. The group has succeeded in producing pathogen-free shrimp through innovative farming practices using fermented rice bran, wheat bran and soya. Being impressed by this new technology and seeing its potential not only for Thailand but also for countries in Asia, designated, offered and supported by AIT (Asian Institute of Technology).

CREATES NATURAL FOOD

- Adding Fermented rice bran (FRB) is inevitable to stimulate the natural production of zooplankton (particularly copepods) prior to stocking shrimp. To create FRB, rice bran is ground to a fine powder, added to water at a 1:1 ratio and then synbiotics are added with aeration.After 24 hours, an initial application of the mixture is made to ponds at 50-100 ppm.

- Synbiotics are a mixture of Probiotics and Prebiotics and commercially available in the market in the name of bacterioplus (Red cap), Bactipost (Green cap), progest (Yellow cap), Engest (White cap).
- Thereafter copepods will bloom within two weeks, depending on the water source, temperature and previous pond management. Periodic applications of synbiotics to pond water andChain dragging during the pond preparation and continuously 20% around the feeding zone per day until the first 15 days after stocking is preferably and throughout the pond will greatly reduce the biofilm development.
- After the copepod bloom, early post-larvae are stocked at 20/m^2, a density that is substantially lower than intensive farms. The exact stocking density depends on pond size, growth rates, water quality and market demand.
- After stocking, FRB is added daily at 1 ppm throughout the culture cycle to serve two important functions. First, this will create some Biocolloids (Copepods, zooplankton, diatoms and bloodworms, etc.). Second, FRB will support pond zooplankton and act to provide supplemental nutrition to the shrimp.
- Once shrimp reach 40-50 g (around 180 days of culture), the crop should be partially harvested to ensure that stocking densities do not become excessive.

COMMERCIALLY AVAILABLE SYNBIOTICS



STEPS INVOLVED IN FERMENTATION OF RICEBRAN

- 100 kg of grounded rice bran per 1,000 sqm.
- 20 kg of NaHCO3
- 160 gram of Red Cap Conc. synbiotics OR 500 ml of Bactipost Plus Conc.
- 400 liter of pond water.

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CULTURING & SEDIMENTING:

- The sedimentation pond should be deeper (up to 4 m in the center and 2 m on the edges) than the grow-out pond to allow sediment accumulation. In it, bottom-dwelling fish species – such as catfish or milkfish, depending on the water salinity – should be stocked at low densities.
- Their feeding on and stirring up the detritus help clean the pond system and the fish can provide food for farmworkers. The sediments from the grow-out pond encourage the production of worms and other benthic invertebrates (benthos) that the fish can consume.
- Meanwhile, if ropes or lines are present, these are frequently and strongly colonized by horse mussels. Further, it is helpful to filtering the pond water and removing suspended solids, but can later be crushed and fed to the shrimp during production. After the sedimentation pond, the water overflows to another pond to increase the retention time and act as a biofilter.
- Fish like tilapia can be added at low densities. From here, water overflows back to the grow-out pond with little nitrogenous waste. Every three years, the sedimentation should be cleaned. Currently, the ratio of these ponds is 1:1 (treatment togrow-out ponds), which obviously requires relatively large areas of land in relation to production.

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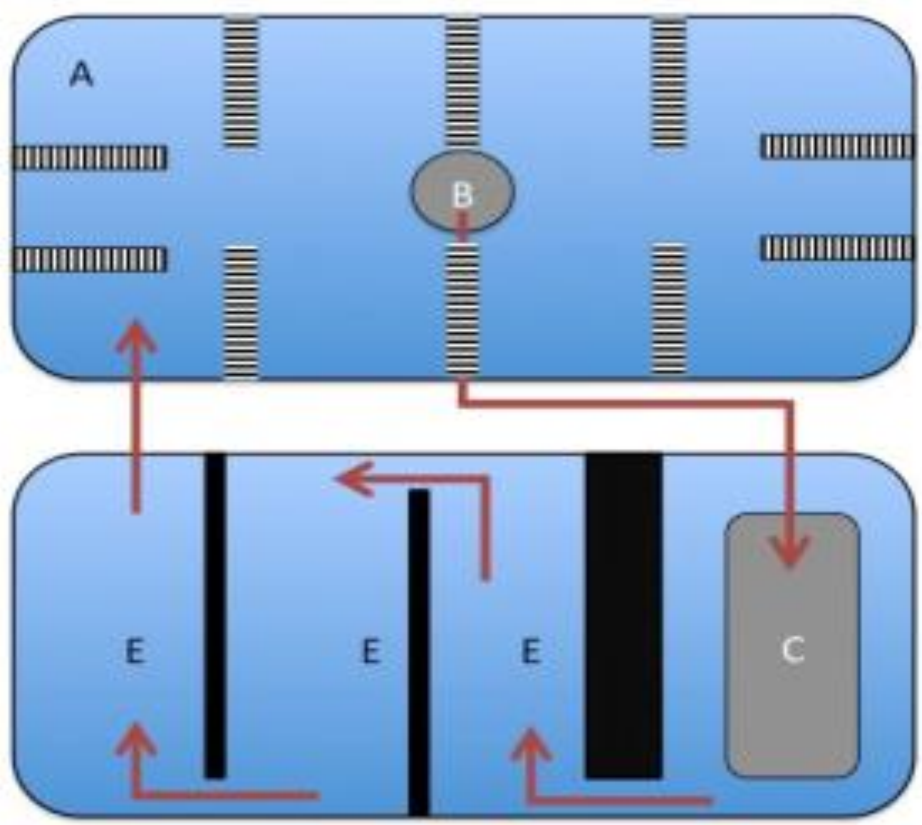

(A) grow-out pond with eight long-arm paddlewheels (3-hp at 85 rpm) arranged to promote water circulation around the pond for solids to concentrate in the center. (B) sump (13-m diameter and 2-m deep) is lined.(C) sedimentation pond (4-m deep in the center) containing milkfish or catfish, and with water overflowing.(E), biofilter pond containing tilapia.

HARVESTING & REUSING:

After harvesting the shrimps or prawns, the pond bottom reportedly has no smells, black soils or accumulated sediments, and the pond will therefore oftenready to be prepared for the next production cycle by the addition of fermented bran and probiotics, as mentioned earlier.

PERSPECTIVES

- Commercial production is already underway in some parts of Thailand, Vietnam, Ecuador, and India. This protocol can be particularly attractive for new or resource-poor farmers not able to invest in expensive aquafeeds.
- Shrimp produced using fermented rice bran or soybean are redder in colour when cooked, likely from the consumption of natural foods that contain pigments.
- This would be beneficial in terms of marketing, while the consumption of zooplankton would also likely increase healthier fatty acids for human consumers.
- There is also a push to market shrimp produced by Aquamimicry as organic. However, such a distinction is prevented because most commercially available soybeans are genetically modified organisms. Although other protein sources should also be investigated, Aquamimicry-produced shrimp could be advertised as “sustainably farmed” to appeal to more conscientious buyers.

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- In addition, it would be particularly helpful for governments to encourage farmers to adopt Aquamimicry system, such as providing incentives and promoting these products to consumers.

CONCLUSION

- We need an ecological approach in the shrimp culture technology or in other words eco-friendly shrimp culture (environmentally friendly) with waste utilization as optimal as possible.The use of ideas inspired by nature for solving the problems faced by humanity and thereby mimicking the natural environment to boost productivity in shrimp farming has shown encouraging results among the practitioners in Southeast Asia.
- This technology, though in its nascent stages will definitely prove worthwhile in the era of sustainable shrimp farming and aquamimicry will soon replace bioflocs in intensive farming systems too where it can be utilized for getting maximum output without jeopardizing the natural regenerative capacity of the soil fertility.

HIGHLIGHT POINTS

- This system can partially/ totally negate the use of commercial feed in the culture which accounts for ~60-70% of the production cost.
- There is no need to provide aeration in the system unlike biofloc.
- Aquamimicry based shrimp farming can keep the shrimps healthy, the diseases at bay and pave way for sustainable shrimp farming.
- Minimizing water exchanges and eliminating disease-causing pathogens.
- Aquamimicry is an eco-friendly shrimp culture (environmentally friendly)

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Management of sugarcane diseases

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Lalita Lakhran and Meera Choudhary
Ph.D Scholar, Plant Pathology, S.K.N.College of Agriculture, Jobner (Jaipur) Raj.303329

(1) RED ROT OF SUGARCANE

First reported by Went in 1893 from Java (Indonesia) who named it as "Hed Root Snot" (Red smut). In India, 1streported by Barber (1901) in cultivar "Red Mauritius" from the Godavari Delta of Andhra Pradesh. E.J. Butler (1906) conducted extensive studies and renamed as Red Rot. It caused epidemic in 1939 & 1942 in northern India [UP & Bihar.] It is a disease of "International Importance".

SYMPTOMS- Loss of color & drooping of 3rd or 4th leaves from top are the earliest symptoms. Later on, canes become shriveled; the rind shrinks and longitudinally wrinkled. If the diseased canes are splited & opened longitudinally, the pith looks red colored. Characteristic "bands of clear white areas" are seen running transversely across the full breadth of the reddened pith. Grayish or white mycelium fills the cavities in the pith. Black colored boat shaped fruiting bodies (i.e. acervuli) appear near the nodes in the sunken areas. The juice gives bad smell(due to alcohol) & does not set well on boiling (during *Gur* making) due to conversion of sucrose into glucose and alcohol as a result of enzymatic action of the pathogen. The protoplasm of host changes its color & a gummy dark-red material oozes out filling the intercellular spaces of the cells..

PATHOGEN: - ***Colletotrichum falcatum*****.** It belongs to Mitosporic fungi (deuteromycetes). It produces black boat shaped acervuli. Its perfect stage or teleomorphic stage is *Glomerella tucumanensis*. Conidia are falcate (i.e.sickle shaped).

DISEASE CYCLE: - The pathogen is soil & sett-borne(seed canes) in nature. The fungus survives through chlamydospores, conidia,acervuli & mycelium in diseased plant. Primary infection caused by mycelium, surviving in the diseased setts and by chlamydospores in the soil. Secondary Infection through Conidia produced in the acervuli developed after primary infection serve as the source of secondary infection..High humidity, Water logged conditions, Lack of proper cultural operations and Monocropping favor disease.

MANAGEMENT- As the pathogen is soil & sett-borne. Use healthy planting material (i.e.disease free setts). Follow crop rotation. Uproot & destroy diseased plants. Maintain field sanitation. Avoid ratooning. Avoid cultivation in low lying areas (to save from water logging). Avoid mono-cropping (same var. should not be repeated year after year).Follow repeated deep ploughing . Include green manuring in crop rotation. Treat the setts in moist hot air at 54 ^{0}C for 2hrs. Treat the setts with benomyl or Agallol or Aretan (0.25 %) for 5 to 10 min. (dipping method). Dipping seed setts in 0.5% carbendazim solution for one hour has also been found effective. Grow resistant var.likeCO449, CO 527, CO 658, CO349, Bo-91,99 etc. Use bio-control agents like- *Pseudomonas fluorescens* or *Trichoderma* sp. Or *Chaetomium* sp. as sett as well as soil application.

(2) WHIP SMUT OF SUGARCANE

It is also called "Smut of Sugarcane". It is called as whip smut (whip tail),because of the whip like smutted stalk. From India, the disease was first reported by Butler in 1906. The pathogen is true culmicolous (stem infecting) smut.

SYMPTOMS:- The most conspicuous symptom is the production of a long, smutted whip like structure from the apex of the attacked stalk. The whips start emerging after2-4 months of age but the peak whip growth occurs at 6th or

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7thmonth. Whip is a curved, pencil-thick growth of gray to black color; covered by a silvery-white, papery membrane. The whip can vary in length from a few inches to several feet long. It contains black teliospores, which are dispersed by wind after rupture of the covering membrane. Affected plants have slender, thin, taller canes than the rest of the crop.

CAUSAL ORGANISM: - *Ustilago scitaminea* (Now known as *Sporisorium scitamineum*). Mycelium is septate & dikaryotic.

DISEASE CYCLE: The pathogen is soil and sett-borne. It survives through mycelium in setts & as spores in soil.It also survives on collateral host- '*Kans'* (*Saccharum spontaneum*). Primary infection By teliospores/smut spores survive in soil. Secondary infection by smut spores / teliospores blown –off from smutted whips & cause sec. infection on healthy plants. Temperature ranging between 25-30^{0}C. 200% RH, favor disease.

MANAGEMENT- As the pathogen is soil . Remove smutted whips from the field carefully. Use of disease free seed pieces. Avoid ratooning (Particularly with susceptible var.). Burning of the infected field after harvest. Apply moist hot air treatment at 54^{0}C for 2hrs.(or Hot water tree at 55-60 ^{0}C for 10min. Dip the setts in 0.25% solution of Agallol or Aretan or 0.8% Bordeaux mixture for 5minutes. Other effective fungicides for sett treatment are Benlate or carbendazim or Vitavax (@5 g/lit) or mancozeb (0.3%). Dip setts in 0.1% solution of tridemorph fungicide for 4 hrs. Grow resistant var. like–CO-449, CO-6806, BO 11,22,24, CO LK8001, 8004.

[3] GRASSY SHOOT DISEASE *(GSD)* OF SUGARCANE

It also known as- New chlorotic disease, Albino disease, Yellowing disease , Bunchy disease and Leaf tuft disease of sugarcane. It is a phytoplasmal (MLO) disease. Phytoplasma is a "*Wall-Less Prokaryotes*. It shows main symptoms like "profuse tillering & grassy appearance of the shoots"that's why it is called Grassy shoot disease (GSD). Leaves are narrow, small; canes are thin with short internodes, giving a bunchy or grassy appearance. The leaves appear yellowish & in some cases may be entirely devoid of any pigment (i.e.white leaf so called albinism or albino disease).

PATHOGEN: Phytoplasma (Earlier known as MLO).

VECTOR /TRANSMITTER: It is transmitted by aphids and dodder (*Amar bel*). (i) *Aphis maydis* (*Rhopalosiphum maydis*). (ii) *Aphis sacchari* (*Melanaphis sacchari*). It survives through diseased canes /ratoons. It also survives on its natural host like sorghum. Aphids transmit it from sugarcane to sorghum & sorghum to sugarcane. Infection caused by phytoplasmal cells.

MANAGEMENT:- Always use disease free setts. At early stage, remove & destroy diseased plants. Give moist hot air treatment to the setts at 54^{0}C for 2hrs. or Hot water treatment at 50^{0}C for 2hrs. Spray insecticide to control aphids. Spray Malathion (0.1%). Spray tetracycline antibiotic (250-300 ppm). Grow resistant var. like CO-449.

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Overview of Krishi Vigyan Kendra, Samastipur

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Bipul Kumar[*] & Dibyanshu Shekhar[**].
[*]Research Schollar, Department of Extension Education & [**]Head, KVK Darbhanga, DRPCAU, Pusa, Samastipur

INTRODUCTION: Krishi Vigyan Kendra, Birauli, Samastipur is recipient of ICAR Best KVK Award-2013. KVK, Samastipur is located in Pusa block of Samastipur district at latitude of 25.98^{oN} and longitude of 85.67^{oE} having elevation of 52.0m from mean sea level. The KVK is situated at Birauli, which is 8 km away from the University headquarters and 15 km from the Samastipur district town. The soil of KVK farm area is predominantly young alluvium and it is calcareous in nature. Soils are deep, light to heavy in texture having $CaCO_3$ more than 10%. Water holding capacity varies from moderate to high. Most of the cultivable land of the farm soil belongs to classes I-III, of which some pockets are problematic due to salinity and production. Vegetable crops like capsicum & tomato are also grown under poly house condition for demonstration as well as production. Mango, litchi, guava, *aonla* and lemon are extensively cultivated in the farm. About 7.5 % of total area is under deep water having appreciable water level in this area throughout the year. Presently, the KVK having 6 scientific and 07 technical and supporting staff strength.

Mandate of KVK

To fulfil the mandates and based on identified thrust areas, the Kendra has undertaken the following activities:

- On farm testing to identify the location specificity of agricultural technologies under various farming system.
- Front line demonstration to establish the production potentials on the farmers' field.
- Training of farmers to update their knowledge and skill in modern agricultural technologies and training of extension personnel to orient them in the frontier areas of technology development.
- To work as resource and knowledge centre of agricultural technology for supporting initiatives of public, private and voluntary sectors for improving the agricultural economy of the district.

Thrust Areas

Based on these mandates and considering the socio-agro-economic status of the district, following thrust areas have been identified:

- Quality seed production
- Improvement of soil fertility
- Sustainable income resources for farming community
- Farm mechanization
- Integrated Farming System

Key activities of KVK Birauli (Samastipur)

Based on the PRA, interaction with farmers, farmers representatives, R&D agencies, input-output suppliers and agro-climatic condition of the district and socio-economic-psychological strata of the farming community, the KVK has prepared a holistic approach for betterment of farming community of the district.

Innovative approaches	Entrepreneurship development
I. Organic Village Concept	➢ Mushroom Production
II. Sustainable Production Consumption System	➢ Vermicomposting ➢ Biogas Production
III. Farm Implement Bank (Custom Hiring Centre)	➢ Beekeeping ➢ Dairy
IV. Self-sustaining Mushroom Resource	➢ Poultry Production

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Centre V. Innovative Approaches for Enhancing Seed Replacement rate ○ Seed Village Concept ○ Farmers Participatory Seed Production ○ Seed Replacement Through Farmer To Farmer Basis VI. Multi-tier Vegetable production VII. Integrated Farming System VIII. High Density Orchard Programme IX. Intercropping in Ochards X. Development of Weaning Food XI. Popularization of SRI XII. Popularization of Hi-tech Horticulture XIII. Sustainable Livelihood Security	➢ Tailoring & Stitching ➢ Medicinal & Aromatic Plants Production ➢ Maintenance and Manufacturing of Equipment's/ Implements ➢ Gardening ➢ Post Harvest Management & Value Addition ➢ Protected Cultivation ➢ Flower Production ➢ Vegetable Production ➢ Spices Production

Technology dissemination mechanism	**Technological interventions**
➢ Community Radio Station ➢ Krishak Samachar/Patrika ➢ Master Trainer ➢ Scientist– Farmers Interface Meet ➢ Farm Visits ➢ Cluster Development ➢ Model Agricultural Villages (Mushroom, Organic, Seed, Multi-Tier Vegetable Production ➢ Production- Consumption Chain ➢ Farmers participatory programmes ➢ Para Extension Worker ➢ Instruction cum demonstration Unit ➢ Leaflet–pumplet ➢ Awareness Camps	➢ Inter Cropping in cereals ➢ Inter Cropping In Orchards ➢ High Density Orchards ➢ Integrated Farming ➢ Multi-tier Vegetable production ➢ Inter Cropping In Sugarcane ➢ Low Cost Vermicomposting ➢ Protected Cultivation ➢ IPM ➢ INM ➢ Organic Farming ➢ Natural Resource Management ➢ Micro Irrigation
Diversification of agriculture	**Women empowerment programmes**
➢ Mushroom Production ➢ Floriculture ➢ Spices ➢ Horticulture ➢ Medicinal plant ➢ Poultry ➢ Goatry ➢ Dairy ➢ Beekeeping	➢ Mushroom Production ➢ Vermicomposting ➢ Knitting ➢ Textile Designing ➢ Food Processing ➢ Candle Making ➢ Soft toys making ➢ Mithila painting

Priority thrust area

- Promotion of seed village programme to ensure availability of quality seed at local level and reasonable price.
- Promotion of new improved cultivar of different crops in place of traditional varieties.
- To promote location specified nutrient management specially in vegetable farming
- Promotion of IPM for sustainable agriculture.
- Development and promotion of Agri based enterprises such as apiculture, vermicompost and nursery management, poultry, integrated farming system etc.
- Promotion of organic fertilizers (vermicompost, NADEP compost, green manuring, brawn manuring etc.).
- Promotion of horticultural crops especially high density planting of mango, guava, litchi and pomegranate etc. and intercropping in orchards.

Infrastructure and Facilities:

The KVK possesses quality infrastructure facilities for training and demonstration of farmers like well-furnished Kisan Hostel, Spawn Culture Unit, Seed Production Unit, Women Training Room, Exhibition Room, Threshing Floor, Instructional Orchard (HDP), Community Radio Station, e-Linkage Facilities, Poly House, Vermicompost Unit, Bio Gas Plant, Fruit & Vegetable Nursery, Farm Machinery Bank for custom hiring of farmers, Self Sustaining Mushroom Resource Centre, Integrated Farming System Model, Children Park, Nursery Hut Cum Sale Counter, Library Cum Reading Room, Zero Energy Cool Chamber, HDPE Vermicompost Unit, NADEP Compost Unit, Surface Method Vermicompost Unit, Implement Shed, Poultry Unit, Duckery Unit, Pigeon Unit, Goatry Unit, In Situ Vermicompost Unit, Azolla Unit, and Training Hall with Smart Board.

Instructional Farm cum Demonstration Units Established At KVK, Birauli

KVK has a model farm which has been developed on IFS pattern with a number of demonstration units established over a period of time. Brief description of farm and demo units is as follows.

Geographical Distribution of Land (KVK, Birauli) (in ha)

Under building	1.5
Under crop	13.0
Orchard	32.2
Agro-forestry	4.0
Deep water body	8.8
Forest area	13.6
Under demo unit	2.0
Tank (4 No.)	1.3
Others (Bund, Road, Channels)	7.4
Total	**83.8**

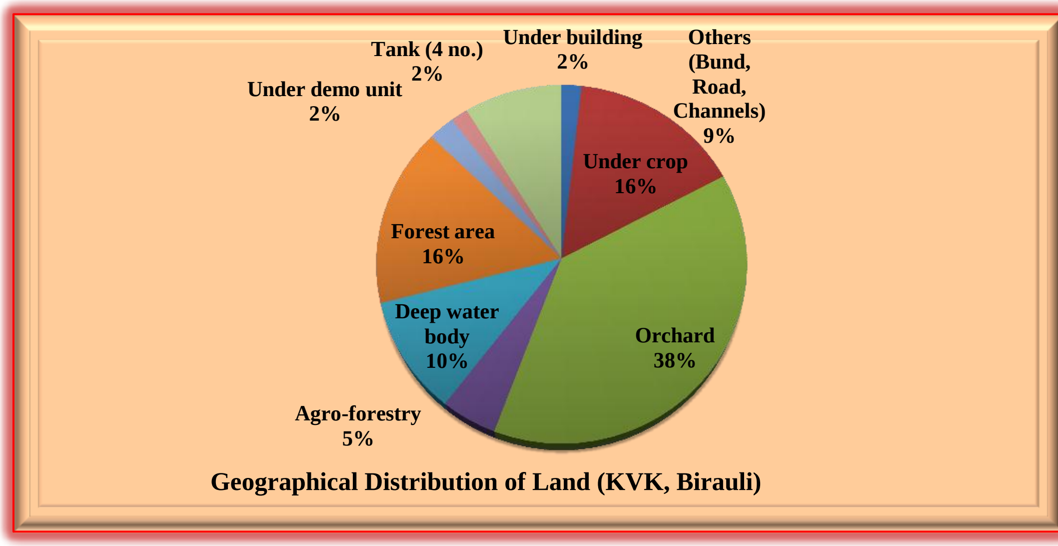

Fig. 1 : Geographical Distribution of Land (KVK, Birauli)

CONCLUSION: The KVK, Samastipur was established in 2004 in 50 Acres of land at Birauli. The KVK, Samastipur has under taken many interventions like training, OFT, FLD and other capacity building programmes to enhance the well-being of farmers through enhancing agriculture production, productivity and profitability.

Acknowledgement: Head, KVK, Birauli. The present information gathered from KVK during my Master Research entitled "Activities of Krishi Vigyan Kendra in Samastipur District of Bihar"

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Biology of lepidopterous stem borers in maize and their management

Article id: 23482

Sucharu Singh
Ph.D. Scholar, Department of Entomology, CSA University of Agriculture and Technology, Kanpur-208002 (U.P.).

INTRODUCTION: Maize (*Zea mays* L.) is an important cereal crop widely grown for food and also as livestock feed. Maize ranks with wheat and rice as one of the world's chief grain crop. Several constraints and reasons are responsible for low yield of maize, but the yield-losses due to insect-pests are the most important factor causing 24 to 83% reduction in its farm production. There are various economical insect-pests, which attack on maize at its different crop growth stages, but the lepidopterous stem borer complex including pink stem borer, (*Sesamia inferens* Walker)*,*spotted stem borer (*Chilo partellus* Swinhoe) and recently invaded fall army worm (*Spodoptera frugiperda* J.E. Smith) are the noxious ones. Yield losses in India caused by pink stem borer, spotted stem borer, and fall army worm ranged between 25.7-78.9%, 26.7-80.4% and 33%, respectively.

List of maize lepidopterous stem borers

1. Pink stem borer (Lepidoptera:Noctuidae)

Biology:-

Eggs: Adult moth lay 120 - 348 eggs under leaf sheath. Eggs always laid in clusters in several rows within the cover of the leaf sheath. The eggs is creamy white in colour and semi-globular, being flattened on the dorsal surface. The larvae hatch out in about a week.

Larva: The neonate larvae are dorsally pink to purplish pink in colour, lighter on the ventral side, smooth and cylindrical with a reddish-brown head is popularly known as the pink stem borer. The total larval period of about 23 to 39 days.

Pupa: Pupation took place inside the stem or in between the stem and leaves. Pupation took place inside the stem or in between the stem and leaves.

Adult: Moths were straw coloured with a mid-longitudinal dark brown broad triangular streak. The male moth was slightly smaller than the female. The adult female live for 6 to 8 days while the males are about 4 to 6 days. It completes life cycle in 35 - 57 days.

2. Spotted stem borer (Lepidoptera: Crambidae)

Biology:-

Eggs: laid in batches of 10-80 on the upperside and underside of leaf surfaces, usually close to the midrib. They are Flat and oval and look creamy white. They hatch after 4–10 days.

Larva: creamy white to yellowish brown in colour. These larvae also have four purple-brown longitudinal stripes and are usually found with characteristically dark brown spots along the back, therefore giving off a spotted appearance. It has a plate on the dorsal surface of the thorax which is known as a prothoracic shield and is reddish brown to dark brown and shiny.

Pupa: The pupae of *C. partellus* are light yellow brown to dark red brown.

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Adult: small moths with wing lengths ranging from 7–17 mm and a wingspan of 20–25 mm. The forewings of adults are brown yellowish with darker scale patterns forming longitudinal stripes. The hind wings of males are a pale straw colour and in females the hindwings are white. The whole life cycle takes about 3–4 weeks.

3. Fall army worm (Lepidoptera:Noctuidae)

Biology:-

Eggs: laid 1000 eggs in clusters, covered with hairs on upper surface of the maize leaf, base of the plant and also in whorls. Eggs were dorso- ventrally flattened. Incubation period ranged from 2-3 days.

Larva: First instar larvae were light greenish colour with black head. The mature larvae were marked with whitish inverted 'Y' on the head with distinct black spots on the body. The four black spots on the 8th abdominal segment .

Pupa: reddish brown in colour with cremaster. Pupal period of about 9 to 12 days

Adult: forewings of male is shaded with gray and brown, with triangular white patch at the apical region and circular spot at the center of the wing. The forewings of female are uniform grayish brown to a fine mottling of gray and brown. The hind wing is silver- white with a narrow dark border in both male and female. Life cycle of FAW is 32 to 46 days.

Management strategies

Cultural Measures

1. Intercropping of maize with suitable pulse crops of particular region. (e.g. Maize + pigeon pea/black gram /green gram).
2. Erection of bird perches @ 10/acre during early stage of the crop (up to 30 days).
3. Sowing of 3-4 rows of trap crops (e.g. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows symptom of FAW damage.

Mechanical control:

1. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosine water.
2. Application of dry sand in to the whorl of affected maize plants soon after observation of FAW incidence in the field.
3. Application of Sand + lime in 9:1 ration in whorls in first thirty days of sowing.

Bio Control:

1. Augmentative release of egg parasitoid *Trichogramma pretiosum* or *Telenomus remus* @ 50,000 per acre at weekly intervals or based on trap catch of 3 moths/trap.
2. Bio-pesticides: If infestation level is at 5% damage in seedling to early whorl stage and 10% ear damage, then use entomopathogenic fungi and bacteria *Metarhizium anisopliae,Metarhizium rileyi (Nomuraea rileyi),Beauveria bassiana,Verticilium lecani*(1×10^{8}cfu/g) @ 5g/litre whorl application. Repeat after 10 days if required then use *Bacillus thuringiensis* v. *kurstaki* formulations @ 2g/l (or) 400g/acre respectively.

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Chemical Control:

1. **Seed treatment:** Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml/kg of seed will be effective for 15-20 days.
2. **Seedling to early whorl stage:** To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE / Azadirachtin 1500ppm @ 5ml/l of water.
3. **Mid whorl to late whorl stage:** To manage 2nd and 3rd instars larvae having more than 10% foliar damage the following chemicals may be used upto early tasselling stage: Spinetoram 11.7% SC or Chlorantraniliprole 18.5% SC or Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC.
4. **Poison baiting:** Poison baiting is recommended for late instar larvae. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 litres of water for 24 hours to ferment. Add 100g Thiodicarb just half an hour before application in the field. The bait should be applied into the whorl of the plants.
5. **8 weeks after emergence to tasseling and post tasseling:**

Bio- pesticides as recommended above to be applied. Hand picking of the larvae is advisable. All the sprays should be directed towards whorl and either in the early hours of the day or in the evening time.

CONCLUSION

A pest is any living organism that is invasive or troublesome to crops, animals, human beings and livestock. We should know about the biology of pest before applying management practices. The lack of information on the dynamics of pest would affect the prediction of the population in other parts. Therefore pest populations must be kept below the economic injury level where economic damages occur. Management does not imply pest eradication. It implies finding efficient and cost effective tactics that minimize environmental damage.

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Potential of Neem tree in Pest Management

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A. Vasudha[*1], M. Sreedhar[2] and Sushil Kumar[2]
1. Department of Entomology, Agrl. College & Res. Instt, Tamil Nadu Agriculture University, Coimbatore-641003 (Tamil Nadu).
2. Department of Entomology, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145 (Uttarakhand).

The neem tree (*Azadirachta indica*) is native to Southeast Asia and India where it is a fast growing ornamental shade tree it's almost year round shade, and its multiple wood and non-wood products. Neem is also called '*arista*' in sanskrit- a word that means 'perfect, complete and imperishable'. Neem products are used as insecticide, pesticide, fumigant, fertilizer, manure, urea coating agent, soil conditioner and compost. The seeds, bark and leaves contain compounds with proven antiseptic, antiviral, antipyretic, anti-inflammatory, anti-ulcer and antifungal uses. The neem tree can provide an inexpensive integrated pest management (IPM) resource for farmers, the raw material for small rural enterprises, or the development of neem-based industries.

Applications of Neem

Neem has anti-bacterial, anti-fungal and anti-nematicidal properties and positive effect in combating several diseases. Neem leaves are used as green leaf manure and also in preparation of litter compost. Neem leaves are also used in storage of grains. Neem (leaf and seed) extracts have been found to have insecticidal properties and used as foliar spray. Neem oil is extracted from the seeds of the neem tree and has insecticidal and medicinal properties due to which it has been used in pest control. Neem seed cake (residue of neem seeds after oil extraction) when used for soil amendment or added to soil, not only enriches the soil with organic matter but also lowers nitrogen losses by inhibiting nitrification. It also works as a nematicide. Neem bark and roots also have medicinal properties. Bark & roots in powdered form are also used to control fleas & sucking pests.

Properties

Neem pesticides play a vital role in pest management and hence have been widely used in agriculture. Substances with pesticidal properties are found in all parts of the neem tree. However, the greatest concentrations of these substances are found in the seed. Azadirachtin, the active ingredient in many pesticides currently available, is extracted from the seed kernels. Azadirachtin consists of more than 25 different but closely related compounds. Azadirachtin acts as an insect repellent and insect feeding inhibitor, thereby protecting the plants. This ingredient belongs to an organic molecule class called tetranortriterpenoids. It is similar in structure to insect hormones called "ecdysones," which control the process of metamorphosis as the insects pass from larva to pupa to adultstage.

Mechanisms of Action

Neem acts as a biopesticide at different levels and in various ways. Primarily it acts as antifeedant *ie*.,when an insect larva is hungry and it wants to feed on the leaf but if the leaf is treated with neem product, because of the presence of azadirachtin, salanin and melandriol there is an anti peristalitic wave in the alimentary canal and this produces something similar to vomiting sensation in the insect. Because of this sensation the insect does not feed on the neem treated surface and ability to swallow is also blocked. Secondly it acts as oviposition deterrent *ie*., by not allowing the female to deposits eggs comes in very handy when the seeds in storage are coated with neem kernel powder and/or neem oil. It reduces the level of the insect hormone ecdysone by disrupting the insect's molting process so that the immature larvae cannot develop into adults. Some soft-skinned insect larvae may be killed by direct contact with the spray. Neem oil works in a number of different ways. The oil forms a coating on the insect's body, blocking the breathing openings and suffocating the insect. It also has a repellent effect on certain insects and mites. Neem oil prevents the germination and penetration of some fungal spores. Neem-based formulations do not usually kill insects directly, but they can alter their behavior in significant ways to reduce pest damage to crops, and reduce their reproductive potential.

Benefits of Neem

Neem does not persist in the environment and is degraded by ultraviolet light and rainfall. Many neem-products tend to have low mammalian toxicity. Because many neem products degrade quickly, they may have less of an effect on non-target beneficial organisms compared to some of the more traditional pesticides. As mentioned previously, azadirachtin has a number of different modes of action. It is less likely that insects or pathogens will develop resistance to neem products compared to materials with a single mode of action. It also helps to nourish and condition the soil, it is environmental friendly, it is nontoxic and it can be used in combination with other pesticide and oil for more effectiveness.

Limitations of Neem

Botanical pesticides, such as neem, have limited persistence in the environment. Temperature, ultraviolet light, rainfall and other environmental factors can degrade neem. Repeated applications may be needed to achieve the desired result. Because it is an insect growth regulator, it is only effective against the immature stages of insects. Rescue treatments will not be effective. Researchers found few effects on many insect predators including spiders, earwigs, and ants but flower fly larvae are very sensitive to neem sprays. Phytotoxicity (damage to plants) may be of concern for certain formulations of neem-based products with flowers being particularly sensitive. Newly transplanted plants with limited root development or plants that are wilted or under stress should not be treated.

CONCLUSION

The neem tree can provide an inexpensive integrated pest management (IPM) resource for farmers, the raw material for small rural enterprises, or the development of neem-based industries. More research is also needed on the other bioactive compounds found in neem and on how they interact to repel or deter insect predators. Some of these also have shown anti-fungal and anti-viral properties. Farmers need better methods for preparing neem extracts to ensure uniform concentrations and quality. They also need better information about how to apply the extracts to maximum effect on different insect species at different life cycle stages. Long-term environmental impacts of the use of neem-based products should be monitored and assessed.

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Glowing skin with home ingredent

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Neetu Kumari
M.Sc. student (Department of FRM)
Dr. Rajendra Prasad Central Agriculture University, Pusa, Samastipur, Bihar 848125

Glowing skin is usually free from any kind of skin problems such as acne, blemishes, blackheads, whiteheads, etc. Women usually try out various home remedies to get glowing skin instantly. The natural remedies for glowing skin tend to make the skin soft, supple, healthy as well as youthful too. The environment around us is becoming polluted day by day which has an intense effect on our skin also. There are various harmful factors which damage the glowing skin in our daily lives. The most common harmful factors include pollution, stress, harmful UV rays, smoking, lack of nutrition and lack of physical activities.
Moreover, there are certain artificial cosmetic products available in the market which promise to provide glowing skin but are harmful to the skin. But the glowing skin secret home remedies are known to have long-lasting effects on the skin and are extremely beneficial for the health of the skin. On the one hand, the harmful cosmetic products make the skin more rough and unhealthy; on the other hand, the home remedies for glowing skin tend to make it look healthy and beautiful.

- **Aloe Vera For Glowing Skin:**

Aloe Vera is considered to be one of the best home remedies for fair skin and glowing skin. It is also very easy for applying aloe Vera on the skin. The leaves of this plant can be applied directly on the skin or it can also be used in the form of a gel which is found easily in the market. It helps in hydrating the skin and rejuvenating it. It acts as a natural moisturizer for the skin. And it prevents acne and wrinkles too.

- ***Turmeric Benefits For Glowing Skin*:**

Turmeric is a very healthy spice which is known to have a lot of healing properties for the benefit of the skin. It is also considered to be one of the best home remedies for glowing skin for oily skin. This spice is very rich in antioxidants because of which it makes the skin glow naturally. It is one of the best home tips for glowing skin. It can also be used as an excellent exfoliator for the face. Its anti-inflammatory properties help in fighting off acne, pimples, dry skin, etc. It helps to even out skin tone and reduces pigmentation and wrinkles.

- ***Use Of Egg White For Glowing Skin:***

Egg whites are considered to be the best homemade tips for fair skin. They are natural skin softeners and natural moisturizers which make the skin glow and look beautiful. These home remedies for fair glowing skin are very much affordable and can be bought easily from the market. They also help in the removal of fine lines and wrinkles from the skin. They help in making the skin look fair, lustrous as well as soft.

- **Coconut Oil Is A Natural Remedy:**

Coconut oil comes with antibacterial, antifungal properties. It is one of the best natural home remedies for glowing skin. This oil can also be used as a natural face moisturizer. It helps in nourishing and hydrating the

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skin as well as the body. Coconut oil also has soothing properties which help in treating other skin problems such as dry skin, eczema, etc.

- **Lemon Juice For Glowing Skin:**

Lemon is known as one of the best natural remedies for glowing skin. It helps in the promotion of clear and glowing skin. Lemon consists of citric acid which helps in removing the dead skin cells off the skin. It also helps in the removal of dark spots and other blemishes from the skin. The bleaching properties present in lemon help in improvising the overall complexion of the skin.

- **Honey With Banana Paste:**

The beauty experts provide tips for healthy glowing skin at home, they recommend the name of honey. Honey is an excellent antioxidant, and it has healing properties too. It also helps in fighting acne as it has antiseptic properties. Honey also helps in retaining the lost moisture of the skin thereby giving a beautiful glow on the face. It can also be used for healing dry as well as itchy skin. Honey is also helpful in keeping the oily skin free from acne or pimples.

- **Banana & Milk Mixture**:

Banana and milk are considered to be excellent home remedies for glowing skin and dry skin. It acts as a wonderful face moisturizer for dry skin. It helps in smoothening of the skin with its rich miniaturization and prevents wrinkles. Milk also helps in making the skin glow and become brighter than ever. When combined together, both banana and milk can work wonders on the skin.

- **Use Of Orange Peel For Skin:**

One of the most excellent tips for glowing skin homemade is through the use of orange peels. The orange peel also has the rich properties of Vitamin C which make the skin look bright as well as shiny too. The orange peel also has antimicrobial and antibacterial which also help in fighting acne as well as oily skin. It can be used as a skin lightening agent and helps in the removal of dark spots and pigmentation.

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Integrated Pest Management of *Spodoptera frugiperda*

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Chandresh B. Solanki, Birari Vaishali V., Manishkumar J. Joshi and Prithiv Raj V.
Ph.D. Scholar, Department of Entomology, S.D. Agricultural University, Sardarkrushinagar, Dantiwada, B. K., Gujarat (India) -385 506

INTRODUCTION

The Fall Armyworm (*Spodoptera frugiperda*), FAW, is an insect native to tropical and subtropical regions of the Americas. FAW larvae can feed on more than 80 plant species, including maize, rice, sorghum, millet, sugarcane, vegetable crops and cotton. FAW can cause significant yield losses if not well managed. It can have several generations per year and the moth can fly up to 100 km per night (FAO 2018). First reported from Africa in 2016 as an invasive alien pest (Goergen *et al*. 2016), In India Fall armyworm has been reported in mid-2018 in the form of pest alerts (ICAR-NBAIR 2018) primarily on maize.

Life Cycle

Egg: Eggs are pale green or white at the beginning, get covered in scales, and turn clear brown to brown before hatching. They hatch within 2-3 days. 100-200 eggs are generally laid on the underside of the leaves typically near the base of the plant, close to the junction of the leaf and the stem. These are covered in protective scales rubbed off from the moths abdomen after laying. When populations are high then the eggs may be laid higher up the plants or on nearby vegetation.

Larvae: There are 6 larvae stages. Young larvae are pale colored. They become brown to pale green, then turn darker at the latest stages. The larvae stages last 12 to 20 days. Half-grown or fully grown caterpillars are the easiest to identify. The larvae are generally characterized by 3 yellow stripes on the back, followed by a black, then a yellow stripe on the side. Look out for four dark spots forming a square on the second to last segment. Each spot has a short bristle (hair). The head is dark; it shows a typical upside down Y-shaped pale marking on the front.

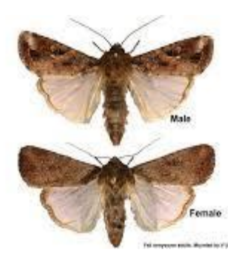
Pupa: The pupa is dark brown and hides in the soil, more rarely in the stalk. Pupa lives 12-14 days before an adult emerges.

Adult: The moth is 3 to 4 cm wide. Its front wings are dark brown while the rear wings are grey white. It will live 2 to 3 weeks before dying

Eggs

Larvae

Pupae



Adults

Nature of Damage

After hatching the young caterpillars feed superficially, usually on the undersides of leaves. Feeding results in semitransparent patches on the leaves called windows. Young caterpillars can spin silken threads which catch the wind and transport the caterpillars to a new plant. The leaf whorl is preferred in young plants, whereas the leaves around the cob silks are attractive in older plants. Feeding is more active during the night. Feeding on young plants can kill the growing point resulting in no new leaves or cobs developing. Often only 1 or 2 caterpillars found in each whorl, as they become cannibalistic when larger and will eat each other to reduce competition for food. Large quantities of frass present. When this dries it resembles sawdust. If the plant is older and has already developed cobs then the caterpillar will eat its way through the protective leaf bracts into the side of the cob where it begins to feed on the developing kernels.

Damage cob

Damage plant

Management

Cultural Control

Avoid late planting, and avoid staggered planting (i.e. planting of fields at different dates in the same area), as this would continue to provide the favoured food of FAW locally (i.e. young maize plants).

Push-pull technology

Push-pull is a habitat management strategy developed and implemented to manage pests such as stem borers, striga weed and address soil degradation, which are major constraints in maize production in Africa. The technology entails using a repellent intercrop (Desmodium as a “push”) and an attractive trap plant (Napier grass as a “pull”).

The Napier grass planted around the maize farm: attracts stemborers and FAW to lay eggs on it; but it does not allow larvae to develop on it due to poor nutrition; so very few larvae survive. At the same time, Desmodium, planted as an intercrop: emits volatiles that repels stem borers or FAW, and secretes root exudates that induces premature germination of striga seeds and kills the germinating striga; so this depletes seed banks of striga in maize farms over time; covers the ground surface between maize, thus smothering weeds enriches the soil with nitrogen, preserves soil moisture and protects the soil from erosion.

Mechanical control

Regularly visit the fields and crush egg masses and young larvae.

Some smallholder farmers in the Americas report using ash, sand, sawdust or dirt into whorls to control FAW larvae. Ash, sand and sawdust may desiccate young larvae.

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Biological control

The Fall Armyworm has many naturally-occurring 'natural enemies' or 'farmers' friends'. These biological control agents are organisms that feed on FAW.

Parasitoides

Egg : Telenomus remus Nixon (Hymenoptera: Platygastridae)
Trichogramma spp. (Hymenoptera: Trichogrammatidae)
Egg larval : Chelonus insularis Cresson (Hymenoptera: Braconidae)
Larval : Cotesia marginiventris Cresson (Hymenoptera: Braconidae)
Fly parasitoids: Archytas, Winthemia and Lespesia (Diptera: Tachinidae)

Predators

- Earwigs (Dermaptera: Forficulidae, Carcinophoridae) : Two species are currently recognized to play a significant role as FAW egg predator in maize crops: *Doru luteipes* (Scudder) and *Euborellia annulipes* (Lucas).
- Ladybird beetles (Coleoptera: Coccinellidae) : Both adults and larvae of ladybugs feed on various phytophagous insects such as mites, aphids, scales, mealybugs, eggs and young larvae of Lepidoptera including the Fall Armyworm.
- Ants (Hymenoptera: Formicidae) : Ants are often among the most important predators of FAW larvae and pupae.
- Birds and bats : Birds and bats Birds and bats have been observed to prey on FAW larvae.

Entomopathogens

- The Fall Armyworm is naturally affected by several different types of pathogens:
- Viruses, in particular Nuclear Polyhedrosis Virus (NPVs) such as the Spodoptera Frugiperda Multicapsid Nucleopolyhedrovirus (SfMNPV), Fungi, in particular *Metarhizium anisopliae*, *Metarhizium rileyi*, *Beauveria bassiana*, Bacteria, such as the *Bacillus thurigensis* (Bt), Nematodes and Protozoa

Chemical Control

- First Window (seedling to early whorl stage): To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE OR Azadirachtin 1500 ppm @ 5ml/ litre of water.
- Second window (mid whorl to late whorl stage): To manage 2nd and 3rd instars larvae at 10-20% damage spray Spinetoram 11.7% SC @ 0.5 ml/litre of water OR Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 0.25 ml/l of water OR Chlorantraniliprole18.5% SC @ 0.4 ml/litre of water.
- Poison baiting: Poison baiting is recommended for late instar larvae of second window. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 litres of water for 24 hours to ferment. Add 100g thiodicarb just half an hour before application in the field. The bait should be applied into the whorl of the plants.
- Third Window: Insecticide management is not cost effective at this stage. Hand picking of the larvae is advisable (Firake *et al*. 2019)

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Role of biotechnology in insect-pests management

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Manishkumar J. Joshi, Prithiv Raj V., Chandresh B. Solanki, Birari Vaishalikumari V.
Ph.D. Scholar, Department of Entomology, S.D. Agricultural University, Sardarkrushinagar, Dantiwada, B. K., Gujarat (India) -385 506

INTRODUCTION

The insects have been one of the biggest causes of damage in food production being these losses of the order of 20 to 30% of world production. It is estimated that approximately 67,000 species of insects cause damage to plantations and tropical regions, usually the poorest in the world, those who suffer most from the high incidence of insects-pests. The insecticides used in pest control are often of low selectivity, therefore can affect the population of natural enemies, favoring the proliferation of pests and even resurgence of others. Due to these factors, the search for alternatives that can minimize or even replace the conventional insecticides was intensified and, currently, the new tactics comprise a series of alternatives: resistant plants, selective insecticides, parasitoids and entomopathogenic microorganisms (*Bacillus thuringiensis*-Bt). An example of this is the use of gene technology (Cry) of bacteria (Bt) in control of the main pests of Lepidoptera. The Bt gene technology diffusion aims to make the environment more sustainable, pollution free, residue free and decreasing the concentration of inert products in foods using insecticides rationally. However, many challenges must still be overcome, with that biotechnology has as a fundamental role, seek new research, sustainable in modern agriculture.

Importance of biotechnology in the control of insect-pests

Biotechnology is the broad area of biology, involving living systems and organisms to develop or make products, or "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use". But, in the context of insect pest management can be defined as the controlled and deliberate manipulation of biological systems to achieve efficient insect pest control. Living organisms have evolved an enormous spectrum of biological capabilities and by choosing appropriate organisms with specific capability; it is possible to obtain meaningful control of such insect pest species. Biotechnology has considerable ability to provide sustainable biological elements of integrated pest management (IPM).

Agricultural biotechnology varieties are used as a tool for agricultural research characterized by gene transfer of agronomic interest (and, consequently, of desired characteristics) between a donor agency (which may be a plant, a bacterium, fungus, etc.) and plants, safely. Therefore, the emergence of modern biotechnology marks the beginning of a new stage for agriculture. The advances in the field of plant genetics have the effect of reducing the excessive dependence on agriculture mechanical and chemical innovations. In addition to increased productivity, modern biotechnology can contribute to the reduction of production costs, better quality foods and for the development of less aggressive to the environment.

Biotechnology and host-plant resistance

Plant resistance is the consequence of heritable plant qualities that result in a plant being relatively less damaged than a plant without these qualities. Insect-resistant crop varieties suppress insect pest

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population by increasing their damage tolerance level. The relationship between the insect and plant depends on three kind of resistance, e.g. antibiosis, antixenosis (non-preference), or tolerance. Antibiosis resistance affects the biology of the insect-pest to reduce its population and subsequent damage caused by same. It results in increased mortality or reduced longevity and reproduction of the insect. Antixenosis resistance affects the behavior of an insect-pest and is expressed as non-preference of the insect for a resistant plant. Tolerance is resistance in which a plant is able to withstand or recover from damage caused by insect-pest population.

During last 30 years, the major biochemical principles governing such resistance and involved genes have been identified for their directed use through biotechnological approaches, but most emphasis has been given to primary protein products of specific genes. For affording host-plant resistance, genes of primary interest are those whose protein product could be harmful to the normal growth and development of the target insect-pest based upon the mechanism of insecticidal action of the gene product. The first transgenic plant (tobacco) expressed a cowpea trypsin inhibitor gene (cpti- an insecticidal gene) and produced the inhibitor protein at 1.0% level to provide enhanced protection against the lepidopteran pest *Heliothis virescens* (Hilder et al., 1987). However, subsequently developed transgenic rice (Xu et al., 1996) and potato (Bell et al., 2001) plants with this gene failed to provide sustainable insect protection. In contrast, insecticidal *Cry* family genes from *Bacillus thuringiensis* expressing insecticidal Cry- proteins found more favour for transformation of tobacco and tomato plants (Barton et al., 1987).

Biotechnology over insecticide

Control of harmful insects is done, most of the time, by agrochemicals and, on a much smaller scale, by the employment of biological insecticides. The indiscriminate use of pesticides in combating the causal agents causes, despite its efficiency, environmental problems severe, human health, reduces number of natural enemies, and provides an accelerated selection of resistant insects. In contrast, biopesticides, Bt based, used for over a century, retainers of features less impactful on the environment and less harmful to humans ever occupied a prominent place on the market for the sale of pesticides.

CONCLUSION

The successful and wide-scale adoption of genetically modified biotech crops worldwide has established the potential of biotechnology in improved crop production. However, the emergence of insect resistance to Bt-cotton occasionally raised concerns on its limited resilience in relation to possible insect resistance development. The future of GM crops however, depending upon the search for new genes, which, by acting differently, could afford similar or supplemented resistance in transgenic plants and has resulted in the identification of a number of genes from diverse sources. Many of these when evaluated have shown significant potential for exploitation in crop protection. Thus, future trends and prospects for biotechnological applications to mediate crop protection against insects include strategies employing stacked genes, modified Bt-toxins, spider/scorpion venom peptides, vegetative insecticidal proteins, lectins, endogenous resistance mechanisms as well as novel approaches. However, while exploiting such strategies, the benefits and risks associated with the adoption of GM insect-resistant crops especially for developing countries and resource-poor small holder farmers need to be kept in mind. Currently, most attention is being focused on vital genes and metabolic pathways that are inherent to the insect pest and host-plant biology. The host–

pest relationship being a complex phenomenon, the identification of such genes and the specific role of their function in this complex metabolism has always remained an unwieldy task.

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Diamond back moth pest of cruciferous crops

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Chaudhari, S. J.*, Chaudhari, N. S. & Rabari, P. H.
Department of Entomology, C. P. College of Agriculture,
Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar

INTRODUCTION

The diamondback moth (DBM), *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) is the most destructive insect pest of cruciferous plants throughout the world (Talekar and Shelton, 1993). The diamondback moth, *P. xylostella* was first recorded on cruciferous vegetable in 1914 (Fletcher, 1914). The pest was first recorded from South America in 1890 and then from Venezuela in 1939 (Saravaiya and Patel, 2005). Now the pest has been noticed all over India infesting plants belong to the Brassicaceae. The production of the brassicadous crops is severely affected by DBM and the different host within this group greatly influence the survival and reproduction of *P. xylostella* (Wakisaka *et al*, 1992).

Nature of Damage:

Cabbage, *Brassica oleracea var capitatat* is one of the important cruciferous cole crops. The early stage of caterpillar of *P. xylostella* feed in mines made on the lower side of leaves, whereas the late instars feed freely on the leaves causing significant reduction in yield and quality. DBM occurs wherever cruciferous crops are being grown. *P. xylostella* is one of the "leaders" among insect pests that are very difficult to control (Sarfraz and Keddie, 2005). It is capable of reducing leaf area, devaluing products, slowing growth and causing plant death if left uncontrolled. It was reported to cause more than 90 per cent crop loss in the area of their outbreaks (Verkerk and Wright, 1996). In India, diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield also reported that there is 52% loss in yield due to the attack of diamondback moth (Gautam *et al.,* 2018). Diamondback moth is the most important pest which causes direct yield loss and economic damage on cruciferous crops.

Economic loss:

The economic loss was estimated to be $ 16 million in India (Mohan and Gujar, 2003) and $ 4-5 billion worldwide (Zalucki *et al.,* 2012). DBM is reported to have developed resistance to different insecticide group like organophosphate, carbamate and pyrethroid and is well on its way to develop multiple resistances (Chauhan *et al.,* 2014).

Life cycle:

Egg:

Meena and singh (2012) observed that eggs of DBM was oval in shape and yellowish white, which darken before hatching. The egg was 0.48-0.58 mm in length with an average 053 mm and breadth was 0.24-0.34 mm with an average 0.29mm.

Larvae:

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Meena and singh (2012) observed that diamond back moth has 4 larval instar and duration of each instar was 1-3, 2-3, 2-3, and 2-4 days with average of 1.80, 2.70, 2.70 and 2.80 days respectively. The total larval period ranged from 7-13 days with an average of 10.0 days.

Pupa:

Gangurde and wankhede (2010) observed the pre-pupa and pupal period of DBM in cabbage were 1to 2 days (mean 1.10) and 3-5 days (mean 4.10).

Adult:

Gangurde and wankhede (2010) reported that total period adult and life cycle period was 5-16 days (mean 10.5) and 14-22 days (mean 16.93) in cabbage at Dapoli. Das and Chaudhari (2007) observed that the adult period of DBM was (9-10 days) with an average 9.50 days on cabbage. Patel (2000) observed the pupal period of DBM on cabbage. The length of male moth 6.0-7.0mm with average 6.25mm. The female moth range from 7.0-7.60mm with an average 7.37mm respectively.

Pre-oviposition, oviposition and post- oviposition period

Das and Chaudhari (2007) observed that the pre-oviposition, oviposition and post oviposition period were 1.75-2.85 days, 3.00-4.00 days and 4.15-5.25 days with an average period were 2.00, 3.25 and 4.75 days on cabbage. Patel (2000) observed the pre-oviposition period was 1to2 days (mean 1.20 days). The oviposition period was (2.0-4.0) mean 3.50 days and fecundity (73-110) mean 93.60. Gangurde and wankhede (2010) observed that pre-oviposition period was 2 to 4 day, oviposition period was 6 to 9 days and post oviposition period was 5 to 7 days of DBM on cabbage.

Fecundity

Meena and singh (2012) observe that biology of diamond back moth on cabbage at Bikaner. The egg laying capacity of female 242 to 305 egg with an average 225.3 ± 19.09 eggs. Adult female preferred lower surface of cabbage leaves for egg laying mainly along the midrib. Sontakke et al (2016) studied the comparative biology of DBM on cauliflower, broccoli, and knol knol. The fecundity of DBM was 206, 168 and 100 eggs per female respectively.

Management Strategies

Cultural method

Patel (2006) reported that late planted crop (13th December) harboured less pest population (1.83 larva/plant) in cabbage. Kumar *et al*. (2009) revealed that cabbage grown with garlic (1:2) had the lowest larval population of DBM. Bediako *et al*. (2010) recorded that lowest pest population in cabbage crop treated with chlorpyrifos which was at par with cabbage intercrop with onion and tomato. Thonger *et al.* (2015) stated that minimum population of DBM was recorded on cabbage variety Rare Ball than on G-8 variety followed by Pride of India, Millenium-111 and BC-76. Sharma *et al.* (2018) observed that cabbage intercropped with mustard and cowpea was found to be more effective treatment in reducing DBM (1.25 larva/plant).

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Mechanical method

Topagi (2014) found that higher numbers of moth were trapped with higher per cent population reduction of DBM in cabbage.

Biological method

Lad *et al.* (2009) recorded that *Trichogramma bactrae* @ 1.5 lakh eggs/ha was superior for 53.94 per cent reduction in larval population of DBM followed by *Bacillus thuringiensis* @ 1000 ml/ha and *Trichogramma chilonis* @ 1.5 lakh eggs/ha in cauliflower. Vanlaldiki *et al*. (2013) recorded the lowest larval population (0.21 larvae/plant) in treatment *Bt* (dipel) and proved to be the most effective treatment, followed by *Bt* (delfin) and dichlorvos 76 EC respectively, as against untreated control (8.88 larvae/plant).

Singh *et al*. (2015) observed that bioasp (*Bt var. Kurtsaki*) treated plots harboured least leaf damage of 13.22 per cent as against 69.18 per cent in untreated control. Devi and Tayde (2017) reported that highest per cent reduction of DBM larvae in *B. thuringiensis* (61.22%) treated cauliflower. Jat *et al.* (2017) found that treatment *B. thuringiensis var. kurstaki* with dose of 2 per cent found effective in both the spray for reduction in larva.

Chemical method

Munde (2010) found indoxacarb 14.5 SC with 0.007% is effective. Because mortality rate high at different intervals.

Patra *et al*. (2016) observed that chlorfenapyr 10 EC @ 200 g a.i./ha treated plot recorded lowest percentage of DBM damage (1.38%) followed by pyridalyl 10 EC @ 150 g a.i./ha (2.33%) and indoxacarb 14.5 SC @ 150 g a.i./ha (2.38%) in cabbage crop. Dotasara *et al*. (2017) reported that spinosad 45 SC @ 0.5 ml/ litre treated cauliflower plot showed highest reduction of DBM (89.97%). Venugopala *et al*. (2017) found that Chlorantraniliprole 18.5 SC was effective among all the treatment for larval reduction.

Sawant and Patil (2018) concluded that chlorantraniliprole 18.5 SC @ 10 g a.i. /ha showed highest reduction of DBM (91%) in cabbage.

CONCLUSION

DBM can be managed by integrating various pest management strategies *viz.,* cultural method (date of transplanting, Intercropping), mechanical method (pheromone trap) bio-control agents (*Trichogramma* spp., *C. plutellea* and *Diadromus* spp.), microbial pesticides (*B. thuringiensis* and *B. bassiana*) and botanical insecticides (neem oil and NSKE). However, among the chemical pesticides *viz.,* spinosad 45% SC, emamectin benzoate 5% SG, chlorantraniliprole 18.5% SC, chlorfenapyr 10% SC and indoxacarb 14.5% SC are most effective chemicals for managing DBM. Moreover, due to overuse of pesticides adverse effects on environment is seen along with the problems of resistance and residues. So, integrated pest management (IPM) tactics should be used for effective and economic management of DBM.

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APSA-80: A Boon to the Farmers

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Rita Sharma
Department of Life Science, ITM University, Gwalior (M.P)

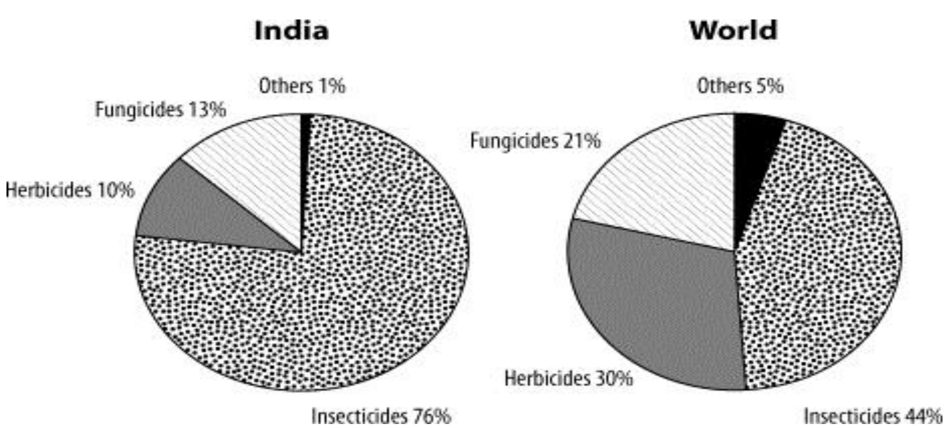
INTRODUCTION

India has a very large land area for farming and crop production. 70% of the population lives in villages and depends on agriculture and farming. Moreover, India ranks second across the worldwide in crop production. India also export horticultural as well as agricultural and processed foods to more than 120 countries like South Asia, Japan, SAARC countries and United states. Indian farmers are now using pesticides and insecticides in a very high amount in order to increase the crop production. Although Indian farmers are highly dependent on weather conditions around the year which is not much supportive nowadays due to global warming. But we all cannot deny towards the harmful impact of using these pesticides, insecticides and the chemical fertilizers. (1,2)

Impact of pesticides

A pesticide includes a wide range of compounds like fungicides, herbicides, insecticides, nematicides, rodenticides and molluscicides and plant growth regulators etc. The uses of organochlorine (OC) insecticides were completely banned after 1960s in several technologically advanced countries. Some new synthetic insecticides – organophosphate (OP) insecticides were introduced in the 1960s, pyrethroids in 1980s and carbamates in 1970s and the introduction of and fungicides and herbicides in the 1970s–1980s contributed largely to pest control and agricultural production. Ideally a pesticide must be lethal to the targeted pests, but not to non-target species, including man. Unfortunately, this is not the case, so the controversy of use and abuse of pesticides has surfaced. The frequent use of such chemicals, under the quote, "if little is good, a lot more will be better" has played havoc with human and other life forms.(3)

Production and use of pesticides in India



Hazards of pesticides on human beings, environment

There are numerous, direct and indirect effect of pesticides on human beings, animals and environment. Pesticides and Insecticides both are consists of the chemical preparations used to kill animal , fungal pests, insects and microorganisms .Around 98% of the insecticides/pesticides sprayed over the crops, reach towards the destination other than the target species.(3)

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It can reach into aquatic environments while wind can take away to the other fields, grazing or undeveloped areas, human settlements which potentially affect the other species. Further, repeated usage leads to the pest/insect resistance, poor production. Production workers, formulators, sprayers, mixers, loaders and agricultural farm workers are at the high risk groups which are exposed to pesticides. The possibility of hazards may be higher during manufacture and formulation, because the precautions are neglected. In industrial settings, workers are at increased risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents and inert carriers. Pesticides can also contaminate water, soil, turf and other vegetation. Moreover, other than killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects, and non-target plants. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risks to non-target organisms.

Apsa-80: A Boon to the Farmers

Amway is always known for its high quality products all across the world. APSA-80, one of the magical product of Amway is an all purpose spray adjuvant which on mixing with insecticides, herbicides, fungicides and defoliators increases their efficacy. It also helps water or any solution to penetrate deeper. This is highly useful in protecting various crops, fruits and vegetables from threatful diseases, insects, pests and unwanted herbs, resulting in high productive yield. It can be mixed in any solution to improve its performance many times as it has 80% of active ingredients. Although, APSA-80 is neither a fertilizer nor an insecticide(4)

Fig.1: APSA-80

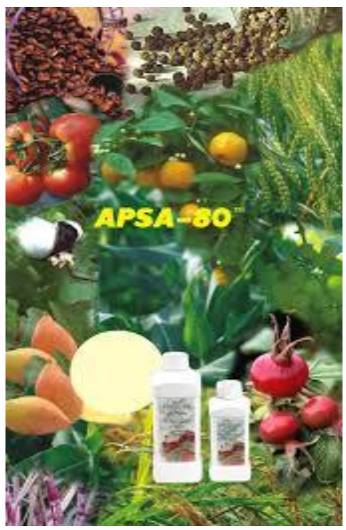

Fig.2 :All purpose adjuvant

Fig 3:Reduces the Surface tension

How does APSA-80 work?

APSA-80 is an adjuvant which decreases the surface tension of water and also aids soil penetration for more efficient and effective irrigation even in hard or compacted soil. Furthermore, it also helps in,

- Minimizing evaporation
- Provides more uniform spread and coverage of spray, insecticides, herbicides and fungicides.
- Acts as an activator to increase the activity of certain herbicides.
- For use on growing and harvested crops.
- Non-corrosive to protect metal pumps, tanks, and equipment

APSA - 80 consists of special elements i.e. Non Ironic Surfactants' that reduces the surface tension of the water. These surfactants act on the surface of the water droplet to minimize its tendency to bead up by pulling the water and the wax on the leaf surface together, reducing the water's surface tension and allow the water droplet to spread out. As a result the water used in pesticide sprays, spreads out more evenly, and covers the entire surface for the leaves in order to maximize its effects. Addition of APSA-80 helps, defoliators, foliar, insecticides and fertilizers to penetrate the surface of the leaf faster and more evenly.

How to Use APSA-80?

1. With Fungicides, Insecticides, Foliar Fertilizers and Defoliators:

Prepare a solution if insecticides / fungicides / foliar fertilizers / defoliators and water. Follow the mixing instructions recommended by the pesticide manufacturer. Mix 5ml of APSA-80 (1 / 4th capful) per 15litres of pesticide or foliar fertilizer solution. Spray normally on the crop

2. With Post - Emergent Herbicides:

Make a solution of the post-emergent herbicide to be used with water in the spray tank. Follow the mixing instructions recommended by the herbicide manufacturer. Mix 20ml of APSA - 80 (1 capful) per 15 liters of post emergent herbicide solution Spray normally on the crop.

3. For use as an Irrigation Aid

Mix 160ml of APSA - 80 (8 capful) in atleast 80 litres per acre. The dosage of APSA-80 will remain 160ml per acre of land even if the wate required is more than 80 litres to cover an acre of land. About 12 hours before irrigating, spray this mixture of APSA - 80 and water directly on the entire land area which is to be irrigated. Spray directly on the soil. Let the water flow into the land and see how it penetrates the soil better and also spreads better. The above mentioned spray of APSA - 80 will remain effective for about 4 weeks. Repeat the above steps for irrigation after a month.

Advantages of APSA – 80

1. Offers farmers an excellent opportunity to increase their crop yields.
2. Spreader - provides more uniform spray deposit on plants; improves coverage of insecticide, herbicide, fungicide and foliar fertilizer sprays.
3. Activator - through wetting action helps improve performance of post-emergent herbicides, insecticides, and fungicides.
4. For use on growing and harvested crops.
5. Helps in dispersing powders and oil-base liquids.
6. The International and Indian test results on variety of crops prove the effectiveness of APSA-80 for improving pesticide coverage and performance.
7. Increases water penetration - gets more water into the soil. Also aids irrigation by reducing run-off; saves water.
8. Aids irrigation by increasing rate at which water soaks into soil; promotes more efficient water usage.
9. Helps keep spray equipment clean and prevents clogged nozzles-reduces down time.
10. Non-corrosive to equipment.
11. Biodegradable.
12. According to Indian researches, APSA-80 fetches a return of 15 to 213 times of the amount spent on it.

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Effect of open dumping yard on groundwater pollution

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Kiran S C
Ph.D. Scholar Department of Forestry and Environmental Science, UAS, GKVK Bengaluru.

Municipal Solid waste and water quality have become major environmental problems in recent years, especially metropolitan cities. Concerns regarding solid waste in the metropolitan are growing, especially in densely populated areas, not only because of the increase of waste caused by rapid urbanization, a growing population, improved living standards, and changing consumption patterns, but chiefly because of the lack of an efficient waste management system. If solid waste is not effectively and properly managed, it can result in adverse impacts on both environmental and human health causing air, soil, and water pollution and disease. Sustainable management of solid waste is important because of the vulnerability of natural resources such as surface waters and underground aquifers landscape, and biodiversity. Furthermore, the deterioration of natural resources may affect the economy of countries where metropolitan cities are the most important economic sector in IT&BT sectors. Open dumping yard have been identified as one of the major threats to groundwater resources not only in India but throughout the world. More than 90% of the Municipal Solid Waste (MSW) generated in India is directly dumped on land in an unsatisfactory manner. The solid waste placed in landfills or open dumps are subjected to either groundwater underflow or infiltration from precipitation or any other possibility of infiltration of water. During rainfall, the dumped solid wastes receivers' water and the by-products of its decomposition move into the water through the waste deposition. The liquid containing innumerable organic and inorganic compounds is called 'leachate'. This leachate accumulates at the bottom of the landfill and percolates through the soil and reaches the groundwater. Areas near landfills have a greater possibility of groundwater contamination because of the potential pollution source of leachate originating from the nearby dumping site. Such contamination of groundwater results in a substantia risk to local groundwater resource user and to the natural environment. Groundwater pollution has become a global environmental problem that poses a continuous and serious threat to the ecological environment and human health. Landfill leachate, which contains many toxic and harmful substances such as heavy metals, persistent organic pollutants and bacteria, has become one of the main anthropogenic sources of groundwater pollution. Groundwater polluted by leachate will not only cause ecological problems such as water blooms and soil salinization, but also cause various aquagenic diseases once exposed to the human body through drinking or bathing. For example, drinking groundwater polluted by heavy metals (such as manganese and arsenic) in leachate for a long time will increase the risk of cancer and infant death, as well as induce motor and cognitive dysfunction in children. Moreover, nitrate (NO^{3-}) is ubiquitous in municipal solid waste landfills (MSWLs), and studies have shown that it is related to blue baby disorder. The impact of landfill leachate on the surface and groundwater has given rise to a number of studies in recent years and gained major importance due to drastic increase in population.

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Managing soils under saline water irrigation

Article id: 23490

V.D.Satpute[1], N.K.Bodkhe[2], D.S.Nagre[3]
Soil Science and Agricultural Chemistry, Agricultural Economics, Agricultural Economics
Samarth Agriculture College Deulgaon Raja

INTRODUCTION

The development of appropriate practices for the use of saline waters for irrigation requires an adequate understanding of how salts affect waters, soils and plants. But, the sustainability of a viable, permanent irrigated agriculture, especially with the use of saline irrigation waters, requires much more. It requires the implementation of appropriate management practices to control salinity, not only within the irrigated fields, but also within irrigation projects and geohydrologic systems. It is important to remember that most water logging and salinity problems presently existing in major irrigation projects throughout the world have resulted with the use of "good quality" irrigation waters. Hence, it may be argued that the major causes of salinity problems presently being generally encountered in typical irrigation projects must first be avoided, if more saline than normal waters are to be used successfully for irrigation, since such use may increase the likelihood of salinity problems in a given field. On the other hand, reuse of drainage waters for irrigation can help reduce overall the drainage, water logging and salt-loading problems that occur, especially at the project or river basin scales and, hence, can result in a net decrease in the totality of irrigation-induced and salinity-related problems, including environmental pollution. In any case, it is imperative that management practices for the control of soil and water salinity at such scales be considered an essential part of the management requirements for using saline waters for irrigation.

Several physical, chemical and biological soil management measures help facilitate the safe use of saline water in crop production. Some important ones in this regard are: tillage, deep ploughing, sanding, use of chemical amendments and soil conditioners, organic and green manuring and mulching.

Tillage

It is a mechanical operation that is usually carried out for seed bed preparation, soil permeability improvement, to breakup surface crust sand to improve water infiltration. If, it might form a plough layer or bring a salty layer closer to the surface. Sodic soils are especially subject to puddling and crusting; they should be tilled carefully and wet soil conditions avoided. Heavy machinery traffic should also be avoided. More frequent irrigation, especially during the germination and seedling stages, tends to soften surface crusts on sodic soils and encourages better stands.

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Deep ploughing

Refers to depth so ploughing from about 40 to 150 cm. It is most beneficial on stratified soil shaving impermeable layers lying between permeable layers. Deep ploughing to 60 cm loosens the aggregates, improves the physical condition of these layers, increases soil water storage capacity and helps control salt accumulation when using saline water for irrigation. Crop yields can be markedly improved by ploughing to this depth every three or four years. Thes election of the right plough types(shape and spacings between shanks), sequence, ploughing depth and moisture content att he time of ploughing should provide good soil tilth and improve soil structure.

Sanding

It is used in some cases to makea fine textured surface soil more permeable by mixing sand in to it, thus are latively permanent change in surface soil texture is obtained. When properly done,sanding results in improved root penetration and better leaching by saline sodic water and when surface infiltration limits water penetration.The method can be combined with initial deep ploughing.

Chemical Amendments

Gypsum is by farthe most common amendment for sodic soil reclamation, particularly when using saline water with a high SAR value for irrigation. Calcium chlorideis highly soluble and would be a satisfactory amendment especially when added to irrigation water. Lime is not an effective amendment for improving sodic conditions when used alone but when combined with a large amount of organic manure it has a beneficial effect.

Sulphur

It can be effective, it is inert until it is oxidized to sulphuric acid by soil micro-organisms.Other sulphur-containing amendments (sulphuric acid,iron sulphate, aluminium sulphate) are similarly effective because of the sulphuric acid originally present or formed upon microbial oxidation or hydrolysis.

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Organic manures

It is organic matter in to the soil has two principal beneficial effects of soils irrigated with saline water with high SAR and on saline sodic soils, improvement of soil permeability and release of CO2 and certain organic acids during decomposition.This will help in lowering soil pH, releasing calcium by solubilization of CaCO3 and other minerals, there by increasing ECe and replacement of exchangeable Na by Ca and Mg which lowers the ESP.

Green manures

Growing legumes and using green manure will improve soil structure. Green manure has a similar effect to organic manure. Increases water holding capacity and decreases soil loss by erosion. Green manuring helps in reclamation of alkaline soils.

Mulching

It reduce evaporation losses will also decrease the opportunity for soil salinization. When using saline water where the concentration of soluble salts in the soil is expected to be high in the surface, mulching can considerably help leach salts, reduce ESP and thus facilitate the production of tolerant crops. Thus, when ever feasible, mulching to reduce the upward fluxof soluble salts should be encouraged. As saline water evaporates from the soil it leaves behind salts. A good mulch under the crop helps reduce surface evaporation, maintains moisture near the soil surface and lessens the build-up of soil salinity.

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Medical Entomology: An overview

Article id: 23491

Birari Vaishali V., Manishkumar J. Joshi, Chandresh B. Solanki, Prithiv Raj V.
Ph.D. Scholar, Department of Entomology, S.D. Agricultural University, Sardarkrushinagar, Dantiwada, B. K., Gujarat (India) -385 506

INTRODUCTION

Medical entomology is a specialisation that involves the study of those insects that are of medical importance, for example mosquitoes, flies, lice and fleas. However, the term medical entomology is usually used in a broader sense to take into account the arachnids, a group of invertebrates that includes ticks and mites, that are not insects but nevertheless may be of considerable medical importance (M. W. Service, 1980). Medical entomology the branch of science that deals with insects that cause disease or that serve as vectors of organisms that cause disease in humans. In medical entomology, for example, research may pertain to the interactions of the arboviruses and their hosts and involve physiology, genetics, biology, and ecology.

IMPORTANT VECTOR OF DISEASE

1. House fly: *Musa nebulo, M. Domestica* (Muscidae: Diptera)

Mark of identification:

- It is the most common fly species found in houses. Adults are grey to black, with four dark, longitudinal lines on the thorax, slightly hairy bodies, and a single pair of membranous wings.
- They have red eyes, set farther apart in the slightly larger female. These soon hatch into legless white larvae, known as maggots.
- After 2 to 5 days of development, these metamorphose into reddish-brown pupae, about 8 mm (0.3 in) long.
- Adult flies normally live for 2 to 4 weeks, but can hibernate during the winter.

Damage:

- Source of nuisance
- Transmits many diseases in human beings dysentery, cholera, typhoid, enteric fevers, tuberculosis, leprosy, anthrax, trachoma, gonorrhoea and many helminthic diseases.

2. Mosquitoes : *Culex sp., Anopheles sp., and Aedes sp.* (Culicidae: Diptera)

Mark of identification:

- **Mosquitoes** are small, midge-like flies. Females of most species are ectoparasites, whose tube-like mouthparts (called a proboscis) pierce the hosts' skin to consume blood.
- In most species, adult females lay their eggs in stagnant water; some lay eggs near the water's edge; others attach their eggs to aquatic plants.
- The mosquito larva has a well-developed head with mouth brushes used for feeding, a large thorax with no legs, and a segmented abdomen.
- As seen in its lateral aspect, the mosquito pupa is comma-shaped. The head and thorax are merged into a cephalothorax, with the abdomen curving around underneath.

Diseases transmitted:

- Anopheles sp. Transmits malaria caused by Plasmodium sp.
- Culex sp. Transmits filariasis caused by wuheretia bancrofti.

- Aedes sp. Transmits dengue fever, encephalitis and yellow fever.

3. Cockroaches: *Periplanata americana, Blatella germenica, Blatella orientalis* (Blatidae: Dictyoptera)

Mark of identification:

- They have a relatively small head and a broad, flattened body, and most species are reddish-brown to dark brown.
- They have large compound eyes, two ocelli, and long, flexible antennae.
- The mouthparts are on the underside of the head and include generalized chewing mandibles, salivary glands and various touch and taste receptors.

Damage: Starchy material are ruined by excreta, offensive smell. Feed on damp books and leather articles management.

4. Sandflies: *Phlebotomus argentipes* (Psycodidae: Diptera)

Mark of identification:

- Sand fly adults are small flies – only about 3 mm long – and are golden, brownish or gray colored.
- They have long, piercing mouthparts that are well adapted for sucking blood from their selected host. Sand flies hold their hairy-looking wings in a vertical V-shape when at rest, a characteristic that distinguishes them from some other small flies. Also, the six legs on the adults are extremely long, being longer than the insect's body.

Damage:

- Adults causes painful bite, itching and swelling.
- Transmits diseases in man like kala-azar, three day fever, tropical ulcer etc., transmits anthrax in cattle.

5. Bed bugs: *Cimex hemipterous* (Cimicidae: Hemiptera)

Mark of identification:

- Bedbugs are small, oval, brownish insects that live on the blood of animals or humans.
- Adult bedbug have flat bodies about the size of an apple seed. After feeding, however, their bodies swell and are a reddish colour.

Damage: Nymph and adult suck blood and inject toxic saliva during night which cause irritation, and painful itching. It does not transmit any diseases.

6. House mice: *Mus musculus* (Rodentia: Muridae)

Mark of identification:

- House mice have an adult body length (nose to base of tail) of 7.5–10 cm and a tail length of 5–10 cm.
- The weight is typically 40–45 g. In the wild they vary in colour from light to dark agouti (light to dark brown), but domesticated fancy mice and laboratory mice are produced in many colors ranging from white to champagne to black.
- They have short hair and some, but not all, sub-species have a light belly.
- The ears and tail have little hair.
- They are found in and around homes and commercial structures, as well as in open fields and agricultural lands.

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Damage:

- House mice can sometimes transmit diseases, contaminate food, and damage food packaging.
- Although the US Centers for Disease Control and Prevention gives a list with diseases transmitted by rodents, only few of the diseases are transmitted through the house mouse.
- Lymphocytic choriomeningitis (LCMV) can be transmitted by mice, but is not a commonly reported infection in humans, though most infections are mild and are often never diagnosed.
- Some concern exists that women should not to be infected with LCMV during pregnancy.
- House mice are not usually a vector of human plague because they have fewer infestations with fleas than do rats, and because the fleas which house mice normally carry exhibit little tendency to bite humans rather than their natural host.

7. Dust mite: *Dermatophagoides microceras* **(**Acarina: Pyroglyphidae**)**

Mark of identification:

- House dust mites are microscopic, eight legged creatures, 0.3 mm in length, and invisible to the human eye.
- They are arachnids, relatives of spiders, not insects.
- The mites are globular in shape, clear to creamy white in color, with hairs on their legs and body.

Damage:

- Dust mites are second only to pollen in causing allergic reactions.
- Asthma, eczema and allergic rhinitis are the three main allergic diseases where the cause of most attacks has been linked to them.
- It is not only the mite that causes the problem.
- The allergen which causes these allergic reactions is actually a protein found in their droppings and carcasses.

8. Flea: *Ctenocephalides felis* (Siphonaptera)

Mark of identification:

- Adult fleas are small (1/16 inch long), dark, reddish-brown, blood-sucking insects. The body is vertically flat (like a fish), hard and covered with many hairs and short spines that point backward. Legs are long and well adapted for jumping. The mouthparts of an adult flea are adapted for sucking blood from a host.
- Immature or larval stages are small (1/4 inch long) white worms with dark heads.

Damage:

- Flea bites make some animals, who are allergic to the insects saliva, so miserable that they gnaw and scratch themselves raw.
- Human bites show up as small, red, itchy bumps most commonly observed on the wrists and ankles.

House fly

Mosquito

Cockroach

Sand fly

Bed bug

House mice

Dust mite

Flea

Fig.1 : Important Vectors of disease

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CISGENESIS: A potential fruit breeeding method

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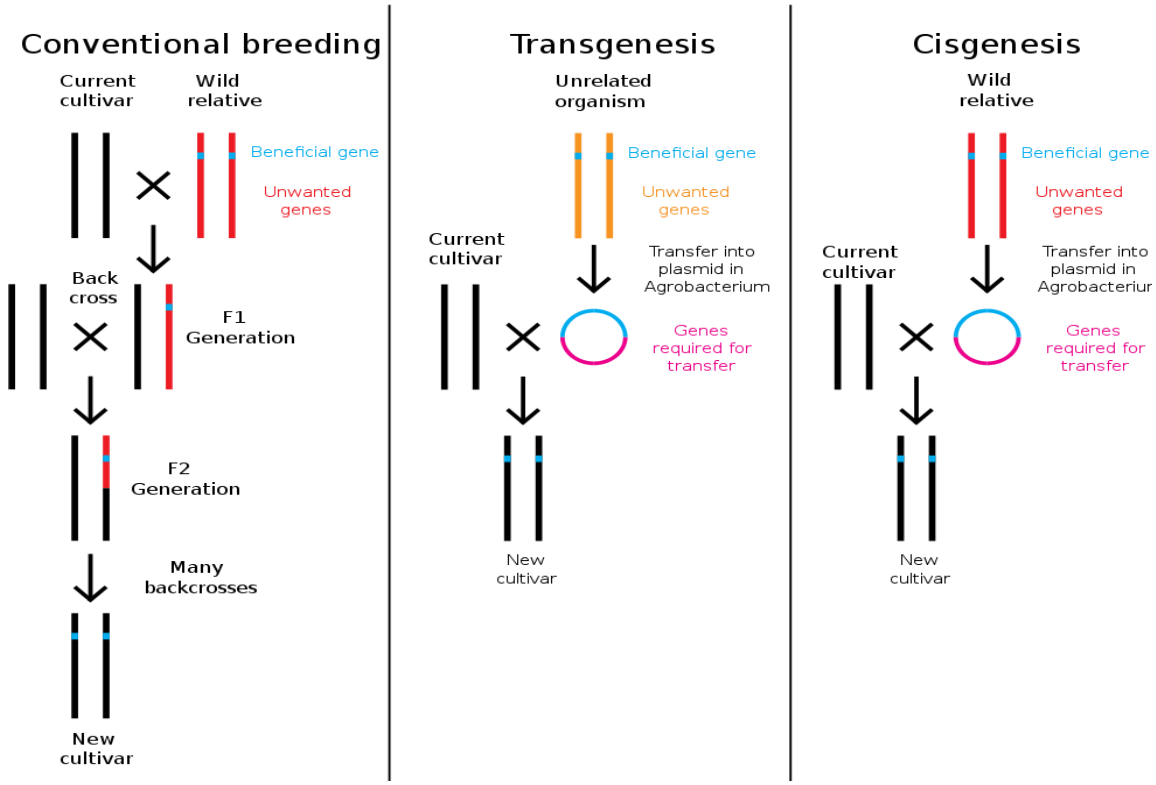
AYUSH K SHARMA* and S P S SOLANKI
Department of Fruit Science, Punjab Agricultural University, Ludhiana

INTRODUCTION

Term cisgenesis introduced by Henk J Schouten and Henk Jochemsen in 2000. It is defined as **cisgenesis** is the genetic modification of a recipient plant with a natural gene from a crossable sexually and compatible plant (Telem *et al* 2013) were it is different from transgenesis as it is defined as genetic modification of a recipient plant with one or more genes from any non-plant organism, or from a donor plant that is sexually incompatible with the recipient plant. In cisgenesis the wild donor parent which have the gene resistant to specific desire character are isolated from wild parent and transfer to the recipient parent through agrobacterium mediated transformation.

Fig 1. Comparative diagram showing conventional, transgenic, and cisgenesis breeding.



https://upload.wikimedia.org/wikipedia/commons/thumb/8/80/Breeding_transgenesis_cisgenesis.svg/1024px-Breeding_transgenesis_cisgenesis.svg.png

Advantages Of Cisgenesis Over Conventional And Transgenic Breeding Method:-

1. Conquer the setback of linkage drag.

In plants fruit crops have the linked gene i.e.(expression og one gene depends on the presence of another gene) this genes are closely spaced and express with each other. In plants the undesirable gene can be linked with desired gene and which cause limitation in the transfer of this gene in the desired plant through conventional breeding methods. From wild parent such link gene can be transfer through cisgenesis in to desirable crops.

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2. Maintains original genetic make-up of plant variety.
Due to transfer of only one desired gene to the recipient genotype, it maintains its original genetic makeup.

3. Reduction in pesticide application.
Due to addition of disease or pest resistant gene to the desired genotype which are responsible for the insect, pest, (a)biotic stress resistant gene which reduces the application of pesticide and chemicals to the crops.

4. Time Saving.
In perennial fruit crops breeding is slow were it take more type to come to bearing, so it become slow in crop improvement which can be address by using cisgenesis technique in breeding.

Cisgenesis Intervention In Fruit Breeding:-

Schaart J G (2004) developed the less susceptible strawberry to the botrytis cineraria as it mostly attack on the ripen fruit which causes pre and post-harvest losses in strawberry. In strawberry weekly spraying of fungicide are suggestive but it is not sustainable way of fruit production. In strawberry gene FaPGIP-gene and FaExp2-promoter sequences is introduced in to commercial cultivar and it is found that the effect of B. cineraria is less compare to earlier genotype of that cultivar.

Kost *et al* (2015) developed the apple cultivar which is more resistant to fire blight, in which cisgenic apple line (C44.4.146) was developed using the cisgene FB_MR5 from wild apple *Malus* × *robusta* 5 (Mr5), and transfer through previously established method involving *A. tumefaciens* mediated transformation of the fire blight susceptible cultivar 'Gala Galaxy' using the binary vector p9-Dao-FLPi. These regenerated plants are tested against the disease fire blight (*Erwinia amylovora*) and cis genic plants are found to be resistant to the disease.

Potential use of CIS genesis in fruit crop improvement:-

In fruit crops conventional breeding methods are slow and give very less per cent of success. The fruit crops like citrus, mango, papaya, banana etc. are affected by the complex diseases and to address such problem in breeding the new crop improvement method which gives more per cent of success and reliable effect on resistant to pest and diseases. In this method wild donor parents with desired gene can be exploited and further used in fruit crop improvement.

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Efficient procedure for callus induction and proliferation

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Vikas Chandra[1*] & Khiromani Nag[2]
Technical Assistant [1]Dept. of Agriculture, Govt. of Uttar Pradesh, Azamgarh (U.P.) 276304
Ph.D. Scholar[2] Dept. Of FLA, CoA, IGKV Raipur (C.G.) 492012

It is an unorganized or undifferentiated mass of cell produced either in culture or in nature and it usually contains parenchymatous cells. Callus formation from explants involves the development of progressively more random plants of cell division, less frequent specialization of cells and loss of organized structures. Callus cells from different plant species may be different in structure and growth habit; white or coloured, soft or hard, fragile or compact.
Callus culture is often performed in the dark and the light can encourage differentiation of the callus. After callus induction the callus is grown further on a new medium, which is referred to as sub-culturing. Subculture is the transfer of culture with or without dilution from one culture vessel to another containing fresh culture medium. It is also known as passage.

Micro callus

The initial colony of cells visible but too small to transfer by different manipulation recovered from cultures of protoplasts, single cells or small aggregate cells.

Induction and maintenance

When freshly cut pieces of surface sterilized plant tissues are grown in agar medium with appropriate nutrient with suitable proportion of auxin and cytokinin, they exhibit callusing which gradually extended to the entire surface of the tissue. Callus culture need to be subcultured every 3-5 weeks in view of cell growth, nutrient depletion and medium drying. Repeated subculture on an agar medium improves the friability of the callus.

Habituation of Callus Tissue

In some plant species the callus tissue is able to grow on a standard maintenance medium or basal medium which devoid of growth hormones. This property of the callus tissue is known as habituation and the callus tissues known as habituated callus tissue.
During the long term culture, the culture may lose the requirement for auxin and or cytokinin. The callus tissues in many cases shows a high potential for organogenesis when first initiated but gradually a decline sets in as subculture proceeds with eventual loss of organogenic response. The genetic effects in a callus tissue are reflected in changes of chromosomal structure or number like aneuploidy, polploidy and chromosomal rearrangements.
Callus cultures are very important in plant biotechnology. Manipulation of the auxin and cytokinin ratio in the medium can lead to the development of shoots, roots or somatic embryos from which whole plant can subsequently be produced. Callus cultures can also be used to initiate cell suspension, which are used in a variety of way in plant regeneration studies.

Steps Involved in Induction of Callus

1. Take any cereal grains at milky stage in a beaker and sterilize with 20% sodium hypochlorite for 10 minutes under laminar flow chamber.
2. Rinse with sterile water for three to five times.
3. Dissect out the embryos.

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4. Place the dissected embryos in the media containing MS+2mg/l of 2,4-D and incubate the culture at 24-26 ^{0}C and the callus will be formed after four week.
5. Scutellar callus should be subcultured once in 15 days.

Applications of Callus Culture

1. To study nutrition requirement of plants
2. To study cell and organ differentiation and morphogenesis
3. To create somaclonal variations and its exploitation
4. For developing cell suspension culture and protoplast culture
5. For genetic transformation using ballistic particle gun technology
6. For the production of secondary metabolism and regulation.

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Isolate and identify the pathogen associated with dry rot disease of potato

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Khiromani Nag[1] and Vikas Chandra[2]
Ph.D. Scholar[1] Deptt. Of FLA, CoA, IGKV Raipur (C.G.) - 492012
Technical Assistant [2]Deptt. of Agriculture, Govt. of Uttar Pradesh, Azamgarh (U.P.)-276304

Potato (*Solanum tuberosum* L.) popularly known as 'The king of vegetables', has emerged as fourth most important food crop in India after rice, wheat and maize. Indian vegetable basket is incomplete without Potato. Because, the dry matter, edible energy and edible protein content of potato makes it nutritionally superior vegetable as well as staple food not only in our country but also throughout the world. Potato is a major food crop, grown more than 100 countries in world. Fusarium dry rot is an important postharvest disease of potato worldwide. Fusarium dry rot can be caused by several different *Fusarium* spp, including *F. solani, F. sambucinum, F. avenaceum, F. culmorum,* and *F. oxysporum,* but *F. solani* appears to be the most aggressive and important. Dry rot *Fusarium spp*. originate from contaminated seed or infested soils, infecting tubers through wounds in the periderm that are common after potato cutting and handling practices. Fusarium spp. introduced into soils by contaminated seed can persist for years. Soil borne inoculum can infect tubers through wounds caused by other pathogens, insects, or during harvest and handling. Rotted cavities are often lined with mycelia and spores of various colors from yellow to white to pink. Dry rot diagnosis may be complicated by the presence of other tuber pathogens. Soft rot bacteria (Pectobacterium spp.) often colonize dry rot lesions, especially when tubers have been stored under conditions of high relative humidity or tuber surfaces are wet. Secor and Salas, (2001) however, average annual crop losses attributed to dry rot have been estimated at 6 to25% and found that more than 60% of tubers in storage can be affected. Fusarium sp. that causes dry rot and spread readily among tubers during handling and planting which results in seed tuber rots and poor plants stand.

Symptoms

Dry-rot is essentially a storage trouble, and under poor storage conditions a high percentage of the tubers are rotted while in the bin. The organisms producing this disease live in the soil and are carried to the cellar with the tubers and finally back to the soil again at planting time. Seed selection and seed treatment will help to prevent these organisms from being carried in great numbers back to the soil. Fusarium Dry Rot (*Fusarium* spp.) can show up in potatoes with both external and internal symptoms. External symptoms show shrinking and shriveling of lesions. Internal symptoms show light to dark brown dry rot with mycelium-filled cavities.

Fusarium – How it Spreads

Fusarium inoculum is spread during seed cutting, handling and planting. This results in misses in the field as well as reduced stem number and plant vigour. Infected seed tubers will infest the surrounding soil. Infection occurs only through wounds in the potato seed tuber.

Production of fusaric acid by *Fusarium* sp.

Fusarium dry rot is mostly a post-harvest disease and can become a serious problem when infected potatoes are stored. Breeding for potato cultivars resistant to *Fusarium* species causing dry rot is an

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important control strategy world-wide. Genetic modification of plants for disease resistance requires that resistant individual plants must be distinguished from large populations of susceptible plants, by inoculating them with the pathogen. Toxins produced by pathogens can be used for the identification of disease resistant plants in vitro or in vivo however, the toxins must play a role in disease development and if the toxin is pathologically important, the role in disease development should be defined. Dry rot of stored potatoes in the main dryland production regions is caused by Fusarium spp. An investigation of the effects of temperature showed that maximum decay occurred at 25°C and that the levels of decay were higher than those reported in other countries. Local isolates of pathogenic *Fusriaum* sp. are possibly adapted to the local high prevailing temperatures.

Collection of samples

The samples of dry rotted potato collected for isolation from local vegetable market of Naini, Allahabad and brought to the department of Plant Pathology laboratory for isolation of pathogen.

Procedure

Dry rot-infected potato tubers were washed thoroughly with water, surface sterilized for 3 min. with 1.5% sodium hypochlorite, and washed twice with sterile distilled water. Tubers were cut and infected tissue was excised from the edge of the lesion or from the inside of potato dry cavity. The infected tissue was then cultured on potato dextrose agar supplemented with 100 mg/ml ampicillin plates were incubated at 25℃, 60% relative humidity and under a 12-h alternation of light and dark. Single spore cultures were obtained by dilution series after 4 days of single spore culture colony diameter was measured and morphological characters were recorded. All isolates were identified using morphological characteristics of colony and conidia including growth ratio and pigment of colony size and shape of conidia, and other morphological structures according to published descriptions (Booth, 1971: Leslie and Summerell, 2006).

Required laboratorical apparatus

Test tubes, Petri plates, cotton plug, spirit lamps, distilled water, forceps, needle, cotton, match box, sodium hypochlorite and laminar air flow.

Cleaning and sterilization of glass wares

The glass wares (Petri plates, pipettes, conical flasks, test tubes, etc.) to be used in the experiment thoroughly washed with detergent powder and dried. The Petri plate and pipettes wrapped in clean paper and sterilized in hot air oven at a temperature of 150℃ to 180℃ for two hours.

Methods

Culture medium

In this experimental study, standard Potato Dextrose Agar (PDA) medium used. The composition of PDA was as follows:

Peeled potatoes	: 200 g
Dextrose	: 20g
Agar agar	: 20g
Distilled water	: 1000ml

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For the preparation of PDA media, 200 gm peeled and sliced potatoes boiled in one liter of water until potatoes became soft. Then it filtered through muslin cloth and adjust the filtrate to one litre and mixed with dextrose 20 gm and agar 20 gm and autoclaved for sterilization at 121.6^{O}C under pressure 1.54 kg/cm^2 for 15 minutes.

Isolation and purification

Dry rot-infected tubers washed thoroughly with water surface-sterilized for 3 min with 1.5 % sodium hypochlorite, and washed twice with sterile distilled water. Tubers cut and infected tissue excised from the age of the lesion which is from the inside of potato dry cavity. The infected tissue then cultured on PDA supplemented with 100 mg par ampicillin. Plates incubated in 25 ℃, 60 % relative humidity, and under a 12-h alternation of light and dark. Single spore culture obtained by dilution series. After 4 days of single spore culture. All isolates identified using morphological characteristics of colony and conidia, including growth ratio and pigment of colony, size and shape of conidia and other morphological structures, according to published description. Plate-:3.5. First isolation for laboratory work of potato dry rot pathogen.

Plating of medium

Autoclaved PDA medium was cooled down to around 45°C and then 20 ml was poured in sterilized Petriplates.

Slanting of medium

The test tube containing 5 ml liquid medium was slanted by putting them on to a wooden rod after autoclaving. After solidification they were used for culturing.

Microscopic Identification

The fungus isolated from diseased specimens critically examined under the compound microscope. The fungus studied for their morphological characters by referring standard books in Mycology and also from the literature. The fungus identified on the basis of morphological characters. The most dominant identified fungi which isolated from samples of both infected tubers and plants with dry rot disease were belonging to the genus *Fusarium,* as shown by microscopic examination. Fusarium isolates were identified *Fusarium solani*. In this respect many researchers recorded that dry rot disease caused by *Fusarium sp.* have limiting effects on potato cultivations.

Fig: 1.0 Dry rot disease infected potato

Fig:2.0 PDA solution

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Fig: 3.0 Conidia of *Fusarium solani*

Fig:4.0 Jatropha leaves

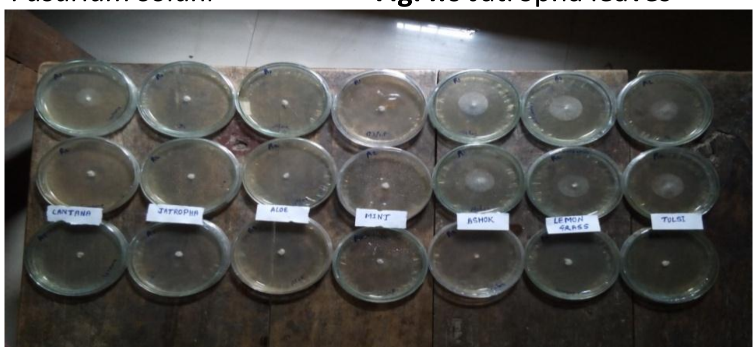

Fig: 5.0 Mycelial growth of *Fusarium solani* affected by treatments 24 hrs.

Structure of *Fusarium solani*

Colonies

Colonies rapidly reached an average colony diameter of 33.9±3.1 and 38.5±6.4 mm at 25 and 30°C, respectively, in three days. Aerial mycelium was usually rather sparse, floccose, felt-like, sometimes zonate and whitish to cream in colour. Pigmentation of colonies did not vary, and the under surfaces of the colonies were predominantly cream-coloured. Some of the isolates had light greenish to bluish flecks, especially old cultures. Sporulation usually commenced in the aerial mycelium as microconidia cohering in false heads after 2 to 3 days. Most of the isolates formed an abundance of macroconidia in white to cream-white sporodochia which became visible in the area of the point of inoculation after 4 to 7 days resulting in these cultures having a pionnotal appearance.

Conidiophores

Primary conidiophores arised laterally from hyphae in the aerial mycelium, at first unbranched, later sparsely branched. Secondary, initially simple but later short multibranched, conidiophores occurred which soon merged, forming sporodochial or pionnotal layers. Microconidia were produced on long and slender monophialides, mostly with distinct colarettes. Macroconidia were produced on shorter, subcylindric obclavate or doliiform monophialides.

Conidia

Micro- and macroconidia were abundantly produced by all the isolates. Microconidia were single- or two-celled and oval, ellipsoid to subcylindrical and macroconidia were long, slightly curved, relatively wide, thick

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walled and predominantly 3- to 4- septate and occasionally 5-septate. For most of their length the dorsal and ventral surfaces were parallel. The apical cells were short, slightly narrow, more or less pointed and hooked, especially for the foreign isolates, and the basal cells were distinctly notched or sometime foot-shaped.

Chlamydospores

Chlamydospores formed abundantly after ±14 days terminally or intercalary in hyphae or conidia either single or in pairs but rarely in chains or clusters. They were globose to subglobose and their walls usually smooth, but some of the isolates occasionally produced rough-walled chlamydospores.

Description

The experiment was conducted as a completely randomized design with seven treatments and three replications. The treatments were 10% concentrations of leaf extract. The treated plates were then incubated at 26 °C in the dark. The average diameter of the mycelia growth inhibition zone around the paper discs loaded with each treatment was measured seven days post incubation (before the plates were completely covered with mycelia of the fungus).The growth inhibition percent was calculated using the formula: IP=c-t/c×100, where IP was the growth inhibition percent, c and t were the diameter of growth inhibition zone in negative control and each of the other treatments. *Saraca asoca* leaf extract (10.00%), *Jatropha curcas* leaf extracts (10.00%) *Lantana camara* leaf extract(10.00%), *Mentha spicata* leaf extract(10.00%), *Ocimum sanctum* leaf extract(10.00%), *Cymbopogon citratus* L. leaf extract(10.00%) and *Aloe barbadensis* Mill. leaf extract(10.00%) leaf extract(10.00%) were tested against *Fusarium solani* using poison food technique using Potato Dextrose Agar (PDA) which used as basal medium. Both the treatments tested were significantly effective in inhibiting the growth of pathogen over control. *Saraca asoca* leaf extract(10.00%) showed minimum inhibition per cent (39.63%) as compared to *Jatropha curcas* leaf extract(10.00%) showed maximum inhibition per cent (75.93%).

CONCLUSION

Ashoka leaf extracts (10%) were found the most effective against *Fusarium solani*, after at 96 hours inoculation. Which were found minimum mycelium growth than Lemon grass leaf extracts (10%) was found effective in mycelium growth as compare to other treatments except lemon grass which was taken as treated control.

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Plant genetic resources and approaches for its management

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Deepayan Roy[1], Kuldeep Nagar[2] and Basu Sudhakar Reddy[3]
[1] PhD Research Scholar, Department of Genetics and Plant Breeding G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India.
[2] Ph.D. Research Scholar, Division of Genetics and Plant Breeding, Rajasthan Agricultural Research Institute, Durgapura, 302018, Jaipur, Rajasthan, India.
[3]PhD Research Scholar, Department of Genetics and Plant Breeding G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India.

INTRODUCTION

Plant genetic resources are plant genetic materials that describe the variability within plants. Through selection over the millenium by human and nature they arose indicating their worth for agriculture. Plant Genetic Resources for Food and Agriculture (PGRFA) is conceptualized as the diversity of genetic material prominent among traditional varieties and modern cultivars in addition to their crop wild relatives and also other wild plant species that can be utilised recently or lately for crop improvement (FAO,1998). Plant Genetic Resources can be classified into two types (Singh, 2015):-

A. On the basis of Origin –
a) Indigenous:
b) Exotic
B. On the basis of domestication –
a) cultivated germplasm
b) Wild germplasm

Categories of plant genetic resources and their definitions:

1. **Landraces**:- since the beginning of agriculture, ancient farmers and cultivators are growing such kinds or better say primitive cultivars that are known as landraces.
2. **Genetic stocks**:- these are generally such plants or plant populations created and/or selected for genetic studies.
3. **Primitive cultivar**:- farmers have selected and cultivated these cultivars for many generations.
4. **Wild relatives**:- cultivated crops are related to some species to which they are related genetically and they are known as their wild relatives.
5. **Obsolete varieties**:- These varieties that are not grown or cultivated anymore but once upon a time they were commercially cultivated.
6. **Parental lines of hybrids**:- as the name suggests these are parental lines utilized with a view to cross with another parent to create a hybrid and such lines which are generally having alleles homozygous and associated with a particular phenotype,.
7. **Farmers varieties**:- :- a variety which is traditionally grown by farmers and about which farmers have a common knowledge.

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History

The Worldwide expedition for collection of seeds and propagating material of large number of cultivated crops, wild and relative species was organized way back in 1926 by Nikolai Ivanovich Vavilov. Later, in the year 1951 he proposed 8 centres of origin and 3 sub-centres of different plant species. In 1961, FAO organized the 1st international technical meeting on plant exploration and introduction. Further development of events in this field includes:

1968 :- The Crop Ecology & Genetic Resources unit (CEGRU) of FAO was established .

1968 :- Sir Otto Frankel coined the term Genetic resources.

1974 :- International Board of Plant Genetic Resources (IBPGR) was established in Rome

1992 :-IBPGR was transformed to a new autonomous organization International Plant Genetic Institute (IPGRI).

1976 :- in order to ensure conservation of various species in India NBPGR was established in New Delhi.

Importance of plant genetic resource

1. It comprises of diversity among and within plant species, that are of direct or indirect value to humans.
2. It is reservoir of useful genes.
3. It is the most valuable raw material in crop improvement, food and nutritional security.
4. PGR constitute national heritage that needs efficient management and conservation for prosperity.
5.It is important as it is getting eroded due to introduction of monoculture of improved varieties, industrialization and changes in agro-ecosystems.

Two of the main activities of plant Genetic resource utilization (Frankel and Bennet, 1970) are as follows:

A. Exploration:

1. Planning the whole expedition.
2. Making contacts with local people for information, gathering equipments (herbarium, Geographical indicator etc), local research of the geographical area.
3. Core sampling using all the botanical information.
4. Sorting collected sample.
5. Reporting to headquarters.
6. Preparation and publication of reports.
7. Distribution/ conservation of collected samples.

B. Collection:

1. Sources of collection:- Germplasm is collected from gene bank, seed companies, gene sanctuaries (Garo hills of Meghalaya is the first gene sanctuary of india for conservation of citrus), farmers field, centre of diversity.

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2. Priority of collection:- Samples should be collected from area which is rich in Diversity, under explore, tribal dominated, hot spots and threatened habitats.
3. Agencies of collection:- samples can be collected from Crop research institute, State agricultural universities , NBPGR IPGRI (International Plant Genetic Resources Institute), Italy.

CONCLUSION

In the world growing with the population of 130 people per minute, genetic resources will be fundamental to our efforts to improve agricultural productivity (Bordoni and Hodgkin, 2012). Germplasm should be maintained in a safe, secure and cost effective manner and should be distributed for utilization in crop improvement.

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Cloud computing in agriculture sector

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M.Ananthi* and V.Anandhi[1]
*Teaching Assistant, Directorate of Planning and Monitoring, TNAU, Coimbatore
[1] Assistant Professor (Computer Science) & TPO to Vice-Chancellor, TNAU, Coimbatore

With the global increase in population, the need for increase in food production is raised. The Food and Agricultural Organization of the United Nation (FAO) predicts that the global population will reach 8 billion people by 2025 and 9.6 billion people by 2050. In order to keep pace, food production must increase by 70 percent by 2050 globally. Thus, to face challenges of food production, we need to develop methods to produce more output with the limited available natural resources. Developing nations based on agriculture can improve the economic condition by using ICT applications. One of the possible way by which this can be achieved is the successful implementation of the new ICT tool is Cloud Computing. IOT and cloud computing technology can be effectively used to increase the crop production to meet the growing needs of increasing population in India. New innovative applications can be developed to increase the quality, quantity, sustainability and cost effectiveness of agricultural production. Use of IOT along with Cloud Computing can help a lot to Indian farmers to to improve food production and commercial activities. As a trend of future information technology applied in various fields, Cloud computing able to give required information along with the consideration of reduction in cost which will be beneficial to farmers.

Cloud Computing

Storing and securing huge amounts of data that is accessible only by authorized users, having ability to use applications on the Internet that store and protect data while providing a service. Used in Web services to integrate photos, maps, and GPS information to create a mash up in customer Web browsers.

Basic Cloud Computing models :

a. Software as a Service (SAAS):

It includes the ICT working tools such as software, web applications etc., without buying/downloading and installing in specific machines. Another characteristic of this model is that the users are charged for whatever has to be used for a specific duration, against the traditional way of buying and paying for the full application.

b. Platform as a Service (PAAS):

It provides clients the computing platform for designing and developing specific applications with minimum redundancy. It also takes care of hosting of those applications without concerning about hardware and data storage requirement. It also guarantees the availability of most recent platforms and their security.

c. Infrastructure as a Service (IAAS):

This model usually includes tangible as well as intangible components used in availing ICT services, such as virtual computers, traffic monitoring and re-directing, basic network components etc. This is the most prominent benefit of cloud computing as the organizations invest the most in establishing infrastructure.

Features of Cloud Computing in Agriculture

- Data acquisition and remote storage
- Low-cost access to ICT resources
- Online agriculture experts consultation

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- Land records automation
- Weather Forecasting

Current Challenges in Indian Agriculture

- Poor knowledge about the weather forecast, pests and diseases.
- Poor ICT infrastructure and ICT illiteracy.
- Non availability of timely and relevant content.
- Lack of awareness among farmers about the benefits of ICT.
- Particular non availability of agricultural information.

Role of Cloud Computing In Solving These Challenges

- Using the applications of cloud the farmers know about hardware and software investment.
- The farmers will send the request for the specific cloud service using a user friendly device, and the cloud service provider will analyze and handle the request dynamically.
- The results obtained mostly up-to-date farming and propagation techniques, pest control knowledge, and can also track the whole process from production, distribution to consumption and can also provide the Supply chain management, Market forecasting and Business decision-making information.

Advantages

- Back up recovery is very easy in Infrastructure as a service (IaaS) provider.
- Considering cloud computing from the aspects of power management, it serves as a virtual server which is easy to implement as compare to physical servers. Hardware management failure can also be localized and rectified with relative ease
- Reduced setup costs can considered as a major advantage for cloud computing.
- Various data centres are spread throughout the country and thus it make easy for business to Use preferred sites.
- The assessment of data can be done a time and is highly beneficial for the IT industry in reducing the workloads
- Automatic Software Integration

CONCLUSION

Agriculture is one of the fields which could be highly benefitted from the features offered by this innovative technology. Cloud computing is an emerging technology which can bring revolutionary changes in the usage of internet. It provides modern agriculture equipment, weather observation and forecasting, agriculture planting and breeding technology, as well as production organization and management methods. The future growth of agriculture is depended on the adaptation of new technologies with a focus on farmer needs such as cloud computing. Therefore, it needs a mass awareness among the stakeholders to acquire it and have a well-established information base for the nation.

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Thermal processing methods used in dairy and food industry: An overview

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Kamalesh Kumar Meena
Assistant Professor, Dairy & Food Microbiology, College of Dairy & Food Technology, MPUAT, Udaipur

1. INTRODUCTION

The losses of food due to spoilage have been estimated between 20-25% in India and other developing countries, which causes the paucity of food in these countries. The food spoilage reactions may of any foods is mainly of chemical, physical, enzymatic and microbiological in nature. The spoilage in foods occurs mainly after slaughtering, harvesting or production. The quality deterioration depends on type of food, composition and environmental conditions. The major cause of spoilage is microbes in most of raw and processed foods. The microbial degradation occurs in foods by its own natural microflora or by the post processing microbial contaminants at different stages of food handling. Therefore, various thermal preservation techniques invented for extension of self-life of the fresh foods.

2. Thermal Preservation Methods

The microbes have their optimum temperature requirement for the optimum growth and reproduction. When the temperature of food increased above the maximum growth temperature of microbes, microbial cells are injured and killed due to thermal inactivation of their key cellular components like cytoplasmic membranes, RNA, ribosome, DNA , and enzymes. Heat kills microbes by changing the physical and chemical properties of its proteins. It is now well established fact that to achieve the adequate level of microbial destruction and to design effective heat preservation method various factors like type and resistance of the target microbes or spore count present in food, the pH and water activity of food, the heating conditions, the thermo-physical characteristics of the container and the post processing storage conditions have to be considered.The heat treatment adopted will also depend upon the other preservative methods to be employed and the effect of heat on food texture, aroma and taste. Foods are subject to thermal processes in a number of different contexts e.g. cooking (baking, boiling, frying, grilling, roasting), pasteurization, appertization etc. which are described below;

1. Cooking

The heat treatments like frying, baking, grilling, boiling, roasting etc., is usually considered in the process of cooking. Cooking does not have specific or defined temperature but it is generally used term for the heat treatments applied to foods for making them tasty and customer friendly. Aim of cooking is not killing of microbes, although it is secondary effect of cooking. During baking the temperature of bread internally not goes beyond 100°C, which is enough to destroy all the yeast and other vegetative cells but not the bacterial spore. In frying, grilling or roasting, internal temperature of food do not go above 100°C but the external temperatures of the food product are too high.

2. Pasteurization

Louis Pasteur recommended that new wine be heated at 55 °C for a short time without air based on his studies. This mild heat treatment was later recognized as "pasteurization". Pasteurization is the process of

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heating a food/food product, generally a liquid-to or below its boiling point for a defined period of time. Its purpose is to kill/destroy all pathogens, reduce the number of spoilage causing microbes, inactivate enzymes and increase the shelf life of a food product. Pasteurization is not intended to kill all microorganisms in the food. It is designed in such way that most heat resistant non-spore forming organisms like *Mycobacterium tuberculosis* and *Coxiella burnetti* can be completely destroyed. The heating may be by means of steam, hot water, dry heat, or electric currents and the products are cooled promptly after the heat treatment. The aim of pasteurization is to achieve 99.999% (5-log) reduction in population of viable microorganisms. Pasteurization is different from commercial sterilization, where aim of sterilization is to kill all viable microbes (pathogenic and spoilage) in the food.

2.1 Purpose of Pasteurization

1. Eliminate or destroy all pathogens associated with the product
2. Reduction or eliminate a large proportion of potential spoilage causing microbes
3. Killing the competing microbes to obtain a desired fermentation by starter cultures as like in cheese making, fermented products etc.
4. Enhancing the shelf-life by combining other potential techniques like aseptic packaging and cooling
5. It is minimal heat treatment which avoids the rigorous heat treatments that might harm the physical, chemical, organoleptic and nutritional quality of the food product.

2.2 Types of Pasteurization

Usually two methods are employed to achieve pasteurization:

i. Low-temperature-long-time (LTLT or Batch method) method (62.8°C for 30 minutes , Fig.1)and
ii. High-temperature-short-time (HTST or continuous method) method (71.8°C for 15 seconds, Fig.2).

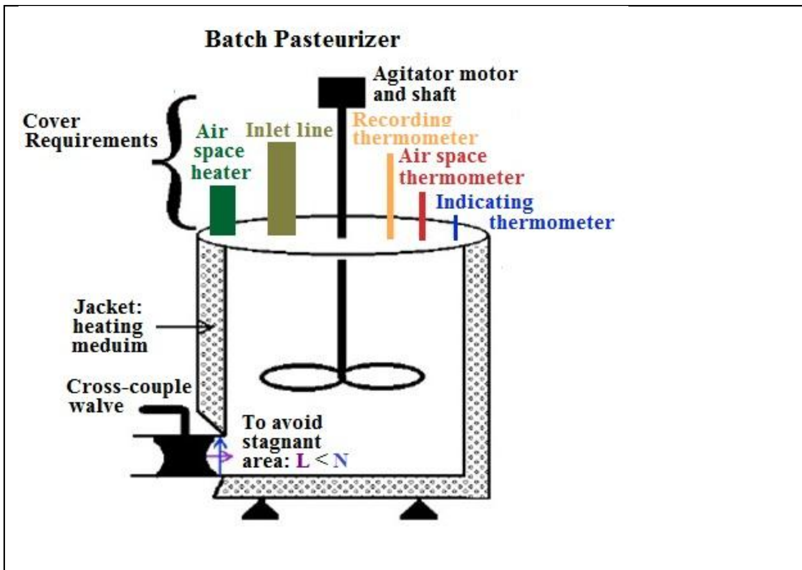

Fig. 1 Batch pasteurizer

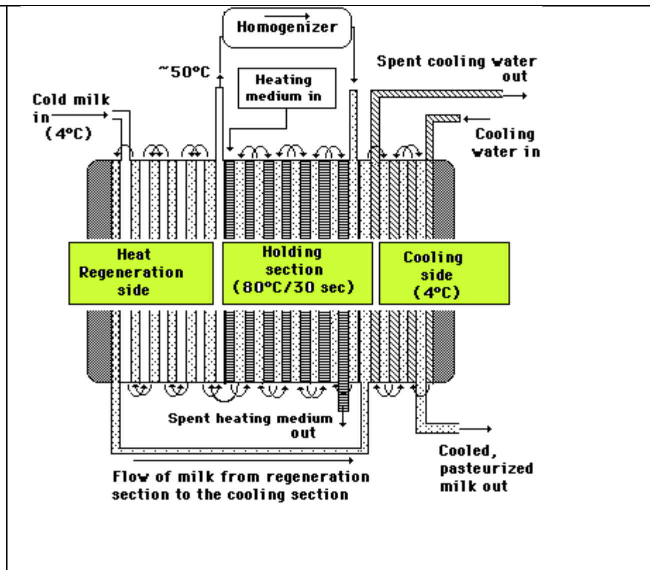

Fig. 2. HTST Pasteurizer

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3. Blanching

Blanching is a slight heat treatment, using hot water or steam, which is applied mostly to vegetables before canning or freezing. Blanching is also a kind of pasteurization generally applied to fruits and vegetables, mainly to inactive natural food enzymes. This technique is used commonly for food products which are to be frozen, while frozen storage itself would not completely arrest enzyme activity. The significant enzymes in foods are Peroxidase and Catalase which is the most heat resistant enzymes found in foods. The activity of these enzymes is used to evaluate the efficiency of a blanching heat treatment. If these are inactivated then it can be understood that other significant enzymes also are inactivated or destroyed. The heating exposure time depends on the method of heating, type of fruit/vegetable, the size of fruits/vegetable or the temperature of the heating medium.

Objective of Blanching

To inactivate enzymes naturally found in food, to remove the tissue gases and to clean the tissue, to increase the temperature of the food and to induce a vacuum in canned goods.

4. Ultra High Temperature Treatment:

The UHT treatment of milk involves heat processing at 138-142°C, for 2-3 seconds followed by rapid cooling and subsequent "aseptic packaging" in a sterile environment. This time/temperature treatment destroys all the viable spoilage as well as pathogenic microbes. UHT processed milk is packed aseptically which does not require refrigeration until opened. The UHT treated milk has the shelf life about 6 months at ambient temperature whereas pasteurized milk has 2 days shelf life under refrigeration. This technique can be applied for a wide range of products like milk, juice, tomato sauce, soups, and other liquid foods.

5. Sterilization (Retorting)

According to the FDA 'Guidance for Industry: Acidified Foods,' the definition of 'commercial sterility' stands for the condition achieved by "the application of heat which renders the food free of microorganisms capable of reproducing in the food under normal non refrigerated conditions of storage and distribution and free of viable microorganisms(including spores) of public health significance." Canned foods are sterilized in a retort which is called commercial sterilization. The history of heat preservation in modern food processing starts from 1795, when Napoleon Bonaparte felt that army needed food during travelling to keep it fit and well fed. Nicholas Appert, a confectioner, used his knowledge to preserve the foods in sugar syrups when kept in tightly sealed glass bottles. In 1804, he conducted experiments that foods kept in hermetically sealed glass jars subjected to heating in boiling water (for varying time according to the type of food) and then cooled showed the extended self-life. After it, Nicholas Appert was called the father of "canning" and the heat sterilization method now known as "appertization". This method provides foods shelf life of more than two years. In this technique foods are subjected to heating in such manner that it ensures complete destruction of *Clostridium botulinum* spores at 121°C under pressure for varying times. The secondary objective of sterilization of foods is the destruction of vegetative and sporeforming organism and pathogens.

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6. **Canning**

It is a form of pasteurization in which cooked fruits or vegetables, sealed in sterilized cans or jars, and followed by boiling the cans or jars to destroy remaining spoilage causing bacteria. The heat treatment and holding time depends on the foods to be preserved. High-acid fruits like Strawberries do not require any preservatives to can and holding time is also short due to its high acid nature. Tomatoes preservation needs longer heating time and addition of preservatives. Some vegetables subjected to pressure canning. The canned foods are on high risk of spoilage after opening the cans. The canned foods may contain *Clostridium botulinum* which produces a dangerous toxin in food and may lead to severe illness or death. This organism is sporeforming and may sustain high temperature and grows anaerobically. It does not produce any gas or obvious taste and remains undetected by taste or smell. This microbe is commonly associated with canned foods like Corn, beef and Tuna. The canning process is divided in Water-bath canning and pressure canning methods. The first method sometimes also called as hot water canning. In this food filled cans or jars are submerged in large kettles of boiling water and heated to the food in such a manner that internal food temperature reaches 212°F and holding it for a definite period of time. This canning method is extensively used for processing of high-acid fruit and vegetables to make products like pickles, pickled food, and tomatoes. The second method (Pressure canning) uses a large kettle that produces steam in a locked compartment and generates pressure. This method is used for low-acid foods, such as meat, poultry and fish.

7. **Drying**

Drying is one of the oldest techniques used for food preservation and delay or prevents bacterial growth by reducing water activity of food. Most of fresh foods have a high moisture content of more than 80% which makes them highly perishable to spoilage. Dehydration extends self- life of foods much longer than fresh food by reducing water activity. The perishable nature of fresh foods leads to application of drying technology. The conventional technique of drying includes solar drying, vacuum drying, air drying, fluidized bed drying, spouted bed drying, and freeze-drying. There are several types of dryers which are used. These include: drum dryer, cabinet dryer, tunnel dryer, rotary dryer, spray dryer and solar dryer. Drying can be broadly classified into two methods; natural and artificial. The natural method of drying uses the solar energy to eliminate the moisture content from the food. Artificial drying has advantages in comparison to natural method of drying.

Natural Methods: It can be divided into direct and indirect method of drying. In direct method (Open sun drying) food is exposed to a number of days to achieve the final desired moisture level in the foods. Indirect method **(**Indirect solar dryer) have been applied to overcome the constraints of direct method of drying. The various types of indirect solar dyers are designed such as Chamber type, chimney type, and wind-ventilated dryers. Mango, guava and anola has been successfully dried using direct type solar dryers.

Artificial Drying Methods

Convective drying: Convective method is used to remove water from the food using heat in equipments meant for drying. Hot air is passed through the food to transfer heat to remove moisture. Recently

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combination of osmotic and convective drying was also studied on many fruits and vegetables such as mango, ginger, button mushroom, jack fruit, and grapes.

Freeze drying: It is the method of drying any substance through freezing and removal of water by direct sublimation. In this about 90% of the water of food is removed in the first phase of freeze drying. One important attribute of freeze dried fruits is the ability of the fruits to rehydrate. The rehydration property of the freeze dried product is quick. The organoleptic property of the rehydrated foods is almost similar to the fresh product. The advantages of freeze dried products are minimum volume reduction, minimum loss of volatile components, very minute chemical change, long storage period, stability during storage, capacity to be used as an antioxidants and colorants. The disadvantage of it is high cost and energy consumed. Collapse of the product can happen due to the high freeze drying time, which may cause in loss of aroma and yield tough product with low rehydration capacities. A drying method was developed by integration of ultrasound and freeze drying to dry bell pepper. When ultrasound at 6.5 µm was used continuously for the foods, it showed immediate heating effect at reduced ambient pressure. The drying time was found to be decreased by 11.5% by using ultra sound.

Osmotic drying: In this food is placed in a hypertonic solution which causes a difference in concentration and causes the water content of foods to be driven out from the sample to the solution. Diffusion of the solutes from the solution into the foods also takes place. The osmosis may cause changes in physical, chemical, nutritional values, taste and structural properties of the final product. Mono & di saccharides and salts such as NaCl are the most widely used active solutes. The process can be conducted at room temperature which makes it more beneficial than other conventional method of drying as energy required for this procedure is significantly less.

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Cropping system model for Dhenkanal district, state-Odisha under differential crop ecology

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Jagadish Jena[1*] and Sameer Ranjan Misra[2]
[1]Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
[2]Division of Agricultural Chemicals, ICAR-IARI, New Delhi-110012, India.

INTRODUCTION:

Cropping system is the cropping pattern followed in a farm which is the yearly sequence of crops and/or crops and fallow and their interaction with farm resources and available enterprises fulfilling the need of the system. Cropping system model should be site and climate specific considering source of inputs, agro-climatic situations, availability of market and also ecological concerns. Objective of cropping system model in irrigated conditions should be maximization of productivity per unit time and land where as for rainfed situation it should be maximization of production per unit water use and giving moisture conservation practices more priority.

District physiographic and agroclimatic profile

- **Geographic co-ordinates of district headquarter:** $20^0$39’22.18” N latitude, $85^0$36’15.35” E longitude and 249m above MSL.
- **Agro-climatic zone (NARP):** Mid central table land (OR-10).
- **Rainfall intensity and distribution and average minimum and maximum temperature:**

Rainfall	Normal rainfall (mm)	Normal rainy days(nos.)	Normal onset	Normal cessation	Temp (^{0}C)	
					Min	Max
S-W monsoon (Jun-Sep)	1109	53.5	Mid-June	Sept. last	25	36
N-E monsoon (Oct-Dec)	143	6.9	-	-	17	33
Winter (Jan-Mar)	66	4.2	-	-	14	38
Summer (Apr-May)	111	7.1	-	-	28	42
Total	**1429**	71.7	-	-	**14**	**42**

Map of Dhenkanal District

- **Source of irrigation**: Pond, well
- **Major soil**: Mostly light textured lateritic soil followed by red sandy loam medium textured soils.

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- **Predominated crops grown**: Paddy, horse gram, green gram, black gram, groundnut and some vegetables like potato, brinjal, onion etc.
- **Purpose of cultivation:** Priority given to family consumption followed by marketing.
- **Transport and Market:** Connected with major cities by N.H and S.H. Export of commodities by nearby agro-export zone and weekly markets in village level for sell and purchase.

Suggested cropping system model:

Situation/Season	*Pre-Kharif*	*Kharif*	*Rabi*
Irrigated upland	Groundnut	Maize	Potato
Irrigated lowland	Green gram	Rice	Maize
Rainfed upland	---	Direct seeded Rice	Mustard
Rainfed lowland	---	Rice	Black gram

RICE

Irrigated low land & rainfed low land

1. **Variety:** Lowland: Swarna, Rani dhan and Mahsuri.
2. **Duration**: 130 – 150 days
3. **Seed rate:** 40-45kg/ha for nursery
4. **Method of sowing:** Transplanting 3-4leaf paddy seedling in puddled field manually.
5. **Sowing time:** 3rd week of June to 1st week of July
6. **Harvesting time:** 1st fortnight of Nov.
7. **FYM application:** 10-15t well rotten FYM 4-6weeks before sowing
8. **RDF (N-P_2O_5-K_2O) Kg/ha:** Irrigated: 80-40-40.
9. **Time of fertilizer application:** All P & K basal. 1/3rd N @ basal, 1/3rd @PI and 1/3rd just before flowering.
10. **Water management:** Maintain enough land submergence during early stage after transplanting and from PI to flowering.
11. **Major weeds:** *Echinochloa sp., Cyperus sp., Fimbristylis sp., Cyanotis sp., Eclipta alba and Ludwigia parviflora.*
12. **Weed control:** Keeping field flooded, beushaning and application of chemical herbicides like Butachlor, Propanil and Bispyribac sodium are effective.
13. **Major Pests:** Stem borer, gall midge, gundhi bug, swarming caterpillar, GLH and BPH.
14. **Pest control:** Grow resistant varieties, Phorate 10% @ 10kg/ha, Sevin 50WP @1g/liter.
15. **Major diseases:** Blast, brown spot, stem rot, false smut, BLB, BLS etc.
16. **Disease control:** Grow certified resistant fungicide treated seeds. Spray 0.2%zineb 75WP and copper oxychloride @ 500g/ha at 10-12 days interval.
17. **Expected yield:** 60-70 q/ha
18. **Special intercultural operations:** Beushaning is the practice of rainwater impounding and cross ploughing the field at 35-45 DAT with an objective of weeding, thinning and inter culturing the crop.

Rainfed upland-DSR

1. **Variety:** upland: Kanchan, Ghanteswari, Nilgiri.
2. **Duration:** 75-90 days
3. **Seed rate:** 60-65 kg/ha
4. **Method of sowing:** Line sowing
5. **Sowing time:** 2nd fortnight of Jun.

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6. **Harvesting time:** 2nd week of Sep.
7. **FYM application:** 10-15 t well rotten FYM 4-6weeks before sowing
8. **RDF (N-P_2O_5-K_2O) Kg/ha:** Rainfed: 60-30-30.
9. **Time of fertilizer application:** All P & K basal. 1/2 N @ basal, 1/2 @ PI.
10. **Water management:** Sowing done after 1st shower
11. **Major weeds:** *Cyperus rotundus, Cynodon dactylon, Digitaria sp. etc.*
12. **Weed control:** Brown manuring, mulching and application of chemical herbicides like Propanil @ 500g/ha and Bispyribac sodium @ 4g/ha are effective.
13. **Major Pests:** Stem borer, gall midge, gundhi bug, swarming caterpillar, GLH and BPH.
14. **Pest control:** Grow resistant varieties, Phorate 10% @ 10kg/ha, Sevin 50WP @ 1g/liter.
15. **Major diseases:** Blast, brown spot, stem rot, false smut, BLB, BLS etc.
16. **Disease control:** Grow certified resistant fungicide treated seeds. Spray 0.2%zineb 75WP and copper oxychloride @ 500g/ha at 10-12 days interval.
17. **Expected yield:** 45-55 q/ha.
18. **Moisture conservation strategy:** Pre shower deep medium to deep ploughing can be done to increase moisture retention.

MAIZE

1. **Variety:** Ganga hybrid-101, Hi-starch, Prakash, Prabhat etc.
2. **Duration:** 90-110days
3. **Seed rate:** Kharif: 18-20kg/ha, Rabi: 25kg/ha
4. **Method of sowing:** Hand dropping in the line drawn by desi plough.
5. **Sowing time:** Kharif: 3rd week May - mid June. Rabi: 2nd fortnight of Nov.
6. **Harvesting time:** Kharif: 1st week of Oct. to 3rd week of Oct. Rabi: 1st fortnight Mar.
7. **FYM application:** 20-25t well rotten FYM 4-6 weeks before sowing.
8. **RDF (N-P_2O_5-K_2O) Kg/ha:** Kharif @ 60-40-40. Rabi @ 120-60-30.
9. **Time of fertilizer application:** All P & K basal. 1/2 N @ basal, 1/4th @knee high and 1/4th at tasseling stage.
10. **Critical irrigation periods:** Knee high, tasseling and silking.
11. **No. of irrigation required:** 1-2 in kharif if required and 4-5 during rabi season.
12. **Major weeds:** *Cyanodon, Digitaria, Eleusine, Sorghum halepense, Trianthema sp., Portulaca sp., Convolvulous arvensis etc.*
13. **Weed control:** 2hoeing at 15-20DAS. Herbicide like attrazine and alachlor can be sprayed at recommended doses and time.
14. **Major Pests:** Stem borer, shoot fly, cut worm.
15. **Pest control:** Application of Endosulfan, Carbaryl, phorate, methyl parathion etc.
16. **Major diseases:** Seed rot, seedling blight, bacterial stalk rot, downy mildew.
17. **Disease control:** Use treated seeds with bavistin/thiram, grow tolerant variety, spray mancozeb at recommended rate.
18. **Expected yield:** Kharif: 45-60q/ha - Rabi maize: 70-75q/ha.
19. **Special operation:** For *Rabi* maize light ploughing the field before sowing fulfills the moisture regime required for germination as well early growth.

GROUNDNUT

1. **Variety:** Smruti, TMV-2, TAG-24, AK 12-24.
2. **Duration:** 115-130days

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3. **Seed rate:** 80kg/ha
4. **Method of sowing:** Placing the seed manually in the small furrow made by desi plough.
5. **Sowing time:** 1^{st} fortnight of Feb
6. **Harvesting time:** 1^{st} fortnight of June
7. **FYM application:** 6-8t/ha well rotten FYM 4-6weeks before sowing
8. **RDF (N-P_2O_5-K_2O) kg/ha:** 20-40: 40-90:20:40
9. **Time of fertilizer application:** All N, P & K basal.
10. **Critical irrigation periods:** Flowering, pegging and pod development.
11. **No. of irrigation required:** 3-4 irrigation only at critical stages.
12. **Major weeds:** *Cyperus rotundus, Chlioris barbata, Celosia sp., Commelina benghalensis, Boerhavia diffusa.*
13. **Weed control:** Hand weeding twice at 20DAS and 35DAS. Fluchloralin and pendimethalin can be applied as PPI and PE for effective control.
14. **Major Pests:** Aphid, Leaf minor, white grub etc.
15. **Pest control:** Spray 1ppm Metasystox 25EC and for white grub Phorate 10G @15kg/ha.
16. **Major diseases:** Tikka, Charcoal rot, Rust etc.
17. **Disease control:** Seed treatment with Thiram @ 5g/kg seeds, spray 0.05% solution of Bavistin and grow tolerant varieties.
18. **Expected yield:** 20-25 q/ha.
19. **Special operation:** Earthing up done 1week before pegging to properly loosen the soil and proper development of pegs.

SUMMER GREEN GRAM

1. **Variety:** Pusa Baisakhi, Pant Mung-1, T-1, Sonali.
2. **Duration:** 70-75days.
3. **Seed rate:** 20kg/ha
4. **Method of sowing:** Continuous sowing in line giving spacing 10-15 cm.
5. **Sowing time:** 2^{nd} Fortnight of Mar.
6. **Harvesting time:** 1^{st} week of June
7. **RDF (N-P_2O_5-K_2O) Kg/ha:** 10:40:20
8. **Time of fertilizer application:** All basal
9. **Critical irrigation periods:** pre sowing, pre flowering and pod filling.
10. **No. of irrigation required:** 4-5 irrigation at 10-15 days interval
11. **Major weeds:** *Eleusine indica, Digitaria sp., Chenopodium album etc.*
12. **Weed control:** Use of Fluchloralin @ 1kg/ha and one hand weeding at 30DAS.
13. **Major Pests:** Hairy caterpillar, leaf hopper, Jassid etc.
14. **Pest control:** Application of Phorate 10 kg/ha and spray Monocrotophos 36 EC @ 1ml/lit.
15. **Major diseases:** Yellow mosaic virus, mosaic mottle, leaf curl, anthracnose etc.
16. **Disease control:** Apply 0.1% Metasystox 2-3 sprays at 10days interval, Zineb @ 2kg/ha.
17. **Expected yield:** 12-16 q/ha

BLACK GRAM

1. **Variety:** T-9, PDM 71-1.
2. **Duration:** 75-85days
3. **Seed rate:** 12-15kg/ha
4. **Method of sowing:** Broadcasting

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5. **Sowing time:** 1st week of November 7-10days before harvesting of rice
6. **Harvesting time:** 1st week of Feb**.**
7. **RDF (N-P_2O_5-K_2O) Kg/ha:** 10:25:15
8. **Time of fertilizer application:** All basal
9. **Critical irrigation periods:** pre sowing, pre flowering and pod filling.
10. **No. of irrigation required:** No irrigation (grown in residual soil moisture)
11. **Plant protection:** Generally, more resistant to weeds, diseases and insect pests so control measures are not economical.
12. **Expected yield:** 6-7 q/ha

POTATO

1. **Variety:** Kufri Pukhraj, Kufri Jawahar
2. **Duration:** 70-90 days
3. **Seed rate:** 20-25 q/ha
4. **Method of sowing:** Place the 25-30 g cut tuber in shallow furrow followed by earthing up after 20-25 DAP**.**
5. **Sowing time:** 1st fortnight of Nov.
6. **Harvesting time:** 2nd fortnight of Jan.
7. **FYM application:** 10-15 t/ha well rotten FYM 4-6 weeks before sowing
8. **RDF (N-P_2O_5-K_2O) kg/ha:** 150-100-100
9. **Time of fertilizer application:** All P & K basal. 1/2 N basal + 1/2 N @ 2nd earthing up
10. **Critical irrigation periods:** germination, tuber initiation, early tuber enlargement and late tuber enlargement.
11. **No. of irrigation required:** 6-8 irrigation.
12. **Major weeds:** *Chenopodium sp., Digitaria sp., Gnaphalium sp., Polygonum sp.*
13. **Weed control:** Fluchloralin as PPI, Metribuzin as pre-immergence and one hand weeding @ 30DAP.
14. **Major Pests:** Cutworm, aphid, potato tuber moth, leaf hopper etc.
15. **Pest control:** Phorate 10G @10 kg/ha, Metasystox 25 EC @ 600 ml/1000lit water/ha.
16. **Major diseases:** Late blight, early blight, black scurf, wart etc.
17. **Disease control:** Grow resistant variety. Spray Metalaxyl 2g/lit.
18. **Expected yield:** 150-200 q/ha.
19. **Special operation:** Earthing_up should be done when plants are at 15-22cm high to make the ridge, cover the fertilizer, aerate the soil and weed management which enhance the yield.

MUSTARD

1. **Variety:** Pusa Bahar (DIR- 247)
2. **Duration:** 110-120days
3. **Seed rate:** 4-5kg/ha
4. **Method of sowing:** Line sowing in small furrow made by desi plough.
5. **Sowing time:** 4th week of Sept.
6. **Harvesting time:** 2nd fortnight of Jan.
7. **RDF (N-P_2O_5-K_2O) Kg/ha:** 50-30-20
8. **Time of fertilizer application:** All basal
9. **Water management:** grown in residual soil moisture after pre sowing ploughing.
10. **Major weeds:** *Trianthema sp., Phyllanthus sp., Chenopodium sp., Anagalis sp. etc.*
11. **Weed control:** PPI application of Fluchloralin @ 1.25kg/ha and PoE application of Isoproturon @ 0.5kg/ha considered effective.

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12. **Major Pests:** Mustard sawfly, mustard aphid, bihar hairy caterpillar etc.
13. **Pest control:** Malathion 35EC @ 1.2 lit/1000lit water, spray 0.07% Endosulfan.
14. **Major diseases:** Alternaria blight, downy mildew, white blister etc.
15. **Disease control:** Spray 0.2% Redomil as soon symptom seen. Spray Mancozeb 75WP @ 2kg in 1000lit water per hector at 10days intervals.
16. **Expected yield:** 8-9 q/ha
17. **Moisture conservation:** Straw mulching can be done to reduce weed problem and maintain adequate soil moisture for proper growth.

CONCLUSION

Targeting Rice-fallow to explore higher potential of available resources is the main priority in E-India whereas crop diversification in rice-wheat areas is the main priority in W-India to sustain the system productivity and soil health. Crop diversification should be followed instead of rice mono-cropping to maintain the soil health and sustain the system productivity. After considering different resource availability and the length of crop growing period, we should take area specific suitable cropping systems to get higher economic yield and profits.

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New Plant Breeding Techniques (NPBTs) - Keyholes for Crop Improvement

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Yengkhom Sanatombi Devi*, Puyam Tondonba Singh[1], Thokchom Nepolian Singh[2]
[,2] Ph.D. Research Scholar, Central Agricultural University, Imphal, Manipur, 795004*
[1]Ph.D. Research Scholar, National Pintung University of Science and Technology, Taiwan,91201

INTRODUCTION

New innovations are key to enhance agricultural food and farming productivity to meet the challenges of the growing population and climate change (according to DESA, *The 2017 Revision*, expected worldwide population in 2050 is 9.8 billion). In the recent past, plant breeders has adopted new technologies which resulted in numerous improved crop, feed, ornamental, and industrial crop varieties while traditional breeding based on crossing and selection remains an important activity since the breeders had to induce or wait for spontaneous mutations in the plant genome to produce a favourable trait, and then spend years in cross-breeding of plants to get that trait into a high-performing variety. New Plant Breeding Techniques (NPBTs) is a set of precise techniques and concepts which all allows the development of new desired traits by modifying the plants at the DNA level in a very short period. It does not necessary to involve transferring of entire genes from one organism to another, instead only target gene. All the NBTs have a similar aim to accomplish the difficulties obtained during traditional breeding method.

Important New Plant Breeding Techniques (NPBTs):

- **Site-specific nuclease (SSN) mutagenesis:** Using SSN technology, any gene of interest can be stably knocked out, mutated, or replaced. Depending upon the type of native repair pathway of plants, three different results can be expected i.e. SSN-1 (Nucleotide Deletion), SSN-2 (Nucleotide Substitution) and SSN-3 (Nucleotide Insertion).

- **Oligonucleotide-directed mutagenesis (ODM):** Introduction of small specific oligonucleotide either RNA/DNA which causes mismatch between native target site and introduced oligonucleotide and is then subsequently triggers cell’s DNA repair system to induce targeted manipulation/mutation of endogenous gene of the parent genome.

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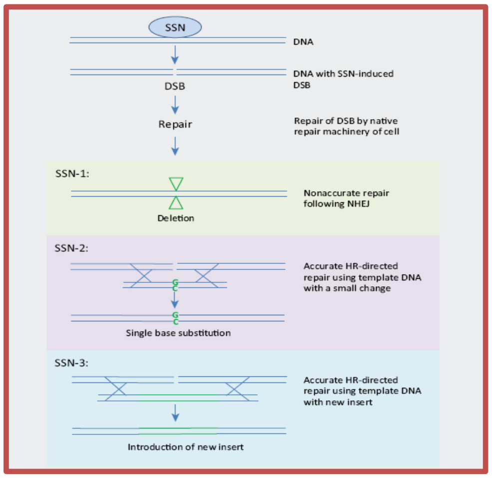


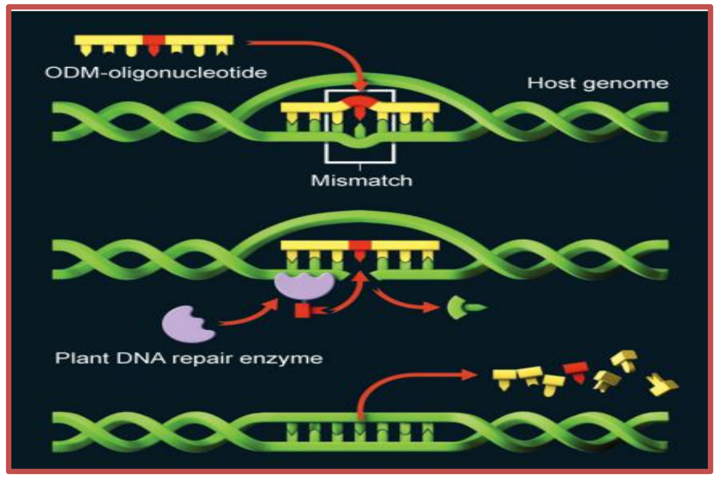
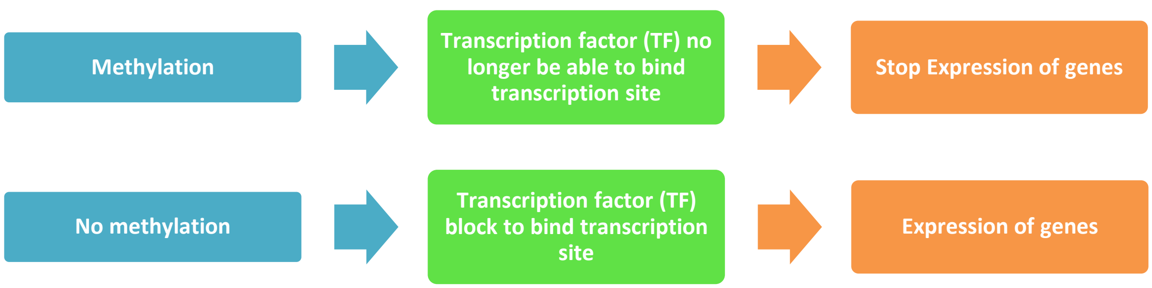


Figure 1: SSN technology (Schaart, 2016) **Figure 2: ODM technology (Source-http://cibus.com/)**

- **RNA-directed DNA-Methylation (RdDM):** RdDM enables changes in gene expression by switching off genes (gene silencing) or enhancing their function without bringing any change in the genomic sequence itself (epigenetics). It can be achieved by altering the methylation patterns of molecules associated with DNA by the introduction of double-stranded RNAs. These latter molecules are processed by different host enzymes of the RdDM machinery system and gene expression can be stably inherited for at least a few generations.



- **Marker-assisted selection (MAS):** Marker-assisted selection (MAS) refers to a breeding procedure in which molecular marker selection are integrated into a traditional breeding program. It allows the selection of monogenic and polygenic traits at the DNA level, regardless of the environment where plants are grown.
- **Cisgenesis and intragenesis:** Cisgenesis involves the production of (genetically modified) GM plants using donor DNA from the same species or a cross-compatible species. The introduced DNA is free from vector DNA and must consist of a natural gene of interest with its own introns as well as regulatory sequences (promoter and terminator).

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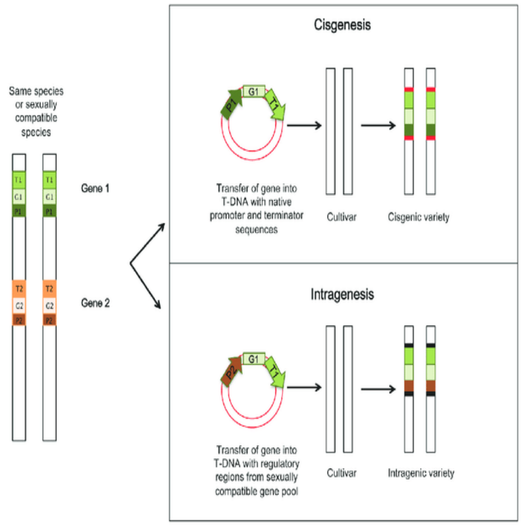

Figure 3: Cisgenicss vs Intragenics technology (Limera, 2017)

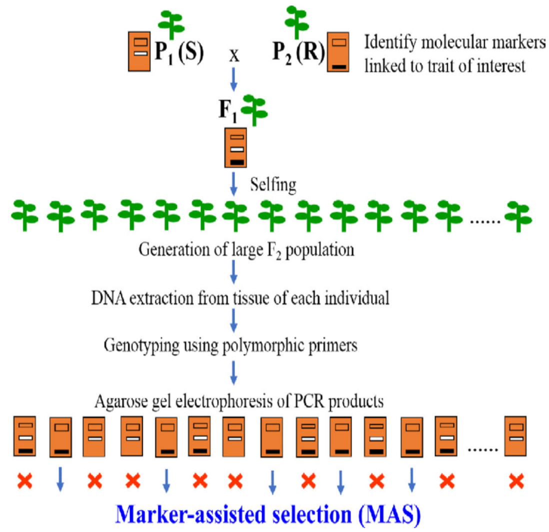

Figure 4: MAS technology (Rana et al. 2019)

Alike cisgenics, intragenics also involves the use of donor DNA from the same or a cross-compatible species, however, new combinations of DNA fragments are acceptable, for example using non-native promoters or introducing RNAi.

- **Transgrafting:** Trans-grafting involves joining of a GM plant with a non-GM plant. If a GM scion onto a non-GM rootstock, then stems, leaves, flowers, seeds and fruits will be transgenic. When a non-GM scion is grafted on a GM rootstock, leaves, stems, flowers, seeds and fruits would not carry the genetic elements of parent rootstock.

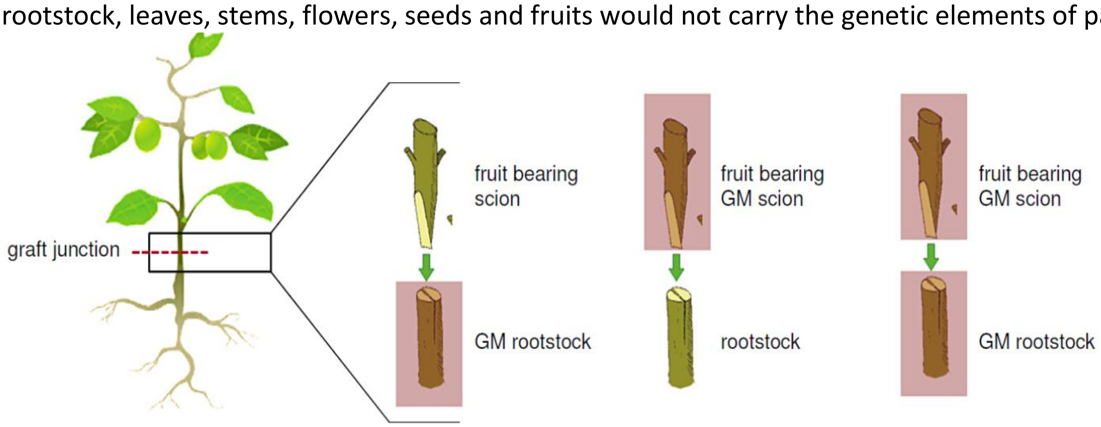

Figure 5: Three types of Cisgenics (Eckerstorfer, 2014)

The main focus in transgrafting is on the improvement of rootstocks by means of recombinant transformation techniques. This technique cannot be made use of in monocotyledonous crop plants like rice, maize and cereals (Schaart and Visser, 2009).

- **Reverse breeding**: During breeding programme, high performing heterozygous individuals that have undefined parentage may be identified in some cases. Reverse breeding is a technique that enables the breeders to go backward from such an individual to directly recreate the homozygous parental lines that created it, eventually allowing mass production of elite heterozygous genotype through seed (Dirks et al., 2006).
- **Agro-infiltration:** Agroinfiltration is a tool to achieve temporarily or local expression of genes that are foreign to the species in a plant itself. Plant parts, mostly leaves, are infiltrated the liquid suspension of *A. tumefaciens* cells for testing the reaction of target plants to transgenes in specific tissues. The response of the plant is monitored to select plants for further breeding. This technique is mainly used to create resistance for crops against diseases.

Potential application in current crop improvement programs

NBTs play an important role to establish a precise way of targeted genetic modifications, which have the capacity to fasten the plant selection speed. In combination of conventional plant breeding methods with new breeding techniques allows to develop plant varieties that can adapt in wider climatic conditions for longer duration. Maize plants tolerant to imidazolinone herbicides have engineered through targeted modification of the endogenous acetohy-droxyacid synthase (AHAS) gene (Zhu et al., 2000). The NPBTs 'induced early flowering' and 'Grafting on a GM rootstock' are promising approaches that may be applied and commercialised in the near future.

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Addressing multi nutrient deficiency in crop's through customized fertilizer

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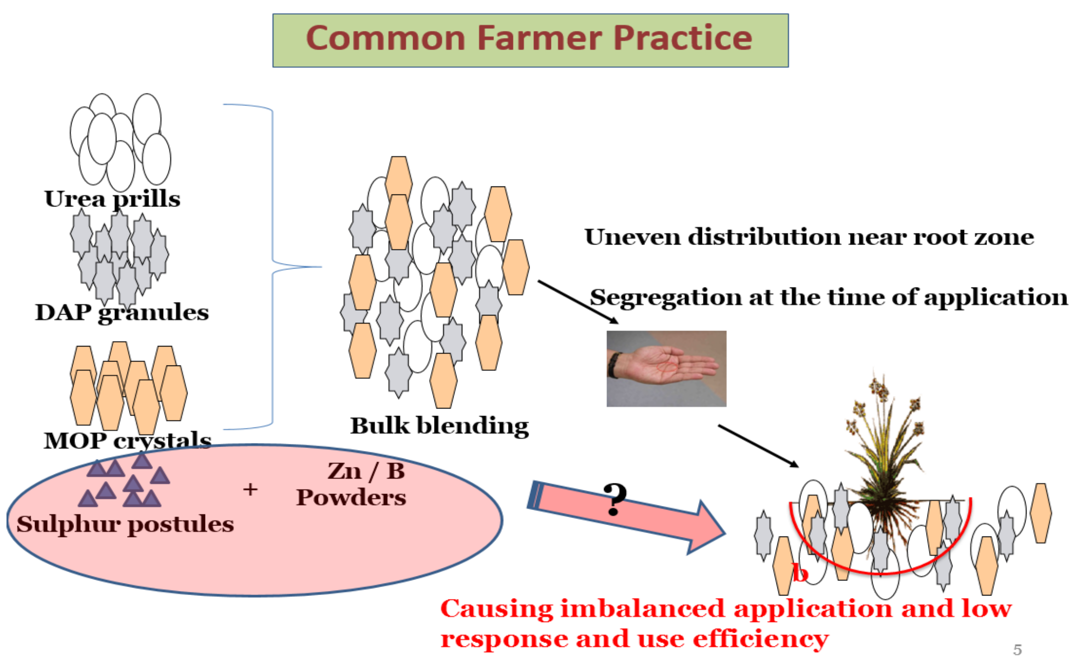
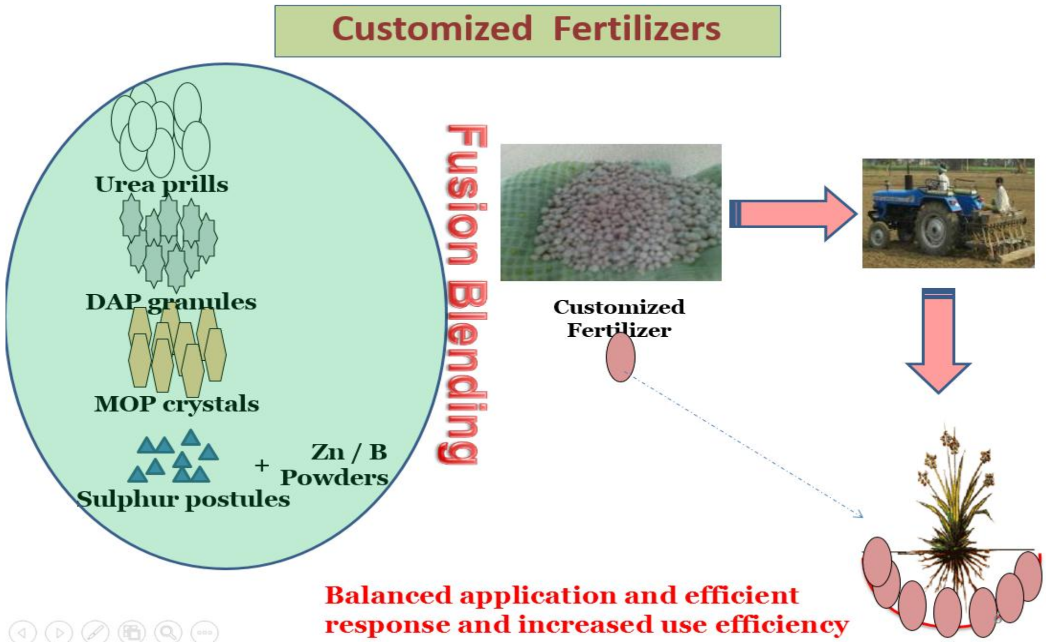
V. V. Rupareliya
Ph.D. (Scholar), Department of agronomy, College of agriculture, JAU, Junagadh-362001.
R. M. Solanki
Agronomist, Farming System Research Station, Department of Agronomy, JAU, Junagadh-362001.

INTRODUCTION

The deficiency of S, Zn, Fe and Mn are the limiting factors for crop yield during different periods. The decrease in productivity was observed to be associated with the new emerging problems of multi nutrient deficiency such as zinc (Zn) and sulphur (S). The balanced nutrient supply to the crops resulted in increasing cop yield and less effect on soil health and environment. The 'Customized Fertilizer', made up of mixing Nitrogen, Phosphorus, Potassium, Sulphur and Zinc has been tested for enhancing crop yield. Customized fertilizers are unique and ready to use granulated fertilizers, formulated on sound scientific plant nutrition principles integrated with soil information, extensive laboratory studies and evaluated through field research. The Central Fertilizer Committee has included customized fertilizers in the Fertilizer Control Order (FCO) 1985, as a new category of fertilizers that are area/soil/crop specific.





Advantages

1) It supplies the plant available nutrient in adequate amount and in proper proportion.
2) Customized fertilizer is a soil-crop-climate based fertilizer and is less influenced by soil, plant and climatic condition that lead to more uptake and less loss of nutrients.
3) Customized fertilizer supplies not only primary nutrients but also secondary and micronutrients.
4) Customized fertilizer reduces the cost of fertilizer application that ultimately reduces cost of cultivation.

5) Customized fertilizer is a major component of Site Specific Nutrient Management and Precision Agriculture, which promotes maximum fertilizer use efficiency of the applied nutrients in a cost-effective manner.
6) Soil health can be improved by developing site and crop specific fertilizers.

The farmers will have preference for customized fertilizers on account of the following points

- ✓ For better crop quality and productivity.
- ✓ Maximize nutrient use efficiency.
- ✓ Specific to crop and area based on soil fertility.
- ✓ Developed using scientific data base.
- ✓ Available in ready to use form in a balanced way.
- ✓ Improves soil fertility and is environment friendly.
- ✓ Adaptable to different field condition/ location.

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Following are some issues in marketing of customized fertilizers…

- ✓ Production Cost is high therefore these are costly fertilizers and not subsidized by Government of India.
- ✓ The diversity in product mix between producers.
- ✓ Allocation of raw material.
- ✓ Awareness of these fertilizers among farmers.
- ✓ These fertilizers are not affordable to small farmers.

Eligibility Criteria for Manufacture and Sale of Customized Fertilizers

- Permission for manufacture and sale of customized fertilizers shall be granted to only such manufacturing companies whose annual turnover is Rs.500 crore and above.
- Manufacturing companies should have soil testing facility with an annual analyzing capacity of 10,000 samples per annum for NPK, secondary and micro nutrients.
- Such laboratory must possess the requisite instrument *viz.,* Atomic Absorption Spectrophotometer, Flame Photometer, pH meter Conductivity Bridge, Kjeldhal Distillation *etc*.
- The grades of customized fertilizers, which company will manufacture, must be based on scientific data obtained from area-specific, soil-specific and crop- specific and soil testing results.
- Prospective manufacturers or marketers are expected to use the software tools like Decision Support System like DSSAT, crop models, etc. to determine the optimal grades of customized fertilizers.
- The manufacturing companies, in association with agricultural universities/KVKs concerned, should also conduct agronomy tests of the proposed grade to establish its agronomic efficacy.
- Such manufacturing companies should generate multi-location trials (not on farm demonstrations) on different crops for minimum one season.
- Such manufacturing companies must draw these soil samples from within its operational areas and should also ensure that minimum one sample is necessarily, drawn from University/ State government may also be used to prepare soil fertility map and for determination of required soil, area and crop specific grades for existing and potential marketing areas.

Manufacturing Methodologies

- ❖ Customised fertiliser manufacture basically involves mixing and crushing of urea, DAP, and MOP, Zn, S, bentonite sulphur and boron granules for obtaining the desired proportion of N, P, K, S and micronutrients.
- ❖ The mixture is subjected to steam injection, drying, sieving and cooling, so as to get a uniform product with every grain having the same nutrient composition.

Methods:

1. Bulk Blending
2. Compound Granulation/Steam Granulation
3. Complex/Chemical Granulation

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Customized Fertilizer Formulations

A better yield starts with a better mix. The system returns a formula using the most economical mix of available ingredients and an application rate minimized to cost per acreage.

Different Customized Fertilizer Formulations available in India

Sr no.	Company	Crops	Formulations (N:P:K:S:Zn:B) / N:P:K: Zn / N:P:K:S:Mg:Zn:B:FeN:P:K:S:Zn:B)	Geography
1	**Tata Chemicals Ltd.**	Potato	8:16:24:6:0.5:0 .15	Agra, Aligarh, Budaun, Buland Shahar And Baghpath
2		Wheat	10:18:25:3:0.5:0	Muzaffarnagar, Barielly, Bijnore, Hathras, Pilibhit, Mathura, Meerut And Etah
3		Paddy	15:32:8:0.5,18 :33 :7:0.5,18:27:1 4:0 .5	Andhra Pradesh
4		Maize	14:27:10:4:0.5	Karimnagar, Warangal and Ranga Reddy
5	**NFCL**	Rice	11:24:6:3:0.5	Andhra Pradesh
6		Maize	14:27:10:4:0.5	Adilabad, Nizambad, Karimnagar
7	**Corom. Int**	Maize	14:20:14:4:0.5	Adilabad, Nizambad, Karimnagar
8		Groundnut	17:17:17:4:0.5:0.2	Anantpur, Chittor, Kadapa, Kurnool
9	**Deepak Chemicals & Petrochemicals corporation**	Grape, Pomegranate, Paddy, Sugarcane, Tomato, Gourds and Leafy vegetables Sugarcane, Citrus	20:10:10:5 :2:0.5:0.3:0.2 15:15:15:5:2:0.5:0:0 .2 10:20:20:3 :2:0.5:0.3:0.2	Nasik, Dhule, Jalgaon, Pune, Ahmednagar and Aurangabad
10		Groundnut	15:15:15:9:0.5:0.2	Andhra Pradesh
11		Maize	20:0:15:0 :0:0.2	Andhra pradesh
12		Paddy(Basal)	16:22:14:4:1:0	East Godawari, West Godawari, Krishna, Guntur
13		Maize(Basal)	14:20:15:4:0.6:0	Karimnagar, Warangal and Nizamabad
14		Groundnut (Basal)	17:17:17:4:0.5:0.2	Anantapur, Chittoor, Kadapa, Kurnool and Mahaboobnagar

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Impact of Tillage on Soil Carbon sequestration

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Mohammad Hasanain*[1], Deepak Kumar Meena[2], Sanjeev Singh[3], Durgesh Kumar Maurya[4], Sandeep Kumar Verma[5], and Pradeep Kumar Singh[6]

[1], Ph.D. Scholar, Division of Agronomy, ICAR-IARI, New Delhi 110012;

[2], M.Sc. Scholar, Department of Agronomy, G.B. Pant University of Agriculture and Technology, Pantnagar-263 145 Uttarakhand

[4,5, 6], M.Sc. Scholar & [3]Ph.D. Scholar, Department of Agronomy, Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut 250110;

INTRODUCTION

Sequestering atmospheric CO_2 is essential by its present concentration which is increasing at the rate of 2 ppm per year. Soil is a larger terrestrial sink of carbon on the planet and store in the form of soil organic carbon (SOC). The ability of soil to store carbon or sequester carbon depends on several factors such as climate, soil type, type of crop and vegetation cover and more importantly agricultural management practices. Several agricultural practices such as conservation tillage, crop diversification, cropping system, etc. Enhance carbon storage in soil, preserving existing soil carbon and reducing CO_2 emission. Carbon sequestration refers to the providing of long-term storage of carbon in the underground, terrestrial biosphere, or in the oceans so that the accumulation of carbon dioxide (the principal greenhouse gas) concentration in the atmosphere will reduce or slow down (Lal *et al.,* 1995). Carbon sequestration by agricultural land has made international interest because of its probable effect and benefits for agriculture and climate change. Agriculture one of the many potential solutions to addressing the greenhouse gases problem by proper soil and crop residue management technique is implemented.

Carbon benefit to the soil

In general, Soil carbon or organic matter is important because it affects all soil quality functions (Fenton *et al*., 1999):

- It sustaining biological activity, productivity, and diversity.
- Buffering, degrading, clarifying, immobilizing, and depolluting organic and inorganic materials, such as public & industrial byproducts and atmospheric deposition.
- It enhances the storing and cycling of nutrients and other elements within the earth’s biosphere.

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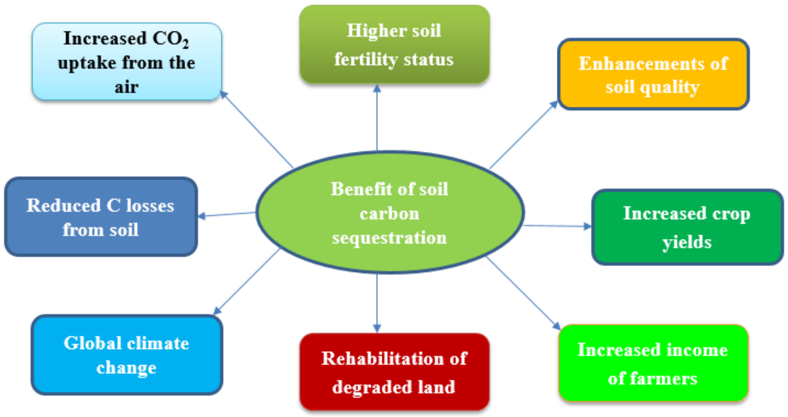
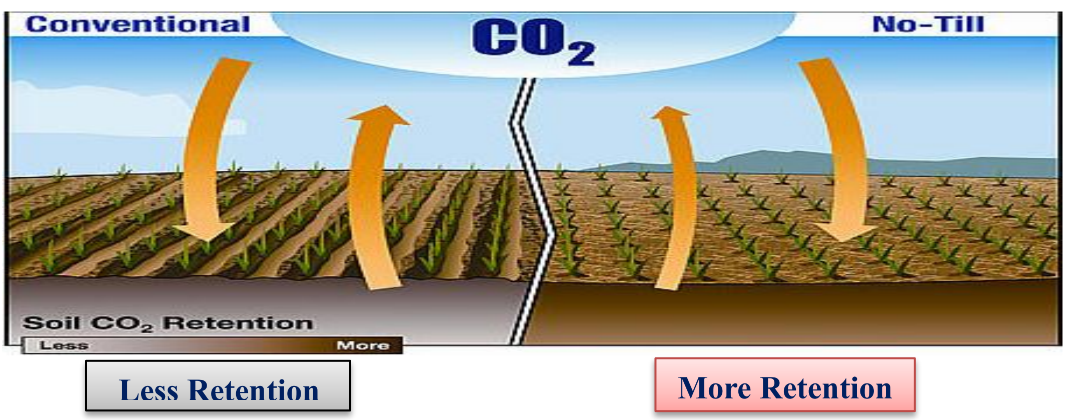


Fig. 1: Benefit of soil carbon sequestration

How Carbon Sequestration is gets enhanced

- Declining the level of soil disruption (*i.e.* tillage) to enhance the physical properties of soil carbon in masses.
- It improves the quality & mass of the plant.
- It maintains a continuous living plant cover on soil.



Impact of tillage on soil carbon sequestration

- ❖ Under conventional tillage the breakdown of residue less than carbon sequestration in the soil system in conservation tillage.
- ❖ Soil physical properties improve such as soil structure, infiltration rate, soil aeration, water holding capacity and other physical properties under higher carbon stored soil.
- ❖ Under crop residue and critical components of soil management wind and water, erosion is reduced.
- ❖ Inappropriate soil and residue managing bare that increased erosion by wind & water.
- ❖ The most effective way to minimize soil erosion is through conservation tillage practices.

- The improving soil quality in terms of carbon content at the upper part of the soil profile where permanent crop residue covers in no-tillage practices.
- Tillage can cause the loss of significant amounts of carbon (lost as CO_2 bursts) immediately after tillage.
- The exposure of soil organic carbon to aeration during soil erosion increases CO_2 emissions.
- In addition, soil erosion can cause carbon to accumulate with soil sediments and be removed from the soil carbon pool.
- The removal of carbon from the soil will lead to a decline in soil fertility and aggregate stability.
- The rapid breakdown of plant residues, reduce CO_2 emission and reduce the production of inorganic dissolved nitrogen (i.e., nitrate and ammonium) in the soil can minimize by conservation tillage practice.
- CO_2 emission from soil and N-uptake by crops both are reduced by converting of conventional tillage to conservation tillage.

CONCLUSION

Thus, it is concluded that carbon sequestration is a long term process to impacts of conservation tillage, residue management, manure and fertilizer use, crop rotations, etc. The system that improves soil carbon sequestration as a long term management tool. Therefore, farmers need to think long term when thinking about carbon sequestration.

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Precision Farming: A Sustainable Way of Agriculture

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Deeksha Gautam* and Apoorva Palled[1]
Ph.D scholar, division of fruit science and technology, College of Agriculture (OUAT, Bhubaneshwar) - 751 003 (Odisha)
Ph.D scholar, division of vegetable science [1]College of Horticulture Bagalkote, (UHS, Bagalkote)- 587 104 (Karnataka)

INTRODUCTION

Increase in population of both man and animal in the last century and fast growing industrialization and urbanization in last few decades have overstrained the natural resource base very fastly. Thus, the attention of whole world is focused on how to increase production to feed the burgeoning population in a sustainable way without harming the natural resources. Successful implementation of precision agriculture depends on numerous factors, including the extent to which conditions within a field are known and manage, the adequacy of input recommendation and the degree of application control.

Precision Agriculture is the application of technologies and principles to manage spatial and temporal variability associated with all aspects of agricultural production for improving production and environmental quality. Precision farming is not simply the application of treatments at the local level, but also requires the monitoring and assessment of an agricultural enterprise at a local and farm level, along with sufficient understanding of the processes involved to apply the inputs. Precision farming not only may utilize fully resources, reduce investment, decrease pollution of the of the environment and get the most of social and economic efficiency, but also makes farm products, the same as industry, become controllable, and be produced in standards and batches. Therefore, the techniques of precision farming is a feasible approach for the concept of sustainable land management.

Components of precision farming:

Major components of technology used for PF management practices includes Geographical Information Systems (GIS), Global Positioning Systems (GPS), sensors, variable rate technology (VRT) and yield monitoring (YM). All are briefly discussed below:

1. Geographical Information Systems (GIS)

GIS computer software for precision farming management will store data, such as soil type, nutrient levels, etc. in layers and assign that information to the particular field location. They can be used for developing application map to analysis the different characteristics of layes. Map based on variability of nutrients levels, soil type, topography, pest incidence and yield can also be prepared which will ultimately help to maintain the yield and production precisely in sustainable manner. But not all the maps are prepared by using GIS.

Software for preparing these maps commonly are of three type. First, that automatically create the map from given data. This is technically just mapping software. For example JDMap, Agleader Precision Map 2000, Micro-Trak utilities, and FarmWorks Quick Yields. In second type, there is flexibility to modify the parameter and prepare map of several traits. Example includes SGIS, Crop Growers VisAg, Farmsite, and AgINFO. The third classification of *GIS* software has a front-end added to it so that it can be used for

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agricultural mapping, such as SSToolbox, FarmHMS, RDI AgMAPP, and AgLink. Whether you decide to create your own maps, or enlist the aid of an expert, it is important to analyse maps carefully.

GPS is a set of 24 satellites in high altitude orbit above the earth which continuously transmit radio signals that are picked up and deciphered by special receivers. A GPS receiver requires atleast four satellites to determine its positions on earth. Sensors are being developing to determine crop stress, soil properties, pest incidence, etc. as the tractor passes over the field, as a scout goes over the field on foot and many more. *GPS* that utilizes a reference signal to gain more accurate positional data is a *differential global positioning system (DGPS).*

2. Variable rate technology (VRT)

Variable rate technology (VRT) includes computer controllers and associated hardware to vary the output of fertilizer, lime, and pesticides. These controllers are manufactured by many companies and can take application map with the GPS to locate your field positions and control the hardware that varies the application rate. Application of herbicides and insecticides is good example of variable rate technology. Variable rate herbicides and insecticides application can be associated with soil sampling, *GPS*, and *GIS.*

Here the *GPS* tells the operator where on the field the tractor is located. The *GPS* links with the *GIS* to tell the controller what the field characteristics are at that location. The pre-determined yield goals and 'on the go' sensor will then dictate the precise amount of chemicals to apply at that spot. The controller then manipulates the machinery to apply the correct amount of chemicals.

3. Yield Monitoring

Yield Monitoring is the most direct method to assess the field production and how it should be better managed. A yield monitor measures the crop as it is harvested. As the yield is measured, data are stored on a computer along with the *GPS* coordinates at the point where the yield was measured. After that Mapping software can create a yield map which will provide information of yield variability, and yield production. Grain yield monitors have also been developed for many crops.

Advantages of precision farming:

1. It will increase the production and yield without degrading the soil with sustained agricultural development.
2. It reduces the excessive chemical use.
3. Resources will be utilized efficiently.
4. Non uniform fields can be sub divided into smaller plots based on their unique requirements.
5. Nitrate leaching loss and ground water contamination can be reduced.

Disadvantages of precision farming:

1. High capital costs, so difficult to adopt by poor farmers.
2. Precision farming is still not a fully developed technique; it requires expert advice before implementation.
3. Difficult to understand and require skills.

Thus, precision farming is not necessarily maximum yield; it may be maximum financial advantage for given environmental constraints. Effective coordination among the public and private sectors and growers is, therefore, essential for implementing such type of new strategies to achieve fruitful success.

However due to unique pattern of Indian lands, poor infrastructure, lack of farmers inclination to take the risk, social and economic conditions, India is still at blossoming stage in adoption of precision farming.

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Water footprint of Crop Production in Indian Agriculture: An overview

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M. Sharath Chandra[1], Rahul Indar Navsare[2], and Shaikh Wasim Chand[3]
[1]Ph.D Scholar, Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P)-250110, India
[2]Ph.D Scholar, Department of Soil science & Agricultural chemistry, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P)-250110, India
[3]Ph.D Scholar, Department of Agronomy, Vasantrao Naik Marthwada Krishi Vidhyapeeth, Parbhani (M.H)- 431402, India.

India has been the fifth largest exporter of virtual water in the world. Based on the water footprint of the country, the magnitude of use of inland water resources for the export of crop products from India has been quite significant. The blue water footprint refers to the volume of surface and groundwater consumed (evaporated) as a result of the production of a good; the green water footprint refers to the rainwater consumed. The grey water footprint of a product refers to the volume of freshwater that is required to assimilate the load of pollutants based on existing ambient water quality standards.

INTRODUCTION

The concept of 'water footprint' introduced by Hoekstra (2003) and subsequently elaborated by Hoekstra and Chapagain (2008) provides a framework to analyze the link between human consumption and the appropriation of the globe's freshwater. India has the highest national freshwater demand globally and 91 percent of our freshwater is used in the agriculture sector. Cereals account for over 50 percent of the dietary water footprint in India and represent a potential opportunity for reducing water use in Indian agriculture.

Definition

Water footprints is defined as the "ratio of the volume of consumptive water use (m^3) to the quantity (ton) of produce of interest and can be used to indicate direct and indirect appropriation of freshwater resources. The water footprints of crops are expressed as volume of water consumed per unit quantity of produce (m^3 ton^{-l} or liter kg^{-l}) but units depend on what is being studied in the water footprint. The water footprint measures the amount of water used to produce each of the goods and services we use. It can be measured for a single process, such as growing rice, for a product, such as a pair of jeans, for the fuel we put in our car, or for an entire multi-national company. The water footprint can also tell us how much water is being consumed by a particular country – or globally – in a specific river basin or from an aquifer.

It can be considered as an indicator of freshwater use that articulates not only direct water use of a consumer or producer, but also the indirect water use along the whole supply chain. But, the extensions in terms of Blue, Green and Grey water provide a rational approach to analyzing indirect water use in an efficient way (Fig. 1).

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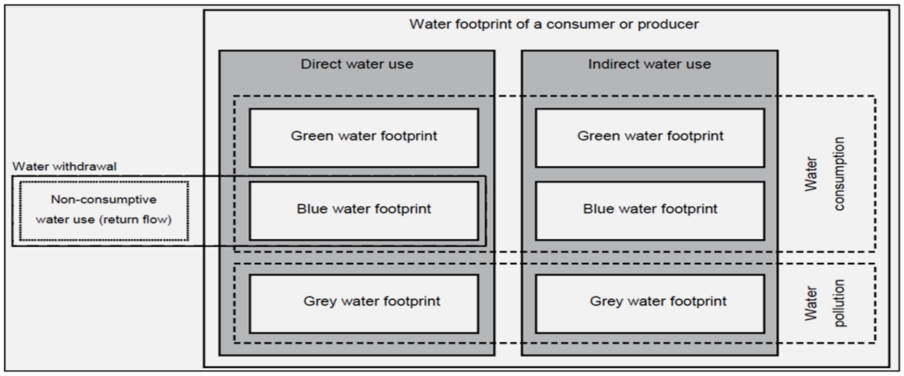


Fig.1: Concept diagram of water footprint

Types of water footprints: The water footprint has three components: green, blue and grey. Together, these components provide a comprehensive picture of water use by delineating the source of water consumed, either as rainfall/soil moisture or surface/groundwater, and the volume of fresh water required for assimilation of pollutants.

1) **Green water footprint** is water from precipitation that is stored in the root zone of the soil and evaporated, transpired or incorporated by plants. It is particularly relevant for agricultural, horticultural and forestry products.
2) **Blue water footprint** is water that has been sourced from surface or groundwater resources and is either evaporated, incorporated into a product or taken from one body of water and returned to another, or returned at a different time. Irrigated agriculture, industry and domestic water use can each have a blue water footprint.

The actual equation to determine the WFblue and WFgreen is rather simplistic; the crop water use (in cubic meters per hectare) is divided by product yield (expressed in tons per hectare).

$$\mathbf{WF\ blue} = \frac{\mathbf{CWUblue}}{\boldsymbol{Y}} \qquad \boldsymbol{WFgreen} = \frac{\boldsymbol{CWU\ green}}{\boldsymbol{Y}}$$

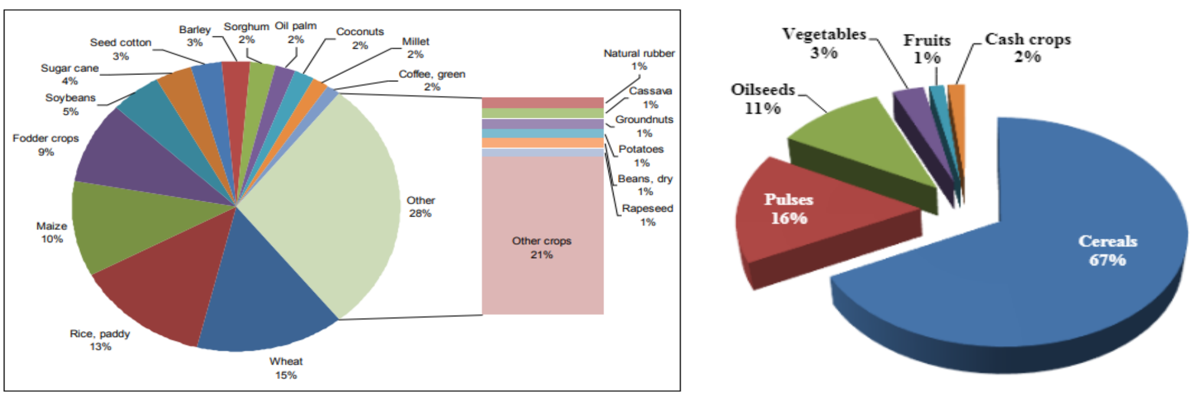
Grey water footprint is the amount of fresh water required to assimilate pollutants to meet specific water quality standards. The grey water footprint considers point-source pollution discharged to a freshwater resource directly through a pipe or indirectly through runoff or leaching from the soil, impervious surfaces, or other diffuse sources. When applied to growing an agricultural crop such as wheat or rice, the grey component of the total footprint is calculated as follows: the chemical application rate (mass per hectare) is multiplied by the leaching fraction, and then divided by the difference in maximum pollutant concentration and natural pollutant concentration. Lastly, the volume per hectare is divided by the crop yield (ton per hectare) (Hoekstra et al., 2009).

$$\boldsymbol{WFgrey} = \frac{(\propto \times \boldsymbol{AR})/(\boldsymbol{Cmax} - \boldsymbol{Cnat})}{\boldsymbol{Y}}$$

Direct and indirect water use:

The water footprint looks at both direct and indirect water use of a process, product, company or sector and includes water consumption and pollution throughout the full production cycle from the supply chain to the end-user. It is also possible to use the water footprint to measure the amount of water required to produce all the goods and services consumed by the individual or community, a nation or all of humanity. This also includes the direct water footprint, which is the water used directly by the individual(s) and the indirect water footprint – the summation of the water footprints of all the products consumed.

Mekonnen and Hoekstra (2010) reported that the global water footprint of crop production in the period 1996-2005 was 7404 Gm^3/year (78% green, 12% blue, and 10% grey). Wheat takes the largest share in this total volume; it consumed 1087 Gm^3/yr (70% green, 19% blue, 11% grey). The other crops with a large total water footprint are rice (992 Gm^3/yr) and maize (770 Gm^3 /yr). The contribution of the major crops to the global water footprint related to crop production is presented in Fig. 2a. Jayaram (2016) reported that the water used for agriculture in india in the year 2007-08 is estimated at 962.167 bcm (billion cubic meters). This water footprint includes water used for production that was consumed within the country i.e., internal water use (IWU) and production that was exported, net of imports. Production of cereals leaves a water footprint of 647.032 bcm followed by pulses which used 152.85 bcm, oilseeds at 103.053 bcm, fruits and vegetables at 43.204 bcm and cash crops at 16.022 bcm. The contribution of individual produce groups to the total water footprint is depicted in Fig. 2b.



(a) **(b)**

Fig. 2: a) Contribution of different crops to the total water footprint of crop production. Period: 1996-2005 [Source: Mekonnen and Hoekstra, 2010]. **b)** Share of produce groups in total water footprint [Source: Jayaram, 2016].

CONCLUSION

The total water footprint of India is the largest mainly depends on green water, blue water footprint and grey water foot print; a large fraction of it is made up of green water. The water footprint of a product in crop production of Indian agriculture: Green water footprint: volume of rainwater evaporated or incorporated into product. Blue water footprint: volume of surface or groundwater evaporated, incorporated into product or returned to other catchment or the sea. Grey water footprint: volume of polluted water.

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Role of Livestock in Indian Economy

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Alok rai
Ph.D. Scholar, Animal Husbandry and Dairying, CSAUAT, Kanpur

Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average 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.

Contribution of livestock to people:

The livestock provides food and non-food items to the people.

Food: The livestock provides food items such as Milk, Meat and Eggs for human consumption. India is number one milk producer in the world. It is producing about 176.30 million tones of milk in a year (2017-18). Similarly it is producing about 95.20 billions of eggs, 7.70 million tonnes of meat in a year.

Fibre and skins: The livestock also contribute to the production of wool, hair, hides, and pelts. Leather is the most important product which has a very high export potential. India is producing about 41.5 million Kg of wool per annum during 2017-18.

Draft: Bullocks are the back bone of Indian agriculture. Despite lot of advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks. In situations like hilly terrains mules and ponies serve as the only alternative to transport goods.

Dung and other animal waste materials: Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man’s cement (dung).

Storage: Livestock are considered as 'moving banks' because of their potentiality to dispose off during emergencies. They serve as capital and in cases of landless agricultural labourers many time it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

Weed control: Livestock are also used as Biological control of brush, plants and weeds.

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Cultural: Livestock offer security to the owners and also add to their self esteem especially when they are owning prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.

Sports / recreation: People also use the animals like cocks, rams, bulls etc for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu) are quite common during festive seasons.

Companion animals: Dogs are known for their faithfulness and are being used as companions since time immemorial. When the nuclear families are increasing in number and the old parents are forced to lead solitary life the dogs, cats are providing the needed company to the latter thus making them lead a comfortable life.

Role of livestock in farmer's economy:

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in different ways.

Income: Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

Employment: A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The landless and less land people depend upon livestock for utilizing their labour during lean agricultural season.

Food: The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners. The per capita availability of milk is around 375 g / day; eggs is 74 / annum during 2017-18.

Social security: The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions. Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; Bulls and Cows are worshipped during various religious functions.

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Draft: The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.
Dung: In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

Livestock Population (20th census,2019):

Species	Number (in millions)	First rank in India
Cattle	192.46	West Bengal
Buffalo	109.85	Uttar Pradesh
Sheep	74.26	Telangana
Goat	148.88	Rajasthan
Pig	9.06	Uttar Pradesh
Camel	------	Rajasthan
Total Poultry	851.81	Tamil Nadu

Production of Livestock in India (2017-18):

Product	Quantity	First rank in India
Milk in million tonnes	176.30	Uttar Pradesh
Egg in billion	95.20	Andhra Pradesh
Meat in million tonnes	7.70	Uttar Pradesh
Wool in million Kg	41.50	Rajasthan
Fish in million metric tonnes	12.61	West Bengal

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Natural and artificial breeding of carp

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Satarupa Ghosh[1*], Kalyan Mandi[2] and Prasanna Pal[3]
[1]Ph.D. Scholar, Aquatic Environment Management Department, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal- 700037, India
[2]Ph.D. Scholar, Department of Dairy Extension, ICAR-National Dairy Research Institute, Karnal, Haryana- 132001, India
[3]Ph.D. Scholar, Animal Physiology Division, ICAR-National Dairy Research Institute, Karnal, Haryana- 132001, India

INTRODUCTION:

Fish cultivation is one of the major professions for the people of India. To achieve a good production, one should have a good knowledge about the breeding of fish, specially carps. In this article, we have briefly discussed about the natural and artificial breeding of carps. In carp, sexes are separate. Sexual dimorphism only become pronounced during monsoon seasons. But Cyprinus carp may breed during winter season also. During spawning, male and female starts courtship activities by wrapping with each other in inundated terrains, which is their main spawning ground. At the time of their sexual embrace, female fish releases egg and male fish releases milt in their surrounding water. As fish exhibit external fertilization, so eggs become externally fertilized by milt which are secreted by male fish during spawning activities. Carp especially Indian major Carps are promiscuous and polygamous fish.

BREEDING SEASON:

Indian Major Carp mainly breeds during south-West monsoon season. They naturally spawn during Aug-Sep in inundated terrains adjacent to shallow waterbody during flood accompanied by thunderstorm. Carp generally does not breed during the first flood.

BREEDING GROUND:

Inundated terrains adjacent to shallow waterbody is the most favored spawning ground of Major Carp. Advantages of inundated shallow terrains as the breeding ground are discussed briefly.

- Fresh flood kills fauna and flora present in inundated shallow water body. Microflora and micro fauna produced through the decomposition of the flora and fauna present in the inundated region. So, there is a constant supply of natural food in inundated shallow terrain.
- Water of fresh flood is very much warm and full of oxygen, so this provide enough oxygen for the growth of the developing embryo.
- This region will be free from predatory insects and predatory fishes that are supposed to feed on carp fry and spawn.

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TYPES OF BREEDING OF CARPS:

There are mainly 3 methods through which carp can breed.

1. **Natural breeding of carp in riverine water:**

Carp generally spawn in flowing waterbodies like stream or riverine waterbodies. Carp does not breed in confined water and exclusively riverine seasonal spawner. During rainy season, when there is enormous flow in the riverine water, mature female fish generally starts swimming against water flow and mature male fish follow her. Then in area with little flow specially inundated shallow terrains, male and female fish start their sex act among themselves. This phenomenon called sporting of fish. At the end of the sporting activities, female fish release large number of eggs into the water. Ovulation immediately proceed spermiation. So, male fish release milt upon the egg mass, which become fertilized as a result of that. This activity is known as spawning activity. Being heavy the eggs become settled at the bottom of the water body. A type of funnel shaped net called "behundi" is used to collect egg and hatchling from waterbody.

2. **Bundh-breeding:**

Bundh-breeding is the first attempt to breed carp in confined water-bodies. Wide spread application of bundh-breeding is mainly seen in various places of Midnapore and Bankura district of West Bengal. Bundh is a seasonal or perennial type of pond which is mainly located at the slope of a catchment area. During rainy season, water of catchment area is allowed to flow through narrow canal into the pond. This kind of water flow during rainy season simulates the riverine condition. Two types of bundhs are there. They are mainly dry bundh and wet bundh. Wet bundh contain water for all the months of the year. But dry bundh does not contain water for year round but contain water during rainy season only.

3. **Artificial or induced breeding:**

Collection of eggs and fingerling from natural breeding ground of Carp is an age-old process. But this process presents some problem regarding quality of collected seed.

- ✓ There are great chances of mixing of carp seed with many predatory fish species.
- ✓ Fish farmers can't select seeds according to their choice of priority.
- ✓ Amount of collected eggs and seed are very less amount.
- ✓ Long distance transport of fish seed is very much cost-effective and cumbersome process.
- ✓ Transportation stress can also cause mortality of the seed and hatchlings.

Advantages of artificial breeding:

- ✓ There are least chances of mixing the eggs of the different fish species. So, fertilized eggs of different species are remained pure. So, there is more or less no chances of mixing of egg of the unwanted species.
- ✓ According to the choice of the consumer, rohu, caltla, mrigel, grass carp and silver carp eggs can be produced.
- ✓ Healthy fingerlings become easily available to the consumer.
- ✓ Egg of carps can be produced and collected from the confined water.
- ✓ There are least chances of wastage of eggs.
- ✓ Multiple breeding can be possible through the adoption artificial technique.
- ✓ Transportation cost of the eggs are very less.

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Necessary steps for artificial breeding in hapa through the use of pituitary gland:

- ✓ Rearing of the mature fishes in the breeding pond.
- ✓ Selection of the ideal fishes for induced breeding purposes.
- ✓ Collection of fish pituitary gland.
- ✓ Conservation of fish pituitary glands.
- ✓ Preparation of fish pituitary gland extract.
- ✓ Determination of level of hormone for injection of pituitary gland extract.
- ✓ Injection of the hormone in fish body in required quantity.
- ✓ Transfer of male and female fishes in the hapa.

Use of hapa in fish breeding:

Mainly there are two kinds of hapas are used in the induced breeding purposes of the carps.

❖ **Breeding hapa:** This kind of hapa is made up of mainly nylon or markin cloth. Area of the breeding hapa depends upon the body weight of the fish. Ideal size of the fish hapa is 2m in length, 1 m in width and 1 m in height. More than half portion of the hapa should be submerged in the pond water. Lower part of the hapa should not touch the mud of lower part of the pond. The sex ratio for male and female fishes in the hapa is 2:1. Female fishes to be injected the 2nd dose of the inducing agent during the 1 st dose of male fish. Then they are released in to the breeding hapa. After 3- 4 hours of the injection, they start their sex play in the water. After 4 to 6 hours female fishes start laying eggs and male fishes start releasing their sperm. Fertilized eggs are become clear and transparent and unfertilized eggs are whitish and pale. After 4-5 hours when they become hardened, transferred to another container.

❖ **Hatching hapa**: Hatching hapa consists of outer hapa and inner hapa. So, it is otherwise known as double hapa. Outer hapa made up of markin cloth and the size is 2m in length, 1 m in width and 1 m in depth. The inner hapa is made up of mosquito net and the size is 1.5m in length, 75 cm in width and 50 cm. in depth.

Use of hatchery in fish breeding:

Mainly there are three kinds of hatchery are used in the induced breeding purposes:

- ✓ **Chinese hatchery**: It is cemented and circular watery area where flowing of water occurred in a circular motion.
- ✓ **Glass -jar hatchery**: It is a well-controlled hatchery system, in which many glass jars are retained. Each jar contains 50,000 eggs.
- ✓ **Cemented hatchery**: This kind of hatchery contains Square/rectangular cemented cylinder.
- ✓ Apart from these Amitava hatchery and Dwibedi hatchery are also used.

Advantages of using synthetic hormones:

- ✓ Single dose is enough for their efficacy.
- ✓ Fishes can hardly face any stresses during their usage.
- ✓ These hormones are usually available in liquid soluble form, so least hindrances are faced during their usage.
- ✓ These hormones can be preserved in normal temperature.
- ✓ Good quality and quantity of eggs can be obtained.

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Some commercial synthetic hormones:

- ✓ Ova-FH: Okhawuirt pvt limited, Mumbai.
- ✓ Ovaprim: Syaden laboratory, Kanada.
- ✓ Ovatide: Hemmofarma laboratory, Mumbai.

CONCLUSION

Pituitary induced spawning of major carps in confined waters has become a wide spread practice. The shortage of pituitary glands is often quoted as important problem for raising large scale production of quality fish seed of Indian major carps by induced breeding. With the rising demand for pituitary extracts and difficulties in their mass procurement in recent year, a need for substitute of pituitary is being increasingly felt by the fish outlets. In this context, it is quite reasonable to believe that use of either EMC or ECG in combination with PG demand by reducing the requirement of pituitary at least by 50% for inducing spawning of Indian major carps.

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Coffee berry borer

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J. Sandeep kumar[1] and R. Nagasri navya [2]
1. PhD scholar, Department of Entomology, AC & RI, Madurai (TNAU)
2. PhD scholar, Department of Entomology, AC & RI, Coimbatore (TNAU)

The Coffee berry borer: *Hypothenemus hampei* (Scolytidae: Coleoptera)

This is an exotic pest introduced in Tamil Nadu, Kerala and Karnataka. The adult is a tiny black beetle. The female beetle is 1.5-2mm long. Its head is so deflexed under the thorax that its mouthparts occur closer to the front legs. The female beetle makes a cleancut circular hole almost always in the tip of the berry in the naval region and bores in for a short distance. The infested berries have a distinct blue green staining. Up to 12 larvae can be inside a berry. Over ripe berries have holes on the sides too. The infested berries fall. Nearly 30-80% of the berries are damaged.

Life cycle:

- The female lays about 50 eggs in the tunnel made by it on the mature berry.
- The eggs hatch in 5-9 days.
- The apodous larvae with a brownish head feeds on the berry making small galleries off the main tunnel bored by the adult.
- The total life cycle occupies 25-36 days.
- The adults live for about 5 months.
- The female to male ratio is 10:1.
- The males are not able to fly.

Management:

- Destroy the infested berries by burning them.
- Use the infested berries after dipping in boiling water for 2-5 minutes.
- Collect the fallen berries thoroughly leaving none on the ground.
- Remove the unseasonal berries.
- Do not leave behind any berry on the plants after harvest.
- Avoid excessive shade and regulate the shade.
- Never allow the coffee plant to grow too high to reach.Remove the dead branches and prune the plants to facilitates better ventilation and illumination.
- The fungus *Beauveria bassiana* kills the borers when the humidity is high
- The exotic parasitoids introduced from Indonesia, Srilanka and Brazil namely *Cephalonomia stephanoderies* and *Prorops nasuta* can be multiplied on the berries infested by the borer and released innundatively in the field.
- *Crematogaster curvispinosa* is predaceous on coffee berry borer.
- Take plant protection measures simultaneously in all plantations.
- Set up traps with ethyl: methyl alcohol (1:1) to attract adults.

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- Spray, if necessary, endosulfan 35 EC 340ml/200 litre at 120-150 days after flowering.
- Follow Post harvest precautions and seed quarantine measures to check the spread by cross infection.
- Fumigate all gunny bags both at estate level and at curing level before filling them with berries.
- The beetle cannot thrive in berries that are dry enough.So dry the berries to the prescribed moisture level while processing at the estate level: Arabica/robusta parchment 10%, Arabica cherry 10.5% and Robusta cherry 11.0%.

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Papaya (*Carica papaya* L.): Enriched source of medicinal and nutritional values

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Archit Singh* **and Tejbal Singh**
Department of Horticulture, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi- 221005 (U.P.)

Papaya belongs to the family Caricaceae, botanically called as berry fruit, it originated from Tropical America, has become a popular fruit due to its fast growth, high yield, long fruiting period and rich in nutritional values. In addition it has been use as vegetable, fruit processing, and papain production at immature stage. The papaya plant has male, female, hermaphrodite (bisexual flower) and some other complex forms. Male plants do not bear any fruit, normally the fruit shape from female plant is shorter, but the fruit shape from hermaphrodite (bisexual flower) plant is longer. Papaya plant grows straight up to 16 to 33 feet tall. Papaya plant are sensitive to frost, strong winds and highly susceptible to water logging or stagnation. The papaya is highly productive and interesting crop as well as highly profitable crop, now. It is easy to grow as short duration crop. As a raw fruit, it is used in cooking and ripe fruit as a table purpose. Ripe fruit is very delicious and rich in vitamin A and Carbohydrates. Its latex is used as a papain in food and medicine industry.

Why cultivation of papaya?

- Papaya produces fruits throughout the year.
- It is short duration, high yielding and more profitable crops.
- It requires less area for plantation, comes to fruiting in a year.
- Provides more income/ha next to banana.
- It has a high nutritive and medicinal value.
- Papain prepared from dried latex of its immature fruits is used in meat tenderising, manufacture of chewing gum, also use in cosmetics.
- It is rapidly growing, fruit plant and easy to cultivate

Uses

Ripe papaya is one of the best refreshing fruits; it is rich in vitamin A and a good source of Vitamin B and Vitamin C. It supplies appreciable amounts of minerals, consisting mainly of iron, calcium and phosphorous and also a little protein. Papaya is rich in the enzyme papain, which helps in digestion of proteins. Ripe papaya is usually consumed fresh as a breakfast or dessert fruit; it can also be processed and used in a variety of products such as jams, fruit juices, and ice cream. Papaya is also consumed as a dried fruit. Culled fruits can be fed to pigs and cattle. Everything in papaya plant such as roots, leaves, peel, latex, flower, fruit and seeds have their nutritional, economical and medicinal significance. Papaya can be used as a food, a cooking aid, and medicinal purpose.

In general, the papaya promotes proper functioning of pancreas, alleviates indigestion, protects against infection, aids in diabetics and hepatitis patients. Metabolism rejuvenates the body and maintains the body's homeostasis because it is rich in antioxidants, B vitamins, folate and pantothenic acid, the minerals potassium and magnesium, and fiber. Papaya juice is a popular beverage and can assist in mitigating infections of the colon and breaking down the pus and mucus. The consumption of ripe papaya is thought to help in the prevention of cancer in organs and glands with epithelial tissue. Papaya has rejuvenation properties that especially assist in controlling the early ageing process. Papaya is an ingredient in a variety of cuisines throughout the world. Unripe fruits and leaves are consumed as vegetables. Papaya seeds are also used as an ingredient in salad dressings. The whole papaya fruit is

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an excellent source of dietary fiber and therefore can also help in preventing the constipation. The fiber content of papaya can help in lowering the high blood cholesterol levels. Papaya is rich in vitamins C and A. One serving of papaya can provide about 100% daily requirement for vitamin C and 30% of vitamin A. It also contributes to small quantities of vitamin E, K, thiamine, riboflavin, niacin, pyridoxine and folate. Papain is milky latex collected by making incisions in unripe papayas. The latex is either sun-dried or oven-dried and sold in powdered form to be used in beer clarifiers, meat tenderizers, digestion aids, wound debridement aids, tooth-cleaning powders, and other products. They are used in preparation of jam, soft drinks, icecream flavouring, and crystallized fruits and in syrup.

Food Value per 100 g of fresh edible Portion of papaya

Parameters	Range	Parameters	Range
Energy	39.0 - 41.4 kcal	Niacin	0.34 – 44 mg
Moisture	86.9 – 89.8 %	Folate	39 – 55 µg
Crude protein	0.5 - 0.6 g	Calcium	17 – 24 mg
Total fat	0.1 - 0.14 g	Phosphorous	5 – 9 mg
Ash	0.5 - 0.7 g	Potassium	90 – 257 mg
Crude fibre	0.4 - 0.8 g	Iron	0.23 - 0.66 mg
Dietary fibre	0.5 - 2.2 g	α- carotene	16 – 31 µg
Carbohydrates	7.5 - 10.98 g	β- carotene	130 – 730 µg
Total Sugars	7.2 - 9.8 g	Lycopene	113 – 4138 µg
Vitamin A	23 – 55 µg	Total carotenoids	321.2 – 7210 µg
Vitamin C	57 – 108 mg	*Total Antioxidant Activity - ORAC	250 – 350 µmol TE

*Oxygen radical absorbance capacity (ORAC) expressed as µmol of Trolox Equivalent (TE) per 100g of fresh weight.

Important medicinal value of papaya

The nutrients found in papaya are rich in medicinal values. They may help protect against a number of health conditions.

Digestion

Papayas contain an enzyme called papain that aids digestion; in fact, it can be used as a meat tenderizer. Papaya is also high in fiber and water content, both of which help to prevent constipation and promote regularity and a healthy digestive tract.

Age-related macular degeneration

Zeaxanthin, an antioxidant found in papaya, filters out harmful blue light rays. It is thought to play a protective role in eye health, and it may ward off macular degeneration. However, a higher intake of all fruits has been shown to decrease the risk of and progression of age-related macular degeneration.

Diabetes

Studies have shown that people with type 1 diabetes who consume high-fiber diets have lower blood glucose levels, and people with type 2 diabetes may have improved blood sugar, lipid, and insulin levels. One small papaya provides about 3 grams of fiber, which is equivalent to just 17 grams of carbohydrates.

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Hair health

Papaya is also great for hair because it contains vitamin A, a nutrient required for sebum production, which keeps hair moisturized. Vitamin A is also necessary for the growth of all bodily tissues, including skin and hair. Adequate intake of vitamin C, which papaya can provide, is needed for the building and maintenance of collagen, which provides structure to skin.

Heart disease

The fiber, potassium, and vitamin content in papaya all help to ward off heart disease. An increase in potassium intake along with a decrease in sodium intake is the most important dietary change that a person can make to reduce their risk of cardiovascular disease.

Inflammation

Choline is a very important and versatile nutrient found in papayas that aids our bodies in sleep, muscle movement, learning, and memory. Choline also helps to maintain the structure of cellular membranes, aids in the transmission of nerve impulses, assists in the absorption of fat, and reduces chronic inflammation.

Bone health

Low intakes of vitamin K have been associated with a higher risk of bone fracture. Adequate vitamin K consumption is important for good health, as it improves calcium absorption and may reduce urinary excretion of calcium, meaning there is more calcium in the body to strengthen and rebuild bones.

Skin and healing

When used topically, mashed papaya appears to be beneficial for promoting wound healing and preventing infection of burned areas. Researchers believe that the proteolytic enzymes chymopapain and papain in papaya are responsible for their beneficial effects. Ointments containing the papain enzyme have also been used to treat decubitus ulcers (bedsores).

Asthma prevention

The risk of developing asthma is lower in people who consume a high amount of certain nutrients. One of these nutrients is beta-carotene, contained in foods like papaya, apricots, broccoli, cantaloupe, pumpkin, and carrots.

Cancer

Consuming the antioxidant beta-carotene, found in papayas, may reduce cancer risk. Among younger men, diets rich in beta-carotene may play a protective role against prostate cancer, according to a study published in the journal *Cancer Epidemiology and Prevention Biomarkers*.

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Bamboo

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Mirza I.A.B[1], A.D Pandagale[2], Shaikh Wasim Chand[3] and Mahesh Darule[4]
[1]Assistant Professor, Department of Agronomy, VNMKV, Parbhani-431 402.
[2]Assistant Professor, Cotton Research Station, Nanded, VNMKV, Parbhani-431402.
[3]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.
[4]M.Sc. Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.

Bamboos are among the earth's most beautiful and useful plants, providing outstanding texture and form as screens, hedges, ground covers and specimens. Bamboos is a large woody grasses that belonging to the family *Poaceae.* They enhance and transform gardens into peaceful sanctuaries of light, movement and space, touching our spirits and stirring our souls. This ancient woody grass widely found in tropical, subtropical and mild temperate zones of the world. It is a tremendously diverse plant, which have the capacity to adapt any extreme climatic and soil conditions. There are about 90 genera and about 1200 species of bamboo found in the world. Most of the bamboos are found in forestry and it also widely spread outside forests usually farmlands, riverbanks, roadsides and rural areas. Bamboo is a long stick like non-wood forest product and sometimes used as wood substitute. It is found in any regions of the world and plays an important economic role. Even though it is used for housing, crafts, pulp, paper, panels, boards, veneer, flooring, roofing, fabrics and vegetable (the bamboo shoot). Products of bamboos are using everywhere and bamboo industries are now thriving in Asia and are quickly expanding across the continents to Africa and America.

Indigenous bamboos are distributed widely throughout Asia, Africa, Australia, and North and South America. Common cultivable Bamboo Species like, *Gigantochloa apus, Gigantochloa atroviolacea, Bambusa lako, Bambusa balcooa, Bambusa bambos* etc. They have evolved to fill a variety of ecological niches ranging from tropical lowland to Alpine highland, from rain forest to dry chaparral, and from acid to alkaline soils. Sixteen countries in Asia together reported a total of close to 24 million hectares of bamboo forest, constituting some 4.4 percent of the total forest area in the countries surveyed. Although the information gathered from Africa is partial, a total of over 2.7 million hectares of bamboo forest was reported by six countries (Ethiopia, Kenya, Nigeria, Uganda, The United Republic of Tanzania and Zimbabwe).

Most bamboos grow best in deep, well-drained, fertile soils, and they generally prefer neutral to slightly acid soils. If your soil is deficient, the extra time and expense of improving it is usually well worth the effort. Bamboo is an extremely diverse plant, which easily adapts to different climatic and soil conditions. Dwarf bamboo species grow to only a few centimetres (cm), while medium-sized bamboo species may reach a few metres (m) and giant bamboo species grow to about 30 m, with a diameter of up to 30 cm. Bamboo stems are generally hard and vigorous, and the plant can survive and recover after severe calamities, catastrophes and damage. Young bamboo shoots were the first sign of new plant life after the nuclear bombing of Hiroshima and Nagasaki.

The shoots are usually harvested when they attain the height of 15-16 cm. After eliminating the fibrous sheaths the inner tender portion or meat has been thoroughly washed in water and then cut into pieces. The pieces are usually eaten as vegetable components in curry or soup by mixing with fish or meat and also as pickle. Shoots of both running (monopodial) and clump forming (sympodial) bamboos are utilized as food. In Northern China and Japan, the monopodial bamboo species such as *phyllostachys edulis*, *p. mitis*, *p. pubescens* are most common and prepared delicious bamboo shoot. It is estimated that bamboo plants constitutes about 13% of the total forest area of the India. About 50% of bamboo produced in North Eastern region and West Bengal of India. It is also estimated that India has the second largest bamboo reserves in the world after China.

Nutritional value for bamboo shoots, cooked, boiled, with salt bamboo shoots is rich and they contains about 18 amino acids and it also contains 96% moisture. The different parts of this plant contain silica, cholin, betain, cynogenetic glycosides, albuminoids, oxalic acid, reducing sugar, resins, waxes, benzoic acid, arginine, cysteine, histidine, niacin, riboflavin, thiamine, protein, gluteline, lysine, methionine, proteolytic enzyme, nuclease, ureas. The silicious substance found inside the bud joint and it is white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste. Literature on the nutritional and medicinal potential of bamboo shoots is scarce.

From the ancient and using the traditional knowledge, pharmaceutical preparations of bamboo shoots like bamboo salt, bamboo vinegar, bamboo extracts are using to control diabetes and keep the cholesterol level within normal limit. Bamboos and bamboos extract has been utilized in Korea for traditional treatment to relieve hypertension, sweating and paralysis. It has been established that bamboo extract have antioxidant activities and anti-inflammatory effects. *Bambusa arundinacea* is highly reputed ayurvedic medicinal plant. Various parts of this plant such as leaf, root, shoot and seed possess anti-inflammatory, antiulcer, anti-diabetic, anti-oxidant, anthelmintic and astringent activity.

Modern research has revealed that bamboo shoots have a number of health benefits such as: improving appetite and digestion, weight loss, curing cardiovascular diseases, antioxidant activities and anti-inflammatory effects. Lack of reliable, comprehensive data on bamboo resources and utilization hampers their sustainable development and limits their potential to contribute to poverty reduction. However, the using potentiality of bamboo remains unexploited.

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Crop diversification with oilseeds for rainfed regions of India

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A.D Pandagale [1], Mirza I.A.B[2], Shaikh Wasim Chand[3] and Sonali Ubale[4]
[1]Assistant Professor, Cotton Research Station, Nanded, VNMKV, Parbhani-431402.
[2]Assistant Professor, Department of Agronomy, VNMKV, Parbhani-431 402.
[3]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.
[4]M.Sc Scholar, Department of Genetics and Plant Breeding, College of Agriculture, Pune, MPKV, Rahuri.

Land degradation and climate change are the twin problems challenging rainfed agriculture in India. The crops are grouped into rice, oilseeds, pulses and coarse cereals. In each production system based upon diversification index and severity of soil degradation, horizontal and vertical diversification are suggested. Horizontal diversification is advantageous in effective utilization for natural resources, while Vertical diversification aims at reducing the soil loss, high biomass production, high income and employment generation through year round activity.

Suggested Diversification

1) Horizontal Diversification

- Castor + pigeon pea
- Castor + Sorghum
- Castor + mungbean / Urdbean
- Castor + Pigeon pea (2:1)
- Intercropping one row of clusterbean between 90 cm castor rows.
- Urdbean + castor (6:1), Castor + Setaria and
- Castor + Cowpea

2) Vertical Diversification:

- **Parkland systems**: *Azadirachta indica, Acacia nilotica, Tamarindus indica*
- **Trees on bunds**: *Tectona grandis, Leucaena leucocephala, Cocos nucifera, Acacia nilotica* etc.
- **Silvipastoral system:** *Leucaena leucocephala + Stylosanthes hamata,*
- **Alley cropping**: *Leucaena leucocephala + Sorghum/Pearlmillet, Gliricidia sepium + Sorghum/Pearlmillet.*
- **Agri-Horti system**: Mango + short duration pulses.
- **Fruit**: Mango, Ber, Custard apple, guava, Pomegranate, Amla.
- **Fodder/green biomass**: *Leucaena leucocephala, Azadirachta indica, Albizia lebbeck, Bauhinia purpurea, Albizia procera and Dalbergia sissoo.*
- **Medicinal and Aromatic Plants**: *Catharanthus roseus, Cassia angustifolia, Aloe barbadensis and Withania somnifera.*

Crop based Production system in Oilseeds:

- In the agricultural economy of India, oilseeds are important next only to food grains in terms of area, production and value.
- The diverse agro ecological conditions in the country are favourable for growing nine oilseeds which include seven edible oilseeds *viz.* groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower and niger and two non-edible oilseeds *viz.* castor and linseed.
- Oilseed crops have potential for increasing cropping intensity and profitability in wide ranging cropping systems.

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- Oilseed crops by nature are hardy crops mostly grown under rainfed conditions and impart stability of production system under harsh conditions.
- Oilseeds will have an edge over other crops in terms of price, wider adoptability and relative optimal production under environmental stress conditions.

1) Diversification of Rice-Wheat system with Oilseeds:

- To reduce the fatigue of rice-wheat system, alternate crops like oilseeds can be grown without hampering the profitability of the system.
- The area which goes to late season wheat due to late harvest of basmati rice can be shifted to sunflower cropping.
- It is suggested that the basmati area may be put to sunflower cropping in place of wheat.
- Soybean and pulses like pigeon pea should be promoted by diverting some of the rice area.

2) Diversification of Oilseeds in Upland rice/Rice fallow situation:

- In rice fallow situations of Cauvery deltaic areas of Tamil Nadu and Coastal Andhra Pradesh, soybean and sesame can be profitably grown.
- In Tungabhadra Project areas of Karnataka and Andhra Pradesh, Sriramsagar Project area of Andhra Pradesh and Jayakwadi project area of Maharashtra, it is profitable to grow groundnut, sunflower and sesame under rice fallow situations.
- Groundnut has great potential under residual moisture after the harvest of *Kharif* rice in coastal region of Karnataka and Andhra Pradesh.

3) Diversification with oilseeds in Non-traditional areas and crop substitution:

- Oilseed crops by virtue of low irrigation requirement and better remunerative price are ideally suited to replace low yielding other crops and become popular even in Non-traditional areas.
- Groundnut, as a replacement crop for minor millets in Bihar and Orissa.
- Soybean, diverting some Kharif cereal area to soybean in situations of water scarcity and to restore soil health in North India.
- Rapeseed-mustard, as a replacement crop for low yielding rainfed wheat.
- Sunflower, as a replacement crop for desi wheat, cotton, chickpea, and sorghum in black cotton soils in peninsular India.
- Sesame, as a summer crop in central peninsular and Eastern India where only limited irrigation is available.
- Castor, As a replacement of cotton in some regions of Western Haryana and Rajasthan

4) Diversification of oilseeds through Intercropping:

(a) Inter cropping with short duration annuals

- Groundnut, a long duration crop can be grown along with sunflower so that early season rains benefits sunflower and late rains benefit groundnut, thereby giving some assurance to the dry land farmers.
- Advancing sowing of groundnut by 15-30 days prior to sunflower reduces the competition due to shading of sunflower.

(b) Intercropping with long duration annuals

- Among the legumes, pigeonpea + groundnut (3:1) are the most prevalent intercropping system in India. Castor intercropped with groundnut is better than growing castor alone.

(c) Intercropping with perennial/plantation crops at early stages

- Intercropping groundnut under cassava could give yield advantage of 33-55%.
- In Trivendrum and Orissa 12 q ha^{-1} of groundnut, in addition to full yield of tapioca was obtained.

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- Growing groundnut between wide spaced rows of Banana is common practice in Tamil Nadu, Maharashtra and parts of Karnataka. Groundnut under coconut plantation is common in Kerala.

5) Diversification with oilseeds in crop sequences:

- Oilseeds being high value crops have been given priority for inclusion in the cropping systems mainly in cereal and legume based crop sequence.
- The level of fertilizer and water supply required for high yielding varieties of Oilseeds can give highest output per unit area and enhanced farm income have been identified for different agro-eco regions.
- Growing of mustard and linseed after rice, urd and maize was marked a common practice in eastern part of Uttar Pradesh.
- Soybean-wheat recorded almost similar net returns that of rice-wheat system in Punjab with high B:C ratio of 2.61 as against 2.41 in rice-wheat system.

6) Maximizing productivity and resource use from oilseed crops:

- The oilseed crops offer excellent opportunity for maximizing productivity under limited moisture availability.
- Sunflower crop productivity can be increased by more than 60% with limited irrigation at critical stages.
- Safflower yields can be doubled by providing two irrigations in Malwa plateau.
- In Bihar, rice-potato-sunflower system recorded higher rice equivalent yield, net returns, B:C ratio, land use efficiency, production efficiency than traditional rice-wheat-green manuring.

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Differential uses of Bamboo

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Shaikh Wasim Chand [1], A.D Pandagale[2], Santosh Thombre[3] and Swapnil Halge[4]
[1]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.
[3]Assistant Professor, Cotton Research Station, Nanded, VNMKV, Parbhani-431 402.
[1]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.
[4]M.Sc Scholar, Department of Agronomy, College of Agriculture, Pune, MPKV, Rahuri.

INTRODUCTION

Bamboo is a crucial element in the balance of oxygen and carbon dioxide in the atmosphere. A grove of bamboo release 35% more oxygen than an equivalent stand of trees. Because of this, planting bamboo is a great way to reduce your carbon footprint and help fight global warming. Bamboo is a viable replacement for wood. It can be harvest in 3-5 years versus 10-20 for most softwoods. It is a great soil conservation tool. It greatly reduces erosion with a sum of stem flow rate and canopy intercept of 25%. This dramatically reduces rain run-off, preventing massive soil erosion and making it very earth friendly. Bamboo can also tolerate extreme conditions that most plants cannot. It was actually the first plant to re-green after the atomic blast in Hiroshima in 1945.

Bamboo is useful for various applications at different ages :

<30 days - good for eating.
6-9 months - for making baskets.
2-3 years - for bamboo boards or laminations.
3-6 years - for construction.
>6 years - bamboo gradually loses strength up to 12 years old.

Uses of bamboo:

1. Bamboo is used for building roads:

Bamboo is being used in road reinforcements in Orissa, India. Bamboo bridges have also been built in China, capable of supporting trucks that weigh as much as 16 tons.

2. Bamboo is used for medicinal purposes:

In China, ingredients from the black bamboo shoot help treat kidney diseases. Roots and leaves have also been used to treat venereal diseases and cancer. According to reports in a small village in Indonesia, water from the culm (the side branches) is used to treat diseases of the bone effectively.

3. Bamboo is used to build houses and schools:

According to UNESCO, 70 hectares of bamboo produce enough of the material to build 1000 bamboo houses. If timber was used instead, it would require the felling of trees from an already diminishing forest. Today, over one billion people in the world live in bamboo houses.

4. Bamboo is used to make clothes:

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Bamboo- it's the new hemp. T-shirts, socks, robes, boxers… your wardrobe can become entirely organic and sustainable.

5. Bamboo is used to make accessories:
Why stop with the clothes? Bamboo is also used to make necklaces, bracelets, earrings, and other types of jewelry.

6. Bamboo is used to feed people and animals:
Bamboo shoots are used mainly in Asian food preparations. In Japan, the antioxidant properties of the bamboo skin prevent bacterial growth, and are used as natural food preservatives. Bamboo leaves and shoots are also the staple diet of pandas and elephants.

7. Bamboo is used for scaffolding:
Bamboo is often used for scaffolding because it proves to be an eco-friendly and cost-effective resource. In Hong Kong, bamboo scaffolding is preferred over metal scaffolding because of its easy availability and because it is cheaper.

8. Bamboo is used to make furniture:
Beautiful and intricately crafted beds, chairs and tables are made from bamboo.

9. Bamboo is used to make rugs:
Exotic woods like the mango are often used in Oriental rugs. Buying a bamboo rug will ensure that you save a tree.

10. Bamboo is used to make diapers:
For those of you who think that going green should start from infancy, wearing diapers made from bamboo cloth is an option. According to Japanese scientists, bamboo cloth can retain its antibacterial quality even after 50 washings.

11. Bamboo is used to make toys:
Growing up, I only had bamboo toys. My parents did not encourage me to play with plastic dolls- and gifts made from plastic were all put away. It was a clear signal from my environmentally conscious parents.

12. Bamboo is used to make durable utensils:
Cups and saucers, spoons and ladles can all be made from bamboo.

13. Bamboo is used to make musical instruments:
Flutes, drums, didgeridoos, even saxophones– bamboo is versatile when it comes to making instruments.

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Integrated Farming System – An holistic approach for small and marginal farmers

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Sujitha. E,
Teaching Assistant (Agrl. Engg.), Institute of Agriculture, Trichy
Tamil Nadu Agricultural University, Coimbatore

In all around the world mostly small and marginal farmers used to work hard but could not make money, because there is very limited profit after they pay for all inputs. Any country's future depends on the success of the farmers. It in effect relies on the implementation of new technologies and judicious resource distribution. Human civilization relies more on farm products for their existence than anything else as food and clothes – agricultural products are the prime necessaries. Many farmers cultivate their land solely for cultivation purposes without complete support for science and technological backup. They are happy whatever they get in the end of the cultivation. Approach to the farming method is a strong instrument for controlling natural and human capital in developing countries like India. This is a multidisciplinary whole-farm approach, which can be used successfully to address small marginal farmers' problems. The approach intends to maximize jobs and profits from limited holdings by integrating numerous farms and by storing crop residues and by-products within the farm itself.

Integrated Farming Systems

IFS can be described as linking two or more normally separate components or undertakings together, which then become subsystems of an entire agricultural system. Two key features of an IFS are: i) waste or by-product utilization in which waste or by-products from one sub-system are an input to a second sub-system; and (ii) enhanced spatial utilization in which the two sub-systems effectively occupy part or all of the space needed by an individual sub-system.

Integrated farming has also been defined as biologically IFS, which: (i) integrates natural resources and regulatory mechanisms into farming activities with a view to achieving maximum replacement of off-farm inputs; (ii) ensures sustainable production of high-quality food and other products through ecologically preferable technologies; (iii) supports farm income; (iv) eliminates or decreases sources of present environment pollution generated by agriculture; and (v) sustains the multiple function of agriculture (IOBC 1983).

While an IFS represents multiple crops (e.g. cereals, legumes, tree crops, vegetables) and multiple undertakings (e.g. livestock, apiary, aquaculture) in an integrated manner on a single farm (Behera et al. 2015a). The approach to IFS is systematic, multidisciplinary, problem solving, regional location and farmer oriented (Singh et al. 1998). IFS ' fundamental goal is to derive a set of resource creation and utilization practices leading to a significant and sustainable increase in agricultural production (Kumar and Jain 2005). There is therefore a network of interactions between the components within farming systems, and it is difficult to deal with these complex inter-linking systems. It is possibly a explanation for the slow and limited progress made in the field of research into farming systems in Asian countries.

IFS can play a crucial role for India's small and marginal farmers in improving their economic situation and their livelihood (Devendra and Thomas 2002a,b, Singh et al. 2006). In comparison to specialized farming systems, IFS operation focuses on selected, interdependent, interconnected and sometimes intertwined production systems centered on multiple crops, animals and related subsidiary careers. An IFS means using one system's primary and secondary products as basic inputs to the other systems, thus having them incorporated into each other as a whole network. Effective linkages and complementarities between different components are required to establish successful holistic farming systems (Singh et al. 2007).

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Scope of Farming System

Farming businesses include crops, animals, poultry, fish, fruit, sericulture etc. When carefully selected, prepared and executed, a combination of one or more undertakings with cropping gives greater dividends than a single undertaking, particularly for small and marginal farmers. Farm as a unit shall be considered and prepared for the efficient integration of the enterprises to be combined with the operation of crop production.

Integration of Farm Enterprises Depends on Many Factors Such as

1. Soil and climatic features of the selected area
2. Availability of the resources, land, labour and Capital
3. Present level of utilization of resources
4. Economics of proposed integrated farming system
5. Managerial skill of farmer

Benefits of IFS

The benefits of IFS include pooling and sharing of resources / inputs, productive use of family labor, conservation, protection and utilization of farm biomass including non-conventional feed and fodder resources, successful use of manure / animal waste, control of soil fertility and health, income and job creation for many people, and economic capital increase. This makes use of resources and offers diversified goods. IFS is a technique for ensuring that natural resources are used sustainably for the good of present and future generations. Productivity, Competitiveness, Sustainability, Nutritious Food, Environmental Protection, Resource Conservation, Year-round Income and Risk Minimization are the main benefits of implementing IFS in a region / country.

Importance of farming system

Recycling and utilization of other resources available on the farm, maximum possible return and profitability, creating sufficient job opportunities, productivity, potential or sustainability, nutritious food, environmental protection, adoption of new technologies, energy saving, meeting forage crises, solving fuel and timber crises, agro-industries, increasing input quality.

CONCLUSION

Research / extension and growth approach to the farming system is recognized as a possible method for managing the large natural resources in developing countries and meeting multiple demands, such as maintaining livelihoods, conserving biodiversity, offsetting emissions, adapting to climate change. An Integrated Farming System (IFS) reflects multiple crops on a single farm (cereals, legumes, tree crops, vegetables, etc.) and multiple businesses (livestock production, fish farming, beekeeping, etc.) It is important to promote IFS for the establishment of sustainable agriculture. IFS offers space for exploring synergistic interactions of farming system components, maximizing the efficiency of resource-use and recycling of farm by-products. The key to promoting IFS in Indian agriculture are the creative strategies, Developmental Farm Model, Energy Self-sufficient Integrated Farming Systems, Farm Development Card, prescriptive farming, synergy through partnership and linkages and farmers, empowerment.

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Integrated management and life cycle of tomato moth, *Tuta absoluta* on tomato crop

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***Ritesh Kumar[1] , Sushil Kumar[1] and Kumari Manisha[2]**
[1] Ph.D Scholar at Department of Entomology G.B.P.U.A.T Pantnagar, Uttarakhand.
[2] Department of Horticulture, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand.

INTRODUCTION:

Tomato leaf miner *Tuta absoluta* (Meyrick) (Lepidotera, Gelechiidae) is a serious invasive tomato pest native to South America, which has affected the production of tomato worldwide including India. *T. absoluta* is a species of moth in family Gelechiidae known by the common names tomato leaf miner, South American tomato moth, tomato borer or South American tomato pinworm. It predominantly found in areas below 1000 m above sea level. Adult moths have no problem but its Larvae can destroy tomato plants during all growth stages. The pest life cycle start with eggs, larvae, pupa and adult moth. Larvae pass through four growth stages or instars. The larvae feeds upon tomato plants, producing large galleries in leaves, burrowing in stalks, and consuming apical buds and green and ripe fruits and can thus cause up to 100% loss in tomato production if control measures were not observed. Their control using chemical pesticides is extremely difficult and quite challenging. Three reasons can be given to explain why their controls using the chemical method is challenging

Pest life cycle:

Egg: The eggs are elliptical, and their colour varies from oyster-white to bright yellow, darkening in the embryonic phase and becoming almost black near eclosion.

Larva: The first-instar larvae are whitish soon after eclosion, becoming greenish or light pink in the second to fourth instars according to food (leaflet or ripe fruit, respectively). There are usually four instars.

Pre-pupa: The pre-pupae are lighter than the feeding larvae (first to fourth instars) and develop a distinguishing pink coloration on the dorsal surface. They leave the mines and build silk cocoons on the leaflets or in the soil, according to habitat. When pupation occurs inside mines or fruit the pre-pupae do not build cocoons.

Pupa: Pupae are obtecta with greenish coloration at first, turning chestnut brown and dark brown near adult emergence.

Adult: Adult moths are about 10 mm long, with silverish-grey scales, filiform antenae, alternating light or dark segments and recurved labial palps which are well developed.

IPM Strategies:

Some insects may be controlled by a combination of practices that are not fully effective when used alone. *T. absoluta* is one of those insects that require more than one practice to be controlled successfully. Therefore, integrated pest management (IPM) programs are being developed in several countries to manage infestations of *T. absoluta*. To control the pest effectively it is critical to combine all available

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control measures including cultural methods, biological control agents and the correct use of registered pesticides. An integrated pest management strategy (indicated below) can be used for the control of *T. absoluta*: (1) Clearing the soil and area of crop residues, fruits and wild host plants, (2) Mass trapping begin prior to planting or upon planting, (3) The use of sulphur, neem oil, Bacillus thuringensis in conjunction with the application of either δ-methrine, spinosad, Indoxacarb or other recommendable bio-pesticide if occasional individuals of *T. absoluta* are observed, (4)Elimination and burning of infected plants during the growing season and of the remnants of the crop immediately after the last fruits have been harvested.

Different trap used:

Water trap: it consist of a plastic container holding water and a pheromone lure. The lure is secured above the water with a wire attached at both ends of the container.

Sticky rolls: these are rolls with T. absoluta pheromone incorporated into the sticky glue, with the pheromone gradually released from the adhesive layer.

Delta traps: these are of two type's i.e Cardboard delta triangle with sticky surface and Cardboard delta triangle with a removable liner. Either one is suitable, although delta traps with nondrying sticky liners are preferred. Traps are available from several suppliers in multiple colors and all should be considered equivalent**.**

Sex pheromone-based control strategies:

Pheromones are chemicals that are secreted in bodily fluids that are believed to influence the behavior of the opposite sex, such as triggering sexual interest and excitement. Pheromones act as natural sexual attractants. Sex pheromones are chemical signals released by an organism to attract an individual of the same species of the opposite sex. *T. absoluta* pheromone lure has been identified as (3E, 8Z, 11Z)-3,8,11-tetradecatrienyl acetate as major and (3E,8Z)-tetradecadien-1-yl acetate minor component.

Physical controls:

T. absloluta and other flying pests like bollworm, thrips and whitefly can be physically excluded from tomatoes grown inside the greenhouses using different methods. This may include screening of vents in the roof and sides of greenhouses and the disciplined use of double entry doors can reduce migration of pests into the greenhouse. Outward facing fans inside the double entry porch can blow back any flying insect pests, which might otherwise be 'sucked' into the crop on thermal currents when the outside door opens.

Biological control methods:

The development of resistance to synthetic insecticides is one of the driving forces for changes in insect pest management biological control occupies a central position in Integrated Pest Management (IPM) Programmes. This is because biological control agents for pests and weeds have enormous and unique advantages; it is safe, permanent, and economical. Biological control method is potentially very beneficial tactic to develop. It has been used against crop pest insects belonging to the orders Homoptera, Diptera, Hymenoptera, Coleoptera and Lepidoptera, among others. Biological control agents (living antagonists natural enemies: predators, parasitoids and pathogens) are considered as one possible solution of the *T. absoluta* crisis. This strategy offers a more sustainable and less expensive alternative to chemical use.

Parasitoids:

Parasitoids of *T.absoluta* eggs, Trichogrammaacheae has been identified as a potential biological control agent of the pest and is currently being released in commercial tomato greenhouses.

Entomopathogens:

Bacillus thuringiensis, an entomopathogenic bacterium has been used in the control of tomato plant pests and reported by many authors as very effective bio-insecticide. It has been used extensively to control the pest in crops where IPM programmes based on biological control are applied. Bio-insecticides like *Bacillus thuringiensis* do not raise any environmental concern as they are environmentally friendly. In addition, the entomopathogenic nematodes *Steinernema carpocapsae*, *Steinernema feltiae* and *Heterorhabditis bacteriophora* have proved to be capable of infecting late larval instars of *T. absoluta* and hence be used in its control.

Chemical control methods:

Chemical control using synthetic insecticides is the primary method to manage the pest, but it has serious drawbacks, including reduced profits from high insecticide costs, destruction of natural enemy populations, build up of insecticide residues on tomato fruits and in the environment and fundamentally the rapid development of insecticide resistance. Besides, the efficiency of chemical control of tomato leaf miner infestations has been poor because of (1) the entophytic habit of its larvae, which are protected in the leaf mesophyll or inside fruits and (2) pest resistance against a number of applied insecticides. In order to reduce the excessive use of insecticides in tomato fields, environmentally sound control strategies have been developed, including cultural control measures (e.g. crop rotation, selective removal and destruction of infested plant material), the use of natural enemies (parasitoids, predators, entomo pathogens and nematodes).Additional alternative control methods, based on the use of the insect's sex pheromones, have also been developed to control *T. absoluta*.

Conclusion and Recommendation:

Tomato is one of the most important edible and nutritious vegetable crops in India that is grown on both greenhouses and open field. The average yield of tomato in India has been decreasing in recent years due to several factors including pest and diseases. The most important insect pest that is of economic importance to tomato production is the new devastating pest, tomato leaf miner –*T. absoluta* (Meyrick). The pest attacks the aerial part of the plant (stem, leaves, and fruit) in all stages of tomato growth; thus capable of causing production loss of up to 80 to 100%. Over the last decade, its pest status has increased world- wide as it has migrated into new territories.

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Management of fruit fly in fruits and vegetables crop in organic farming

Article id: 23513

Shalendra Pratap Singh[1] and Sucharu Singh[2]
Research Scholar, Department of Entomology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (UP) India.

The importance of horticulture can be substantiated by its high export value, high yield and returns per unit area. Several species of fruit flies (Diptera: Tephritidae) are invasive pests of horticultural crops worldwide, due to their adaptation to various regions, high polyphagia and rapid reproduction. *Bactrocera* spp. is more harmful in Indian climatic conditions and cause lot of loss to the various fruits, vegetables, oilseeds and ornamental plants etc. They lay their eggs inside the fruits and after hatching, maggots bore their way to the interior, feed on fruit pulp and protect from insecticides. This is a quarantine pest because it causes serious damage in export mango fruits at international level. In organic farming, management of fruit flies is very essential by use various control methods which are not harmful and toxic to human health and helpful to farmers to generate foreign money by export good residual free quality fruits and vegetables at international level.

INTRODUCTION

The flies belonging to dipteran family Tephritidae are commonly known as fruit flies. Fruit flies cause direct damage to fruits and vegetables by the puncture for oviposition by the female and the larval development inside the fruit (Aluja, 1994). These pests cause direct damage to important export crops leading to losses of 40% to 80% (Kibira et al., 2010). The presence of these pest species limits access to international markets due to quarantine restrictions imposed by importing countries. Countries that harbor these important pests spend millions of dollars each year on control and have trade sanctions imposed by rigorous treatments of products prior to export, (Dhami et al., 2016). The management of fruit flies is challenging because third-instar larvae leave decaying fruits and drop to the ground to pupate in the soil; consequently, both larvae and pupae in fruits and soils are protected from surface-applied insecticides (Heve et al., 2017). The control of fruit flies is becoming increasingly difficult in many countries, as formerly effective broad-spectrum and systemic-acting insecticides are removed from the market (Böckmann et al., 2014). Due to progressively more stringent restrictions on the use of insecticides and the increasing demand for healthy food around the world, new environmentally friendly techniques for fruit fly control are arising (Navarro-Llopis et al., 2011).

Life cycle of fruit fly

Fruit flies belong to the holometabolous group of insects which contains four stages of life cycle i.e. - Egg, larvae, pupae and adult.

Egg - The egg is elongated, white to creamy yellow in colour, they become darker before hatching. Shape of egg is usually elliptical and size varies in different species. Posterior end is somewhat rounded while anterior end has a distinct micropyle. Ventral surface straight while dorsal surface may be convex.

Larvae - Larvae are creamy-whitish in colour maggot-like, legless (apodous), amphipneustic however, sometimes appear to be of different colour because of gut content which is visible through translucent skin. The mouthparts are present in the form of cephalopharyngeal skeleton with well-developed mouth hooks. There are three larval instars, which show differences in their size, structure of cephalopharyngeal skeleton, sense organs, spiracles and caudal segment. Mature larva may pupate inside the host or in soil.

Pupa: Fruit flies have execrate pupae in which appendages are free. Pupa is encapsulated within a barrel shaped puparium which is the hardened skin of last larval instar. In Bactrocera spp. puparia are usually pale yellow to

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brownish-yellow in colour, and pupal age and larval host also affect their colouration. Under favourable conditions their life cycle may complete within 2 weeks.

Adult- Adults occur throughout the year and begin mating after 8-12 days of emergence (usually between 7:00 to 10:00 A.M). Adult flies primarily feed during the morning hours. Adult flies may survive for 1-4 months (up to 12 months in cool conditions) depending on species, climatic conditions and presence of hosts. In winter, the flies may become inactive or congregate beneath large leaves and with the onset of summer adults become active.



Fig- Infected fruit by maggots Fig- Pupae of fruit fly Fig- Oviposition of eggs

Management Practices

1. Cultural practices

1.1. Field sanitation: Fruit fly lays eggs in fruits/vegetable and the larvae hatch inside. Generally such fruits fall down to ground and larvae crawl out of the fruit and enter into the soil for pupation. Therefore, the collection and destruction of fallen, damaged, over-ripe and excess ripe fruits is strongly recommended to reduce resident populations of fruit flies.

1.2. Sound crop hygiene: The weeds and other undesirable plants should not be allowed to grow as these may harbour adults at rest.

1.3. Early harvesting: Avoidance of fruit fly infestation is possible by harvesting crops at stage of maturity when fruits or vegetables are not susceptible to fruit fly attack. Some fruits like banana, papaya and some mango varieties remain free from fruit fly infestation at green mature stage or colour-break stage. In certain parts of country, the fruits are harvested well before the fly population starts damage.

1.4. Raking/ploughing of the soil: Larvae of fruit flies not only pupate inside the soil but also overwinter in pupal stage under unfavourable conditions. The pupae of fruit flies can be easily destroyed by raking/ploughing of the soil.

1.5. Wild host destruction: Polyphagous fruit fly species survive on non-cultivated wild hosts during dearth period when cultivated hosts are not available. Elimination/destruction of such hosts would certainly reduce the reproductive potential of pest species.

2. Mechanical method

2.1. Bagging of fruits: The bag provides a physical protection, preventing adult female flies to lay eggs. This is useful when fruit are less in number especially in kitchen garden. This practice is extensively followed in many countries as it is an environmentally safe method for the management of fruit flies.

2.2. Wire netting: Fine wire netting of small orchard is another way of protecting fruits from fruit fly; however, this is a costly affair.

2.3. Destruction of adult flies: During winter a number of adults congregate below large leaves during morning hours, such adult flies can be easily collected and destroyed.

3. Physical methods

3.1 Cold treatment: Cold storage at temperatures of 2° or 3°C can effectively kill immature stages of fruit flies in citrus stored for 14 to 16 days. However, cold treatment at these temperatures provides greater market flexibility and reduces problems associated with cold chilling such as internal fruit and skin damage.

3.2. Hot water dipping: Hot water dipping technique can be effectively used for post-harvest treatment for mango and some other tropical fruits.Dipping of mango fruits within 24 hours after harvest at 48^{o}C temperature for 1 hour results in 100 per cent mortality of immature stages of fruit flies.

3.3. Vapour heat treatment: Vapour heat treatment is performed under a state of high temperature and saturated water vapours with the goal to kill the insects without injuries to the hosts. The treatment has advantages over chemical fumigation as there is no necessity for anxiety about chemical residues.

3.4. Cover spray of insecticides: In case of fruit flies only adults are exposed to control measures while eggs, larvae and pupae remain protected. Fruit flies can be away from the fruits and vegetables by using neem based botanical insecticides and 5% solution of insecticides can spray on the fruit or vegetable crop at 10-15 days interval. Insecticide may also keep the flies away from the crops.

4. Biological control

4.1. By Insects:

Parasitoids of the Braconidae family are the main natural enemies of fruit flies included *D. longicaudata and Psyttalia spp. [Psyttalia concolor, Psyttalia fletcheri, Psyttalia lounsburyi, Psyttalia ponerophaga and Psyttalia humilis* (Silvestri)] (Bon et al., 2016). The egg parasitoid, *Fopius arisanus* (Sonan) (Hymenoptera: Braconidae), and the pupal parasitoids *Coptera haywardi* Loiácono (Hymenoptera: Diapriidae) and *Aganaspis daci* (Weld) (Hymenoptera: Figitidae) are considered as alternative species to fruit fly biological control with larval parasitoids (Ali et al. 2016).

4.2 By Fungi:

The control with entomopathogenic fungi has shown interesting results. For Rhagoletis cerasi (L.), the control with *Beauveria bassiana* (Balsamo) Vuillemin, *Isaria fumosorosea* (Wize) and Met*arhizium anisopliae* Sorokin caused 90–100% mortality and had the strongest influence on fecundity in laboratory (Daniel and Wyss, 2009).

4.3 By Nematodes: Entomopathogenic nematodes, such as *Heterorhabditis* spp. (Rhabditida: Heterorhabditidae) and *Steinernema* spp. (Rhabditida: Steinernematidae), were used for control of larvae and pupae of various fruit fly species.

5. Genetic control:

Genetic control involved the use of RNA interference (RNAi), which is a mechanism of gene regulation and an antiviral defense system in cells, resulting in the sequence-specific degradation of mRNAs (Huvenne and Smagghe, 2010). As with mechanical control, the PCA showed separation of genetic control from the other methods

6. Bait Application Technique:

Fruit fly suppression is mainly based on the use of food baits mixed with a killing agent that attract both male and female flies; however, such baits are not species-specific. A number of locally derived baits, e.g. protein, sugar, jaggery, molasses, fruit juice, fermented materials, toddy, yeast, etc. have been used as baits against fruit flies. Spraying of a mixture consisting of 1 ml malathion 50 EC + 10 g crude sugar or jaggery in 1 liter water is recommended for spraying.

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7. Male Annihilation Technique:

7.1. Methyl eugenol:

Use of combination consisting of ethanol + methyl eugenol or cue-lure + malathion 50 EC (6:4:1) can be successfully used in annihilation of male flies from the environment. Such mixture should be soaked in ply wood blocks (5 x 5 x 1.2 cm) and suspended in self-made plastic bottle traps (made of 1 litre mineral water bottle).

7.2. Basil plant extract:

Basil plant extract is one of the cheaper and best controlling method for fruit flies attraction. It attracts various species of fruit flies belong to genus *Bactrocera.* Basil extract can be used with malathion in the ratio of 4:0.05 (Basil extract : malathion) as attractant to male fruit flies. It attracts 7 species in Kanpur UP (Singh et al., 2020).

8. Control with natural product insecticides

Natural product insecticides containing mainly plant and fungi extracts have been used against fruit flies.Plant-derived insecticides, such as azadirachtins.(Silva *et al*., 2013). Ali *et al*. (2011) used different plant extracts and minimum percent damage (41.94%) was found in neem seed extract treated plots. The results of the experiment revealed that botanicals can be replaced for the management of melon fruit flies instead of using the synthetic pesticides in order to save the environment from their hazards. The soil can also be inoculated with neem cake and other botanical formulations to kill pupating larvae (Ekesi and Billah, 2006).

CONCLUSION

Fruit flies are serious problem in those countries where they are found abundantly specially in tropical and subtropical regions. Fruit flies have protective nature in immature stage against insecticides so it is very difficult to control in immature stage in organic farming. It is a quarantine pest cause economic loss when export fruits and vegetables to foreign countries. On the basis of above problems this is very essential to manage the fruit flies by using organic bio pesticides which provide better protection against fruit flies and no residual effect on the food material. Hence, farmers can generate extra income by export their organic crops to different state of India and foreign countries.

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Sericulture

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S. J. Sindhi and D. N. Hadiya
Krishi Vigyan Kendra, Junagadh Agricultural University, Khapat-Porbandar (Gujarat)

Sericulture is defined as a practice of combining mulberry cultivation, silkworm rearing and silk reeling. Sericulture is a recognized practice in India. India occupies second position among silk producing countries in the world, next to China.

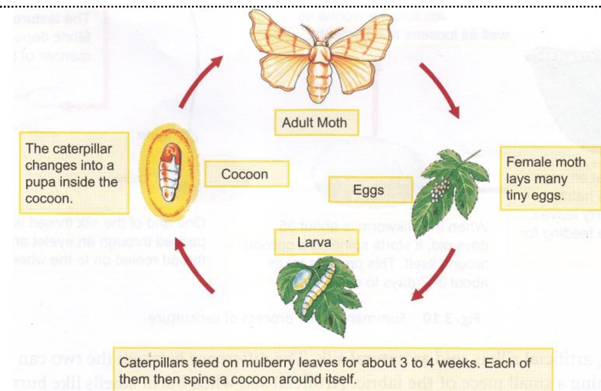
Moriculture: Cultivation of mulberry plants is called as 'Moriculture'. There are about 20 species of mulberry, of which four are commonly cultivated. They are *Morus alba, M. indica, M. serrata* and *M. latifolia*.

Silk worm rearing:

There are four types of silk worm viz.

(i) Mulberry silk worm – *Bombyx mori*
(ii) Eri silk worm – *Philosamia ricini*
(iii) Tassar silk worm – *Antheraea mylitta*
(iv) Muga silk worm

Green HDPE Plastic Netrika or Plastic Chandrika HDPE Sericulture Net



Life cycle

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Larva

Eggs

Moth

All stages of life cycle

Cocoon

Mullberry plant

Processing

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Silk

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Integrated Root Knot Nematode Management: A solution for doubling farmer's income

Article id: 23515
[1]Chidanandappa, [2]Saddamhusen Alase and [3]Amoghavarsha Chittaragi
[1]University of Agricultural Sciences, Dharwad
[2]University of Agricultural Sciences, GKVK, Bengaluru
[3]University of Agricultural and Horticultural Sciences, Shivamogga

INTRODUCTION

Root-knot nematode (RKN) caused *Meloidogyne* species is an obligate parasite nematode. It can be found in varieties of plants. Their potential host range encompasses more than 3,000 plant species. The presence of RKN in the crops becomes one of the major problems nowadays because they cause great agriculture loss. Among the many genera of nematodes, *Meloidogyne* spp. are responsible for a large part of the economic impact in a 100 billion dollar losses / annum attributed to nematode damage (Abad *et al*., 2003). This review discussed on presence of RKN in different kind of crops and the importance of an integrated approach used in *Meloidogyne* spp. management strategies (Ralmi *et al.,* 2016). Several alternative techniques are considered for management of *Meloidogyne* spp, including cultural, chemical, host plant resistance and biological methods. Many practices are only partially effective for nematode control; thus, combining control methods helps to the doubling farmer's income.

Symptoms in infected plants:

Infected plants shows signs of nutrient deficiency such as yellowing of the leaves, stunted growth, wilting of the plant and the worse situation the plant died. Heavy infection of older plants causes the plants to wilt unexpectedly and die off early. As the result of nematode induced expansion of root cells, swellings or galls develop on the roots of infected plants. The galls vary in size from slight thickenings to lumps 5 to 10 cm across. Stems or leaves may be galled but this is rarely seen in plants growing outdoors. Galls caused by *Meloidogyne hapla* are much smaller than those caused by other species. All root knot galls damage the vascular tissues of roots and thus interfere with the normal movement of water and nutrients through the plant. They also increase the susceptibility of the root system to be invaded by disease-causing fungi and bacteria (Rahman, 2003).

Integrated Root Knot Nematode Management:

1. Cultural:

- Crop rotation with cereals.
- Solarization during nursery preparation.
- **Use of trap crops and antagonistic crops**:

Trap crops: Green manure crops susbania, glyciridia.
Antagonistic crop: Marigold the roots of this produced an alkaloid **α - tertheinyl** toxic to Root Knot Nematode**.**

2. Chemicals:

Fumigants DD (Dichloropropene and dichloropropane) -300 to 400 l/ha pre plant application and coral.
DBCP – Dibromochloropropane (nemagol) – both pre and post plant application 40 l/ha.

- Seed treatment with Carbosulphon (Marshal 25 ST) 3 – 6% (based on seed size).
- Bare root dip of seedlings with Fensulfothion or Thionazin. 500 – 600 ppm for 15 minutes.
- Vapam (SMDC – Sodium methyl dithiocarbanate) fumigant 20ml/sqm apply through irrigation water.
- Granular nematicides – Carbofuran, phorate 1 - 2 kg/ha.

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3. Host Plant Resistance:

Tomato

Meloidogyne incognita: Pusa Ruby, S-120, NTDR-1, VFN-8, Nematex

N. incognita: Race 1: Karnataka Hybrid
Race 2: Pusa 120, A-1-1-2
Race 3: Punjab 6NR-7, VFN-Bush
Race 4: Pusa 120, Punjab 6NR-7, VFN-8, VFN-Bush

M. javanica: S-120, SL-12, Resistant Bangalore, NTDR-1, Pusa 120, Punjab 6NR-7, Nematex, VFN-360, VFN-8, VFN-bush

Brinjal

M. incognita: black Beauty, Giant of Banaras, Vijay, Mysore Green, Pusa Purple Long

M. javanica: Bhanta, Muktakeshi, Round Red, Coolie, Mathis B, Mysore Green, American Big Round,Arkasheel, R-34, Sonepat, BR-112

Okra

M. javanica: Long Green Smooth, IC-9273, IC-18960

Chilli

M. incognita: Race 1 Pusa Jwala, Jwala
Race 2 Jwala
Race 3 Pusa Jwala, Jwala
Race 4 Jwala

M. javanica: Pusa Jwala, Suryamukhi Black, Jawala, Bull Nose, 579, CAP 63, Chilli NP-46-A, Chilli G-3.

Cucumber

M. javanica: Improved Long Green, S-445 (muskmelon)

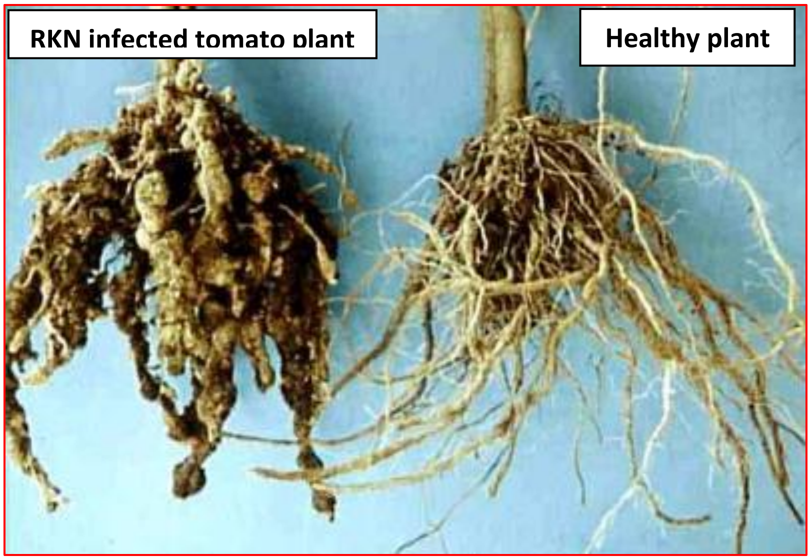
M. incognita: GY-5937-587

4. Biological:

- Egg parasitic Fungi: *Paecilomyces lilacinus, Pochonia chlamydosporia*
- AM fungi *Glomus fasciculatum, G.mossae* – produces nematicide chemicals arginine, citrulline.
- *Pasteuria penetrans* – bacteria infect nematodes and prevent their reproduction
- Organic amendments of neem oil cake, cotton oil cake 1t/ha. during sowing – releases micronutrients and builds up antagonistic microflora.
- 5% neem seed powder treatment to seeds.

CONCLUSION

RKN which came from *Meloidogyne* genus can cause severe damage to the crop. Most countries in the world faced the same problem regarding the infection of RKN especially in tropical, subtropical and temperate region. Invasion of nematode starts with penetration to the roots, then they migrated to the vascular cylinder, where they initiate a series of damage in the root, resulting in the formation of galls. This affects the transportation of water and nutrient in plants. The degree of severity caused by root knot nematode depends on the host plants. The highly susceptible host plants enhanced the distribution of *Meloidogyne* spp. while the less susceptible suppress their development as well as reduced their distribution. Thus, integrated management is required for doubling the farmer's income.



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Value addition - A boon to reduce post harvest loss of flower crops

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Sanchita Ghosh
Subject Matter Specialist (Horticulture), KVK Samastipur, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar-848113

INTRODUCTION

India is bestowed with diverse agro climatic condition, suitable for growing of various flower crops throughout the year. Unfortunately a huge amount of products do not reach to the consumer because of post harvest loss which refers to the quantitative and qualitative losses that occur in horticultural commodities between harvest and consumption. It has been variously estimated that 25 to 30 per cent of the horticultural produce is lost before consumption because of poor harvesting, handling, storage, transportation and marketing practices. Loss of cut flower quality is estimated to be about 70 per cent. Post harvest loss reduction technology encompasses the usage of optimum harvest factors, reduction of losses in handling, packaging, transportation, storage with modern infrastructure machinery, processing of the harvested product into a wide variety of products, home scale preservation with low cost technology. Value addition can be a viable alternative to reduce huge amount of losses in flower crop. This article deals with the detail value addition technology and its applications in flower crops.

What is value addition?

Value addition means converting the fresh produce into products which could be utilized for immediate purpose or stored for future use by applying various indigenous and high techniques suitable for each crop. The main value added products of flower crops include bouquets potpourris, dry flower etc.

Merits of value addition

1. Prevention of colossal wastage of fresh produce
2. To extend the shelf life of the produce
3. Self employment opportunities
4. Provides convenient and preferable forms to the consumers
5. Foreign exchange earnings from the export of processed foods

Areas of value-added floriculture

A) Essential oil extraction from flowers: Essential oil yielding crops are: Rose, Jasmine, Tuberose, Narcissus, Murraya, Marigold, Calendula etc. This essential oils are mostly used in aromatherapy, perfumery, flavouring, agarvati and food industries (Verma *et al.,* 2012).

Techniques used for analysis of essential oils:

1. GC spectrometry techniques: IR, UV, NMR, MS are some of the techniques used for identification of fractions separated from fractional distillation.
2. Coupled instruments like GC-UV, GC-IR, GC-NMR also plays important role in the analysis of essential oils.

3. Liquid chromatography techniques like Thin layer chromatography (TLC), High pressure liquid chromatography (HPLC) and column chromatography. Isotope ratio mass spectrometer (IRMS) and GC can be used for detection of adulteration in essential oils.
4. Essential Oil Association of India (EOAI), perfumes and favours Association of India (PFAI) are the chief association which deals with determination of constituents of essential oils, flavours and perfumes.

B) Products from flower crops

1. Rose Products: Main rose products are gulkand, pankhuri, rose water, rose attar etc. Gulkand is prepared by mixing rose petal and sugar in 1:1 ratio. Pankhuri is dried rose peats. These products are used as flavouring agents, cosmetics.

2. Marigold: Marigold flowers are rich source of carotenoids and being grown on commercial scale for extracting these carotenoids. Flower petals contain xanthophylls which are major carotenoid fractions and lutein forms 80-90 percent of the total xanthophyll content. Carotenoids are the major source of pigment for poultry feed used for intensification of colour of egg yolk and boiler skin. It has been reported that dietary carotenoids are the agents for prevention and treatment of several illness such as concerned photosensitivity diseases. The purified extract of marigold petals, containing lutein dipalmitate has been marked as an ophthalmologic agent under the name "Adaptional". They also protect the eye from long term damage by light which can lead to a progressive condition known as age related macular degeneration (AMD). Some of the carotenoids have been in the market for more than 20 years and are used extensively in food colouring. Marigold petals have antifungal, antibacterial and anti-inflammatory properties that can be utilized for the production of creams. Marigold species especially *T. minuta* oil is the most valuable and precious for using in high grade perfumes and cosmetics. Marigold leaves and flowers possess a good insect repelling properties It has juvenile hormonal and insect repellent activities against flies, ants and mosquitoes. Therefore, marigold oil is being used on commercial scale for formulation of insect repellent. *Tagetes spp*. have been reported by numerous researcher's to provide a method for protecting crop plants from damage caused by various nematode and insect pests .Extract of marigold flowers can be used for coloration of 100 % cotton, silk, and wool fabrics (Ghorpade, and Vankar, 2000).

C) Potpourris: It is a mixture of dehydrated flowers, berries and leaves which is exported either raw or scented. The common method of display is in glass bowls or ceramic jars which are placed in bedrooms and bathrooms. This product can be packed in small muslin bags or sachets which are then placed in wardrobes and drawers are clothes- fresheners. Use of potpourri as a natural scent as well as decorative feature has gained wide acceptance. Potpourri overcomes the harmful effects of ozone depleting aerosols. Over 300 products are used in potpourri mixes. In India, major products used in potpourri are bachelor‟s button (globe amaranth), cocks comb (*Celosia argentea*), marigold flower (*Tagetes sp*), rose petals, bougainvillea petals, green leaves (such as bay leaves), neem leaves (*Azadirachta indica*), stones from plums, peaches, apricot, amaranth etc.

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D) Dry flowers

Flower drying is an important post harvest technique which involves reducing moisture content of flowers to a point at which bio-chemical changes are minimized. Important characteristics of dried flowers are novelty, longevity, aesthetics, flexibility, Year –round availability (Kher and Bhutani, 1979). Dry flowers constitute more then 2/3rd of the total floricultural exports. Nearly 40-50% of Indian floricultural exports comprise of dry flowers and nearly 15% of the global floricultural business forms the major share in Indian floricultural exports as well. Dried flowers can be used for preparation of handicrafts items, collages, cards and covers (press-dried flower and foliage). Arrangements in glass containers etc can be produced Some flowers that are dried and used include rose, chrysanthemum, delphinium, larkspur, zinnia, lavender, African marigold, strawflower, statice, Globe amaranth etc (Westland, 1995).

Methods of drying: There are several methods of drying which includes Sun drying, Air drying, Press drying, Desiccants drying (Silica gel, Borax, River sand), glycerin drying, microwave oven drying, freeze drying, embedding, water drying, hot air oven drying (Bhutani 1995).

Innovative packaging, Handling and Storage of dried products:

Dried plant material should not be roughly handled during transport and distribution and it must be protected from moisture throughout the marketing channel. Different containers like glass desiccators, tin boxes, cartons, wrapped with plastic sheets or wax paper and herbarium vasculums fitted with cork sheet are used for packing of dried ornamental plant material. A small quantity of silica gel may be placed at the bottom to absorb moisture. Protect the material from direct sunlight or high light intensity, especially form incandescent lamps. The storage should be dust free and the cartons / boxes cleaned from time to time.

Major Company in India exporting dried flower products:

M/s Ramesh Flowers Limited –based in Tuticorin has emerged as the single largest exporter of dried flowers with a turnover of over Rs 270 million. They have technical and financial collaboration with Schleef of Germany (Schleef holds 51 per cent of the company‟s equity). Schleef helps in product design and development for European markets. M/s W. Hogenwoning India, a prominent Dutch company has also started exporting from Tuticorin

1. Singhvi International, Kolkata -having 60 per cent of total dried flower exports from India. The Singhvi family has a stronger export base in Tuticorin
2. M/s Minex Agencies, Kolkata.

Major companies export their product to U.S., Holland Germany, Denmark, Czechoslovakia, Italy, France, Spain, UK, Belgium, South Africa, Srilanka, Australia and Mexico.

CONCLUSION

Value addition is a promising approach for reducing huge post harvest loss as flowers are highly perishable item. It also helps in creating employment opportunities especially for rural woman as they can make different handicraft items, potpourris etc. sitting at home itself using dried flower parts etc. Apart from that extraction of essential oils and dyeing technology are also effective technologies. Extensive training among rural youth, progressive farmers/farm woman would be effective ways for disseminating

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the technology among the farmers to improve their livelihood standards and successfully creating employment opportunities as well as reducing post harvest loss in eco friendly way.

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Crop diversification in food security for india

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Durgesh Kumar Maurya*[1], Mohammad Hasanain[2], Sandeep Kumar Verma[3], Sanjeev Singh[4], Deepak Kumar Meena[5] and Pradeep Kumar Singh[6]

[1, 3, 6,] M.Sc. Scholar & [4]Ph.D. Scholar, Department of Agronomy, Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut 250110;*

[2], Ph.D. Scholar, Division of Agronomy, ICAR-IARI, New Delhi 110012;

[5], M.Sc. Scholar, Department of Agronomy, G.B. Pant University of Agriculture and Technology, Pantnagar-263 145 Uttarakhand

INTRODUCTION

India is a country in which about one billion people. In rural areas lives more than 70 % of India's population where the main occupation is agriculture. The averages farm size of small holding farmers is 1.57 ha. Around 93 % of farmers have a land holding smaller than 4 ha and they cultivate nearly 55% of arable land (Hazra,). Our country has made considerable progress during the last 50 years in the farm sector. From 'hand to mouth' conditions in the early sixties, the country has not only become self-reliant in food grains but have acquired sufficient resilience to drift over the adversative conditions. In India Farming continues to be the major source of nutrition, food, employment & income for the maximum of the rural population. But the country is blessed with miscellaneous agro-climatic conditions that allow producing a large number of agricultural commodities to the farmers. In the focus on commercial farming, the rich custom of crop diversity of Indian farming lasts its magnificence. The cultivated land is under irrigation system is a total 40 percent and farmers on the remaining 60 percent of the land are completely dependent on rainfall, which is also greatly considered by large variations in terms of precipitation both spatially and temporally.

Food security occurs when all people, at all times, have physical and economic access to sufficient, safe and nutritive food to meet their dietary needs and food preferences for an active and strong life. (FAO)

Major problems and constraints in crop diversification in India

- The majority of the cropped area (89%) is entirely dependent on rainfall and is affected by other biotic and abiotic stresses.
- Sub-optimal use of critical production inputs like organic manures, biopesticides, etc.
- Very poor mechanization of agriculture due to Small and fragmented landholding.
- Inadequate post-harvest technologies and inadequate infrastructure for post-harvest handling of perishable crop produce.
- Poor supply of quality seeds and planting material of improved cultivars.
- Non-availability of agro-industry.
- Declined investments and interest in the agricultural areas.
- Poor storage and other post-harvest facilities.
- The remoteness of the region.
- Disturbing roadside, landslides cause shutting of roads during monsoon season.

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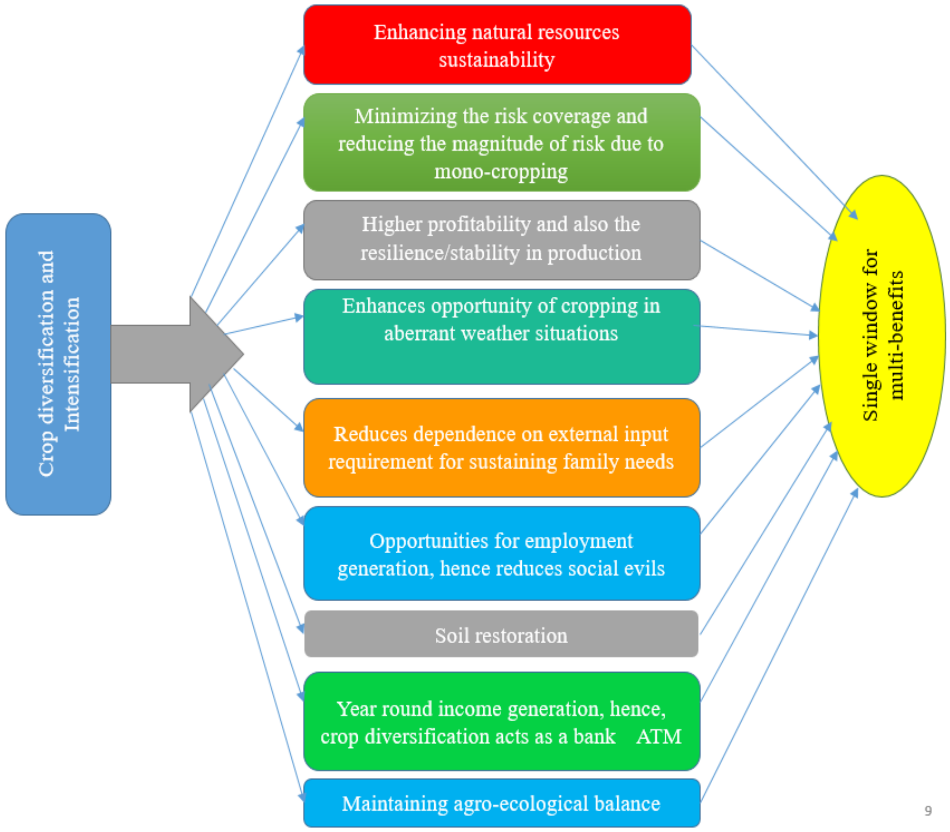

Fig. 1: Need for crop diversification and intensification

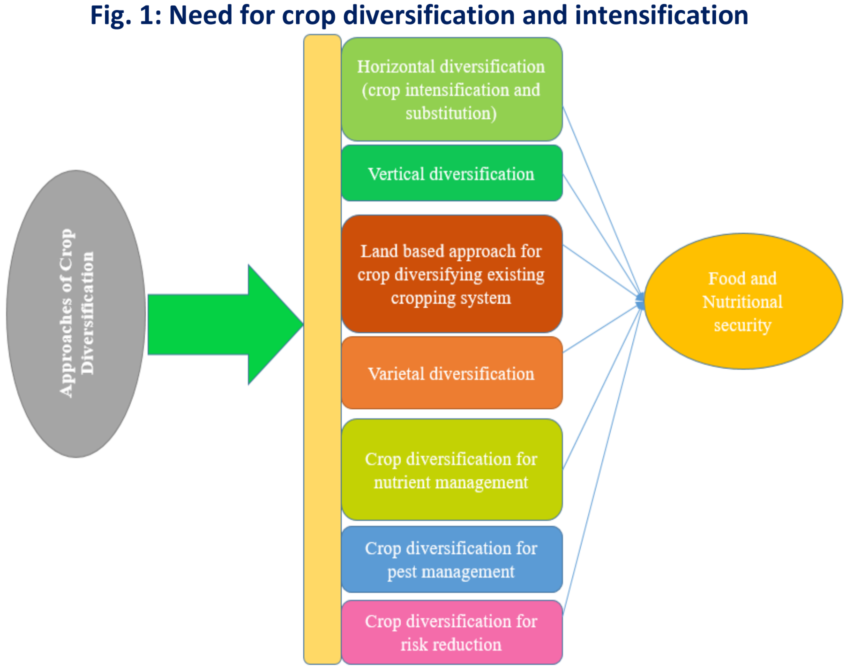

Fig. 2: Approaches of Crop Diversification for India

Strategies of Agronomic intervention for Crop diversification

- Diversification approach should promote the substitution of low yielding traditional cultivars with high yielding varieties.
- Crop diversification approach should follow the principles of crop rotations. Legumes intervention.
- Crops having both domestic and international demand should be included in the cropping systems.
- Inclusion of crops with comparative advantages.
- In this system rational choice of crop varieties.
- Inclusion of energy-efficient crops.
- The systems with high productivity, sustainability and profitability should be selected.
- Cultivation of specialty crops like cereal, pulses, oilseed, commercial crop, and fruits, etc. should be helped in cropping system style.
- The cropping sequence.
- Conservation tillage and irrigation practices.
- Cover cropping, in-situ residue/biomass management, water, and nutrient saving technologies, rainwater harvesting approaches.
- low-cost plastic rain shelters, Low-cost plastic tunnels and greenhouse (low cost).
- Reutilizing of crop residues and all kinds of biomass.
- Integrated organic nutrient management strategies should be adopted in diversified production systems.
- Owners of diversified farms.

CONCLUSION

This is concluded that crop diversification is a way to achieve food security in India. There are different strategies included *viz* introduction of high yielding variety, crop rotation, cropping sequence, the inclusion of legume in the cropping system, efficient crop and varieties, recycling of biomass, conservation tillage and agronomic intervention for achieved high productivity, profitability and sustainability for food security.

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Role of zinc oxide nanoparticles on Field crop to enhanced crop productivity

Article id: 23518

Sandeep Kumar Verma[1*], Mohammad Hasanain[2], Durgesh Kumar Maurya[3], Pradeep Kumar Singh[4], and Sanjeev Singh[5]

[1, 3, 4,] MSc Scholar & [5]Ph.D. Scholar, Department of Agronomy, [7] MSc Scholar, Department of Soil Science, SVPUA&T, Meerut 250110*

[2,] Ph.D. Scholar Division of Agronomy, ICAR-IARI, New Delhi 110012

Zinc nutrient is the fourth important nutrient after nitrogen, phosphorus and potash which required by field crops in an adequate amount. The supply of zinc by traditional fertilizers is less effective because the nutrient use efficiency of traditional fertilizers is very low as compared to zinc oxide nanoparticles (ZnO-NPs). We increased the productivity of field crop by using nano zinc because nano zinc have very less particle size (100nm), so they easily penetrate in the crop and lead to nutrient use efficiency. Thus the productivity of field crops can be increased by using zinc oxide nanoparticle (ZnO-NPs).

INTRODUCTION

Fertilizers are a major role in increased crop productivity and the quality of high yielding varieties. But more use of traditional fertilizers soil have a detrimental effect and also reduced the nutrient use efficiency. In the field crop, zinc fertilizers play a vital role in growth and development. Zinc deficiency is more common in rice growing soil with a high content of organic matter and high pH or when organic manure is applied (Dobermann and Fairhurst, 2000). Severe Zn deficiency causes more losses of grain yield with low Zn content contributes to human nutritional Zn deficiency (Johnson et al., 2009). The Zn available in rice field in very low amount causes poor tillering and leaf bronzing at early growth stages, this leads to delayed maturity and significant loss of yield (Neue et al., 1998; Dobermann and Fairhurst., 2000). If we apply Zn by traditional fertilizers to the crop, these are less effective because of lower nutrient use efficiency of traditional fertilizers as compared to zinc oxide nanoparticles (ZnO-NPs). Zinc oxide nanoparticles play important role Zn uptake, translocation and growth performance in field crops. Plants treated with nano zinc oxide (ZnO) showed increased chlorophyll content, biomass, plant height, tiller number, and yield. By this study, we know the productivity of field crops can be increased by using zinc oxide nanoparticles (ZnO-NPs).

Characteristics of ZnO-NPs

- Zinc oxide nanoparticles have a very little particle size (100 nm).
- They have larger surface area and high catalytic activity.
- It should be non-toxic to plant and environment.
- They easily penetrate in the plant tissues because these have less particle size and larger surface area.
- It causes less pollution as compared to Zn applied by traditional fertilizers.
- It increased Zn use efficiency due to nutrient release very slow.
- ZnO-NPs are very effective for cereal crops.

Why need of ZnO-NPs ?

In Indian soil, Zn deficiency is very common. Zn is the fourth impotent nutrient of the crop after nitrogen, phosphorus and potassium. Zn deficiency causes several diseases in field crops like- khaira disease in rice, white bud of maize, little leaf of cotton lead to lower productivity of crops. Zn fertilizers have lower nutrient use efficiency and use in the higher amount they lead detrimental effects of soil and also crops. Thus the productivity of crops is very low. The problems mentioned above can be addressed by using Zinc oxide nanoparticles (ZnO-NPs). Nano zinc has higher Zn

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use efficiency due to its fewer particle size and larger surface area. We increased the productivity of field crops by using zinc oxide nanoparticles (ZnO-NPs).

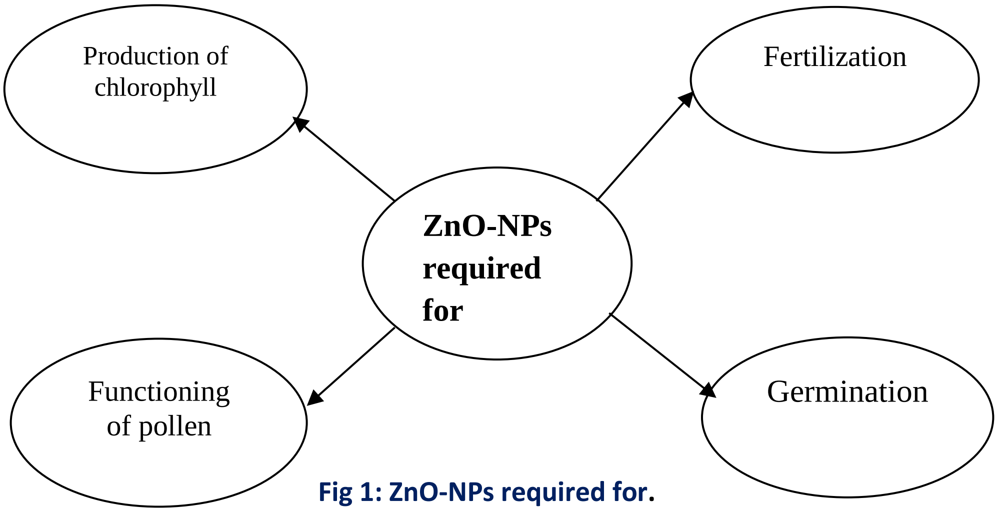

Fig 1: ZnO-NPs required for.

Effect of zinc oxide nanoparticles (ZnO-NPs) on different field crop

The germination and seedling growth of plants depends on the concentration of nanoparticles and varies from plant to plant. Zinc oxide nanoparticle (ZnO-NPs) increased plant growth and development in wheat crop (Ramesh et al. 2014). In *Cyamopsis tetragonoloba,* ZnO-NPs induced plant biomass, root area, protein synthesis, microbial population, shoot growth, chlorophyll and phytase activity in cluster bean (Raliya and Tarafdar 2013).

Table 1: The effect of ZnO-NPs on different crops depends on the concentration of zinc oxide nanoparticles and they vary from crop to crop.

	Concentration (ppm)	Beneficiary plant	Effective part of the plant	Reported by
ZnO-NPs	1.5 ppm (Foliar spray)	*Cicer arietinum L.*	Shoot dry weight	Burman et al. (2013)
	20ppm(suspension, foliar spray)	*Vigna radiata*	Biomass	Dhoke et al. (2013)
	1000 ppm	*Arachis hypogea*	Germination	Prasad et al. (2012)
	1000 ppm	*Arachis hypogea*	Stem, root growth and yield	Prasad et al. (2012)
	500, 1000, 2000 and 4000 ppm	*Vigna radiata*	Dry weight	Patra et al. (2013)

Nanocomposites ZnO were safe for wheat seed germination, emergence and growth of seedlings and they provide nutrients at the need of time to wheat plant. The positive effect of ZnO-NPs on bajra crop germination and growth (Nandhini et al.2019). Zinc is a necessary component of various types of enzyme-like- oxidoreductase, transferase, hydrolases, isomerases, lyases and ligases (Auld, 2001). We increased the growth and yield of the crop by application of ZnO-NPs. Nanopowder can be used with the mixing of pesticides and fertilizers in a very small amount (Selivanov and Zorin 2001, Raikova et al. 2006 and Batsmanva et al. 2013).

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CONCLUSION

Thus, it is concluded that the application of ZnO-NPs increased the germination, crop growth, root and shoot growth, yield attributes, yield and nutritional quality of produce. ZnO-NPs are significantly enhanced of crop productivity in several crops. It also increases the nutrient content (Zn) in grain which is playing vital role in the nutritional quality of grain and addressing the problem of malnutrition in children.

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Basics of extension education and rural sociology

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Aditya Kumar Malla[1], Jeebanjyoti Behera[2], Abhisek Tripathy[3], Pooja Konhar[4], Ashruti Kesharwani[5]
[1&2] Ph.D. Research Scholar, Dept. of Extension Education, O.U.A.T, Bhubaneswar
[3]Ph.D. Research Scholar, Dept. of Plant Pathology, O.U.A.T, Bhubaneswar
[4]Ph.D. Research Scholar, Dept. of Agricultural Entomology, IGKV, Raipur
[5]Ph.D. Research Scholar, Dept. of Plant Pathology, IGKV, Raipur

Extension Education: Education is the process of bringing desirable change in human behaviour. *Extension (L)* consists of two words that is *Ex (out) and Tensio (stretching)*. Thus the terms extension education mean the type of education which is stretched out into the villages and fields beyond the limits of schools and colleges to which formal type of education is normally confined. It is an out of school system of education for adults and youth including farmers , farm women, farm youth and school dropouts for improvement in farm and home practices. Extension Education, therefore, is a non-formal educational activity conducted outside the framework of formal educational institutions to provide select type of learning to particular sub-groups.

Agricultural extension may be defined as a special branch of extension education which deals with the economic and social aspects of people engaged in /associated with agriculture. It deals with providing need and demand based knowledge in agronomic techniques and community management skills to the rural people in a systematic participatory manner with the objective of improving their production, income and quality of living. Thus, Agricultural extension is essentially an educational process that aims at bringing about transformation in the production behaviour of rural people and their different social groups for enhancing their socio-economic conditions through agricultural improvement.

Definition of extension education

D. Ensminger (1957) - Extension is an education and that its purpose is to change the attitudes and practices of the people with whom the work is done.

J.P. Leagans (1961) – Extension education is an applied science consisting of content derived from research, accumulated field experiences and relevant principles drawn from behavourial sciences synthesized with useful technology in to a body of philosophy, principles, content and methods focused on the problems of out-of-school education for adults and youth.

Kelsey and Hearne- Extension is an out of school education in which young and adult people learn by doing the practices.

Scope of Extension Education

The scope of agricultural extension includes all activities directed towards the development of the rural people that can be aimed at by application of specific efforts. It hints at the wide area which can be reached by the under mentioned activities.

1. Assessing the socio economic conditions of rural people
2. Studying their needs, interests, culture and values for effective intervention through rural sociology.
3. Transfer of Technologies through the principles of diffusion and adoption of innovations.
4. Training skills for leadership development.
5. Concentration on development and use of natural resources.
6. Increasing efficiency in the marketing, distribution and utilisation of agricultural inputs and outputs.

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7. Better extension teaching methods for changing the production behaviour of rural people.
9. Methods of Programme planning and evaluation for increasing efficiency in agricultural production.
10. Strengthening Extension Administration and Supervision for management of field activities

Importance of Extension Education

i) **For community development** :
Various community development programs organized by government of India have been successful through extension education like NADP (national Agricultural Development Programme),IADP (Intensive Agricultural District Programme, HYVD (High yielding varieties programme), IID (Innovative Technology Dissemination), NES (National Extension Service), ATMA (Agricultural Technology Management Agency) etc.

ii) **Increase in production and productivity** :
Improved knowledge, inputs, instruments and their proper use increase production and productivity (Production / Unit area). This knowledge is transferred through extension worker.

iii) **For produce sales and marketing development** :
After getting innovative ideas or technologies through extension service, farmers apply these in field condition and produce bumper yield. But if this yield will not get proper market to be sold, then the knowledge will have no value to the farmers. Hence, extension not only transfers technology but also helps farmers how, when and where to sell in produce to get satisfactory income.

iv) Management of farm and home :
Management includes efficient use of resources to get maximum benefit. Through extension efficient use of farm implements takes place. Also for success of extension only farmer is not responsible, cooperation of whole family i.e. farm women, school dropout boys and girls is necessary which involves have management.

v) For rational farm & home decision making:
Agricultural extension is central to formulating and disseminating farm and home information and helping farmers to be competent decision makers so that they can involve themselves in solving their own problems. It makes them more efficient worker.

vi) Attention to the rural people :
Extension mainly approaches for development of rural people through dissemination of knowledge, information, technologies. Extension education's main motive is to bring desirable change in behavior of rural people, to make them efficient worker, to make them competitive decision maker so that they will have a better life style.

In brief-

1. It enhances people's stature and ability to take rational decisions by applying democratic educational approach.
2. It helps in the adoption of farm and home innovations by influencing the knowledge skill and attitude of farming community.
3. It creates confidence for solution of diverse and critical farm problems which can be dealt with efficient extension agency.
4. The soundness of the trained extension workers help understand the farmers" problem well and assist the technology dissemination process.

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SOCIOLOGY

The term "sociology" is derived from the Latin word Societus/ "socius," meaning society/ companion or associate, and the Greek world 'Logos,' meaning discourse study or science. Thus, the etymological meaning of sociology is the study/ science of society.

Auguste Comte (1789-1875), the French philosopher, is considered as the "Father of sociology'. Comte, introduced the word 'sociology' for the first time in his famous work, "Positive Philosophy" (1838-39) and established two specific problems for sociological investigation i.e. Social statics(order & stability) and Social dynamics(social change).Other social thinkers include H. Spencer, Emile Durkheim, Max Weber, E.S. Bogardus. R.M. MacIver, W.F. Ogburn, P.A.Sorokin etc. who took a leading role in making sociology a complete science.

Definition of sociology

Sociology is the science of society and the study of social groups. It has been defined in a number of ways by different sociologists. Some important definitions are as under:

1. **Auguste comte :** Sociology is the scientific study of human society and social behaviour
2. **M. Ginsberg :** Sociology is the study of human interactions and interrelations, their conditions and consequences.
3. **P.A.Sorokin:** Defines sociology as a generalized study of structure and dynamics of social systems.
5. **J.B. Chitambar**: It is the study of human beings in group relations.
6. **Max Weber**: Sociology attempts the interpretive understanding of social action.
7. **J.F.Cuber**: Sociology is a body of scientific knowledge about human relationships.

The definitions above suggest that sociology attempts a study of the social behavior of people in group relations and the influence of surroundings on it.

Rural sociology

Rural sociology is a specialized field of sociology. It is the study of social life in the rural environment. It is a systematic and scientific study of rural society. Majority of people in our country live in rural areas. The pattern of occupation, way of life, norms, behavior, values and beliefs etc. are somewhat different from those living in urban or industrial areas. So, Rural Sociology has emerged to study the rural people and rural society.

Definition

1. Bertrand. Rural sociology is the study of human relationships in rural environment.
2. A. R. Desai: It is the science and laws governing the development of rural society
3. F. S. Chapin: Sociology of rural life is a study of rural population, rural social organizations and the social processes operative in rural society.
4. Sanderson: Rural sociology is the sociology of rural life in rural environment.

Thus rural sociology is related to the organized and scientific study of the life of rural people, rural institutions, social structure, and social changes that take place in the rural societies.

Scope of Rural Sociology

The scope or subject matter of rural sociology is basically the study of rural society with all its complexities. According to Lowry Nelson, "The subject matter of rural sociology is description and analysis of the progress of various groups as they exist in the rural environment. The main tasks of rural sociology therefore are as follows :

1. Rural community & rural problems: This includes the characteristics & nature of rural community and study of its problems.
2. Rural social life :Study of the various aspects of the rural people in its inherent aspects
3. Rural Social structure and Institutions :- Study of various social institutions including family , marriage, religion, caste and neighborhood etc.
4. Rural Social Organisations :- This includes the study of various political, economic, religious, social & cultural organizations those contribute to rural upliftment.
5. Rural planning & Reconstruction :- Rural sociology has great practical applications in the field by way of planning & reconstruction which is the main task of rural sociology.
6. Social Change & Social Control :- This studies the impact of city on rural life. The mechanism of social control of the rural society are also examined here.
7. Rural Religion & Culture :- Religion plays an important role in a rural set up. Culture of rural society exhibits striking peculiarities. These come within the domain of rural sociology.
8. Rural social Processes :- Different social processes like co-operation, competition, integration, isolation, differentiation etc., that take place in rural society are also studied in rural sociology.
9. Rural Urban context :- The study of rural society also includes the differences between the rural & urban societies also.

Importance of Rural Sociology

1. Rural population is in majority who need to be addressed and understood well.
2. Rural sociology helps understand social change to bring community development.
3. Rural sociology helps to understand social psychology and culture for successful extension intervention.
4. Rural sociology helps to understand cross-cultural situations to overcome the rural ethnocentrism.
5. Rural sociology helps to understand the social hierarchy for ease of extension work.
6. It helps to understand the rural value systems for effecting productive social change.

Difference between Rural Sociology and Extension

Rural sociology	Extension education
1.It studies the laws governing the structure and development of rural society	1. It is informal education aimed at developing rural society in desirable lines.
2. It studies the attitude and behavior of rural people.	2. It seeks to modify /change the attitude and behavior of village people for better.
3. It studies the needs and interest of rural society.	3. It helps rural people discover the needs and problem and builds educational programmes based on it.
4.Analyses rural-social relationship between leaders, groups and organistaions in rural areas	4. It makes use of the groups and organistaions to achieve the objective of rural development.
5.It studies social situations and assemble social facts on rural society	5. It makes use of social data as a basis of building up extension programmes.
6. It investigates the social, cultural, political and religious problems of rural society.	6. It studies the problems with reference to their impact on extension work in villages.

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Exploiting potential of Medicinal and Aromatic plants in semi-arid region of Bundelkhand in Uttar Pradesh

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Neetu[1], Sarita devi[2] and Brijesh Kr. Maurya[3]
Banda University of Agriculture and Technology

Majority of the population is present in the rural region of the country. People having poor economic condition in the rural areas are primarily depended upon the traditional medicinal practices. These traditional medicinal systems are almost dependent upon the herbs having medicinal importance cultivation in different eco-logical regions of the country. Natural forests are decreasing due to ever increasing human population. Many species of MAPs are already threatened from collection pressure.

The natural population of commercially important MAPs is declining which has outputted serious risk of extinction. So it is pressingly imperative to explore their patterns along the different physiographic region of the country to launch effective conservation strategies and programs

Besides enormous potential to grow the medicinally important plant their cultivation has gain setback in the comparison to the other agriculture commodity like cereal, vegetable, etc. due to many prevailing reasons. Little ability of the farmers to bear risk and the practice of the new innovation in the field has brought the cereal based mono-cropping pattern of farming in the community. At the same time inappropriate and insufficient mentoring about the identification of the valuable medicinal an aromatic plants, lacks of skills and planting materials, changing climate and plant adaptation, etc. are major factors making it much vulnerable.

Uttar Pradesh state is broadly divided into nine Agroclimatic Zones and into five regions, the Western, Central and Eastern Plains, Southern Hills and Plateau and Bundelkhand. Uttar Pradesh has an area of about 240928 Sq.Km . Based on climatic conditions, these regions have been categorized into nine zones i.e.,Tarai,Western Plains ,South Western semi dry plains , Mid plains ,Bundelkhand ,North –Eastern Plains, Eastern plains and Vindhyachal.There are visible differences in the agricultural resources,climatic conditions,soiltypes, topography, land use pattern and development of infrastructure , non agricultural activities, and in the source of income of the people of the region. The Western part, which contains about 36% of the state's population, is relatively better developed in agriculture in comparision to the other regions. The Eastern region, which contains about 38% of the state's population, is dominated by traditional and poor agricultural practices. The Central region, which accounts for about 17% of the state's total population, resembles the eastern region in several agriculture characteristics. Bundelkhand, inhabited by about 5% of the state's population ,is a semi arid and resource poor region ,where rainfall based agriculture practices is dominated Various researchers have reported that poverty is the main cause of degradation of plant resources. Further, haphazard collection of medicinal plant has created an adverse impact on the habitats of other plant species amongst which they exist.

Geographically Bundelkhand is situated in semi arid region of Central India(south western part of U.P.state) between 24.1˚26.27′N latitude and 78.17˚ 81.34′ E longitude at 250-300 m.asl.The majority of the vindhya region is covered by Laterite soil, which consists of iron bricks(locally termed as mauram);thus ,part of this region has red soil (Choudhary 2010).The climate of the region is tropical dry sub humid. Rainfall varies from 850 to 1050 mm mostly during June to September. Temperature varies from 19.2-27.1˚C(minimum) 38.8 to 42.4(maximum) in summer and 6.0 to 22.5˚C in winter. Table 1, shows the medicinal and aromatic crops having potential for commercial cultivation in Bundelkhand region .Important medicinal crops suitable for Bundelkhand

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Table 1: Important medicinal and aromatic plants

Common name	Botanical Name
Medicinal plant	
Aloe vera	*Aloe vera*
kantkari	*Solanum surattense*
Ashwagandha	*Withania somnifera*
Sarpagandha	*Rauwolfia serpentine*
Kalmegh	*Andrographis paniculata*
Aromatic plant	
Lemongrass	*Cymbopogon flexuosus*
Citronella	*Cymbopogan winterianus*
Palmarosa	Cymbopogan martinii
khus	*Vetiver zizindoides*
Tulsi	*Ocimum basillicum*

Kalmegh (*Andrographis paniculata*)

Kalmegh is an important traditionally used medicinal plants occurs throughout hotter parts of India. The whole herb is bitter in taste and is source of several diterpenoids of which a bitter water soluble lactone “andrographolide” is important. The plant is acrid, cooling, laxative, antipyretic, antiperiodic, anti-inflammatory, expectorant, sudorific, anthelmintic, digestive and stomachic. It is useful in burning sensation, chronic fever, malaria and intermittent fever, inflammation, cough, bronchitis, skin diseases, intestinal worm, dyspepsia, flatulence, colic, diarrhoea, dysentery, haemorrhoids and vitiated condition of pitta. The plant is often used as a substitute for Chirayita *(Swertia chirayita).*Considering its pharmaceuticals potential ,there is a need to increase its large scale systematic cultivation in bundelkhand.

Kantkari (*Solanum surattense)*

Plant is widely distributed throughout India in dry situation as weed ascending to 1500 meter on the Himalaya, abundant by road sides and wastelands, mainly in Rajasthan, Gujarat,Madhya Pradesh, Uttar Pradesh and Haryana. Kantakari is essentially a warm season crop grow mainly in tropical and sub tropical regions. Generally a long period of warm, preferably dry weather with abundant sunshine is required. (whole herb including roots) and berries, have anthelmintic property, useful in bronchitis, asthma, fever relieving, thirst and given in urinary concretions. The leaves have good application for piles. The fruit is laxative. Fumigations with the vapour of the burning seeds of this plant are found useful for the cure of toothache. An average crop of Kantkari yields abou 16-20 t/ha of dry biomass (Panchang) including 500 kg berries (dried) under good management practices. After drying, 15-20% dry matter can be obtained under these conditions. Rs. 21938/- is the estimated cost of cultivation for one hectare.

Satavar (Asparagus racemosus)

Satavar is an indigenous medicinal plant and popularly known as satavari used in Ayurvedic Siddha and homeopathic medicines. It belongs to the family Liliaceae .Shatavari roots are used mainly as lactogogue which promotes secretion of breast milk.It is estimated that in India ,more than 500 tonnes of shatavari roots are required every year for medicinal preparations. This crop is propagated by the seeds during the monsoon season. The two year crop yields about 50-60 quitals of dry roots in one hectare. Well matured and dried satavari roots can be marketed @ Rs 80-100/kg. Therefore, the production gives a gross income and net profit Rs.500000/- and 3,50,000/ha. respectively

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Sarpagandha (*Rauwolfia serpentine)*

Rauwolfia serpentine is an erect, evergreen 0.60 to 1 m high shrub and grows in Indian sub continent,Sri lanka, Thailand and Indonesia. It is generally collected from wild areas. Its cultivation is on a limited scale. It is one of the most important drugs used in both traditional and modern system of medicine. In Ayurvedic and Unani systems of medicine, it is a drug for various types of ailments,ranging from disorders of the central nervous system such as maniacal behavior, insanity, epilepsy and insomnia to intestinal disorders. The plants are raised from seeds as well as from root cuttings during the monsoon season. The two years crops gives an average yield of 12 to 15 quintal per hectare and the market price of the root is Rs. 200 per Kg which yields a net profit of Rs. 1,50,000/-per hectare.

Ashwagandha (Withania somnifera): Ashwagandha is an ancient, important medicinal plant. Roots of the plants have been commonly used in traditional systems of medicines, Ayurveda and unani. This shrubbery bush plant grows well in dry and subtropical regions. Therefore ,ashwagandha is a potential cash crop for greening the dry land Zone ,making it productive and reclamation of wasteland .It is cultivated in different part of uttar Pradesh specially in dryland area of Bundelkhand regions.

It is shown in table that ashwagandha has an average root yield of 8-10 q/ha and can be produced in a period of 6 to 7 months. 50kg/ha seeds can be produced.Commercially 6-15 mm diameter and 7-10 cm length root pieces are better. Alkaloid percentage in roots is 0.13-0.31%.The crops gives a net income of Rs.95000 from one hectare area.

Aloevera

Aloe vera is avery hardy perennial tropical plant that can be cultivated in drought areas as well.This plant became very popular in the world due to its medicinal value . This plant also called a miracle plant or natures tonic.This plant is being used extensively in the cosmetic industry and consumer product segment. Its cultivation doesn't require tons of water for its growth. It can grow in the presence of low water availability and hence best suited for cultivation in arid and semi-arid regions of Rajasthan, Gujarat, Madhya Pradesh and Maharashtra. Aloevera has also been used in antibiotics, antiseptic, antibacterial, antifungals, germicidal,antiviral . Thus, there are opportunities in the state for investment in such cosmetic and medical industries.

Important aromatic crops for Bundelkhand region

Lemon grass (*Cymbopogon flexuosus*)

Oil of Lemongrass,obtained from the leaves of C.flexuosus,is used in soap perfumery and is a source of citral, a chemical used in perfumery and flavour industries and also a raw material for the manufacture of vitamin A. About 250 tonnes of tne oil valued at about Rs.10 crore is being produce annually for domestic consumption as well as for export.Lemon grass oil has very good demand in the world market. The production of Lemongrass oil in the country has declined in recent years and there are immense possibilities for production of good quality Lemon grass in the state in bundelkhand region.One hectare plantation of Lemongrass yields about 200 Kg oil giving a net profit of about Rs. 80,000/-per annum.

Java Grass (*Cymbopogan winterianus*)

Citronella oil of java quality is obtained by steam distillation of leaves. It is important source of perfumery chemicals, such as citronellal, geraniol and hydroxycitronellal. As a result

Palmarosa (*Cymbopogan martini*)

This oil is obtained from the flowering tops, leaves and over-ground parts of palmarosa plant. Palmarosa oil is used in perfumery, cosmetics and flavour industries particularly for flavouring tobacco. Palmarosa has great opportunity

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where salt affected cultivable wastelands are available. One hectare crop of palmarosa gives about 100-150 kg oil resulting into a net return of about Rs.8500/-per annum

Khus (*Vetiveria zizanioides*)

Vetiver oil is obtained by steam distillation of roots of Vetiveria zizanioid.The oil is used in high grade perfumes. The oil is extracted from the roots of wild varieties.This crops can be cultivated in the underutilized land which gives a better profit to the farms.The plant offers immense possibilities for expansion, especially along the river bed and waste land s which are not suitable for the production of cereals and horticultural crops.

Tulsi (*Osimum basilicum*)

Indian tulsi is a short duration aromatic crops which is cultivated on commercial scale in India for the production of valued essential oil. The seed contain edible oil and a drying oil similar to linseed oil extracts of the plant are used in traditional medicine and have been sown to contain biological active constituents that are insecticidal, nematicidal, fungistatics and anti microbial. Besides being an aromatic herb is often used in potpourri and sachets .The cosmetic industry uses basil oil in lotion, shampoos, perfumes and soap.

Problem faced by the growers

Despite having competitive advantage in terms of favourable conditions for production,R&D backup,increased farm income,employment generation etc., there are several weakness too,which hamper progress of essential oil based and drug industries in the state. Some of the major weakness are mentioned below.

- **Lack of market information and regulatory aspects**

There is lack of authentic information on the production, supply, future demand, prices, etc in medicinal and aromatic plants sector. Unfortunately, very few economics studies have been published on essential oils as compared to other research aspects which have been covered widely in national and international publications and database. Lack of market information causes difficulties in marketing of the produce. The growers are denied remunerative prices for their produce.The trade of medicinal and aromatic plants is yet to be covered under regulation act.

- **Non availability of quality planting material**

There is a lack of quality planting material of MAPs which directly affect the area expansion under these crops and quality production of the produce.

- **Lack of processing facilities**

Small scale processing of aromatic plants is prevalent in the rural areas. The distillation plants are generally less efficient and take more than desired time in completing the process.

CONCLUSION

The future of medicinal and aromatic plants rests on today's ability to resolve the conflicts between conservation and use, and the shift towards more resource-based agriculture increasingly challenged by the globalization of economies. Our major objectives therefore were to explore the potential in medicinal plants resources, to understand the challenges and opportunities with the medicinal plants sector, and also to suggest recommendations based upon the present state of knowledge for the establishment and smooth functioning of the medicinal plants sector along with improving the living standards of the underprivileged communities.

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Perks of grafting for the improvement of vegetable crops

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Bajrang Kumar [1]*, Prachi Pattnaik[1], Ashutosh kumar[1]
[1]Department of Horticulture, Institute of Agricultural Science,
Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India.

Vegetables are of paramount importance in human diet which are rich source of carbohydrates, protein, roughages, vitamins and mineral. So, they are often referred to as "protective food". Vegetable crops are very sensitive to climatic vagaries. It is necessary to grow those variety which are well adapted and having resistance to biotic and abiotic stress. In such a scenario, grafting in vegetable has been emerging as a promising and an alternative tool unlike of the slow conventional breeding methods. Grafting has also paved a way for escalation in water and nutrient uptake as well as increasing plant vigor and extending duration of economical harvest time. Identification of compatible and desirable disease resistant rootstocks is an important aspect and the basic requirement for continued success. Focus should be given to further research for the development and use of successful grafts for vegetable production.

INTRODUCTION

Vegetables are of paramount importance in human diet which is rich source of carbohydrates, protein, roughages and vitamins and mineral. So, they are often preferred as "protective food". Vegetables are considered as a crucial component in the diversification of horticulture to provide food and nutritional security for the ever increasing population. Vegetable crops are very sensitive to climatic vagaries; therefore any fluctuation in climatic parameters at any phase of crop can affect the normal growth, flowering, fruit development and subsequently the yield. It is necessary to grow that variety which are well adapted and having resistance to biotic and abiotic stress. Various breeding methods are in use for development of such varieties but these conventional breeding methods takes time for the final release of varieties. So, there is need to apply a quicker method for propagation of vegetable crops. In such a scenario, grafting in vegetable has been emerging as a promising and an alternative tool unlike of the slow conventional breeding methods.

What is grafting?

By definition, "grafting" is an art of joining together two plant parts (a rootstock and a scion) by means of tissue regeneration, in which the resulting combination of plant parts achieves physical reunion and grow as a single plant. The scion of the grafted procures the upper portion of the plant and it can be selected for its quality of fruit characteristics. Commercial vegetable grafting by using resistant roots stocks is one of the best tools for sustainable vegetable production. Rootstock (lower portion of the graft) is a plant already has an established, healthy root system and is selected for their ability to resist different abiotic and biotic stress condition or their ability to increase vigor, precocity, enhanced quality and productivity.

Application of grafting in vegetables

Grafting is not only aimed at increasing tolerance to biotic and abiotic stresses but also induces vigour, precocity, better yield and quality, survival rate in vegetables. This technique has gained more popularity in case of cucurbits, tomato, eggplant and pepper using vigorous and disease resistant rootstocks to ensure adequate yields, whereas biotic and abiotic stresses limit the productivity. Vegetable grafting also reduces the dependency on agrochemicals; thus promoting organic production. Grafted seedlings are being progressively adopted by the vegetable growers as

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propagules of choice for crop establishment. Grafting has also paved a way for escalation in water as well as nutrient uptake and extending duration of economical harvest time.

Grafting in vegetables for the first time was done with rootstock of watermelon (*Citrullus lanatus*) and pumpkin (*Cucurbita moschata*) in Japan and Korea in the late 1920s. However, commercial grafting in vegetable crops only originated in the early 20th century with the aim of managing soil borne pathogens. Among the Solanaceous crops, eggplant (*Solanum melongena* L.) grafting onto scarlet aubergine (*Solanum integrifolium* Lam.) was started in the 1950. Similarly, tomato (*Solanum lycopersicum* L.) grafting was started in the 1960. In India, grafting work has been started in IIHR, Banglore by Dr. R M Bhatt and his associates and is also being carried out at TNAU, Coimbatore producing brinjal grafts using *Solanum nigrum* as rootstock. NBPGR regional station, Thrissur, Kerala have worked on cucurbit grafting by taking *Momordica cochinchinensis* as rootstock with success rate of 98%. Many private and public sector institutes in India have initiated progressive research works in this direction. One of the major advantages of using grafted plants is to utilize the strong tolerance or resistance of rootstocks to certain soil borne diseases such as those caused by *Fusarium* spp., *Verticillium* spp. and *Pseudomonas* spp. even though the degree of tolerance varies considerably with the variety of rootstocks. Hybrid squashes (*Cucurbita maxima* Duchesne × *Cucurbita moschata* Duchesne) widely used as melon rootstocks are highly resistant to fusarium wilt and tolerant to verticillium wilt, monosporascus suddenwilt, and gummy stem blight. Pepper scion ('Nokkwang') grafted onto breeding lines ('PR 920', and 'PR 921', and 'PR 922') exhibited resistance to both *Phytophthora* blight and bacterial wilt when inoculated with *Phytophthora capsici* and *Ralstonia solanacearum.* Some studies also reported that grafted watermelons had a greater tolerance when watered with saline water than did the non-grafted plants and also showed resistance to flood. Fig leaf gourd rootstock has been commercially used to increase the tolerance of cucumber, watermelon, melon and summer squash to low soil temperature. Grafting leads to salt and flooding tolerance, improved water use efficiency, increased nutrient uptake and alkalinity tolerance. *Cucurbita hardwickii* scion grafted on monoecious or gynoecious cultivars of cucumber expressed higher number of total flower and pistillate flower.

Basic requirements and management of grafts

There are certain prerequisites to perform grafting such as selecting the right rootstock/scion, grafting aids, screening house where seedlings are grown prior to grafting, healing chamber which is most crucial in promoting callus formation in graft seedlings and acclimatization chamber for hardening of seedling before transplanting. Different types of grafting methods in practice such as Cleft/ Wedge grafting, Tongue/ Approach grafting, hole insertion/ Top insertion grafting, Splice grafting/ Tube grafting and Pin grafting.

The field management of grafted plants is quite similar to that of non-grafted plants but some specific care must be taken into consideration such as use of clear polyethylene covered rain shelters to shield plants from direct impact of heavy rainfall and provide shade. The graft union must be kept above the soil line or else it is more likely for the adventitious roots to develop from the scion and grow into the soil. Removal of adventitious roots that develop on the scion should be practiced to prevent infection from soil-borne diseases. Staking of grafted plants should be done two to three weeks after transplanting. Future prospects include making healthy grafted seedlings available to the farmers at reasonable price. Techniques used should be of low cost so that these could be adopted by farmers for commercial production. More research is needed to minimize the losses during post grafting period. Also there is a scope for vegetable breeders and private companies of India to develop resistant rootstocks. Various rootstocks and corresponding methods of grafting used in some of the vegetables are presented in Table. 1.

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Table 1: Grafting methods and rootstocks used in vegetable crops

Scion plant	Root stock	Methods
Eggplant	*Solanum torvum*, S. *sisymbrifolium*, S. *khasianum*	Tongue and cleft method
Tomato	L. *pimpinellifolium*, S. *nigrum*	Only cleft method
Cucumber	C. *moschata*, C. *maxima*	Hole insertion ad tongue method
Watermelon	*Benincasa hispida,* C. *moschata,* C. *melo, Lagenaria siceraria*	Hole insertion and cleft method
Bitter gourd	C. *moschata, Laginaria siceraria*	Hole insertion and tongue method

CONCLUSION

Thus, grafting is a viable proposition that revitalizes modern vegetable production in challenging environments. The method provides farmers with an effective measure to manage soil borne diseases and waterlogged soils, helping them bring in a good harvest despite adverse growing conditions. However, despite this recent advance, the percentage of grafted plants in overall vegetable production is still relatively low; mainly because of the high cost of grafting, damage by soil-born pests and diseases, and adaptation of the grafted seedlings to abiotic stresses are the major constraints**.** Identification of compatible and desirable disease resistant rootstocks is an important aspect and the basic requirement for continued success. Storage technology for grafted transplants also demands attention of researchers; also the developments of databases, software, mobile applications and crop models in accordance to grafted vegetables will assist nursery managers as well as farming communities in the selection of suitable scion and rootstock cultivars**.** Further, inventions are being focused to improvise mechanized and robotic grafting as an eco-friendly approach**.**

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Management strategies for increasing oilseed production in India

Article id: 23522

Shaikh Wasim Chand [1], Mirza I.A.B[2], Santosh Thombre[3], and Mahesh Darule[4]
[1]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431402
[2]Assistant Professor, Department of Agronomy, VNMKV, Parbhani-431 402.
[3]Ph.D Scholar, Department of Agronomy, VNMKV, Parbhani-431402
[4]M.Sc. Scholar, Department of Agronomy, VNMKV, Parbhani-431 402.

INTRODUCTION

With an annual average yield of about 29 million tons, India stands as forth leading oilseeds producing countries, next only to the USA, China, and Brazil. Though the country has made a significant paradigm in the total oilseeds production. The country is still importing around half of its domestic consumption requirements of edible oils from various global exporters. Soybean and Mustard oil being consumed as a vegetable oil by the large proportion of the Indian population occupies an important position in edible oils sector of India. The demand for edible oils is increasing exponentially in the country. It covers 20.8% of global area of oilseed crops, the country produces only around 10% of the total production causing disparity between the demand and the supply of these oils that has to be met via imports annually. Booming populations with higher income is likely to further increase the domestic consumption of edible oils. The country is not able to meet up with the annual demand that is increasing at the rate of 6% with production increasing with mere 2% per annum.

Nutritional value of Oilseed crops:

The bio-chemical composition and quality of the oilseeds and their products are important for the food and feed purposes.

- Edible oils are the concentrated sources of energy. The energy content of oil is much higher (39.80 MJ/kg) than protein (23.88 MJ/kg) or carbohydrate (16.76 MJ/kg).
- They contain useful carbohydrates, essential fatty acids and vitamins A,D,E and K and provide essential fatty acids.
- Oil cakes/ oil meals are rich sources of protein (40-60%) to human and animals. They can also be used as organic manures.
- Oil quality for food purpose can be described in terms of Saturated Fatty Acid (SFA), Monounsaturated Fatty Acid (MUFA) and Poly Unsaturated Fatty Acid (PUFA).
- Groundnut, coconut, sesame and sunflower oils have moderate amounts of saturated fatty acid but lack in one essential fatty acid i.e. linolenic acid.
- Soybean, safflower and mustard oils have both essential fatty acids as Linoleic and Linolenic acids.
- Rapeseed and mustard oil have high amount of erucic acid, an anti-nutritional factor and leads to coronary diseases.

Keeping quality of Oils:

- The ratio of oleic to linoleic acid affects the storage ability of edible oil and hence affects the nutritional quality. It shuld be greater than 1.6 for longer shelf life.
- Sunflower and safflower oils cannot be stored for longer periods.
- Soybean oil loses its original flavour after once deep frying.
- Groundnut oil has very good stability due to the presence of tocopherols (vit E) and can be stored at room temperature even upto 18 months without any quality deterioration.

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- Sesamum oil – highly stable due to the presence of ' Sesimol', anti-oxidant
- Mustard oil is also rich in vit.E and has good stability at high temperature also.

Supplementary sources of Oils:

- **Sources of vegetable oils** - Rice bran is highly nutritive value and cotton seed oil having 18% oil.
- **Tree Based Oils:** Jatropha, Karanj, Pongamia, Neem, Mahua, Sal.

Among the major tree crops, Oil palm forms another high potential, prospective and cheaper source of edible oil in International market.

Management strategies:

- The good quality seed of recommended varieties for the specific area and situations should be chosen and cultivated.
- Bringing more area under drip and sprinkler irrigation.
- The seed should be treated with fungicide, bactericide etc. as recommended before sowing of seed in the field.
- It is most important to select a levelled field with good drainage should be provided for the oil seed crops, especially for the kharif crop.
- A fine seed bed free from weeds and clods should be prepared to facilitate good germination and stand.
- The sowing of the seed should be done at appropriate time with optimum plant population.
- Early sowing escapes the attack of many diseases and pests.
- The suitable variety for each crop must be chosen for the tract and season.
- Adoption of improved crop production technologies.
- The recommended doses of fertilizer for the specific crop should be applied at appropriate time.
- The field should be kept free from weeds particularly during first 20-30 DAS.
- The protective irrigation should be provided wherever possible during *kharif* season and irrigation should be applied at critical stages for rabi/summer crop.
- The plant protection measures should be under taken, if needed.
- Harvesting should be done at right time to avoid capsule shattering and reduction in oil content of seed.
- The seed should be cleaned and dried well before storage.
- Oil extraction from sources such as rice bran, cotton seed and corn apart from flora under-utilized plants of forest.
- Introduction of oil seed crop as intercrops along with cereals in non-traditional areas and also in double/multiple cropping sequences.
- Extending oilseed cultivation i.e. safflower, sunflower, sesame etc. to under-utilized situations like rice fallows.
- Strengthening of processing facilities as crushing, solvent extraction, oil refining and hydrogenation for value addition to products in the context of WTO.
- Provision of favourable Govt. policies such as price and credit policies etc. strengthening of farmer's support system through supply of all inputs.

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Recent advances in evaporative Cooling storage structure (ECSS)

Article id: 23523

Saurav Kumar[1], Dharmender[2] & Silpa mandal[2]
M.Tech. Scholar, Division of Agricultural Engineering, ICAR-IARI[1]
Ph.D. Scholar, Division of Agricultural Engineering, ICAR-IARI[2]

One-third of food produced in the world is lost or wasted every year. The quality and storage life of fruits and vegetables depend on the temperature and relative humidity. For extend the shelf life of fruits and vegetables they need to be properly stored. Although, refrigeration is very popular but poor power supply and low income of farmers in the rural area makes refrigeration storage expensive. Evaporative cooling storage structure (ECSS) is cost effective structure to reduces the storage temperature and also increases the relative humidity. Alam et al., (2017) studied that with the increase of pad thickness and air velocity there was an increment of cooling efficiency. The present study indicated that the coconut coir pads have higher potential as wetted-pad material. N. J. Ogbuagu, et al., (2017) found that the average temperature drops and saturation efficiency in the evaporative cooler during the no - load test was 5°C and 42% respectively and ECSS reduces the weight loss of fruits and vegetable as compare to keeping the produce in ambient air conditions. Rayaguru et al., (2009) tested a Zero energy cool chamber (ZECC) and found that the chamber was kept average temperature of its environment less by 5–8°C than the outside temperature and maintained more than 90% RH. The ZECC was very effective in extending the storage life of potato, tomato, brinjal, mango, banana and spinach by 3 to 15 days as compared to ambient conditions. Under the experimental coastal conditions of Orissa, water application rate of 75, 90 l/day is the cut-off points during summer and winter, respectively to achieve the effective performance of the cool chamber. kapilan et al., (2016) studied the Computational Fluid Dynamics Analysis of An Evaporative Cooling System To study the flow pattern of the fluid in cooler and found that at inlet the pressure increases due to fan speed and as the flow take place through the tunnel the pressure of the flow reduces, however the pressure drop take place at the cooling pad and the pressure of flow further reduces and is just above the atmospheric pressure at the outlet of cooling system. And temperature variation also tested found that 31℃ at inlet and decreases to 25℃.

INTRODUCTION: Evaporative cooling storage structure (ECSS) is a double wall structure having space between the walls which is filled with porous water absorbing materials called pad. These pads are kept constantly wet by applying water. When unsaturated air comes in contact of wet pad, transfer of mass and heat takes place and the energy for the evaporation process comes from the air stream. This is a storage chamber, use for fresh fruits, vegetables and flowers to extends their marketability and works on the principle of Evaporative cooling. Evaporative cooling is a well-known system to cool the environment. This is adiabatic process, in which ambient air is cooled as a result of transferring its sensible heat to the evaporated water carried with the air. In the evaporative cooled structure, the maximum advantage of the natural environment is taken for lowering down the temperature of outside ambient air to a considerable low level. Evaporative cooling storage system is easy to operate, efficient and affordable most especially for peasant farmers in developing countries who may find other methods of preservation quite expensive and unaffordable.

The quality and storage life of fruits and vegetables depend on the temperature and relative humidity. Within a few hours of harvest quality of food starts to deteriorate. The major problem during storage is the change in the quality parameters of the produce especially the physical characteristics such as the color, texture, and freshness in which the price depends on. For extend the shelf life of fruits and vegetables they need to be properly stored. Although, refrigeration is very popular but it has been observed that several fruits and vegetables, for example banana, plantain, tomato etc. cannot be stored in the refrigerated storage at low temperature as they are susceptible to chilling injury. And also, the poor power supply and low income of farmers in the rural area makes refrigeration storage expensive. The conditions at which evaporative cooling take place effectively are temperature is high, humidity is low, air movement is available (from wind or by electric fan). This is the most economical way of reducing the temperature by humidifying the air. It has many advantages over refrigeration system, as it does not use refrigerant so it is friendly to environment (reduces CO2). It does not make noise as there is no moving part. It can be operated without electricity i.e. saves energy, if no human interference is required then there is a water pump needed for move water. It does not require high initial investment as well as operational cost is negligible. It can be quickly and easily installed as this simple in design. Its maintenance is easy. It can be constructed with locally available materials in remote area and most important. Refrigerated storage is not suitable for on farm storage in the rural areas. Evaporative cooling storage structure is an alternative of mechanical refrigeration system. An Evaporative cooler reduces the storage temperature and also increases the relative humidity within the optimum level of the storage thereby keeping the fruits and vegetables fresh. It can be used for short term preservation after harvest. Thus, evaporative cooling is a low-cost technology for storage of fruits and vegetables. The technology of evaporative cooling is cost effective in comparison to the refrigeration system and could be used to prolong the shelf-life of agricultural produce.

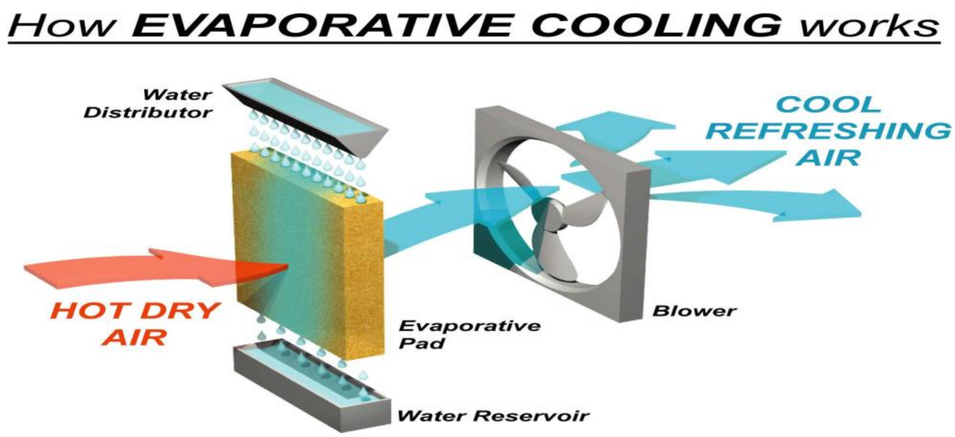

Fig 1: Schematic diagram of Evaporative cooling

Approaches of Evaporative Cooling

Direct type (DEC): Water evaporates directly into the air stream, thus reducing the air temperature while humidifying the air.

- Increase humidity inside the room.
- Efficiency (η): 55 to 70

Indirect type (IEC): Primary air is cooled sensible with a heat exchanger, while the secondary air carried away the heat energy from the primary air as generated vapor.

- Reduce temperature inside the room without adding moisture.
- Efficiency(η): 60 to 70 %

Types of Evaporative Cooler

Pot in pot (Janta cooler): A pot-in-pot refrigerator, clay pot cooler is an evaporative cooling refrigeration device which does not use electricity. It uses a porous outer clay pot (lined with wet sand) containing an inner pot ,which can

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be glazed to prevent penetration by the liquid within which the food is placed. The evaporation of the outer liquid draws heat from the inner pot. The device can cool any substance, and requires only a flow of relatively dry air and a source of water.

Fig 2: View of pot in pot cooler

Bamboo cooler

Base made of large diameter trays containing water. Cloth is wrapped around the bamboo frame, ensuring that the cloth is dipping into the water to allow water to be drawn up the wall.

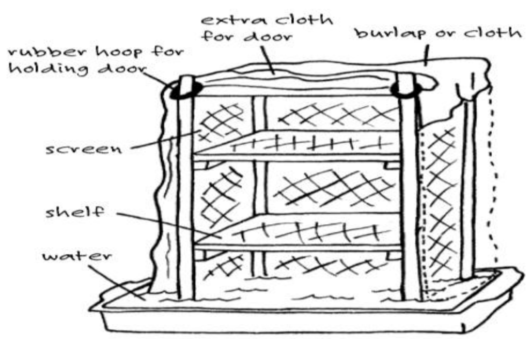

Fig 3: View of bamboo cooler

Charcoal cooler

Open timber frame covered in mesh, inside and out, leaving a 25mm cavity which is filled with pieces of charcoal and sprayed with water, and when wet provides evaporative cooling.

Fig 4: view of charcoal cooler

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Zero energy cool chamber (ZECC)

Cavity wall is constructed of brick around the outer edge of the floor with a gap of about 75mm (3") between the inner wall and outer wall. This cavity is filled with sand. 400 bricks are needed to build a chamber of the capacity of about 100kg.

Fig 5: view of zero energy cool chamber

Pad and fan system

An evaporative cooling pad is installed in ventilation opening, ensuring that all incoming vent air travels through pad before entering the house. (Efficiency70-80%).

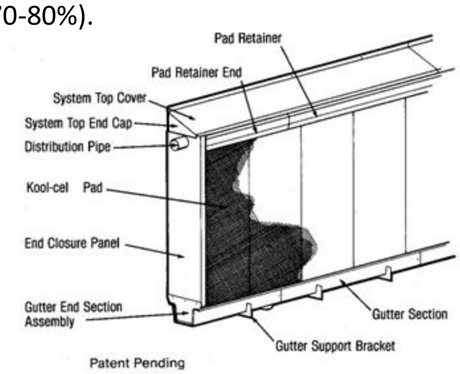

Fig 6: view of fan and pad system

Fog system

Nozzle of fog system is installed throughout the green house, produce small droplets (2-60 µm) which evaporate before reaching plant surface. (Efficiency 90 %)

Fig 7: view of fog system

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CONCLUSION

- Coconut coir, jute fibres, celdek, charcoal, sack cloth are some of the common padding materials used in ECS. Proper padding material, optimised air velocity and mass flow rate of water are key factors for efficiency of the structure.
- A composite wall ECS provides better cooling performance and higher stored produce life compared to single padding material.
- Various modelling tools such as CFD are highly successful in application and are being used in order to study the temperature distribution, cooling fluid flow characteristics and hence maximise the efficiency of ECS.
- An ECS can serve the purpose of being easily construct able structure for storage of Fruits and vegetables especially in rural areas for short to medium duration.

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Application of Computational Fluid Dynamics in Food Processing

Article id: 23524

Saurav Kumar[1], Dharmender[2]& Silpa mandal[2]
M.Tech. Scholar, Division of Agricultural Engineering, ICAR-IARI[1]
Ph.D. Scholar, Division of Agricultural Engineering, ICAR-IARI[2]

The application of the principles of fluid motion and heat transfer to design problems in the food industry has undergone remarkable development in the last couple of decades. Problems involving heat and mass transfer, phase change, chemical reactions, and complex geometry, which once required either highly-expensive experimental rigs or over-simplified computations, can now be modelled with a high level of spatial and temporal accuracy on personal computers. This remarkable progression is due to the development of advanced computer design and analysis tools, like computational fluid dynamics (CFD). It is a simulation tool, which uses powerful computer and applied mathematics to model fluid flow situations for the prediction of heat, mass and momentum transfer and optimal design in industrial processes. It is only in recent years that CFD has been applied in the food processing industry. Kapilan *et al*., (2016) studied the computational Fluid dynamics analysis of an evaporative cooling system and found that at inlet the pressure increases due to fan speed. As the flow take place through the tunnel the pressure of the flow reduces, however the pressure drop takes place at the cooling pad and the pressure of flow further reduces and is just above the atmospheric pressure at the outlet of cooling system. Cordioli *et al.*, (2015) studied CFD modelling and experimental validation of thermal processing of canned fruit salad in glass jar ad found that RMSE values between simulated and experimental values of temperature for both syrup (1.47°c) and fruit pieces (1.63°c) was expressed in good agreement. F-value of different fruit were influenced by the natural convection motion of syrup. Zhang *et al.*, (2017) studied CFD in belt dryer for optimization of feed thickness and find their effect on distribution of airflow velocity, they found that as feed thickness increased, distribution of airflow was non- uniform. Feed thickness has significant effects on the distribution of airflow velocity in the drying chamber. At feed thickness of 140 mm, the highest airflow velocity (Outlet), 6m/s was observed. The feed thickness is recommended to be 140 mm when the airflow inlet velocity is 8 m/s. Airflow velocity is reduced when penetrating the feed, and the direction of airflow is from the left side (inlet) to the right (outlet). Airflow velocity near the inlet and outlet is higher than the rest of regions. Thus, the tool of CFD can be of immense importance in food processing industries.

INTRODUCTION: The application of the principles of fluid motion and heat transfer to design problems in the food industry has undergone remarkable development in the last couple of decades. Problems involving heat and mass transfer, phase change, chemical reactions, and complex geometry, which once required either highly-expensive experimental rigs or over-simplified computations, can now be modelled with a high level of spatial and temporal accuracy on personal computers. This remarkable progression is due to the development of advanced computer design and analysis tools, like computational fluid dynamics (CFD), as these tackle complex problems in fluid mechanics and heat transfer, and many other physical processes with important industrial processes (Norton *et al*., 2013). Computational fluid dynamics (CFD) is a simulation tool, which uses powerful computer and applied mathematics to model fluid flow situations for the prediction of heat, mass and momentum transfer and optimal design in industrial processes. It is only in recent years that CFD has been applied in the food processing industry (Xia & Sun, 2002).

Computational fluid dynamics analysis of an evaporative cooling system

kapilan *et al*., (2016) studied that the use of chlorofluorocarbon-based refrigerants in the air-conditioning system increases the global warming and causes the climate change. The climate change is expected to present a number of challenges for the built environment and an evaporative cooling system is one of the simplest and environmentally friendly cooling systems. The evaporative cooling system is most widely used in summer and in rural and urban areas of India for human comfort. In evaporative cooling system, the addition of water into air reduces the temperature of the air as the energy needed to evaporate the water is taken from the air. Computational fluid dynamics is a numerical analysis and was used to analyse the evaporative cooling system. The CFD results are matches with the experimental results.

Fig 1: Experimental setup

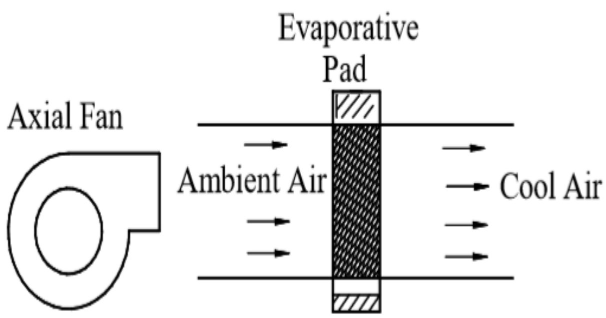

Fig 2: Evaporative Cooling System

CFD Analysis

To perform a CFD analysis, the analyst will state the problem and use scientific knowledge to express it mathematically. The analysis using CFD involve three major standard protocol to be followed as mentioned in Fig. 1.

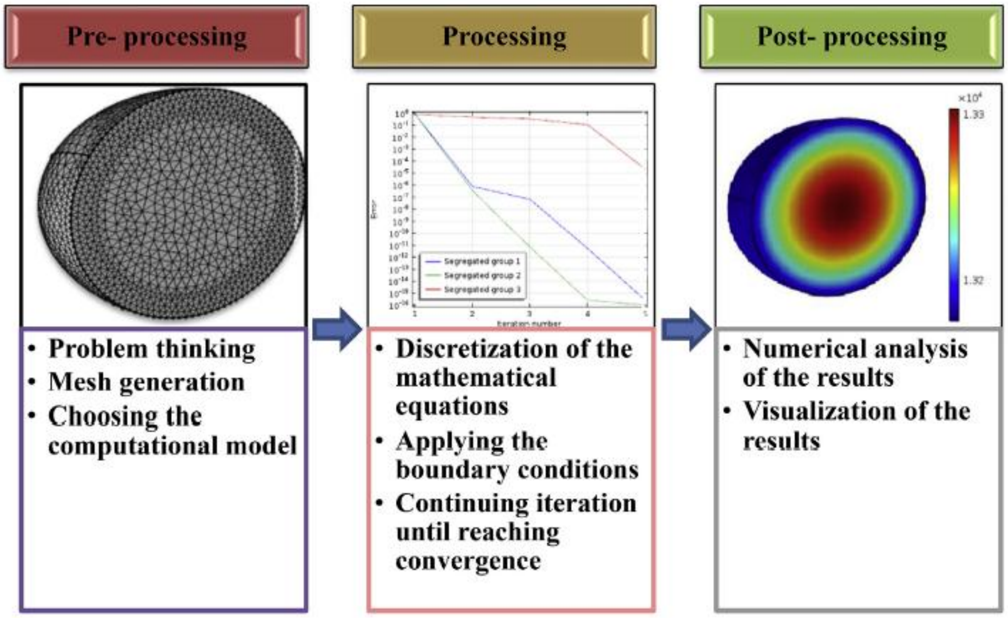

Fig. 1 Main scheme of CFD analysis (Malekjani & Jafari, 2018)

Table 2: Advantages and disadvantages of CFD modelling in food processing

Advantages	Disadvantages
Providing detailed understanding of heat, mass and momentum transfer in the drying systems.	Very small time steps are needed in some cases because of different time scale of fluid flow, heat, mass and scalar transport resulting in long computation times.
Declining scale up problems for drying systems.	Incapability of online controlling the thermal processes.
Working as virtual sensors in drying systems to improve final product quality.	Lack of adequate data about physicochemical properties of food materials during drying.
Simulating unusual conditions such as hot temperatures or dangerous environment.	Shrinkage during drying which makes mesh generation more complex.

CONCLUSION

❖ Various modelling tools such as CFD are highly successful in application and are being used in order to study the temperature distribution, cooling fluid flow characteristics and hence maximise the efficiency of ECS.

❖ An ECS can serve the purpose of being easily construct able structure for storage of Fruits and vegetables especially in rural areas for short to medium duration.

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Arsenic poisoning- A burning issue for health

Article id: 23525

Sneha and Shriman Kumar Patel
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur-813210.

INTRODUCTION

Arsenic occurs naturally in rocks and soils. It is released in the environment mostly through industrial processes like metal smelting, mining and also by agricultural processes. Arsenic is a versatile metal and it is found in two forms (organic and inorganic) in which inorganic form *i.e.,* trivalent form (As^{3+}) and pentavalent arsenic (As^{5+}) is more toxic. Arsenic is present in three allotropic form *i.e.,* metallic grey, yellow and black. The grey arsenic (most stable) is the only form that is used in industry. Sublimation occurs in arsenic under standard atmospheric pressure. Arsenic trioxide (As_2O_3) acts as a poison, only tenth of gram is enough to kill. Arsenic is still used as a wood preservative and also in herbicide, mostly in growing cotton. Globally, as human health is concern, arsenic toxicity is a serious problem.

Sources of Arsenic

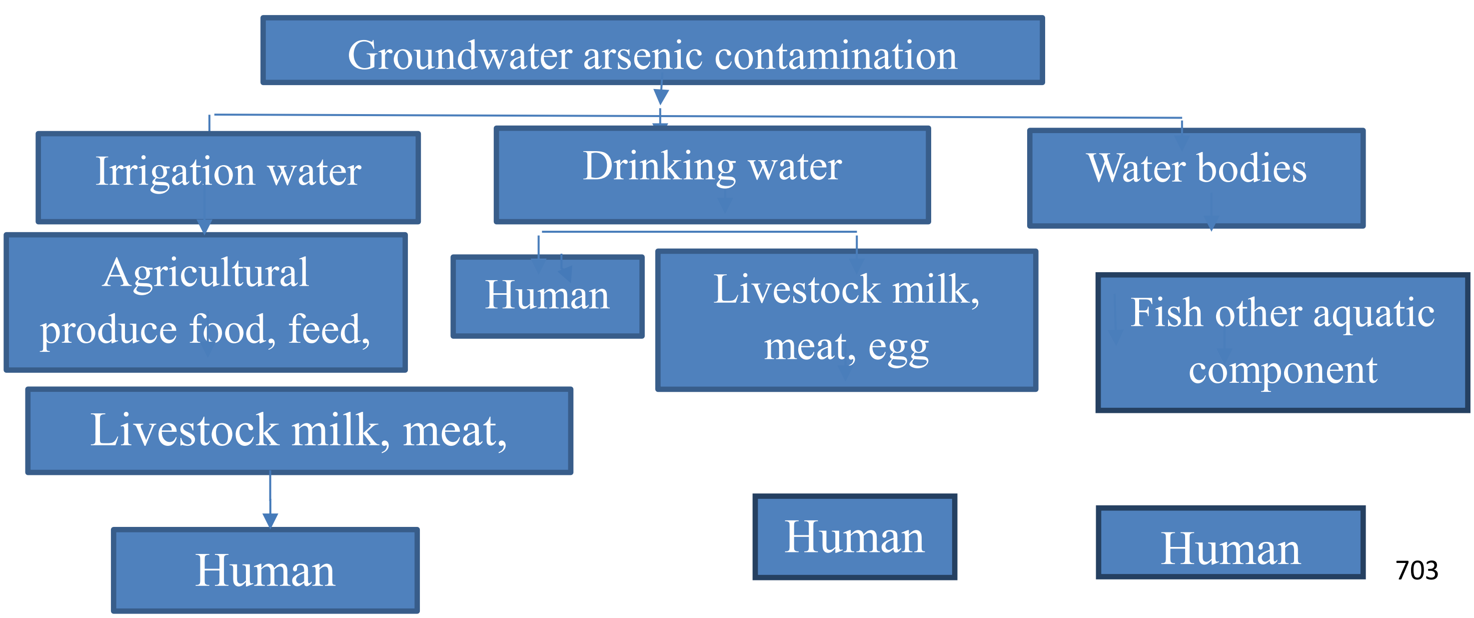
Natural source

One-third of arsenic atmospheric flux is of natural origin. Arsenic is found in more than 200 mineral species, out of which arsenopyrite is the most common. The most important natural source of arsenic is due to volcanic action. Inorganic arsenic is mostly found in ground water and organic arsenic compounds like tetramethyluronium, arsenocholine are found in marine organisms like shellfish.

Man-made source

Anthropogenic activities such as mining, burning of fossil fuels, smelting of non-ferrous metals, timber treatment, agricultural chemicals lead to arsenic contamination in the environment. It is also commonly used as an alloying agent, glass processing industry, pigments, textiles, metal adhesives, paper, wood preservatives etc.

Pathway of arsenic from groundwater to human body



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Health related problems

Arsenic poisoning leads to several health problems. According to the FDA, long-term exposure of arsenic is associated with higher rates of lung and skin cancers and also heart disease. A large dose of arsenic can cause immediate sickness and death. People addicted towards tobacco smoking can also be exposed to the natural inorganic arsenic content of tobacco as tobacco plants can up take large amount of arsenic naturally present in the soil. The acute arsenic poisoning includes the symptoms like vomiting, abdominal pain intestinal pain and diarrhea that lead to muscle cramping, numbness, severe thirst, coma and death in extreme cases. Ingestion of 70 to 180 mg of arsenic trioxide can be fatal. Arsenic contaminated drinking water causes symptoms of chronic arsenic exposer. Initial symptoms of arsenic exposure are high perspiration rate, muscle tenderness, garlic odour on the breath, weakness and changes in skin pigmentation whereas advanced symptoms are related to cause anemia, reduced sensation in body parts, peripheral vascular disease, skin changes on palms and soles.

Effect of arsenic in human health

The prolonged exposure of arsenic in water causes the most serious human disease *i.e.,* cancer. The International Agency for Research on Cancer (IARC) has classified arsenic compounds as carcinogenic to humans. Arsenic exposure has been linked with cancer in the skin, lungs, kidney and bladder. Inhalation of arsenic is a major risk factor for causing lungs cancer. Most of the people working in smelting industry suffer from lungs cancer as they chronically inhale arsenic dust. The risk of cancer increases where drinking water has an arsenic concentration of 50 µg/liter and the risk also depends on the amount of arsenic ingested. Other health effects that are caused by ingestion of inorganic arsenic include developmental effects, pulmonary disease, diabetes and cardiovascular disease. Arsenic-induced myocardial infarction, leads to high mortality. Arsenic exposure causes adverse pregnancy outcomes, infant mortality and also several harmful impact on child health.

Regulatory Standards for Arsenic:

EPA - Drinking water 10 µg/L (10 ppb)
OSHA - Workplace air - 0.5 mg/m^3
ATSDR - MRL - 0.3 µg/kg/day (chronic exposure)

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CONCLUSION

Arsenic contamination leads to variety of disorders such as respiratory and nervous system disorder, skin lesions and also causes different types of cancers which might be fatal. The most common cause of arsenic toxicity that deteriorates human health is by drinking arsenic contaminated ground water. So, to prevent our health from arsenic toxicity, assessment of safe water for drinking and irrigation purpose should be maintained.

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Mapping of soil nutrient status in Elamdesam block of tropical humid region, Kerala, India

Article id: 23526

Chandrakala, M.
ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Hebbal, Bangalore-560 024, Karnataka, India

Information on soil fertility status in crop field is very important and useful for fertilizer recommendation and also management of the crop and soil. Soil fertility maps are of vital necessity as reference materials for scientific soil nutrient management. Nutrient status of the Elamdesam block, Idukki district, Kerala belongs to tropical humid region, was mapped in Arc GIS using fertility point data obtained from laboratory soil analysis. Results reveal that, the pH of the soils varied from 4.06 to 6.48. The electrical conductivity of the soils varied from 0.018 to 0.32 dS m^{-1}. The organic carbon content of the soils varied from 0.89 to 3.34 percent. The phosphorus content of soils varied from 1.08 to 453.2 kg ha^{-1}. Potassium levels in soils varied from 11.35 to 494.28 kg ha^{-1}. The available calcium content of the soils varied from 18.44 to 977.05 ppm. The magnesium content varied from 3.86 to 223.67 ppm. Available sulphur content varied from 0.83 to 28.3 ppm. The iron and manganese content of soils varied from 10.4 to 242.1 ppm and 0.9 to 22 ppm, respectively. The copper content of soils varied from 0.6 to 20.5 ppm. The zinc content of the soils varied from 0.3 to 11.00 ppm. The available boron content of soils varied from 0.09 to 0.60 ppm. The nutrient maps generated can be used to identify deficient or sufficient areas for efficient fertilizer management and to minimise fertilizer misapplication.

INTRODUCTION

Soil fertility refers to the ability of a *soil* to sustain agricultural plant growth, i.e. to provide plant habitat and result in sustained and consistent yields and are of high quality. It is the component of overall soil productivity that deals with its available nutrient status and its ability to provide nutrients out of its own reserves and through external applications for crop production. Soil depletion occurs when the components which contribute to fertility are removed and not replaced, and the conditions which support soil's fertility are not maintained. This leads to poor crop yields. In agriculture, depletion can be due to excessively intense cultivation and inadequate soil management. In order to assess the nutrient status of soils, 134 surface soil samples (0-20 cm) were collected randomly from all the panchayaths of the Elamdesam block (Todupuzha taluk, Idukki district, Kerala), representing all the major land use systems (Chandrakala *et al*., 2018). The soil samples were brought to the laboratory, air dried, ground and sieved through 2-mm sieve. The samples were analyzed for their pH, organic carbon, major (N,P and K), secondary (Ca, Mg and S) and micronutrients (Cu, Zn and B) following standard procedures as outlined in Laboratory Manual (Sarma *et al*., 1987). The data obtained were used for preparing various fertility maps using Arc GIS software by interpolation method.

RESULTS

Soil reaction (pHs)

The acidity of soils is a serious constraint to crop production in the region. Soil reaction classes of Elamdesam block (Map 1), indicated that the pH of the soils of block varied from 4.06 to 6.48. In Elamdesam block 37.71 per cent area is very strongly acid in reaction followed by 12.06 per cent area is strongly acid and 11.91 per cent area is extremely acid in reaction. Moderately, strongly, very strongly and extremely acidic soils can be reclaimed by a treatment with lime, dolomite or a combination of both.

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Soil organic carbon content

The organic carbon content of the soils of the Elamdesam block (Map 2) varied from 0.89 to 3.34 per cent. About 45.61 per cent of area is very high in organic carbon status followed by 18.23 per cent of area is high.

Available phosphorus

The phosphorus content of Elamdesam soils varied from 1.08 to 453.2 kg ha^{-1} (Map 3). About 14.53 per cent area under medium, 14.02 percent area under very low, 12.59 per cent area under low, while 10.14 per cent area rated as extremely high and 9.47 percent area is very high in available phosphorus status.

Available potassium

Potassium levels in soils of Elamdesam block varied from 11.35 to 494.28 kg ha^{-1} (Map 4). About 32.62 per cent of area under very low followed by 15.94 per cent of area under medium and 13.56 per cent of area under low.

Available calcium

The available calcium (Ca) content of the soils of the Elamdesam varied from 18.44 to 977.05 ppm (Map 5). About 40.01 per cent area rated as very low and 13.9 per cent area rated as low and 10.47 per cent area comes under adequate.

Available Magnesium

The magnesium (Mg) content of the soils varied from 3.86 to 223.67 ppm (Map 6). About 54.59 per cent area is categorized under very low and 9.78 area under low in available magnesium status.

Available Sulphur

Available sulphur (S) content varied from 0.83 to 28.3 ppm in soils of Elamdesam block (Map 7). About 25.17 per cent area is under low followed by 21.89 per cent area is under adequate and 17.32 per cent area is under very low.

Available copper

The copper (Cu) content of soils of Elamdesam block varied from 0.6 to 20.5 ppm (Map 8). About 62.61 per cent area is under adequate and 1.76 per cent area under deficient.

Available zinc

The zinc (Zn) content of the soils of the Elamdesam block soils varied from 0.3 to 11.00 ppm (Map 9). About 48.01 per cent area is under deficient and 16.36 per cent area under adequate.

Available boron

The available boron (B) content of soils of Elamdesam block varied from 0.09 to 0.60 ppm (Map 10). About 61.4 per cent area is under adequate and 2.98 per cent area under deficient.

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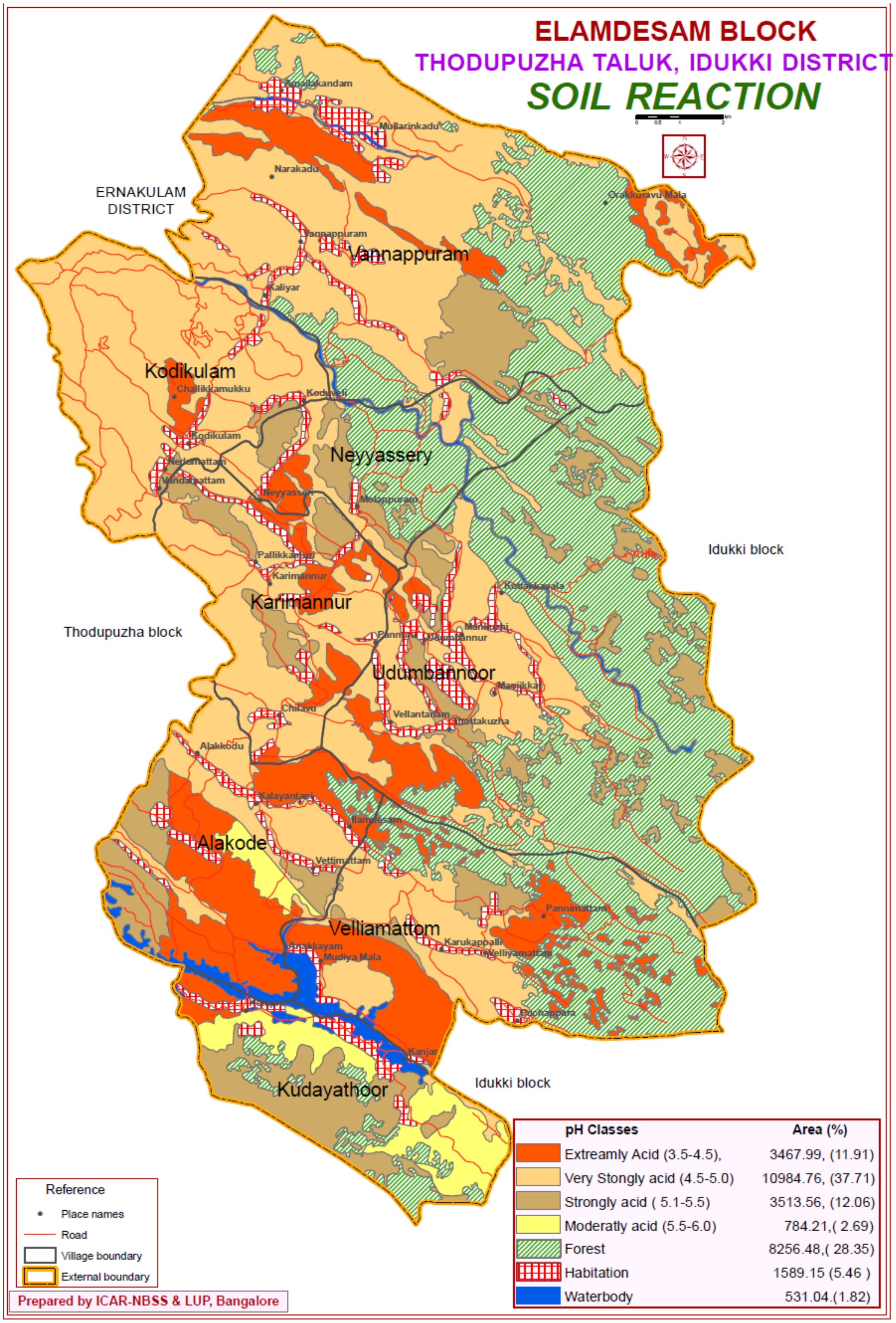

Map 1: Soil reaction of the Elamdesam block

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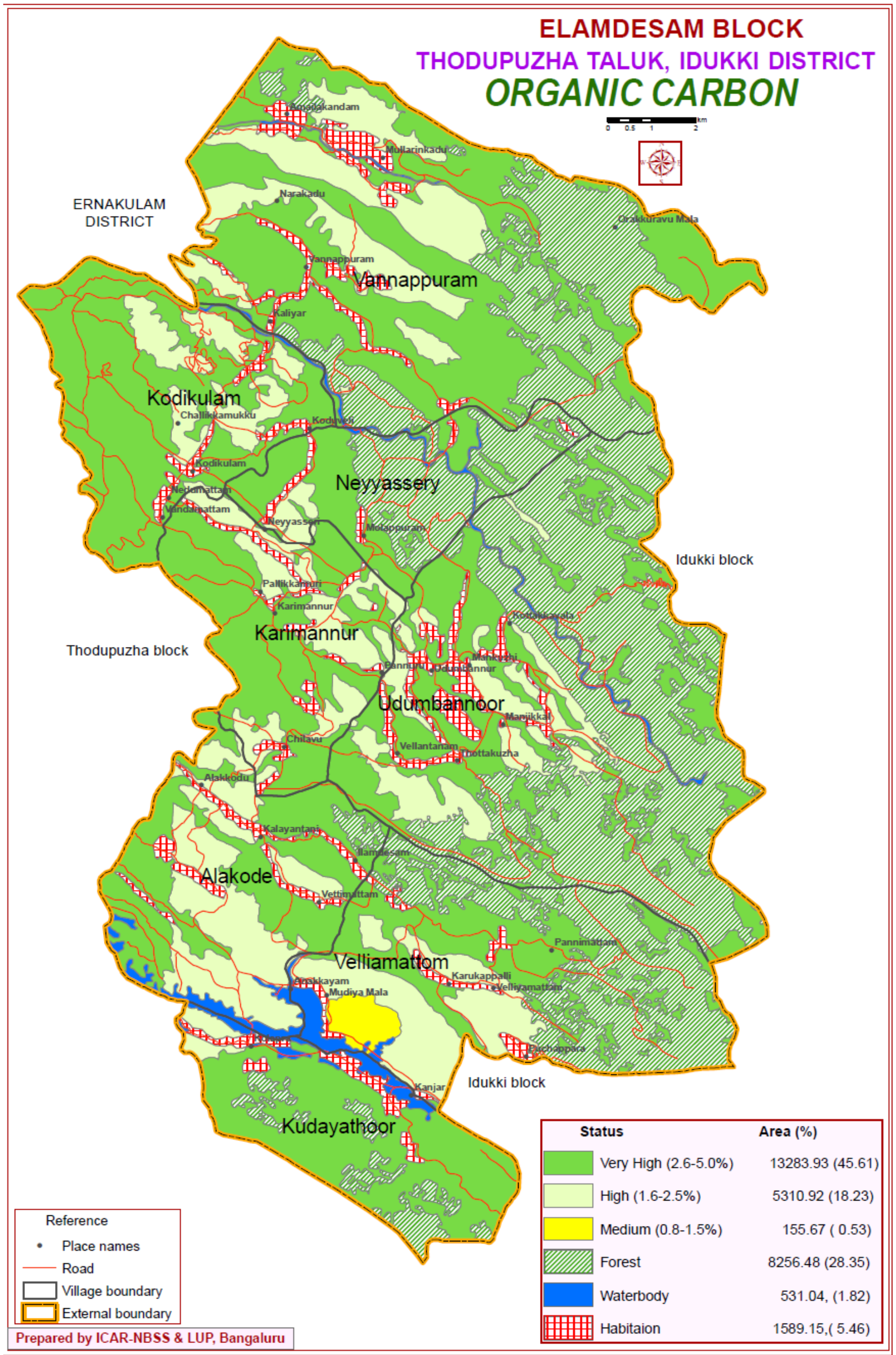

Map 2: Soil organic carbon status of Elamdesam block

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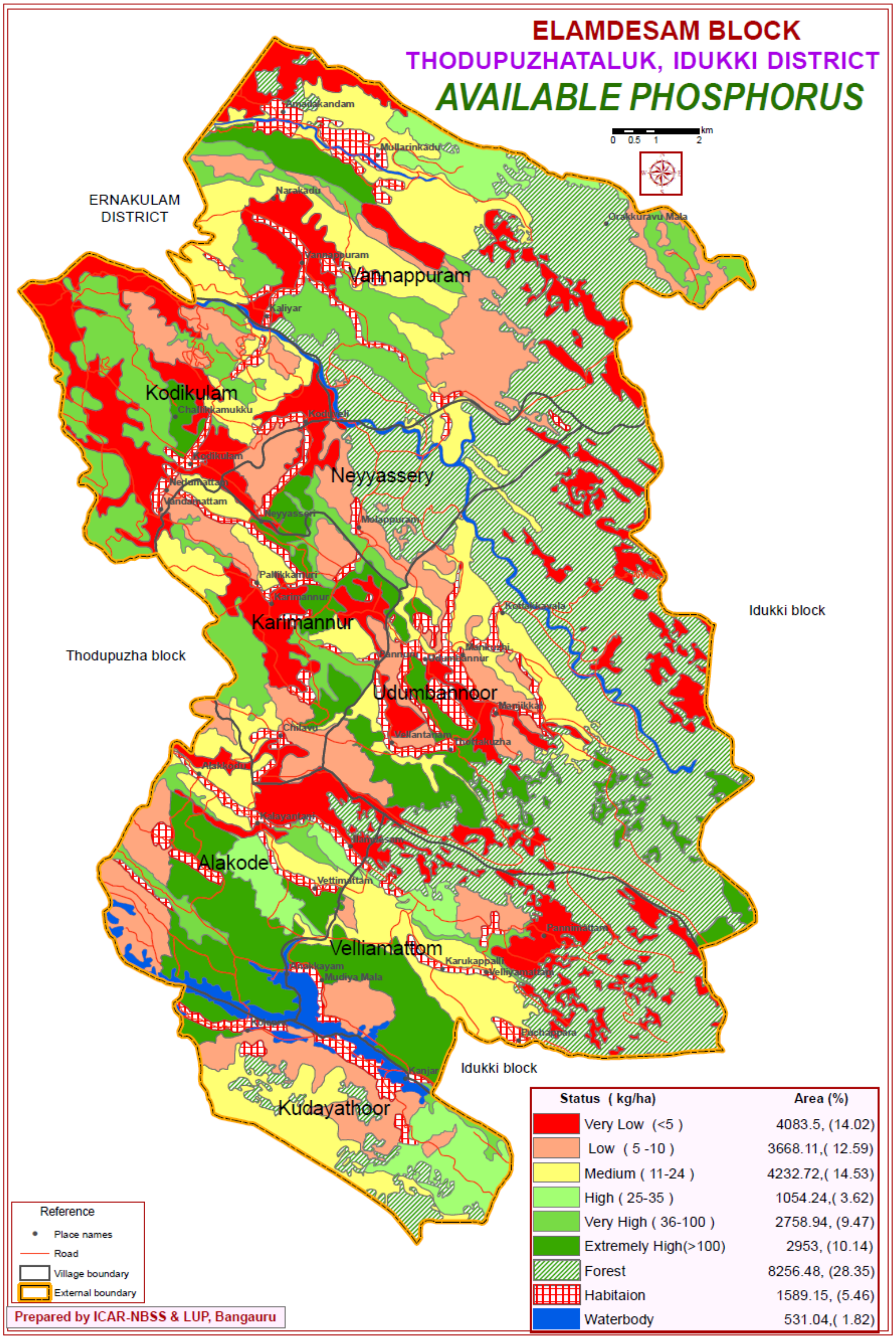
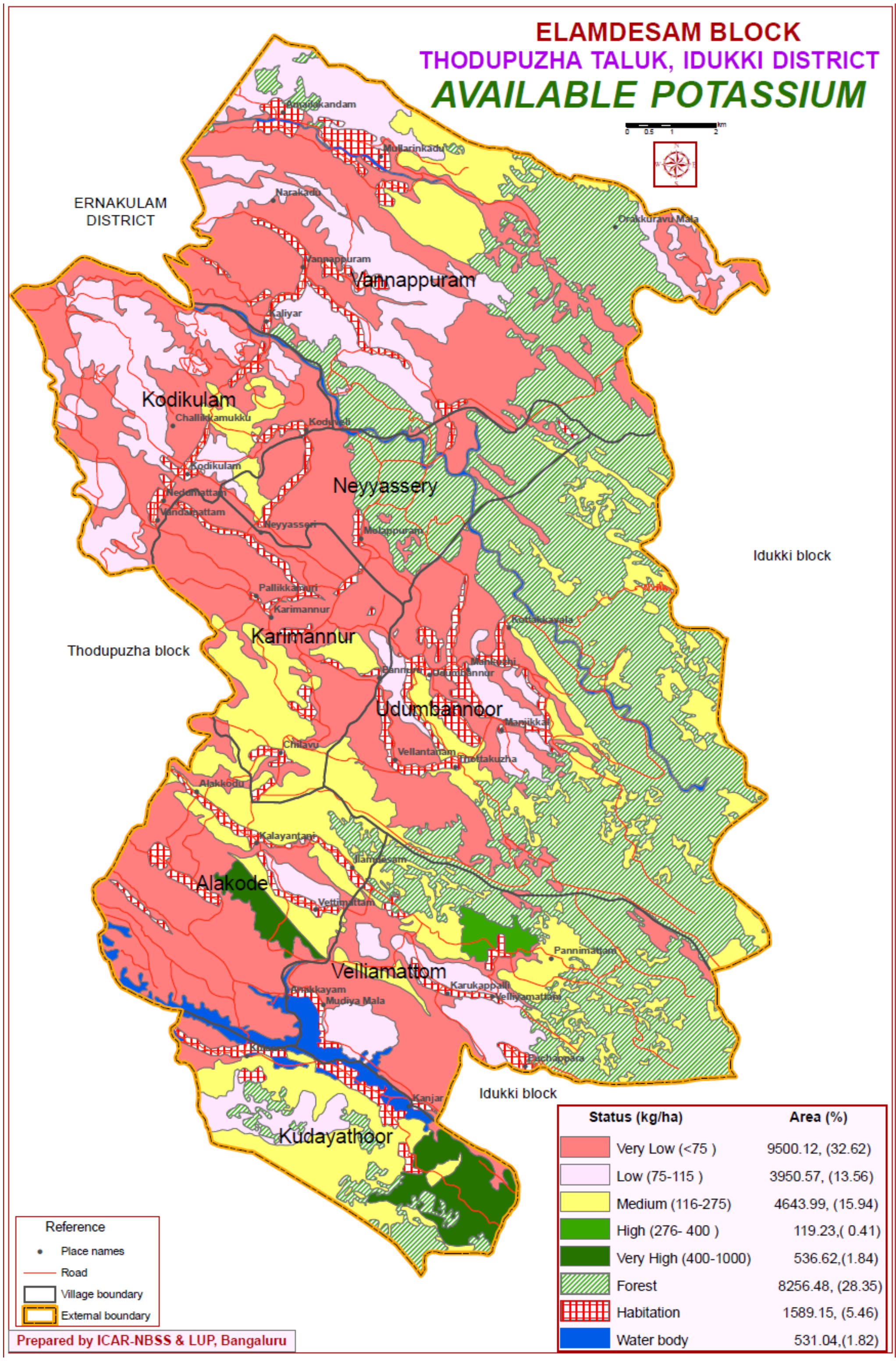


Map 3: Available phosphorus status of Elamdesam block



Map 4: Available potassium status of Elamdesam block

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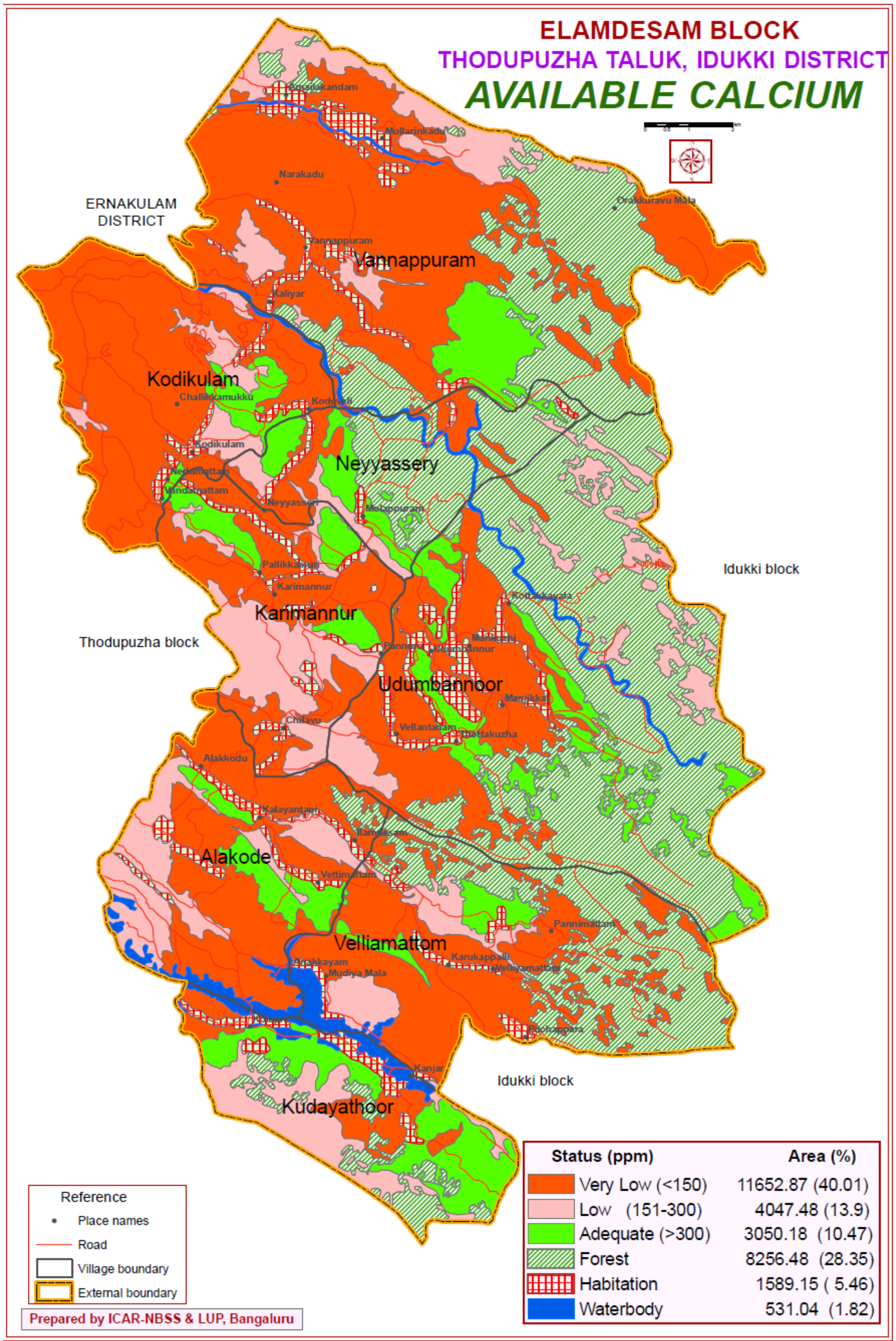

Map 5: Available calcium status of Elamdesam block

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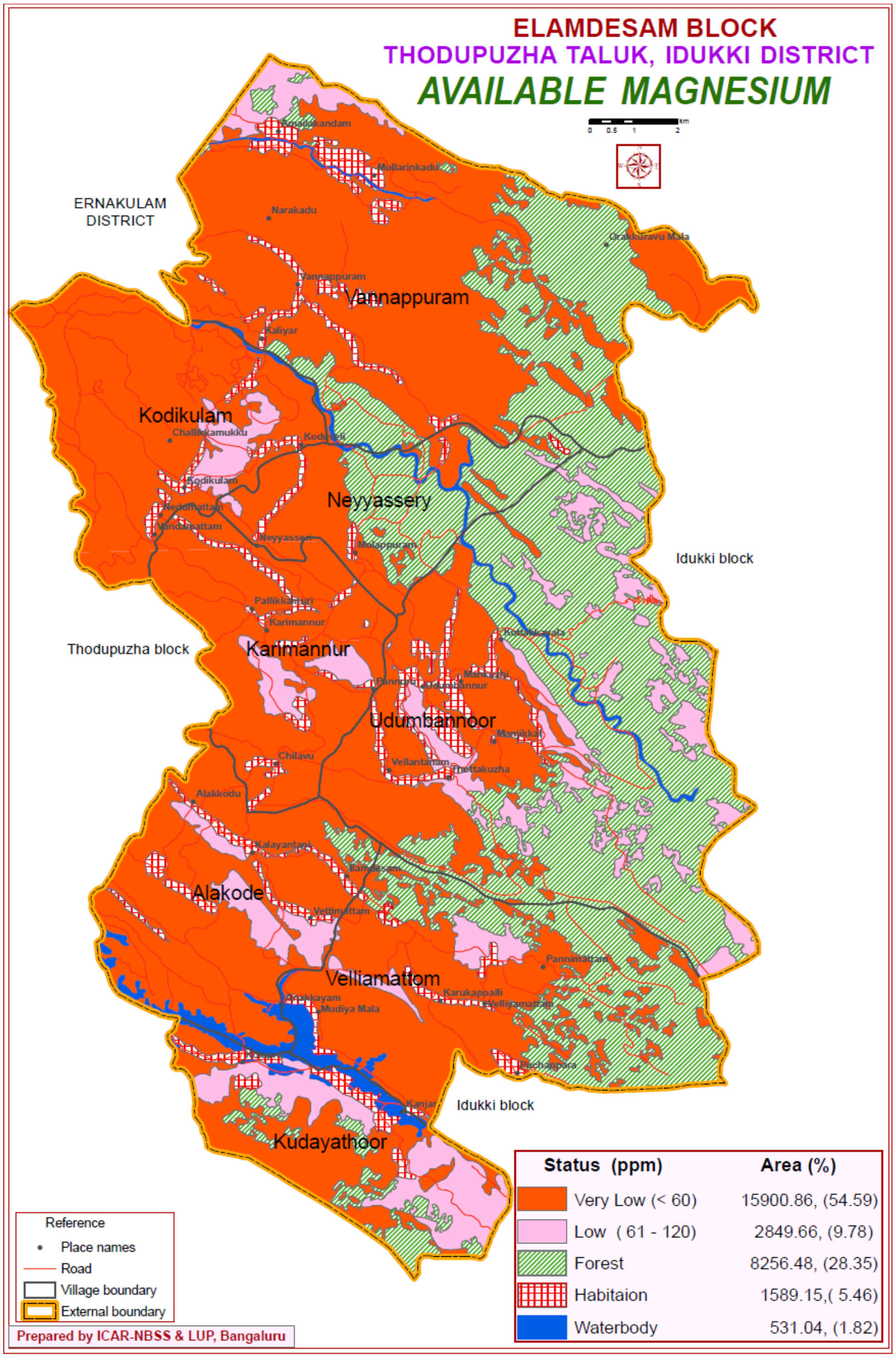
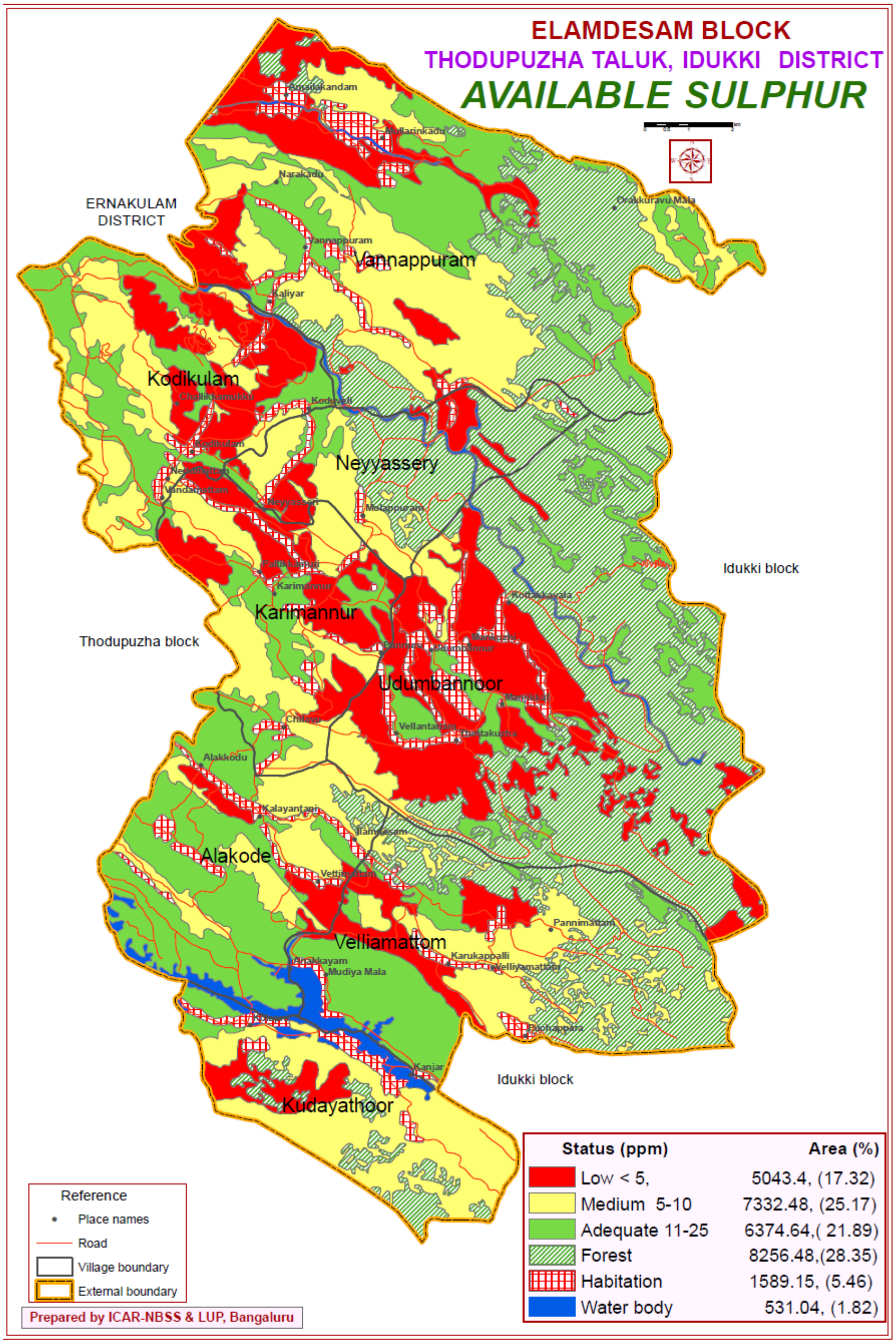


Map 6: Available magnesium status of Elamdesam block



Map 7: Available Sulphur status of Elamdesam block

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Map 8: Available copper status of Elamdesam block

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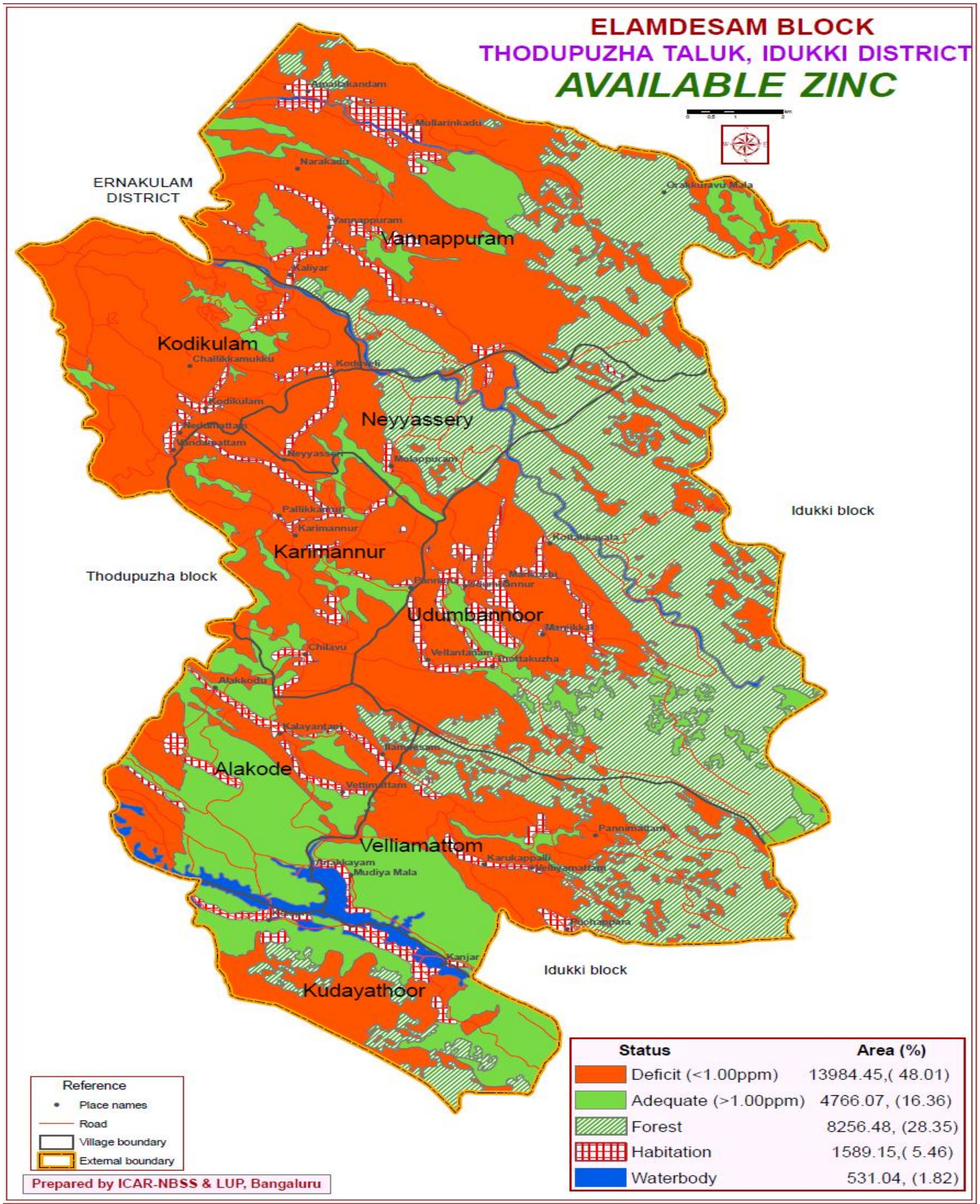

Map 9: Available zinc status of Elamdesam block

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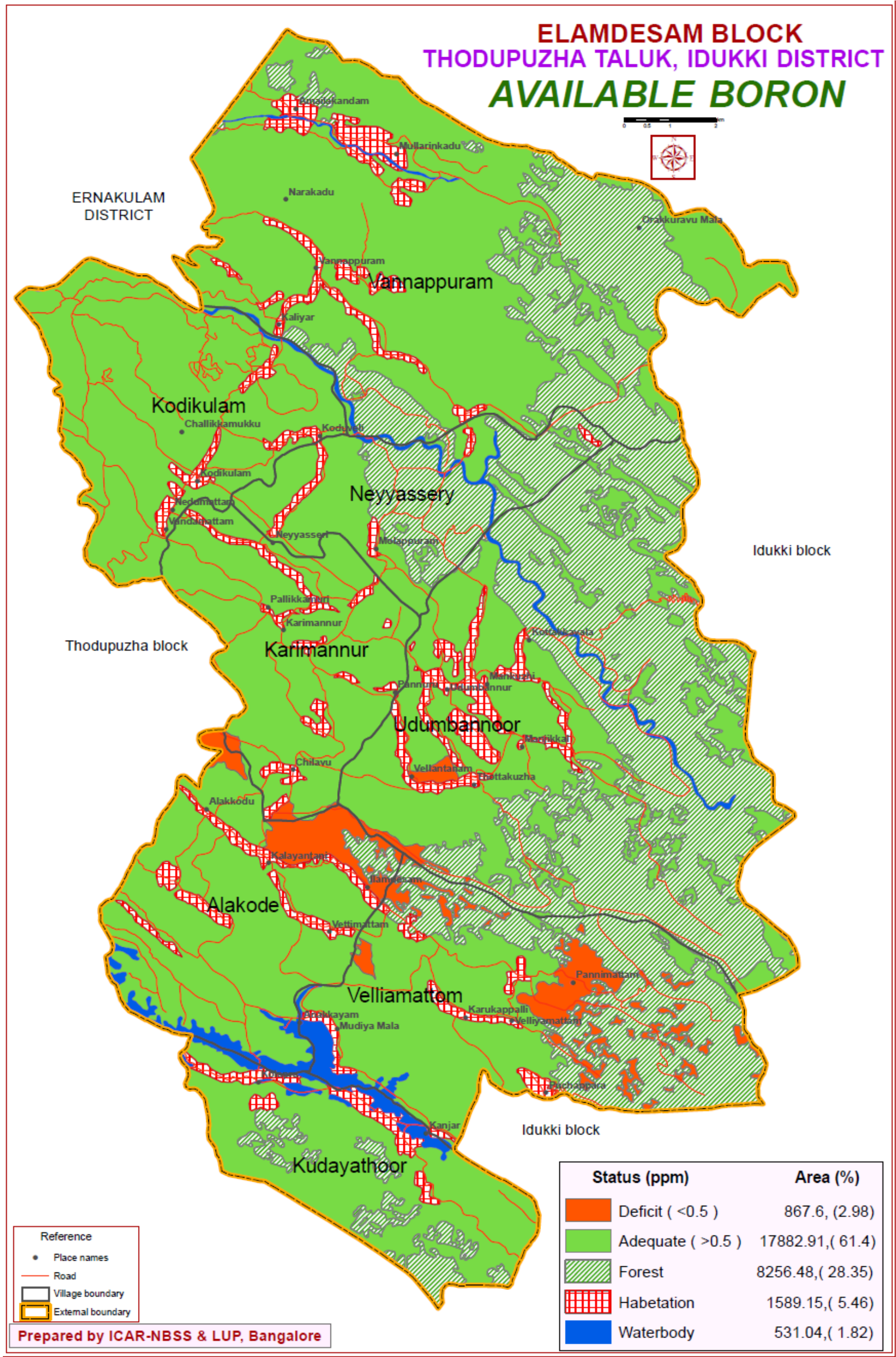

Map 10: Available boron status of Elamdesam block

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Camel Milk: A Natural Boon for Dairy Industry

Article id: 23527

Vinod Bhateshwar
Ph.D. Scholar, Department of Animal Husbandry and Dairying, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi - 221005 (U.P.) India

INTRODUCTION

Ayurveda has referred medicinal value of camel milk under the classification of "Dugdha Varga". The camel has also been mentioned among the animals as miracle of God in the Quran. Camel is known as "Ship of the Desert". Indian camels yield 3.5 kg to 10 kg of milk per day. The taste of camel milk depends upon availability of plants for grazing. Camel milk is a valuable food with a long history of its use for thousands of years in many cultures. In many countries, camel milk is being given to babies suffering from malnutrition and thus has emerged as a new super food with miraculous health benefits. Camel keepers utilize milk either raw, boiled or for tea preparation. Various camel milk products were prepared and commercialized available viz., ice cream/ kulfi with different flavors, flavored milk, fermented milk, cheese, tea and coffee. The vitamin C levels are three times that of cow milk and one-and- a-half that of human milk. Camel milk is used for treating dropsy, jaundice, spleen ailments, tuberculosis, asthma, anemia and piles.

Chemical composition of camel milk

Camel milk is considered a very healthy drink because of low fat and cholesterol level. Further, modern medical studies showed its effectiveness for the treatment of various life style disorders. The milk consists of enough nutrients to sustain a person healthy throughout the day without consumption of any other foods. Normally it is opaque white in color with normal odor sweet and sharp taste, but sometimes it is salty due to various physiological factors.

Table 1: Proximate chemical composition of camel milk

Parameters	Values
Moisture (%)	86-88
Fat (%)	2.9-5.4
Lactose (%)	3.3-5.8
Protein (%)	3.0-3.9
Ash (%)	0.6-1.0
Acidity (% LA)	0.13-0.21
Specific gravity	1.027-1.038
Viscosity (cp)	1.72-2.24
Surface tension (dyne/cm)	56.39-60.93
Refractive index	1.340-1.346
Freezing point (0C)	-0.51 to -0.61
Electrical conductivity (millimohs)	5.89-6.45

Shelf life of camel milk

The unprocessed camel milk has shelf life of 5 days at 7°C. Whereas shelf life of pasteurized milk is 22 days, when heated at 65°C for 20 minutes and kept at 7°C.

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Therapeutic attributes of camel milk:

The camel milk is being consumed for centuries by nomadic peoples due to its nutritional and medicinal properties. The medicinal properties of camel milk can be attributed due to presence of protective proteins, which may possibly play pivotal role for enhancement of immune defense mechanism. Antibacterial and antiviral activities of camel milk proteins have been investigated e.g. inhibit Mycobacterium tuberculosis. In addition camel milk also plays an important role to control number of health disorder such as diabetes, allergy, autism etc.

Diabetes

The camel milk is not only low in fat and cholesterol but it also contains desired level of vitamins and minerals, as well also a rich source of insulin. Camel milk can be used as an adjunct to insulin therapy as it appears to be safe and efficacious in improving long-term glycemic control and also helps in the reduction of insulin requirement in type 1 diabetic patients.

Allergies

The milk protein i.e. β-lactoglobulin present in cow and mare milk is responsible for allergies in humans. However, camel milk known to be lacking of this protein and thus do not pose problem of allergies in sensitive individual. β - casein present in cow milk also causes hypersensitivity into humans. Although, camel milk also contains β - casein, but the structure of camel milk protein is very different from the cow milk protein. Therefore, camel milk may be suggested as a new protein source for nutrition for children allergic to cow's milk. The camel milk has emerged to have potential therapeutic effects in patient suffering from autism.

Antimicrobial activity

Camel milk contains various protective proteins, mainly enzymes which exert antibacterial and immunological properties. The presences of these proteins explain some of the natural healing properties of the milk. The known protective proteins such as lysozymes: participates in primary immune system, which is based on targeting of structures common to invading pathogens. Immunoglobulins: These give immune protection to the body against infections. Lactoferrin: Iron-saturated lactoferrin prevents microbial growth of undesirable microorganism in gut. Camel milk apparently contains much more lactoferrin than ruminant (cow, sheep and goat) milk.

Anti-aging

Camel milk has anti aging effect due to presence of α-hydroxyl acids which are known to plump the skin and smoothies fine lines. In addition, liposome occurring in camel milk is applicable for a potential cosmetic ingredient to improve anti-aging effect.

Arthritis

Camel milk has higher amount of iron chelating protein known as lactoferrin. This protein removes free iron from joints of arthritic patients thereby improves arthritic.

Camel milk products

Value additions of camel milk can be an alternative to make it more important in daily life; bye-products can be prepared and stored for longer period for transportation. Camel milk is consumed by the camel keepers of Rajasthan, Gujarat and Haryana. Camel keepers utilize milk either raw, boiled or for tea preparation. Various camel milk products were prepared and commercialized available viz., ice cream/kulfi with different flavors, flavored milk, fermented milk, cheese, tea and coffee. Recently, camel milk skin cream has been developed and it can be used as an emollient agent.

Fig 1: A Raika man drinking camel milk the traditional way with an aak leaf.

CONCLUSION

Camels produce more milk of high nutritional quality and for a longer period of time than other species in an environment that may be rightly termed as hostile in terms of extreme temperature, drought and lack of pasture. Camel milk is rich in vitamin C, which should not be present in cow milk. Camel milk and its products are a good nutritional source for human diet. It has potential therapeutic properties and useful for preparation of milk products.

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CO.1 Star Jasmine- a round the year blooming jasmine variety with immense prospect to introduce in West Bengal

Article id: 23528

Sanchita Ghosh
Subject Matter Specialist (Horticulture), KVK Samastipur, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar-848113

INTRODUCTION

Jasmine belonging to family oleaceae is one of the most important traditional flowers, widely being used as popular fragrant loose flower and highly preferred garden plant as well as for production of jasmine concrete, which is used in cosmetic and perfumery industries. In India, Tamil Nadu is the leading producer of jasmine in the country with an annual production of 1,36,901 tonnes from an area of 13,246 ha with a productivity of 11.21 t/ha (Annonymous, 2017). The genus *Jasminum* contains around 200 species (Bailey, 1958). A critical analysis of these species, however, has revealed the number of true species to be only 89, of which 40 inhabit the Indian sub-continent (Veluswamy *et al.,* 1975). Among the large number of species existing, only three species (*J.sambac, J. grandiflorum, J. auriculatum*) have attained importance in commercial cultivation (Green and Miller, 2009) in states like Tamil Nadu, Karnataka, Andhra Pradesh, Uttar Pradesh and some parts of Bihar and West Bengal, while *J. multiflorum* (Syn: *J. pubescens*) is cultivated in some parts of Karnataka. Preliminary research taken up at TNAU, Coimbatore has indicated that besides the above species, few more species namely, *J. nitidum*, *J. calophyllum* , *J. flexile and J. rigidum* possess economic importance since they produce flowers which are suitable for use as loose flower and the plants of these species are suitable for use as fragrant flowering garden plants (Ganga *et al*. 2015).

Importance of the variety

CO.1 Star Jasmine is a clonal selection of *J. nitidum* that has been released in the year 2019 for commercial cultivation as loose flower as well as for gardening owing to their attractive plant architecture by the Department of Floriculture and Landscaping of TNAU, Coimbatore. This variety has the added merit of flowering throughout the year (Ganga *et al*. 2015), as the three commercially important jasmine species undergo 'off-season' during the cooler months (November to March) leading to unavailability of flowers in the market. This particular variety has also added advantage of being relatively free from major pests and diseases. It has good keeping quality, mild fragrance, easy to pluck and highly suitable for string-making with a yield of about 7.40 t/ha. According to Raman (1969) *J. nitidum* species produces pinkish purple color unopened flower bud. The pleasant fragrance of the flowers and the greater number of linear lanceolate lobes of the corolla are the features that confer an ornamental appeal. The size of open flowers is distinctly larger than *J. auriculatum* and *J. sambac*. This variety is propagated by semi-hardwood cuttings. It has significantly good flower quality characters viz., hundred flower bud weight (18.01 g), corolla tube length (1.35 cm) and girth of flower bud (1.64 cm). Furthermore, the attractive purple-pink tinge of unopened flower buds of CO.1 Star jasmine makes it comparable with the popular species *J. grandiflorum*. Study on shelf life indicated that this variety had the longest shelf life of 40 h at room temperature, which was longer than the shelf life recorded by the three commercial types. Similarly under cold storage at 4°C the shelf life was 124 h for CO.1 Star jasmine which is quite high than the existing commercial varieties(Ganga *et al.,* 2019).

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CONCLUSION

Commercial jasmine varieties are already in good demand in flower market of West Bengal during festive season so, this particular variety has huge prospect to be introduced as a potential alternative jasmine type for *J. grandiflorum* (CO.1 Jathimalli), which can fill the market gap created by the commercially cultivated species during off-season.

Flower buds

Strings with flower buds

CO.1 Star jasmine in full bloom

Single Open flower

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Mushroom cultivation

Article id: 23529

S. J. Sindhi and D. N. Hadiya
Krishi Vigyan Kendra, Junagadh Agricultural University, Khapat-Porbandar (Gujarat)

Mushroom is an edible fungus with great diversity in shape, size and colour. Essentially mushroom is a vegetable that is cultivated in protected farms in a highly sanitized atmosphere. Just like other vegetables, mushroom contains 90% moisture with high in quality protein.

Species*:* There are three types of mushrooms popularly cultivated in India.

(i) Oyster mushroom – *Pleurotus sp*.
(ii) Paddy straw mushroom – *Volvariella volvacea*
(iii) White bottom mushroom – *Agaricus bisporus*

Method of production

(i) Oyster Mushroom: Take fresh paddy straw and cut into small pieces of 3-5 cm length. Soak them in water for 4-6 hours and then boil for half an hour. Drain the water and dry the straw in shade till it is neither too dry nor wet. Take polythene bags of 60 x 30 cm size and make two holes of one cm diameter in the center of the bag such that they face opposite sides. Tie the bottom of the bag with a thread to make a flat bottom. Fill the bag with paddy straw to 10 cm height. Then inoculate with the spawn. Likewise prepare 4-5 layers of straw and spawn alternatively. The last layer ends up in straw of 10 cm height. Keep this in a spawn running room maintained at a temperature of about 22-28 ^{o}C and with RH 85-90%. After 15-20 days when the spawn running is completed, cut open the polythene bag and take it to cropping room and allow it to grow for 7 days and harvest the mushroom. Mushroom yield is around 0.5-1.0 kg/bag.

(ii) Paddy straw Mushroom: Cut the straw into long pieces of 60-90 cm and soak in water for 12 hours and sterilize 15 minutes. Arrange the straw in bundles. Lay the moistened straw bundles on the slightly raised concrete floor or on wooden platform in layers of four bundles width. Spawn or seed the beds simultaneously in each layer either by broadcasting or placing the grain spawn at different spots. Sprinkle grain dhal over each layer on the spawn. Don't spawn below the topmost layer. Maintain it at 30-35 ^{o}C. Harvesting is ready after 25-30 days. Yield is around 1-1.5 kg/bed.

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(iii) Button Mushroom: It requires a complex method of preparing compost, which is used as a substrate for mushroom production. Spawning is done by three methods, *viz.,* surface spawning, layer spawning and trough spawning. Fill the trays with compost and do spawning. After spawning, compost is pressed hard to make it compact. The trays are arranged in the cropping room in tiers and cover with newspaper sheet sprayed with 2% formalin. The temperature of 20- 25 ^{o}C and RH of 90-95% should be maintained. After spawn running is completed in 15-20 days and do casing. Pin heads appear within 10-15 days after casing. Cropping continues for 60-75 days. Mushrooms can be harvested at button stage. Yield ranges from 6-7 kg/m^2.


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Phytoremediation of heavy metal contaminated soils

Article id: 22530

Vivek, M. S[1] and Sagar, R[2]
1. PhD Scholar, Department of Soil Science and Agricultural Chemistry, UAS Raichur
2. PhD Scholar, Department of Soil Science and Agricultural Chemistry, UAHS Shivamogga

INTRODUCTION

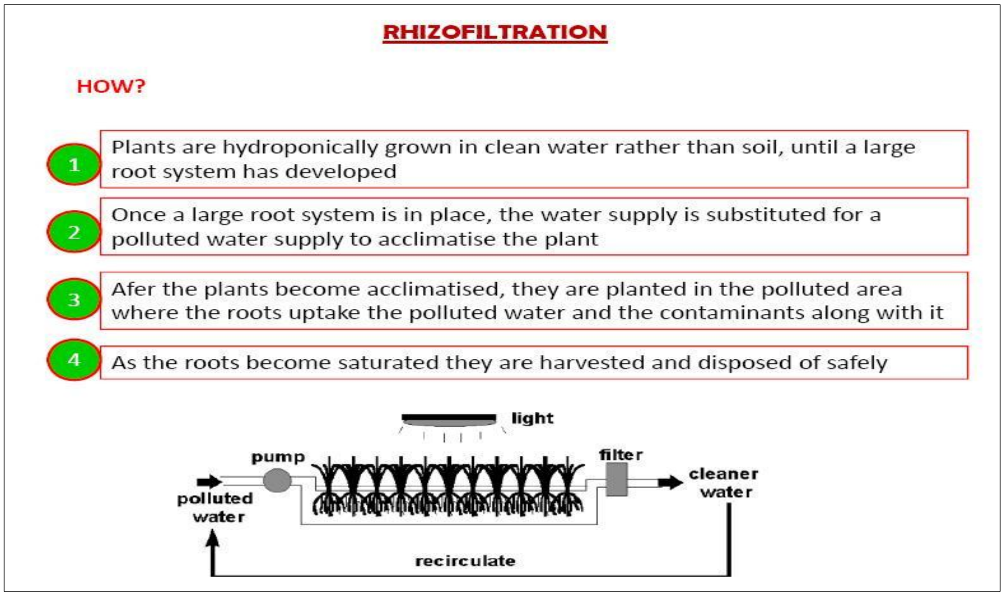
Increased soil pollution with heavy metals due to various human and natural activities has led to a growing need to address environmental contamination. Pollution of the biosphere with toxic metals has accelerated dramatically since the beginning of the industrial revolution. The primary sources of this pollution are the industrial effluents, mining and smelting of metalliferrous ores, metallurgical industries, municipal wastes, fertilizers, pesticides and sewage.

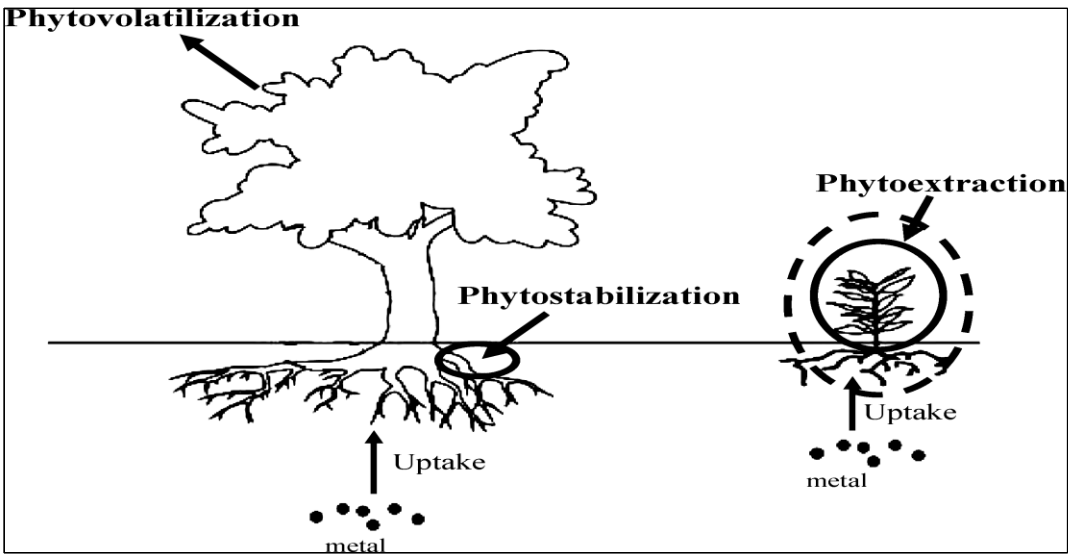
Some remediation technologies have been developed to treat contaminated soil, but a biology-based technology "Phytoremediation" which uses plants and their associated rhizospheric microorganisms to remove, degrade or immobilize various contaminants from polluted soils and also from sediments, groundwater or surface water has been evolved by researchers. Early research indicates that Phytoremediation is a promising clean-up solution for a wide variety of contaminated sites, although it has its limitations. It includes phytovolatilization (for effluent), phytostabilization, phytoextraction and artificial constructed wetlands using hyperaccumulator species or a chelate-enhancement strategy. To enhance Phytoremediation as a viable strategy, micro biota from the rhizosphere can play an important role.

Different approaches of Phytoremediation:

It can be used for both organisms and inorganic pollutes of solid or liquid. Various phytoremediation strategies are possible for the remediation of heavy metal contaminated soils. Different phytotechnologies make use of different plant properties.

- **Phytoextraction:** The term "phytoextraction" mainly concerns the removal of heavy metals from soil by means of plant uptake. This technology is based on the capacity of the roots of plants to absorb, translocate and concentrate toxic metals from soil to the aboveground harvestable plant tissues.
- **Phytodegradation:** The use of plants and associated microorganisms to degrade organic pollutants to less toxic forms or rendering them immobilized to prevent their entry in to the food chain or environment.
- **Rhizofilteration:** It is defined as the use of plants to absorb, concentrate and precipitate contaminants from the polluted aqueous sources. It can partially treat industrial discharge, agricultural runoff or acid mine drainage.
- **Phytostabilization:** The use of plants to reduce the bio availability of pollutants in the environment through reduction of leaching, run off and soil erosion. Prevent migration to the ground water or air.
- **Phytovolatilization:** The chemical conversion of toxic elements into less toxic and volatile compounds is a possible strategy for detoxification of metal ion contaminants, resulting in the removal of specific harmful volatile elements (Hg and Se) from soil and plant foliage to the atmosphere. For example, the volatilization of Se involves the assimilation of inorganic Se into the organic selenoaminoacids, selenocysteine and selenomethionine. Later it can be bio methylated to form dimethylselenide, which is volatile and can be lost to the atmosphere.





Advantages of Phytoremediation:

- Cost effective when compared to other conventional methods
- Natural method, more aesthetically pleasing
- Minimal land disturbance
- Reduces potential for transport of contaminants by wind, reduces soil erosion
- Multiple contaminants can be removed with the same plant

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Disadvantages of Phytoremediation:

- Slow rate and difficult to achieve acceptable levels of decontamination
- Potential phase transfer of contaminant
- Possibility of contaminated plants entering the food chain
- Contaminant might kill the plant
- Possible spread of contaminant through falling leaves

Hyper accumulators used for phytoremdiation:

Elements	Plant species	Maximum conc. (mg/kg)
Cadmium	*Thlaspi caerulescens*	500
Chromium	*Brassica juncea, Helianthus annus*	1400
Nickel	*Alyssum lesbiacum, Sebertia accumulata*	47000
Lead	*Thlaspi rotundifolium, Brassica juncea, Zea mays*	8200
Cobalt	*Haumaniuastrum robertii*	10000
Zinc	*Thlaspi caerulescens, Brassica juncea, B. oleracea, B.campestris*	51000
Selenium	*Brassica juncea, B.napus*	900
Copper	*Ipomoea alpine*	12000

How long will it take for Phytoremediation?

- Depends on amount of metals present
- Type of the plant used
- Size and depth of polluted area
- Type of soil and conditions present

Disposal after phytoremediation:

- Volume reduction and disposal in to the landfill
- Composting and compaction
- Combustion
- Gasification
- Recovery of metals from the ash

CONCLUSION

- The eight energy crops were moderately tolerant to high levels of Cd contamination
- Reduction of Cd toxicity via exclusion strategy.
- Four energy crops with higher Cd tolerances (hemp, flax, castor and peanut) could be planted on Cd polluted land for biodiesel production.
- Three of the crops (peanut, hemp and flax) were better Cd accumulators. Therefore, the best candidate for phytoremediation and fuel production on Cd contaminated soil.
- Among these peanut accumulated most Cd in the shoots.

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Future needs:

- Complete knowledge on the rhizosphere mechanisms of hyperaccumulator plants.
- A better knowledge on cultivation practices and harvest of hyperaccumulator plants.
- Knowledge on uptake, transport and tolerant mechanisms existing in the hyperaccumulator.

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Panchagavya- An ecofriendly insecticide

Article id: 23531

Sucharu Singh
Ph.D Scholar, Department of Entomology, CSA University of Agriculture and Technology, Kanpur-208002 (U.P.).

INTRODUCTION

From several years, synthetic chemicals are used to reduce the insect-pests. Just because of these chemicals, have caused extensive damage to soil, crops, water, natural enemies and to human and animal health. Now it's time to go back and to adopt organic and natural farming techniques. Panchagavya is an organic formulation, which in Sanskrit means the blend of five products obtained from cow i.e. milk, ghee, curd, dung and urine (all these products are individually called as "Gavya" and collectively named as panchagavya).

Panchagavya requires mainly five products of cow along with certain other ingredients as listed below (Natarajan, 2002);(1) Fresh cow dung - 7 kg; (2) Cow urine - 3 l; (3) Cow milk - 2 l; (4) Cow curd - 1 kg(5) Cow ghee - 1 kg; (6) Sugarcane juice - 3 l or 500 g jaggary; (7) Tender coconut water – 3 l; (8) Riped banana – 12 Nos.; (9) 100 g yeast + 100 g jaggary dissolved in 2 l of warm water.

Flow chart for preparation of Panchagavya (Natarajan, 2002)

Mix thoroughly the fresh cow dung (7kg) + Cow ghee (1kg)

↓

Incubate for 2 days

↓

Add cow urine (3 l) + 10 litre of water

↓

Stir properly (morning and evening, daily for 1 week)

↓

Add sugarcane juice (3 litre) or jaggery mixed in water at 1:6 ratio **+** Cow milk (2 litre) **+** Cow curd (2 litre) **+** Coconut water (3 litre) **+** Yeast (100 g) and 12-ripe banana

↓

Stir properly (morning and evening, daily for 3 weeks)

↓

Panchagavya is ready to use

All the above items can be added to a wide mouthed mud pot or concrete tank or plastic bucket as per the above order. The container should be kept open under shade. The content is to be stirred twice a day both in morning and evening. Sugarcane juice and coconut water are reported to accelerate fermentation. Toddy also accelerate fermentation and helps in minimizing the bad odour. To prepare toddy two litres of tender coconut water has to be kept in a sealed airtight plastic bottle for a week. However, 100 g of yeast powder can be made use of in case of non-availability of toddy.

Panchagavya as Insect control

In annual moringa sprayings of Panchagavya doubled the stick yield besides giving resistance to pests and diseases (Vivekananda, 1999) and Boomiraj *et. al*. (2004) reported that Panchagavya was effective against leaf hopper (*Amrasca biguttula biguttula*) and white fly, (*Bemisia tabacci*) in bhendi. Panchagavya + NSKE proved as best in managing *Spodoptera litura* larvae followed by panchagavya + *Vitex nigundo* and calotropis in groundnut and

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soybean. Whereas, panchagavya + cow urine in combination with NSKE proved next best over spinosad in controlling DBM (*Plutella xylostella*) in cabbage and shootfly in sorghum (Mudigora *et al.*(2009).

Panchagavya doses:

For storing: seeds are socked in 3% of the panchagavya solution for 10- 15 min and dry them under shade and store them for 360 days.

For spraying:

3% of the solution in water i.e. 3 liters of Panchagavya to every 100 liters of water is the most appropriate proportion for spraying.

For irrigation:

3% of the panchagavya solution can be used in irrigation water. The amount of Panchagavya per liters should be 20 liters/acre.

For seed treatment:

Soak the seeds for 20 minutes in 3% Panchagavya solution in water before planting. Similarly rhizomes of turmeric or ginger and cutting of sugarcane should be soaked for 30 minutes before planting.

Periodicity of Panchagavya dosage:

- When the crops are in the pre flowering stage, then there should be two sprays in a span of 2 weeks. The no. of sprays depends on the duration of the phase of the crops
- During flowering stage, then two sprays should be given in a span of 10 days
- In the pod maturing stages or fruiting stage, then the spray should be given for one time during the pod maturation.

CONCLUSION

Today, we can avoid synthetic fertilizers, pesticides and growth regulators for farming and choose organic farming process. In this way we can reduce the effects of adverse chemicals which are penetrated through pesticides. Panchagavya contains growth harmones , macro and micro nutrients along with the effective microorganisms in the Panchagavya. Since it has all the nutrients it is widely used for the agriculture and horticulture crop as biofertilizer and biopesticides.

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Option for nutrients management in organic farming

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Jaydev Haldar
M.Sc. (Agricultural Extension)

Agriculture is the backbone of our country, it provides all the essential food items to all living beings in direct or indirect ways, as well as focus on nutrient management in organic farming to maintain stability, openness, independence, health and safety. It becomes necessary to give. The effects of the Green Revolution have encouraged farmers to take up organic farming. Changes have occurred in a quantum boom during the Green Revolution in the form of agriculture, changes in the environment as a result of pollution, degradation in soil health, loss of biodiversity, agricultural chemicals and others. it is a key point to manage the inclusion activities in organic farming properly, because without management, there will be no profitable outgoing of organic farming. This article highlights all the activities that come under organic farming so that the adoption of organic farming Farmers were able to get good income.

INTRODUCTION: The root system of plants is always in close association with a multitude of microorganisms and other nutrients. In the root zone, germs are retained and formed due to a variety of secretions from the roots, often described as the 'ere rhizosphere'. However, crop productivity and nutrient cycles are integral to the exploitation of soil health and soil erosion through nutrient depletion and erosion, leading to long-term strategies to avoid the use of chemical fertilizers that adversely affect crop productivity. is needed.

Nutrient management is one of the main challenges facing the organic farmer. (1) In the short-term, the problem is sufficient sufficient nutrients to the crop at the correct point in its development to achieve economically viable yields. (2) In the long-term, the challenge is to balance inputs and off takes of nutrients to avoid nutrient rundown or environmental pollution. Both of these goals must be achieved in the most part through the management of organic matter Within most organic systems. Organic soil fertility management is based on feeding the soil a rich, complex diet of plant residues, animal manure, and compost. Many biological inputs (such as cover crops, crop residues, weeds, and compost) are added to the soil for reasons other than fertility management, yet they contribute to the pool of nutrients in the soil. Second, most organic material, including manure and compost, is only a small component of soluble nutrients; Most of their nutrients must be changed through biological processes before they become available in plants. Third, most manures and fertilizers do not have a consistent nutrient content. Plant and animal residues are mineralized, microbial biomass contains nutrients, and nutrients that are mineralized from decomposing residues. As a good organic producer, you should determine the availability of current and future nutrients for each of these nutrients.

The following are components in the nutrient management system

Fertility Building Leys- The fertility building ley is the cornerstone of most organic rotations. A well-managed ley will provide nitrogen to cash crops, forage for animals and aid in the control of weeds, pests and diseases. Despite the importance of the ley in fixing atmospheric nitrogen, that many factors are involved, such as legume species, soil type, climate, pests and disease.

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Manure management - The main route of entry for nutrients brought onto the farm is usually via animal feed and bedding. Animal manure provides an important method for redistributing nutrients around the farm. Despite the obvious importance of manure to the organic farmer, there is plenty of scope for improved management on many organic farms. Fresh manure, especially slurry and poultry manure, contains a considerable proportion of nitrogen in readily available forms, which can be easily and rapidly lost to the atmosphere. Similarly, nutrients can be washed out by rainwater. Both ammonia and nitrate losses can cause environmental pollution as well as representing a loss of N that could be used by the crop.

Green manure and cover crops- Research has shown that green manure and cover crops are used Regularly in rotation for less than six months Cash can be equally effective in maintaining soil N among crops. Concentrations and yields as long-term (3 years). They also add fresh organic matter to the soil, which Soil increases microbial activity, protects soil from erosion and Some can be used for forage. There are two principle types:

- Those who catch nitrogen prevent them from being leached.
- Those that fix nitrogen promote soil fertility.

Supplemental application of organically approved amendments- Soil amendment is also known as conditioner. Encourage nutrient recycling by developing the innate structure of a soil. Improving a soil structure and ultimately its ability to deliver water, air and nutrients to plants. Biological amendments are the safest and effective means to promote soil fertility

Nutrient Addition and Addition of compost/FYM- most of the nitrogen is available when they die and rot. The amount of nitrogen added by legumes depends on the type of legumes, soil conditions and harvest methods. Thus, growing legumes in nitrogen-rich soil, with grasses or as companion crops with non-legumes, will lead them to more nitrogen. Populations of microorganisms that make soil come alive with productivity and enable plants to battle diseases and pests thrive in such an environment. Will be required Organic standards recognize this need and allow limited amounts of nutritional supplements to be used, such as rock phosphate, potassium sulfate, and green waste compost.

Crop residues- Crop residues can be an important source of nutrients and organic materials. Both the quantities produced and their nature vary between crop types. For example, cereal straw contains only about 35 kg N / ha and has a wide C: N ratio, compared to 150 kg N / ha for some vegetable residues, a narrow C: With n ratio. The narrow C: N ratio of green leafy residues means that N is released much more rapidly than grain straw. Consequently, different types of residues will require different management if the maximum benefit is to be achieved. AIf this is not possible, then a cover crop can be used to maintain N. The inclusion of fewer N residues, such as grain straw, may have the opposite effect, dipping N from the soil.

Coir pith compost- The largest by coconut products are coconut husk from which coir fiber is extracted. This extraction process produces a large amount of dust material called coir dust or coir pith. The coir pith has gained importance in horticulture due to its properties as a growth medium. To increase the human value of the pith. Manure of coir pith reduces its bulk and converts plant nutrients into available form.

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Nutrient conservation and management- Good nutrient management uses crop pruning and cover crops to provide the main crop with nutrients when they are needed and nutrient conservation in the soil during the harvest season, when they would otherwise be leaching, erosion or may be lost through evaporation. In one example, you can apply manure that contains the proportion of nutrients needed for your crops. This can cause excess levels of nutrients, especially phosphorus, to build up in the soil. Crop rot may reduce or bind excess nutrients in the soil. Cover crops increase plant nutrients as they grow, then release these nutrients back into the soil when they are cut or incorporated and undergo decomposition.

Biodynamic Farming- Biodynamics has much to do with other organic approaches - it emphasizes the use of compost and compost and excludes the use of synthetic (synthetic) fertilizers on soil and plants. Methods unique to the biodynamic approach include the treatment of animals, crops, and soil as a single system, an emphasis from its inception on local production and distribution systems, the use of traditional and new local breeds and cultivars. Some methods use astrological sowing and planting calendars.] Biodynamic agriculture uses various herbal and mineral additives for compost additives and field sprays; These are prepared using methods that are more similar to sympathetic magic than agronomy, such as quartz, the ground buried in cow horns, known as "cosmic forces in the soil".

Nutritional supplements- In time, all organic systems will need supplemental nutrients to replace those removed from the farm or lost to the environment in crops and animal products. In some cases, soil reserves may be able to supply nutrients for hundreds of years, but on some soils and in some systems, such as intensive vegetable production, regular supplementation of nutrients to reduce nutrients Will be required Organic standards recognize this need and allow limited amounts of nutritional supplements to be used, such as rock phosphate, potassium sulfate, and green waste compost.

Reliance of soil fertility management on biological processes- Many synthetic fertilizers dry out the soil or make it acidic or saline. In contrast, a primary principle of organic farming is to feed the soil so that the soil can feed the plants. A healthy soil contains a good amount of tilt and mineralizes the organic material, so as to provide the plants with their essential nutrients. It also has a diverse population of soil organisms that increase plant growth in a variety of ways, such as through symbiotic relationships with the plant, ejecting enzymes in the soil, destroying toxins, and competing with pathogenic organisms.

Nutritious Food Rotation- Deep-rooted plants can reclaim nutrients that have reached below the root depths of other plants. These plants do not add nutrients to the soil, their ability to capture or store nutrients can help build soil fertility. The nutrients absorbed by these deep-rooted plants are not available until they are harvested or incorporated and allowed to rot.

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CONCLUSION

Agriculture The optimization of soil health is the foundation of organic agriculture. In keeping with the key aim of organic agriculture of maintaining biologically-active healthy soil, nutrient levels are maintained at optimum levels across the whole rotation. To whom Consistent with balanced / optimal nutrient levels, soil biological activity and high levels of organic matter are being emphasized successfully. Soil tests and budgets provide the information to establish the best fields on which to use farm produced manures and, where necessary, Organics farming aims to feed the soil to feed the crop. It is necessary to increase soil biology and nutrients at optimum levels throughout the rotation, rather than a non-organic approach to maximize the current crop and to apply nutrients

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Bio - intensive complementary cropping systems for higher productivity

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P.M. Shanmugam
Associate Professor (Agronomy), Institute of Agriculture, Kumulur -621712. Tiruchirappalli District

INTRODUCTION

Bio-intensive complementary cropping systems (BICCS) and crop diversification are the budge words in agricultural scenario at the national and international levels. Green revolution is need of enhancing total food grain production; emphasis was given on increasing the cropping intensity and crop productivity. Long term perspective, this approach digressed from the principles of crop production, where the basics of crop rotation and crop sequences played an important role. Approach of BICCS / diversification has been envisaged as a new strategy towards enhancing and stabilizing productivity, Making Indian agriculture export competitive and increasing net farm income and economic security. Now almost a normal feature of stable agriculture and progressive farm management in most of the extensive agricultural parts of the world. Bio - intensive complementary cropping systems which focuses on maximum yields from the minimum area of land, while simultaneously improving and maintaining the fertility of the soil.

Goal

- To achieve long term sustainability on a closed system basis.
- To utilize growing space more fully to increase the yield without required additional land
- It is particularly effective for small and marginal farmers and has also been used successfully on small scale commercial farms.

Advantages

- Increased productivity
- Water saving upto 40-50%
- Increase in soil fertility
- Reduce by 50% or more the amount of land required to grow a comparable amount of food.

Bio - intensive method

- deep soil cultivation to create raised and aerated beds (FIRB, Sunken raised bed)
- intensive planting
- companion planting
- composting
- planting ratio

Need of BICCS

Bio - intensive complementary cropping systems has become an important option to attain several objectives Viz.,

- Natural resources sustainability
- Ecological balance
- Output growth
- Buffer stocks
- Employment generation
- Risk coverage : Mono cropping - high risk

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Concepts

- A shift of a crop or cropping system to another crop or cropping system
- Use of resources in best possible way by changing and modifying the degree, trend and time options of crop/cropping activities
- A shift from less profitable and sustainable crop or cropping system to more profitable and sustainable crop/cropping system

Necessity for BICCS arises on account of the reducing the risks associated with yield, market and prices, aarresting the degradation of natural resources and environment and attaining the national goals like self-reliance in critical crop products, earning foreign exchange and employment generation.

Determinants

- Resource endowments like, agro climatic conditions, soil, labour and facility of irrigation
- Technological factors
- House hold factors
- Institutional and infrastructural factors
- Price factors

Long term benefits of BICCS

- For raising farm income
- Sustainable production and income
- Food and nutrient security
- Promotion of export
- Poverty alleviation
- Judicious use of land and water resources
- Reduction in environmental pollution

Priorities

1) Changing of resource use efficiency parameters
2) Crop rotation effect
3) Incorporation of crops and technologies
4) Research on actual farm environment through farmer participatory mode
5) Assurance against the risk to farmers under changing weather and sharp fluctuation in prices
6) National issues like nutritional and food security

Required steps for BICCS

- delineate area : scientific data base priorities and target the area
- choice of alternative crops and technology
- priority input / credit supply for alternative crops
- share the risk of new system
- market support - rural up-linking

Issues and functions provided by BICCS in dryland regions

- Productivity and stability - Increased yield, reduce intra seasonal variation and improved stability through diverse components viz., crop, tree, plant and animal

- High risk and high cost - Risk and cost minimization through yield and income from annual and perennial mixtures
- Unabated land degradation - Minimization of kinds, effect and extent of land degradation by appropriate land care through alternate land use system
- Inadequate employment - Staggered employment round the year
- Low profitability - High components income generation from various area
- Poor energy management - Energy efficient implements

Evaluation of bio - intensive complementary cropping systems

- Evaluation and productivity of multiple CS or of component crops should be done on quantitative terms
- It is relatively easy to compare the productivity of crops and agrl. systems that produce similar produces and use similar resources.
- A number of efficiencies in resource use becomes operative when two or more crops are present in the same field during the same year and these can be most complex when crops are grown simultaneously

Stability Index (SI) /Sustainability Yield Index (SYI)

The trend of yield over the year in systems reflects the stability/ sustainability of a crop / cropping system. Less fluctuation in yield over the years reflects positive side of stability. The stability index ranges from 0 to 1.

$$SI / SYI = \frac{Y - sd}{Ymax}$$

SI is stability index
Y is the average yield over years n
sd is the standard deviation
Y max is the maximum yield obtained in any of the year.

Inference: The value nearing unity shows higher stability reflecting that the system is higher sustainable.
Prerequisite: Minimum four year yield data are required to calculate the stability index.

CONCLUSION

BICCS is a new paradigm of sustainable agriculture. Not only a shift from traditional and less remunerative crop(s) to more remunerative crop(s). Demand driven, need based situation specific and national goal seeking, continuous and dynamic concept involve spatial, temporal, value addition and resource complementary approaches. Crop substitution and addition of more crops in existing cropping system has been the major approach of diversification in India. The nature of BICCS is has been mainly from low value coarse cereals to high value oilseeds and other food grains

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Significance of Fruit drop in Horticulture

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Shashank Singh[1], Akanksha Singh[2]
Assistant Professor[1], Research Scholar[2]
KNIPSS, Sultanpur-228001 (UP)[1], GBPUAT, Pantnagar-263145, Uttarakhand[2]

INTRODUCTION

Fruit drop is a premature shedding of fruits before harvesting for commercial purpose. There are so many reasons for fruit drop like internal (Hormonal balance, morphological and genetically) and external (biotic and abiotic) factors. Fruit drop is very much serious in some fruits like apple, peach, currant, mango, citrus etc. Fruit drop may occur at various stages of fruit growth, starting right from fruit setting till its harvesting. It may be natural, environmental or pest related. Losses due to fruit drop at various stages have long been a serious threat to the fruit growers. After determining the actual cause of fruit drop, adoption of a suitable control measure can bring relief to the growers. Among different drops, pre-harvest drop is of great economic importance which can cause serious crop loss to farmer.

Losses resulting from pre harvest and harvest drop of fruits have long been a serious problem to the fruit growers. As the fruits of some species and varieties approach the picking maturity, they tend to loosen from the stalk and considerable quantities may drop prior to and during the picking operation. Such fruits are badly damaged and if salvaged have a very low value compared with those picked from the tree. In certain fruit crops, the problem of fruit drop is very serious. Whereas in some, the fruit drop starts right from the time of fruit set and is severe at a number of stages of fruit development. In some fruit crop serious drop occurs before harvest.

Kinds of drop:

Fruitlet abscission is a common phenomenon that occurs in many plants in response to developmental and environmental cues leading to significant crop losses. There are usually three periods of fruit abscission, the first is the period of fruit set, which usually lasts for a month following full bloom also called as cleaning drop. The first drop occurs shortly after flower opening. Usually flowers with aborted pistils drop off at this stage. The second period of intense fruit drop may occur at the onset of hot summer and is referred to as "Second drop". Unfertilised flowers and some fertilized ones drop off at this stage. Some fertilized flowers also drop off as a result of adjustment in the tree between the nutritional factors and fruit set. The third drop is commonly referred to as "Post set drop". This occurs when the fruits are of „marble‟ size due to formation of abscission layers in the young fruit stalks. This drop occurs in most deciduous fruits and this naturally thinning of fruits helps the tree to produce fruits of good size. The period of intense fruit drop may occur with the onset of hot summer and is referred as June drop or Pre harvest drop. At this stage, half developed and three-fourth developed fruits are shed due to many causes. This is the loss to the fruit grower and is a serious problem confronting the fruit growers.

Causes of Drop

The chief causes of shedding of blossom and young fruits are:

(i) Structural defects

Defects in flower parts, winter injury, spray, damage due to insect, defective pistils are responsible for early shedding of blossom in apple. Defective ovules are also responsible.

(ii) Non pollination

Self pollination may fail, while cross pollination may be prevented by lack of suitable pollen or by the absence of carriers. Even if pollen reaches the stigma, it may be washed off by rain before it can exert a stimulus.

(iii) Non fertilization

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(a) Gametic sterlity

This condition seems to be common in polyploids containing an uneven multiple of the basic number of chromosomes especially in triploid varieties of apple. Such pollen grain either fails to germinate or if pollen tubes are formed these usually burst easily or they reach the ovary and give rise to unbalanced embryo.

(b) Incompatibility*:* Incompatibility in apple and pears is due to physiological reactions occurring between the pollen tube and the style and ovarian tissues.

(c) Failure of double fertilization

This may prevent the formation of the endosperm and thus that of the embryo.

(iv) Abortion of embryo

It may arise from genetical and unfavourable nutritional conditions and usually results in shedding of fruits.

Contributory factors affecting fruit drop

(i) Weather Condition:

Heat waves followed by cold nights frequently cause excessive drop. Cool weather on the other hand tends to reduce the intensity, though it may prolong the duration of the drop or it may postpone it till its maturity. Winds blowing with rapid speed by shaking the fruit trees may loosen the fruits from their stalk and cause waves of heavy shedding.

(ii) Climatic factors:

The formation of abscission layer is enhanced under high temperature, low humidity and very low temperature. In conditions of high temperature, the rate of transpiration is usually high from the leaves and fruits, consequently such fruits are unable to withstand water stress and shed easily. In mango normally the shedding of fruit is very severe when the temperature is high and humidity is low. The heaviest drop of citrus fruits known as June drop occurs when the atmospheric humidity is low and the transpiration rate is very high. Abrupt rise in relative humidity and temperature have direct relation with fruit cracking in litchi, pomegranate, cherries, lemons etc., which more often drop off from the plants in later stages.

(iii) Physiological factors

Physiological factors such as abnormal function in moisture content of the soils in the day or other causes resulting in disturbance of moisture relationship causes heavy fruit drop particularly in arid and semi arid fruit crops like ber and pomegranate.

(iv) Nutritional factors

Proper and balanced application of fertilizer is a pre-requisite for a tree to be able to carry its normal crop to maturity. Nitrogen seems to favors the early stages in setting but at later stage tends to favour shedding. Carbohydrate is important, particularly in connection with the drop of the young fruits. June drop can be prevented by a favorable supply of carbohydrate in the plant.

(v) Insect pest and diseases

Pest and disease incidence on fruit plants can result in severe shedding of blossoms and fruits. For example, mango flowers and fruits in early stages are attacked by a number of pests such as hoppers, mealy bug and diseases such as anthracnose and powdery mildew which causes heavy loss to the crop.

Fruit drop and its control in some important fruit crops

Mango

Mango fruits drop primarily at two periods. The first drop consists of flowers and young fruitlets from anthesis to 21 days. The second drop of its young developing fruits from 28-35 days after pollination and fertilization. In third drop, fruits drop irregularly. During the first and second periods of fruit drop, high level of inhibitors and low levels of promoters appear to be major factor consisting fruit drop which have been controlled by exogeneous applications of auxins, gibberellins, cytokinins, growth retardants (cycocel, Alar) silver nitrate etc. To control fruit drop in mango NAA or Planofix 20 ppm (0.002%) should be sprayed when the fruits are pea size.

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Citrus

In citrus huge quantities of fruits have been reported to drop wherever sweet oranges grow in Punjab. The first drop in citrus occurring during the month of May-June is mainly due to inadequate and imbalanced manuring of the trees and insufficient care.

The second drop occurring in the months of August and September is due to the attack of fungus C*ollectotrichum gloeosporiodes*. As this organism is a weak parasite and becomes aggressive only on the neglected plants, under nourishment of the trees appears to be the cause.

The third drop, which is the most serious, occurs in December and January when the fruits are mature. This is caused by the fungus *Alernaria citri*. The attacked fruits ripen earlier and develop an unusual deep organge colour. The diseased fruits show a characteristic blackening of the central portion.

The use of 2, 4-D in concentration of 10 ppm and 20 ppm and in combination with Zinc sulphate (0.05%) considerably reduces the dropping of fruits. Even when used in a low concentration of 5 ppm, the 2, 4-D was found to be quite effective.

Apple

Chemicals like 2, 4-D and NAA in concentrations of 10 and 20 ppm have been found to be effective. However, the varieties of apple have shown more specificity in this respect.

Apricot

Shipley variety of Apricot is susceptible to fruit drop. 2, 4, 5-T at 20 and 40 ppm was found effective in controlling fruit drop in apricot. Sprays of plant growth regulators are therefore recommended around the last week of march or first week of April.

Management of Fruit Drop

Planting windbreaks and shelterbelts

High wind velocity causes mechanical damage to the fruits and branches and their desiccation due to excessive transpirational loss of water. Windbreaks of fast growing and deeprooted trees are planted around the orchard to provide a protective barrier against hot and cold winds and reduce the extent of fruit drop.

Water and Moisture Management:

Moisture stress during fruit set and fruit development causes severe fruit drop in most of the fruit crops. In irrigated system, water application should be based on optimally sequenced evapo-transpiration deficits. In the deep-rooted perennial fruit trees, the concept of irrigation scheduling based on plant water content should be ideal.

Conservation of soil moisture by mulching enhances water use efficiency by reducing evaporation from soil surface as a result of cutting supply of heat energy to the evaporating site and lowering its thermal conductivity. Such practice helps in minimizing fruit drop. Mulch materials such as wheat and rice straw, sugarcane trash, sawdust, black or white polyethylene can be used for mulching.

Nutrition Management:

Fertility management for controlling fruit drop should be done in such a way that the fruit trees derive most of their nutritional supplements from the residues of the intercrops. However, annual application of manures and fertilizers near the zones of maximum root activity coinciding with rainfall incidence is useful. Foliar feeding with recommended doses micro nutrients helps in overcoming nutrient deficiencies.

Pest and Disease Management

The perennial nature of fruit trees provides a comparatively stable agro-ecosystem for several kinds of pests and disease to thrive and multiply. A close watch needs to be kept on build up of various pests and diseases and suitable control strategies should be initiated so as to obviate their harmful effects.

Pollinizers

The cultivar which is used as a source of pollen grain is termed as a pollinizer. Fruit crops which require pollinizers for effective pollination should be planted in adequate ratio. For example Royal delicious is used as a pollinizer for Golden Delicious. In Kagzi Kalan lemon, 10% plant of pumello serve the purpose of pollinizer. Likewise in aonla 10% plant of cultivar Chakiya should be planted with cultivars NA-7 and Banarasi.

Use of growth regulators

Various growth regulators are recommended in different fruit crops for controlling fruit drop. However, care should be taken during preparation of solution. Recommended concentration for controlling fruit drop should be strictly followed, for example 2, 4-D at lower concentration acts as a hormone but at higher concentration may act as a weedicide.

Table Prevention of fruit drop in different crops at a glance

Fruit crop	PGR	Concentration	Time of Application
Mango	NAA or 2, 4-D	20-30 ppm	Last week of April or when the fruits attain marble size.
Citrus species	2, 4-D or Gibberelic acid GA3	8-10 ppm 50 ppm	Before the young fruits attain growth, two sprays of the recommended dose may be given.
Litchi	NAA or 2, 4-D	10-15ppm +1% ZnSo4.	At the time of fruit development
Cashewnut	2, 4-D or NAA	10 ppm	At the time of fruit development
Grape	Gibberelic acid GA3 or PCPA	100 ppm	Before harvesting
Apple	NAA or 2, 4-D or 2,4,5-T	10 ppm 20-50 ppm	Immediately after the petals drop.

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Role of biochar in soil health and mitigation of climate change

Article id: 23535

Govind Kumar Yadav[1], Kamlesh Yadav[2]
[1]*Ph.D.* Scholar, Department of Soil Science and Agricultural Chemistry, S.K.N. College of Agriculture, Jobner, Jaipur
[2] *M.Sc.* Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, Udaipur

INTRODUCTION

Biochar is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at low temperatures (~350–600°C) in an environment with little or no oxygen. Biochar is not a pure carbon, but rather mix of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S) and ash in different proportions. The central quality of biochar and char that makes it attractive as a soil amendment is its highly porous structure, potentially responsible for improved water retention and increased soil surface area. The solid product of pyrolysis, called biochar in the context of climate change mitigation, is highly heterogeneous material with chemical composition that varies widely depending on feedstock and pyrolysis conditions (Spokas, 2010). The bio char is a thermo-chemical process where biomass is heated in the absence of oxygen. As a result, bio-oil, synthesis gas with different energy values and black carbon (biochar) are obtained.

Effect of Bio char on Soil Health and Climate Mitigation

The application of biochar introduces functional groups and to enhance the specific surface area and pore fraction. Various raw biomasses like rice straw, almond shell, walnut shell, olive stone, palm oil shell, sewage sludge, soybean oil cake, safflower seed press cake, has been studied for physical and chemical activation for increasing surface topography and structural properties. In general, the processed biochar used in soil application is a finely grained and highly porous charcoal, which is extremely important in soil amendments. The high porosity of biochar helps soil to retain nutrients, water and also works as a habitat for soil microorganism. Additionally, biochar has also found to improve the protection against some soil-borne diseases. The presence of carbon in biochar prevents its degradation and thus, it can persist in soil for thousands of years. The high concentration of sodium, phosphorus and calcium and potassium in biochar can be utilized as nutrient by plant or it may be used as a nutrient source of microorganism. Each pore in biochar provides the void volume to allow growth of soil beneficial microorganism, and increase the moisture and air quantity result in increase in growth rate of plants. Conversion of agricultural waste into a powerful soil health enhancer (i.e. biochar) with many promising benefits can be used to conserve cropland diversity, prevent deforestation and most importantly to reduce the national food insecurity. Based on various research findings, presenting ting the benefits of biochar that comprises but not limited to:

- Increased water retention capacity of soil
- Reduction in the leaching of water-soluble nutrients
- Abatement in soil acidity
- Reduced leaching of nitrogen into ground water
- Minimized emissions of nitrous oxide

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- Increased cation exchange capacity (CEC) of soil to improve soil fertility
- Increased persistence of beneficial soil microbes
- Influencing seed germination, early growth of seedlings and crop production
- Increased earth-worm abundance, liming effect and priming effect

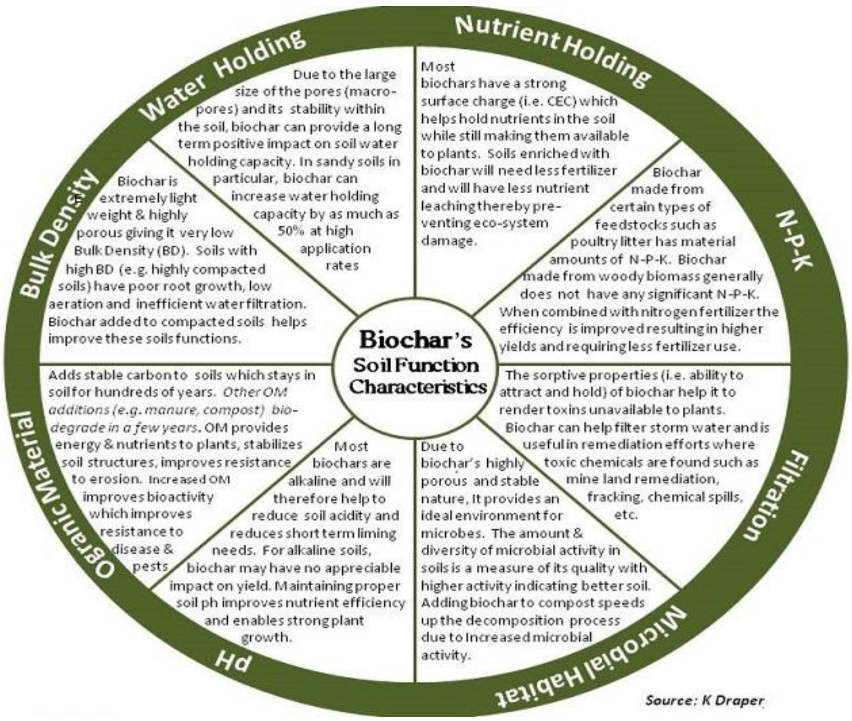

Fig. 1. Effect of biochar on soil health

Soil C sequestration is the removal of atmospheric CO_2 through photosynthesis to form organic matter, which is ultimately stored in the soil as long-lived, stable forms of C. The global carbon cycle is made up of flows and pools of carbon in the Earth's system. The important pools of carbon are terrestrial, atmospheric, ocean, and geological. The carbon within these pools has varying lifetimes, and flows take place between them all. Carbon in the active carbon pool moves rapidly between pools. In order to decrease carbon in the atmosphere, it is necessary to move it into a passive pool containing stable or inert carbon. Biochar provides a facile flow of carbon from the active pool to the passive pool. In comparison to burning, controlled carbonization converts even larger quantities of biomass organic matter into stable C pools which are assumed to persist in the environment over centuries. Apart from carbon sequestration, there are other environmental benefits that can be derived from the application of biochar in soils which include reduction in the emission of non-CO_2 GHGs by soils. Soil is a significant source of nitrous oxide (N_2O) and both a source and sink of methane (CH_4). These gases are 23 and 298 times more potent than carbon dioxide (CO_2) as greenhouse gases in the atmosphere. Biochar is reported to reduce N_2O emission could be due to inhibition of either stage of nitrification and/or inhibition of denitrification, or promotion of the reduction of N_2O, and these impacts could occur simultaneously in a soil. It has carbon in recalcitrant form and can hold it in soil for hundreds of years. Due to high retention power, it reduces N_2O and CH_4 emission from soil, otherwise easily decomposable OM can change in to resistant form by converting to biochar.

CONCLUSION

Biochar is a fine-grained and porous substance, similar in its appearance to charcoal produced by natural burning Biochar is sterile, odorless, high carbon solid that may be produced from a variety of organic feedstock which can be tailored to suit the crop, soil type and management system to reach maximum benefit. It improves physical, chemical and biological properties of soil and increase the carbon sequestration and reduce the emissions of greenhouse gases.

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Water quality indices and suitability for irrigation purpose

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Govind Kumar Yadav[1], Kamlesh Yadav[2]
[1]*Ph.D.* Scholar, Department of Soil Science and Agricultural Chemistry, S.K.N. College of Agriculture, Jobner-303328
[2] *M.Sc.* Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, Udaipur

INTRODUCTION

Water is universal solvent. It contains variable quantity of dissolved solids and gases. Sometimes, suspended and colloidal organic and inorganic material is occurred as well as. Water are usually classifieds as hard or soft according to the concentration of calcium and magnesium ion. The irrigation water which contained Ca and Mg ions, is hard and not suitable for domestic use, but makes agricultural land soft. On the other hand, water which contained Na ions is soft for domestic use, but makes agricultural land hard. Important indices of water quality parameters are given below.

pH: - The pH value is the negative normal logarithm of hydrogen ion activity (mol L^{-1}). As a result of the presence of strong bases and weak acids e.g. Na_2CO_3 increase the pH values, salts of weak bases and strong acids (e.g. $CaCl_2$) cause decreases. The pH values of neutral water usually lie between 6.5 and 7.5 and lower values are a result of free CO_2. pH of water samples is determined directly by pH meter with glass-calomel electrode assembly.

EC: - Electrical conductivity of water is directly proportional to its dissolved mineral matter content. The unit of electrical conductivity is dS m^{-1}. Since electrical conductivity varies directly with temperature of the sample, the result is usually reported at 25^0C. Electrical conductivity of water samples is determined directly by conductivity bridge and values corrected for temperature and cell constant.

Classes of irrigation water on the basis of salinity hazard by the (Richards, 1954)

Sr. No.	Salinity Class	Water quality Rating	EC range (dS m^{-1})	Suitability
1.	C1	Low salinity Water	Below 0.25	Suitable for most of the crops and soils.
2.	C2	Medium salinity	0.25-0.75	Suitable for soils of moderate drainage
3.	C3	High salinity	0.75-2.25	Unsuitable for soils with restricted drainage
4.	C4	Very high salinity	Above 2.25	Unsuitable for Cultivation

Sodium Adsorption Ratio (SAR): - It is calculated to indicate the sodicity or alkalinity hazard of irrigation water.

$$\text{SAR} = Na^{+}/\sqrt{Ca^{++} + Mg^{++}/2}$$

Where concentration of cations is in meq per litre. Based on the values of SAR, waters can be rated into different categories of sodicity as under (Richards, 1954).

Suitability class	SAR, rating
Safe	Less than 10
Moderately safe	10-18
Moderately unsafe	18-26
Unsafe	More than 26

Residual Sodium Carbonate: - This index is important for carbonate and bicarbonate rich irrigation waters. It indicates their tendency to precipitate Ca^{+2} as $CaCO_3$.

$$\text{RSC} = (CO_3^{-2} + HCO_3^{-}) - (Ca^{2+} + Mg^{2+})$$

Where concentration of both cations and anions are expressed in me L^{-1}. Sodicity hazard in terms of RSC is categories as under (Eaton, 1950)

Suitability class	RSC, rating
Safe	Less than 1.25 me L^{-1}
Moderate	1.25-2.50 me L^{-1}
Unsafe	More than 2.50 me L^{-1}

Magnesium, Mg: Calcium, Ca ratio: - The high level of magnesium usually promotes higher development of exchangeable sodium in irrigated soils. The ratio of Mg to Ca are categorized as shown below.

Suitability class	Mg to Ca ratio
Safe	1.5 and less
Moderate	1.5-3.0
Unsafe	3.0 and more

CONCLUSION

The quality of irrigation water depends on the concentration and composition of salts dissolved in it. The concentrations of these constituents above permissible limit have profound effect of physical and chemical properties of soil. The damage to soil is observed in respect of low water permeability of soil, swelling and dispersion of clay particles, clogging of the soil pores, precipitation of calcium and magnesium. All these cause injuries to crops thereby reducing crop production and productivity of these crops and in severe cases the soil becomes totally uncultivable, requiring costly reclamation measures.

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Sustainable Agriculture: Emerging Challenges and Opportunities

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Akankhya Guru[1*], Soumya Kumar Sahoo[2], & Selukash Parida[3]
[1]Department of Plant Physiology, IAS, Banaras Hindu University, Varanasi
[2]Department of Plant Physiology, COA, Indira Gandhi Krishi Vishwavidyalaya, Raipur
[3]Department of Plant Physiology, COA,Odisha University of Agriculture & Technology, Bhubaneswar

Sustainable agriculture – It is a method of sustainable farming that includes productive, competitive and efficient practices meanwhile protecting and improving the environment and the global ecosystem as well as the socio-economic conditions of local communities in line with human dignity.

- A sustainable agriculture must be economically viable, socially responsible and ecologically sound with a goal to meet society's present food and textile need without compromising the ability of future generations to meet their needs.

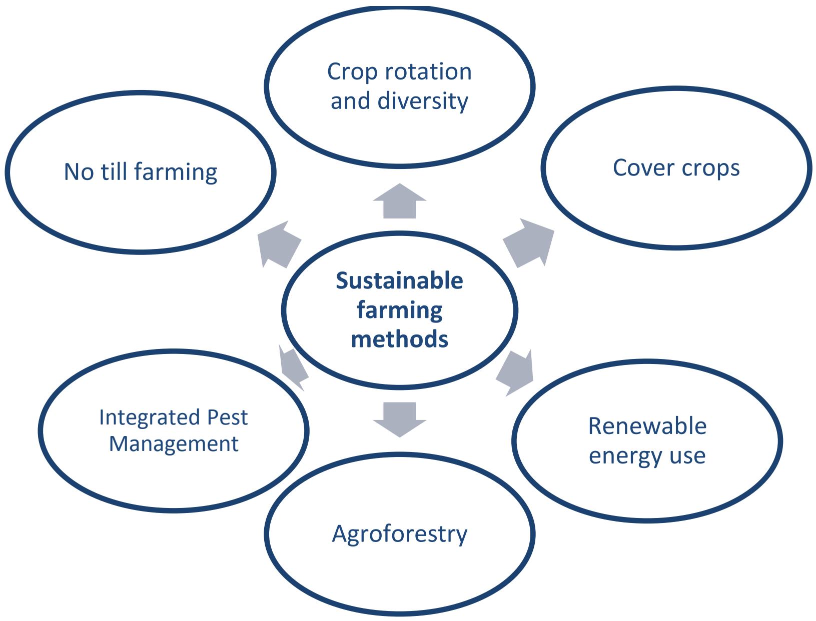
Why do we need sustainable agriculture?

1. Eliminating the practice of monoculture that relies on planting of single plant breed due to which plants can become more vulnerable to diseases.
2. Making better use of land that will result in production of more food per acre.
3. Reducing pollution by recycling and water reclamation efforts.
4. Increasing the welfare of animals by mixing a limited number of animals with plant based farms so as to provide enough space for grazing and roaming.
5. Stabilizing the food supply.

Benefits of sustainable agriculture

- It helps to replenish land and other resources like soil, water, and air to make them sufficiently available for future generations.
- Minimizes the use and cost of purchasing fossil fuel and reduces the transportation costs, thereby reducing the overall cost in farming process.
- Provision of a fair wage to farmers involved in sustainable farming.
- It plays a vital role in decreasing the use of non-renewable environmental resources and is thus quite beneficial for the environment.

Sustainable agriculture practices



Opportunities for sustainable agriculture

1. Emergence of investments in supporting long-term ecosystem services and land stewardship where the landowner has a secure and unambiguous claim on the land.
2. Foods and locations diversification to reduce the vulnerabilities and detrimental environmental and health outcomes that arise from over-dependence on a few staple energy crops grown in some regions.

Challenges

1. **Food security and productivity:**

There is a requirement for sustainable agriculture to prove itself facing with intensive agriculture. With the growing population and the persistently higher levels of hunger and malnutrition, sustainable agriculture yields need to address the food security issue by producing more in less time, while using fewer natural resources.

2. **Availability of natural resources:**

Another big challenge that sustainable or green agriculture is facing undoubtedly the rapid degradation and depletion of natural resources.

CONCLUSION

In regards to the future of sustainable agriculture, many believe by the time earth's population reaches nine billion we will be fully deprived of many natural resources that will require alternative sustainable solutions. Sustainable agriculture is not the only step in the wave of preserving our planet, but act significantly as an important building block in taking preventive measures in order to maintain the resources we have left.

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Role of green manuring for improving soil health

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Deepak Kumar Meena[1*] & Mohammad Hasanain[2]
[1*]*M.Sc. Scholar, Department of Agronomy, G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand*
[2]*Ph.D. Scholar, Division of Agronomy, ICAR-IARI, New Delhi-110012.*

To meet the demands of growing population, Intensive agriculture has become an inevitable practice. This led to the degradation of natural resources including soil, water and others. Soil health, being one of the major concerns of modern agriculture. This article focusses on the use of green manure crops for improving soil health physically, chemically and biologically.

INTRODUCTION

Agricultural research has been prosperous in our country with the issue of several competent varieties and GAPs to increase the crop yield both quantitatively and qualitatively. The "Effect of agriculture on Environment" has become a thrust area of research in recent times. Soil and water degradation are very crucial issues in the modern era (Gardner, 1996). Soil health has been degraded due to intensive soil disturbance and excessive use of chemical inputs. To overcome which, shift towards organic agriculture has been encouraged. Organic agriculture includes the use of several plant and animal origin inputs like FYM, compost, green manure, several organic preparations. Green manures are considered as one of the important inputs.

"*Green manuring is the method of growing leguminous crops in the field and then turning off these into the soil by ploughing at appropriate stage." It increases the fertility status of soil by improving the physical, chemical and biological properties of soil. Green manuring is of two types: green manuring in-situ and green leaf manuring*.

In green manuring in-situ, crop is buried in the same field in which it is grown. Burying by ploughing is done at the flowering stage which generally comes after 7-8 weeks. The important green manure crops are sunnhemp, dhaincha, pilipesara, Sesbania and clusterbeans etc.

Application of green leaves and twigs of trees, shrubs and herbs collected from some other place. Important plant species for green leaf manure are neem, mahua, wild indigo, glyricidia, karanji, calotropis etc.

Fig. 1: Various green manure crops and green leaf manure crops

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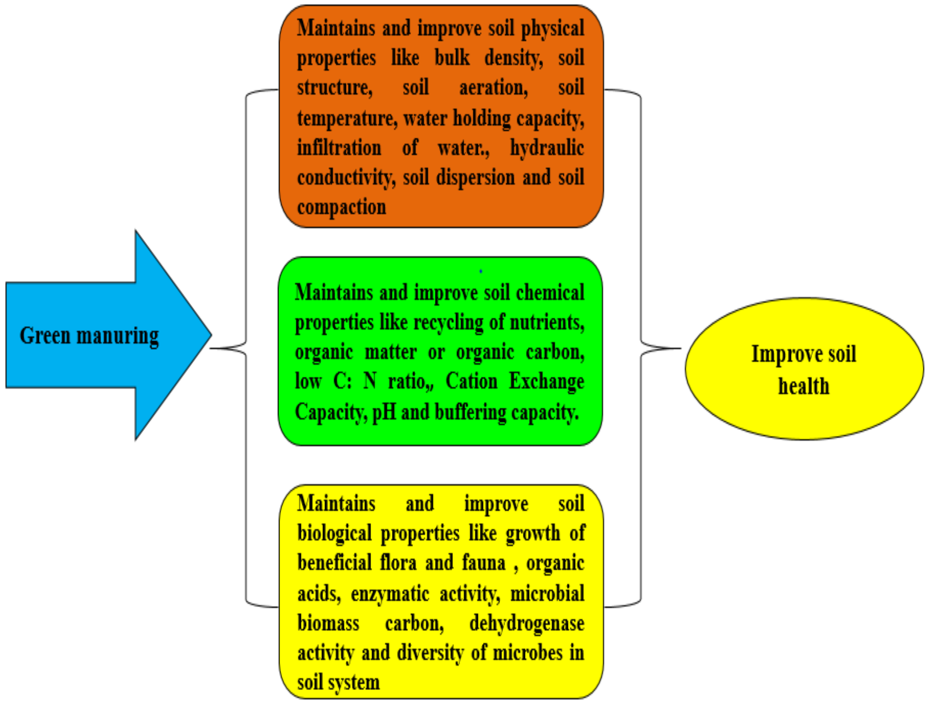

Fig.2: Green manuring for improving health soil

Green Manuring: A complete treatment to soil

Green manuring can be considered as a complete treatment to soil as it works with majority of the aspects of soil that limits crop production. It not only helps in improving physical, chemical and biological environment of soil but also helps in reclamation of problematic soils (alkaline soil) and in the management of pests like root knot nematode.

Green manuring for improving physical health of soil

- Green manuring are improve the stability of aggregates and improvement of soil structure
- It improves water infiltration in soil.
- It increases water holding capacity and porosity of soil.
- It reduces runoff and thus erosion and considered as a soil conservation method and it reduces bulk density of the soil.
- Under a rice-wheat cropping system effect of green manuring on the physical properties of soil. Improvement in hydraulic conductivity, bulk density, soil dispersion etc. has been observed (Joshi et al., 1994).

Green manuring for improving chemical health of soil

- It helps in recycling of nutrients from the deeper layers of soil due to deep root system
- It increases the organic carbon in soil as it decomposes faster due to low C: N ratio.
- It increases the availability of several mineral elements by releasing the organic acids due to decomposition like Phosphorus, calcium, potassium, magnesium and iron.
- It increases the Cation Exchange Capacity (CEC) of the soil.

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Green manuring for improving biological health of soil

- Incorporation of green manure favours the growth of beneficial flora and fauna in the soil.
- It stops the disease cycle of various pathogens.
- It has been reported to show allelopathic effect on several weed species.
- It helps in the control of root knot nematode.

Green manuring for reclamation of problematic soil

With the release of organic acids, green manure crops help in the reclamation of alkaline soils and saline soils.

CONCLUSION

After analysing the research work done under the thrust area of green manuring, it can be concluded that green manure is one of the important practices whose adoption should be increased, so that along with the increase in yield and productivity, soil health can also be taken care of. The practices of green manuring helps in the overall holistic care of the soil as well act as a supplement in pest management and nutrient management practices. Certainly, Green manuring can be regarded as one of the major tool for achieving sustainable crop production for the betterment of human, soil and overall environment.

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Metarhizium sp. - A biopesticide

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Rupeshkumar J. Choudhari
Assistant professor, Department of Plant Pathology
Kewalramji Harde College of agriculture, Chamorshi, Gadchiroli (MS)-442603.

INTRODUCTION: The term microbial control was first used by Steinhaus (1948). Microbial control refers to all aspect of exploitation / utilization of disease causing organisms or their products to suppress the pest population below economic damage. Biopesticides are naturally occurring substances (biochemical pesticides) that controls pests, micro-organisms that control pests (Microbial pesticides) and pesticidal substances produced by plants containing added genetic material, plant-incorporated Protestants. Biopesticides, key components of IPM programmes.

Biopesticides fall into three major classes

Microbial pesticides may consist of the organisms themselves and / or the metabolites they produce. Microbial pesticides are generally divided into 3 different categories products: Bacteria, Fungi, viruses.

- Plant incorporated protestants (PIPs) have genetic material from other species incorporated into their genetic material (i.e. GM crops) Biochemical pesticides are naturally occurring substances that controls pests by nontoxic mechanisms.
- First pathogen found to cause disease in insects were fungi.
- The diseases caused by fungi are turned as mycoses. Le Conte (1873) firstly advocated the use of disease as a means of insect control.
- The microorganisms found suitable for insect control are: Bacteria, Viruses, Rickettsiae, Protozoa, Nematodes and Fungi.
  These placed into two groups :-
  - Ingested microbes (Bacteria, Viruses, Rickettsiae and Protozoa) which enter insect body along with food (and are linked to stomach insecticides).
  - Penetrating microbes (Nematodes and Fungi) that enter by penetrating the integuments (and are linked to contact insecticides). (Shrivastawa K. P. and G. S. Dhaliwal. 2010).

Microbial Control Agents (MCA)

Examples (Kachhawa D., 2017).

Bacteria:- *Bacillus thuringiensis*, *B. popilliae*
Viruses:- *Nuclear polyhedrosis virus*
Fungi:- *Metarhizium spp, Beauveria bassiana, Verticillium lecanii, Trichoderma spp.*
Protozoa:- *Nosema bombycis*
Nematodes:- *Steinernema* spp, *Phasmarhabditis hermaphrodita*

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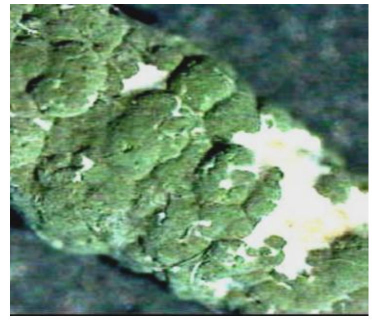
Classification of *Metarhizium*

Kingdom: Fungi
Division: Eumycota
Sub-division: Ascomycota
Class: Pyrenomycetes
Order: Hypocreales
Family: Nectriaceae
Genus: Metarhizium

Metarhizium anisopliae **(Metschnikoff) Sorokin**



Important species of *Metarhizium* are

Metarhizium majus :- Virulent against scarabaeidae, a family beetle. Large spores (typically2.5-4 micro mm x 10-14 micro mm long) e.g. Coconut and oil palms beetle pests.

Metarhizium acridum :- Virulent and specific to Acrididea. Mostly infects Grasshoppers. e.g. Locust and Grasshoppers.

Metarhizium flavoviride:- Virulent against Hemiptera and some Coleopteran. Spores are light gray-green and oval shaped (approx. 7-11 cm long). Difficult to mass produce, so less commercial activity than with other *Metarhizium spp.*

Species of Metarhizium:

Metarhizium anisopliae includes many isolates previously described as *Metarhizium anisopliae* var. *anisopliae.* Previously in *M anisopliae*: *Metarhizium guizhouense* (syn. *M. taii*) *Metarhizium pingshaense* , *Metarhizium acridum* (*M. anisopliae* var. *acridum*), *Metarhizium lepidiotae* (*M. anisopliae* var.*lepidiotae*), *Metarhizium majus* (*M. anisopliae* var. *major*) , *Metarhizium globosum* , *Metarhizium robertsii* , *Metarhizium brunneum.*

Biology of Entomopathogenic fungi

- Infection Starts with conidia getting in contact with insect cuticle they germinate and produce penetration structures -Germ-tube, Appressorium
- Host death
  Depletion of nutrients
  Physical obstruction or
  Invasion of organs and toxinosis (Destruxins...)
- Hyphae emerge from the cadaver Sporulation occurs on the host surface

1st Major Targets

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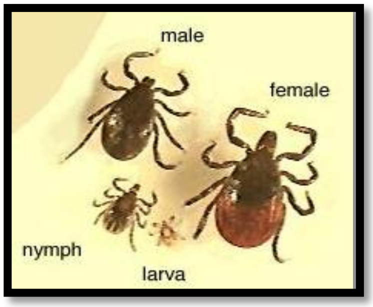
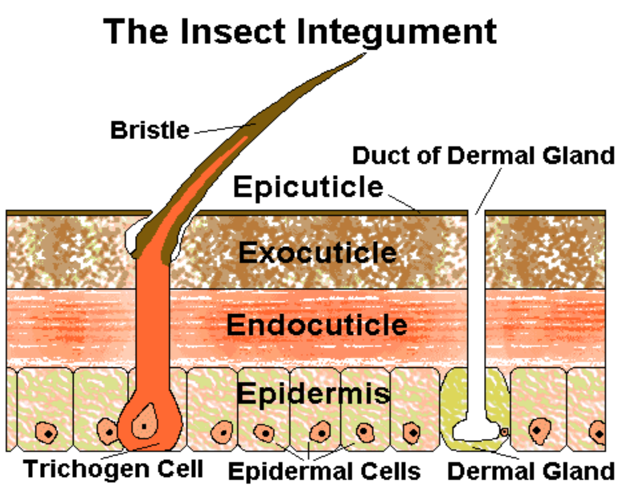


Mode of Action

- *Metarhizium spp* generally enters insects though racles and spores.
- Infection unit in most is a spore, usually a conidium.
- After germination of conidium gives short germ tube i.e. appressorium.
- Appresorium attaches itself to the cuticle and sends out an infection peg.
- By enzymatic dissolution of chitin and protein, hyphae then penetrate the layers of the integument.
- Remify first in the cuticle and then reach the haemocoel and internal organ
- The fungus enters the egg shell, cuticle, tarsi, mouth parts, anus etc.
- Prior to death toxins (destruxins) appear to play a part in helping the fungus.
- After consuming internal contents, the fungus breaks through the cuticle and sporulates.
- Mortality occurs in 2-3 days.
- Inhibt to all stage of insect and cadaver's cuticle becomes red. In high humidity, a white mold grows on the cadaver, which turns green as spores are produced



- **Microbial Count:** CFU of *Metarrhizium anisopliae* 1 X10^8.
- **Crop:** Fruit, vegetables, cotton, sugarcane, forest, ornamental, and plantation crops.
- **Target Pests:** Caterpillars, Semiloopers, Grubs, Cut worms and sucking insect Aphids, Pyrilla, BPH and Mealybugs on all field.

- **Mass production:** On large scale in semi-solid fermentation. Fungal spores can also be grown on sterilized rice in plastic bags for small-scale production.
- **Packing:-** Regular packing available – 1 kg.
- **Shelf life:-** Minimum 6 months, store in well ventilated cool & dry place at temperature below 40^0 C.

Dosage & Direction:

Foliar Application:

1. Mix pH store at the rate 10 gm in lit of water with the required quantity of water or mix 1 kg is 120 lit of water and spray evenly on the foliage. Also drench the soil near root zone of the plant.
2. The first spray can be done around the 30th day after sowing or planting. The spray can be once 15 to 30 days depending upon the pest population.

Soil application:

1) Mix 3 kg of phytometa with organic manure or Farm Yard Manure or vermicompost (250 kg to 500 kg) for 1 acre.
2) After mixing, leave the mix in a heap at covered dry and cool place for 24 hours and this soil application done at least 3 days before sowing or planting.
3) Soil application can be repeated once in 90 days.

Precautions:

- Store product in dry place at room temperature.
- Avoid direct sunlight.
- Avoid extreme temperature condition.
- Do not mix with chemical fertilizers or fungicides or insecticides.
- Keep the interval of 10 to 15 days between the application of chemical products and Biopesticides.

Advantages of Bio-pesticide:

- Do not leave harmful residues.
- Substantially reduced impact on non-target spp.
- When locally produced, may be cheaper than chemical pesticide.
- In the long term may be more effective than chemical pesticides.
- Suitable alternative to the use of chemical pesticides.
- Effectively controls pests than non-conventional chemical pesticides.
- Promote the growth of natural enemies of pests.

Disadvantages of Bio-pesticide:

- High specificity.
- Slow speed of action.
- Variable efficacy due to the influence of various biotic and abiotic factors.
- Living organisms evolve and increase their resistance to biological, chemical, physical or any other form of control.

Successful examples:

- Bioblast (commercial biopesticide) of *M. anisopliae* that is used to control termites such as *Reticulitermes* spp.
- *Metarhizium anisopliae* is highly pathogenicand used for management of ticks and Lyme disease.

- *Metarhizium anisopliae* var. *acridum* fungus highly specific to grasshopper & locusts.
- Control of Cockchafer in Australian pastures with *Metarhizium anisopliae*

CONCLUSION

- Conidial ascomycete, asexual reproduction.
- Cosmopolitan distribution.
- Wide host range, with strains and varieties specializing on different groups.
- Successfully against White grub, Locusts, Beetle grubs Japanese beetle, Red palm weevil, Root weevil, Black wine spittle bug and termites.
- Under development as a commercial product.
- Broad spectrum bio-pesticides and Non-toxic to mammals.
- Dose not leaves residual effect.

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Soil Heavy metal pollution and soil ecology: A Review

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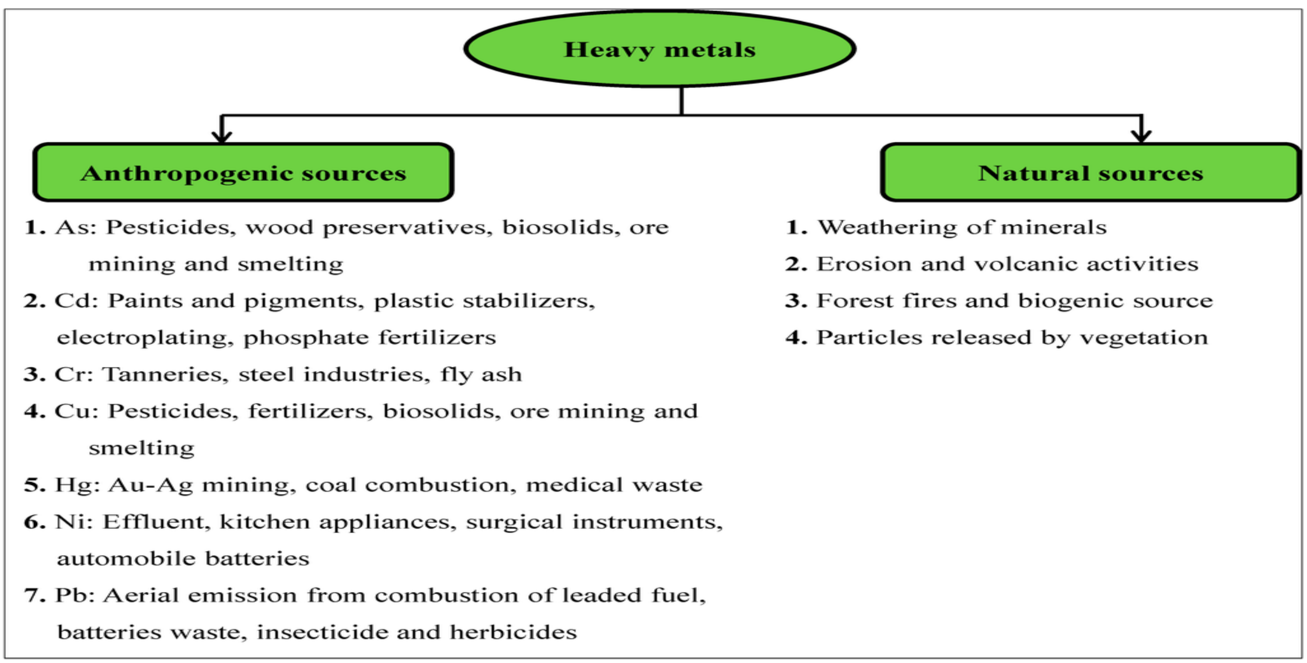
Kamlesh Yadav[1] and Govind Kumar Yadav[2]
[1]Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur-313001
[2]*Ph.D.* Scholar, Department of Soil Science and Agricultural Chemistry, Sri Karan Narendra Agricultural University, Jobner-303328

INTRODUCTION

Farmers are using higher doses of inputs like fertilizers, pesticides and insecticides to get higher production and profit but they are unaware about losses of cost and biological fertility (microbial activity) of their soils. The functioning of the soil as a vital system and the support on its biological productivity depends to a higher extent on the soil microflora activity. The microbial population of the soil depends on various factors such as chemical and physical environment surrounding rhizosphere environment. heavy metal contamination could influence conversion or mineralization of various nutrients *viz*, P, S, Zn, Fe, Cu and Mn of the soil. The changes in soil microbial equilibrium can serve as an "early warning" for negative alterations in the soil conditions long before they could be detected by soil pollution.

Main heavy metals and Sources in rhizosphere soil: -



Effect of heavy metals on soil Ecology: There is number of microbial factors which are influenced by heavy metals

1. **Decrease in microbial respiration rate**: - According to Shi and Ma (2017) there is continuous decrease in microbial activity have been observed due to of heavy metal contaminated of soil which is indicated by reduction

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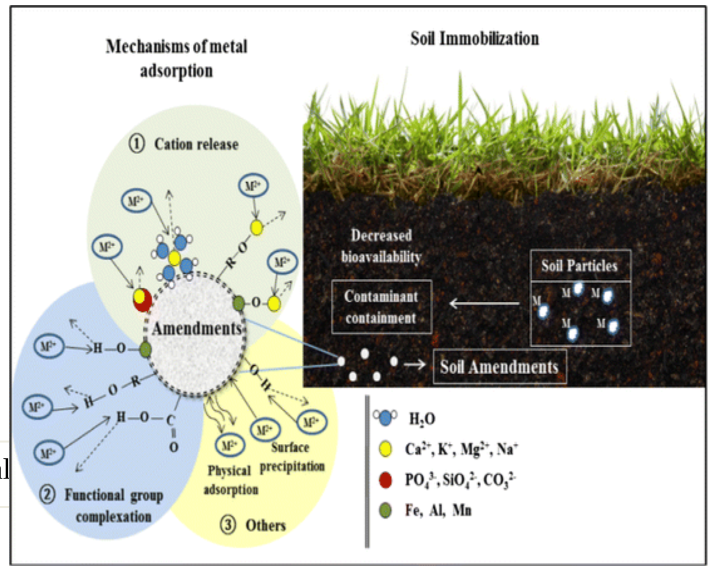
in respiration rate which dependent on the type of the soil. He also reported that toxicity of heavy metals decreased due to microbial complexing with heavy metals. The decrease in respiration rate take place when concentration increase above a certain level.

2. **Decrease in enzymatic activity:** - There is continuous decrease in various enzymatic activities *viz;* catalase, soil urease, amylase which indicates the lower mineralization of nutrients in soil and lower microbial growth.
3. **Low soil organic carbon, total N, C/N ratio and DNA:** - Chen *et al,* (2013) reported a decline in soil organic matter total N and C/ N ratio due to lower microbial activity in the rhizosphere zone.
4. Lower biomass carbon, fungal and bacterial population in contaminated soil was observed by Chen *et al,* (2013).

Remedial measure of heavy metals in soil - Here some remedial technologies has been giving which are economically suitable for farmers

1. **Excavation: -** Excavation and physical removal of the soil is perhaps the oldest remediation method for contaminated soil.
2. **Stabilizing Metals in the Soil: -** This consists of adding chemicals like phosphate fertilizer to the soil that cause the formation of minerals (pyromorphite) that contain the heavy metals (lead in case in of Phosphate fertilization) a form that is not easily absorbed by plants, animals, or people. This method is called in situ (in place) fixation or stabilization (Lambert *et al*., 1997).
3. **Phytoremediation or Use of Plants Growing plants**: - It has the advantage of relatively low cost and wide public acceptance. It can be less than a quarter of the cost of excavation or in situ fixation. Phytoremediation has the disadvantage of taking longer to accomplish than other treatment. Plants can be used in different ways. Sometimes a contaminated site is simply revegetated in a process called Phyto stabilization.

Metal



4. **Phytoextraction**: - Some of the plant species like Indian mustard can take up heavy metals and concentrate them in their tissue thus contaminated plant material disposed of safely. Sometimes soil amendments are added to the soil to increase the ability of the plants to take up the heavy metals.
5. **Rhizofiltration**: - In this method, heavy metals are removed directly from water by plant roots. The plants are grown directly in water or in water rich materials such as sand, using aquatic species or hydroponic methods. In field tests sunflowers on floating rafts have removed radioactive metals from water in ponds.
6. **Use of organic inputs-** use of more organic or renewable sources also reduces the heavy metals in the soil.

CONCLUSION: - The soil pollution caused by heavy use of synthetic fertilizers and chemicals is unconcerned by the most of the farmers which restrict the biological ecology of the soil and farmers production after use of all inputs. Therefore, awareness about disadvantage of heavy use of these inputs should be spread among farmers will give better and long term yield benefits over current system of farming.

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Minimum Tillage Technology for Conservation Agriculture

Article id: 23541

Neha Singhal
Ph.D. Scholar, ICAR- Indian Agricultural Research Institute, New Delhi

INTRODUCTION

Conservation agriculture is the practice of cultivation of crops to conserve natural resources like water, soil as well as labor and energy. In World, Conservation agriculture was started in the 1930s. Brazil, America and Australia are the top practitioners of conservation agriculture. India practices conservation agriculture on 3 million hectares of land.

Tillage is an important component of agricultural practices. Tillage is the practice of disturbing soil for the cultivation of crops with the help of some tilling equipment. Different machines are being developed and used for ploughing, field preparation for interculture and harvesting stages in the field. Ploughs as mouldboard plough, disc plough, harrow, disc harrow, rotavator, sowing machines as seed drill, fertilizer cum seed drill, transplanter, harvester, thresher etc. are generally used equipments. Some of these machines in combination with some other machine can be used for conservation agriculture.

Conservation agriculture is based on three principles:
1. Minimum soil disturbance
2. Soil coverage with organic biomass
3. Crop diversification

Minimum tillage/ soil disturbance

Minimum tillage is one of the principles of conservation agriculture. For this, the soil surface should not be disturbed by more than 30%. There are two methods for this- Zero Tillage or no-tillage and Reduced tillage. In zero tillage, negligible or no disturbance of soil takes place while strip tillage is practised in reduced tillage practice.

Need for Minimum tillage technology in India

1. India has around 10 million-hectare of land under the Rice-Wheat system. But rice planting is mainly dependent on rain in our country and later wheat is sown. Due to dependency on rain, the rice plantation usually gets delayed. After harvesting rice, wheat is sown and normally it takes 20-25 days for land preparation. This period needs to be shortened.
2. Farmers' expenses are increasing because of maximum tillage.
3. Phalaris minor in wheat has become a big problem.

Machines used for minimum tillage

1. **Zero tillage seed drill:** this is the most commonly used machine in India. In this machine, a seeding mechanism is provided with a hopper. Tynes attached with furrow openers in various configurations are used to dig in the field. The machine is operated with tractor in the field. Ground clearance is maintained with the aid of ground wheel. This machine can be used in various crops including wheat, maize etc.
2. **Zero-tillage multi-crop planters:** These machines can sow more than one crop simultaneously without disturbing the soil. Here more than one hopper and seeding or planting mechanisms are installed. These are most widely used for intercropping practices.

3. **Strip tillage machine:** This machine is ideal for reduced tillage practices. It combines the soil drying and warming benefits of conventional tillage with no-till. In this, only the portion of field containing row of seeds is disturbed.

Depending on the location and the type of power required, the zero-tillage technology has been improvised accordingly. Two-wheel tractor operated zero tillage, Happy seeder and Super seeder etc. are other machines which are widely used for conservation agriculture.

Benefits of minimum tillage

- Sowing of wheat on the same day of rice harvesting is possible
- Sowing in the field with paddy stubble is possible
- Land preparation and sowing both are possible in one operation
- Shortens the planting duration by 15-20 days
- Time, labour and energy saving
- Reduction in weed problem
- Increases 15- 20% of wheat yield
- Saving of irrigation water
- Improvement in farm water productivity
- Reduction in the overall cost of production

Minimum tillage technique can be used in all crops, cropping systems and location. It is suitable for all cropping systems like Rice- Wheat, Rice- Maize, Maize- Wheat, Rice- Pulses, Cereal- Pulses etc. This can also be used in other crops like cereals, legumes, oilseeds, even tuber crops and vegetables.

Limitations

- Need to modify the machine as per the choice of crop
- Seeding mechanism needs to be fitted according to the crop
- Can be used for sowing operation only
- Not suitable for crop rotation of tuber crops
- Location specific, requires proper adjustments according to location, crop, soil type and environment

CONCLUSION

To achieve sustainable development, the management of resources is the most important concern. Indian farming is rainfall dependent system which is erratic and gets delayed generally. This causes a time gap between consecutive crops. Minimum technology prevents this loss of time as well as fuel, energy, manpower and water. This is also helpful in improving overall production and productivity in various cropping systems.

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SYNTHETIC SEEDS: A novel way of seed production

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Soumya Kumar Sahoo[1], Selukash Parida[2] And Akankhya Guru[3]
[1]Department of Plant Physiology, COA, Indira Gandhi Krishi Vishwavidyalaya, Raipur
[2]Department of Plant Physiology, COA, Odisha University of Agriculture & Technology, Bhubaneswar
[3]Department of Plant Physiology, IAS, Banaras Hindu University, Varanasi

Synthetic seed: Synthetic seeds are artificially encapsulated somatic embryos, shoot buds, cell aggregates, or some other tissue that enclosed in an artificial medium that supplies nutrients. This type of seeds can be used for sowing and that has ability to convert into a plant under *in vitro* or *ex vitro* conditions and that retain this potential also after storage. Kitto and Janick in 1982 produced first synthetic seeds by using carrot somatic embryos.

Why synthetic seeds?

In many horticultural crops seeds propagation is not successful due to;
- Heterozygosity of seeds particularly in cross pollinated crops.
- Minute seed size (eg: orchids).
- Presence of reduced endosperm.
- Some seeds require mycorrhizal fungi association for germination (eg: orchids).
- No seeds are formed.

In these crop species, vegetative means like micro propagation and clonal propagation is best suited option.

Characteristics of synthetic seeds

1. High volume. Large scale propagation method.
2. Maintains genetic uniformity of plants.
3. Propagules directly used in the field, thus eliminating transplants.
4. Cost per plantlet is less.
5. Rapid multiplication of plants.

Advantages of synthetic seeds over somatic embryos for propagation

1. Ease of handling while in storage.
2. Easy to transport.
3. It can be stored for long period without losing viability.
4. Maintains the clonal capacity of the resulting plants.
5. Serves as a channel for new plant lines produced through biotechnological advances to be delivered directly to the green house or field.
6. Allows economical mass propagation of elite plant varieties.

Types of synthetic seeds

According to established technology, two types of synthetic seeds are known:

1) Desiccated*:* The desiccated synthetic seeds are produced from somatic embryos either naked or encapsulated in polyoxyethylene glycol (Polyoxr) followed by their desiccation slowly over a period of one or two weeks. Such types of synthetic seeds are produced only in plant species whose somatic embryos are desiccation tolerant.

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2) Hydrated: The hydrated synthetic seeds are produced in those plant species where the somatic embryos are recalcitrant and sensitive to desiccation. Hydrated synthetic seeds are produced by encapsulating the somatic embryos in hydrogel capsules (sodium alginate-MS liquid media).

Procedure for synthetic seed production:
The somatic embryos for synthetic seeds are produced in the lab through culturing of somatic cells and treating with different hormones to produce root and shoot. The following are the different steps involved in artificial seeds production;

1) Establish somatic embryogenesis
2) Mature somatic embryos
3) Synchronize and singulate somatic embryos
4) Mass production of embryos
5) Encapsulation of matured somatic embryos
6) Desiccation
7) Field planting

Pre-treatment of somatic embryos
Obtain somatic embryos by in vitro morphogenesis. Transfer somatic embryos to basal liquid medium with 10% sucrose and 1mg/L of abscisic acid. Incubate on rotary shaker at 90rpm in dark at 25-29°C. Allow somatic embryos to harden for 20 days. This treatment stops their precocious germination and often leads to their separation. Harvest somatic embryos aseptically by filtration/decantation and use them for encapsulation. Synthetic seeds from non-pretreated somatic embryos may be store for about 6 weeks at 4°C and synthetic seed of pretreated somatic embryos can be stored for 4 months at 4°C. Synthetic seed can be cultured /maintained in liquid MS medium on rotary shaker and germinated on gelled media, incubated at standard conditions. Similarly, the lateral buds can also be pretreated and encapsulated.

Self-breaking Synthetic seeds
This was developed for carrot embryos (Onishi *et.al* .,1994).

1. Best quality somatic embryos were encapsulated in sodium alginate as explained earlier.
2. Rinse synthetic seeds to remove excess of calcium ions with water
3. Dip synthetic seeds in 200μM KNO3 solution for 60 minutes. Here K+ ions will partially substitute for Ca++ ions with tap water for 40 minutes, observe slight swelling o beads.
4. Sow seed in low salt medium (3/4 strength to ½ strength basal salts leading to low conductivity conditions. Here, beads will further break open exposing the somatic embryos.

Somatic embryos:
Somatic embryos are bipolar structure with both apical and basal meristematic regions which are capable of forming shoot and root, respectively.

Somatic embryogenesis is the development of embryos form vegetative cells with in vitro systems. Specific tissues have a capacity for somatic embryogenesis in cultural systems. This allows the clonal propagation of normally seed-propagated crops analogous to the production of apomictic seedlings. Somatic embryos develop through stages similar to zygotic embryos, however, the final size for the cotyledons are usually reduced and there is no development of endosperm or seed coat.

Procedure of somatic embryogeneis:

1) Surface sterilization was carried out to petiole explants plants and cultured on SH medium (Schenk and Hildebrandt, 1972) containing 2,4-D, kinetin and many other nutrients. 2,4-D activates the cell cycle of many cells in the petiole - those in the vascular cambium develop into a callus, whereas some sub-epidermal cells develop into a somatic embryo.

2) The initial somatic embryos (small dense cell clusters stage), are embedded in a callus mass of non-differentiated cells.

3) To release these proembryonic structures, and to stimulate the formation of more embryos, the callus is dispersed in a liquid medium to form a suspension culture containing 2,4-D but not kinetin.

4) After 7 days, the sieved suspension is transferred to solid medium lacking 2,4-D. On this medium the embryos develop through morphological stages that appear to be globular, heart and torpedo.

5) **Maturation Phase I:** When the majority of embryos reach the torpedo stage (7-10 days after sieving) they are transferred to an enriched medium containing a high level of sucrose, nitrogen and sulphur to prevent precocious germination and to enable deposition of storage reserves. The embryos rapidly accumulate to 1-2 mg dry weight per embryo.

6) Maturation Phase II: To develop desiccation tolerance, the somatic embryos are placed on a modified medium containing abscisic acid (ABA) for 3 days; afterwards they are removed from the medium, washed to remove sugar and other nutrients, and dried.

7) The standard method of drying is to place the somatic embryos in a sealed chamber over a saturated salt solution designed to give specific relative humidifies. For a period of one week, the embryos are transferred progressively to a lower relative humidity chamber and finally dried at ambient conditions. At this stage, the embryos have reached approximately 15% moisture and can be stored for a year or more with good viability.

Encapsulation of matured somatic embryos:

Somatic embryos produced naked embryos which lack of storage materials and protective layer (seed coat). The somatic embryos produced are encapsulated using gel agents like agar, alginate, polyco, carboxy methyl cellulose, guar gum, sodium pectate etc. Among all of these, alginate encapsulation was found to be more suitable and practicable. Alginate hydrogel is very commonly used as a matrix for synthetic seed because of its moderate viscosity and low spinnability of solution, low toxicity for somatic embryos and quick gellation, low cost and bio-compatibility characteristics. Alginate plays crucial role in capsule formation and also the rigidity formed due to alginate beads provides better protection to the encased somatic embryos against mechanical injury.

The somatic embryos are mixed with sodium alginate (2%) and the suspension is dropped into the calcium salts solution (200mM). The principle is that, when sodium alginate dropped into the calcium salt solutions it from round firm beads as ion exchange between Na^{+} in sodium alginate and Ca^{2+} in calcium salt solutions and finally sodium alginate form calcium alginate in 20-30 minutes.

Application of synthetic seeds

By combining the benefits of a vegetative propagation system with the capability of long-term storage along with the clonal multiplication, synthetic seeds have many diverse applications in the field of agriculture.

1) Multiplication of non-seed producing plants, ornamental hybrids or polyploidy plants
2) Hybrid seeds can be successfully produced by propagating male or female sterile plants.
3) Germplasm of recalcitrant species can be conserved successfully.
4) Transgenic plants should be multiply rapidly.

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Limitations:

1. Limitation in the production of viable micropropagules, those are useful in synthetic seed production.
2. Improper somatic embryos maturation those are inefficient for germination and conversion in to normal plants.
3. Absence of dormancy and stress tolerance in somatic embryos that limit the storage of synthetic seeds.
4. Somaclonal variations which may alter the genetic constituent of the embryos.

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Linseed: A unique oilseed crop

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Gayatri Verma, Arvinder Kaur Toor and Charanjeet Kaur
Soil Chemist, Regional Research Station, Gurdaspur, PAU, Ludhiana
Plant Breeder, Regional Research Station, Gurdaspur, PAU, Ludhiana
Agronomist, Regional Research Station, Gurdaspur, PAU, Ludhiana

Importance of Linseed

Linseed (*Linum usitatissimum* L.) is an ancient and multipurpose crop cultivated for seed, fibre oil and nutraceutical properties. Linseed belongs to the genus *Linum* which is believed to be originated in either the Middle East or Indian regions and spread throughout Asia and Europe and later into the New World (Dash *et al* 2017). Importance of Linseed is unique among oilseeds for its technical grade vegetable oil producing ability and fibre (good quality having high strength and durability) production. Linseed oil is rich in omega-3 fatty acid and alpha-linoleic acid which is beneficial for heart disease, inflammatory bowel disease, arthritis and a variety of other health conditions. Its oil cake is used to feed milch animals for milk and meat production. India is the sixth largest producer in the world with contribution to global linseed area and production 13 % and 5.5 %, respectively. The major linseed growing states are Madhya Pradesh, Himachal Pradesh, Chhattisgarh, Uttar Pradesh, Maharashtra, Bihar, Odisha, Jharkhand, Karnataka and Assam.

Botanical Description

- It is an erect annual plant growing to 120 cm tall with slender stems.
- The root system is usually shallow. The main tap root is slender and having numerous small lateral roots that develop in the top 30 cm soil. Stems are narrow and may branch from the base. Seed varieties possess more branches than flax.
- The leaves are narrow and short, alternate on the stem and sessile. The leaves are linear to lanceolate and blunt at the apex.
- The inflorescence consists of a terminal panicle that bears numerous flowers. Flowers are usually white or blue, complete and perfect with 5 petals, 5 sepals and fine stamens.
- The seeds are flat, shiny and relatively small. The seed colour ranges from white to shining yellow or light brown.

Improved varieties

To harvest the maximum potential, it is important to select a suitable variety for a particular region. Flax/linseed is a diploid (2n=30) and primarily a self-pollinating crop plant. Genetic diversity within the crop is low and cannot be readily supplemented by intraspecific hybridization. Methods of hybrid seed production have not been developed.. Different breeding programs use different breeding methods for the development of improved cultivars. Conventional breeding methods include pure-line method, pedigree method, bulk method, single seed descent backcross breeding, mutation breeding and use of genetic markers in flax breeding.

Table 1: General description and features of some linseed varieties

Variety	Duration of maturation	Average Yield (kg/ha)	Oil content (%)	Recommended States
LC-2063 (I)	158	1200(I)	38.4	Area of Punjab state
LC-2023 (I)	158(R),163(I)	1100	37.4	Area of Punjab state
Sheela	155-160	1379 (R)	41.0	HP, Punjab, Haryana and J&K

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Suyog (SLS-27)	118-125	1509 (I)	41.4	Rajasthan, UP, MP, Maharashtra, Chattisgarh, Orissa, AP & Karnataka
Binwa (KL-210)	179-186	858 (I)	40.0	Haryana, Punjab, HP and J&K.
Kartika (RLC-76)	103-108	1078 (R)	42.9	Rainfed areas of Chattisgarh
Baner (KL-224)	171-203	511(U)	39.7	Haryana, Punjab, HP and J&K
Pratap Alsi-1 (RLU-6)	129-135	1997(I) 834 (R)	41.1	Rajasthan Kota Command area
Azad Alsi-1 (LMS 9-2 K)	125-130	1610 (I)	39.9	Bundelkhand of UP, MP & Rajasthan
RLC-92	111	1196 (I)	37.7	CG, MH, Orrisa & Karnataka
Himani (KL-214)	177-200	583 (U)	36.4	HP, J&K, Haryana & Punjab
PKV NL-260	102-106	963 (R)	37.7	Maharashtra
Shival (SLS-67)	108-110	1252 (R)	40.2	Bundelkhand of UP, MP & Rajasthan
Pratap Alsi-2 (RL-26016)	129-135	1957 (I)	42.0	Rajasthan
Kota Barani Alsi-4 (RL-10193)	120-126	1100 (R)	40.4	UP, MP& Rajasthan
Divya (BAU-0603)	170-180	1540 (I)	40.2	Punjab, Haryana, HP and J&K

* (I- Irrigated; R- Rainfed; U-Utera; MR- Moderately resistant) Kaur *et al* 2019

Climatic Requirement

- Linseed is a cool season crop. Moderate temperatures (21-26°C) are ideal for the vegetative development of the crop.
- Temperature above 32°C accompanied with drought during the flowering stage reduces the seed yield, oil content in seed and also the quality of the oil. Frost at the time of flowering is harmful to the crop.
- The crop is well suited to tracts of low rainfall and is generally raised where the average annual rainfall ranges from 45 to 75 cm.

Cultivation Practices

Land Preparation

- Linseed can be profitably raised in places where the other crops may fail.
- It is often grown on marginal and sub-marginal rainfed soils as pure crop, mixed crop, intercrop and paira or utera crop.
- Land should be ploughed 2-3 times followed by 2-3 harrowings to bring a fine tilth and well pulverized seed bed.
- The weed and crop residues should be removed to get weed and stubble free seed bed.

Sowing time

The sowing time of linseed varies from October to 15 November in different states depending on the availability of irrigation/moisture conditions. Sowing can be delayed by a week under irrigated conditions.

Method of Sowing

Linseed is sown by drilling or sometimes by broadcasting in the standing rice crop. The system of sowing linseed by broadcasting in standing rice crop is called as paira or utera cropping. A row spacing of 20-30 cm and plant to plant spacing of 7-10 cm is ideal to get higher production. The normal seed rate of 20-30kg/ha in case of line sowing and 35-40kg/ha in case of broadcasting is required.

Soil requirement

- Linseed can be grown on different types of soils except sandy and heavy clay. Heavy-textured soils with good water-retention capacity should be preferred. It also grows best in water retentive alluvial and deep black soils with good drainage.
- It is exhaustive crop and soil become linseed sick, if crop is grown on same field year after year.
- To conserve moisture, it is advisable to create soil mulch with the help of a hoe after each good shower.

Manures and Fertilizers

Application of 8-10 tonnes of farmyard manure (FYM) at the time of final field preparation is beneficial. Its application improves the porosity and structure of the soil and makes it less sticky. It also provides micronutrients. Oilseed flax responds well to moderate nitrogen application. Application of 60kg N/ha and 40 kg P_2O_5/ha is recommended for linseed at sowing. Excess nitrogen application stimulates vegetative growth and increases disease susceptibility and lodging. Once lodged, fiber flax is extremely difficult to harvest. For obtaining higher yields, application of right quantity of nutrients, choice of right sources of fertilizers to supply the required nutrients and application at right time by adopting proper methods should be followed.

Cropping systems

- Linseed is a component of various sequential and intercropping systems. It is usually grown in rotation with hybrid maize, sorghum, pearlmillet, soybean, groundnut, cowpea etc.
- Higher monetary returns can be realized if linseed is grown as a pure crop instead of a mixed or intercrop.
- Piara or utera cropping system is also followed for efficient use of residual moisture in rice fields, where tillage is a problem. In this practice, linseed is broadcast in the standing rice fields when the rice crop is between flowering and dough stages.
- Crack system of sowing: It is a new method, which can be followed in areas where sufficient water is available. In this method 5 cm deep cracks are allowed to develop in the field, when the rice crop is at the boot-leaf or panicle formation stage and the field is irrigated. After keeping the water standing for 5-7 days, the normal practice of utera is followed. This method has been found to give 50-100% more yields and has no adverse effect on rice yields.

Water management

Linseed is a crop of rainfed areas. However, it responds well to irrigation.

- Branching, flowering and capsule formation stages are critical for irrigation. Two irrigations are sufficient to obtain good yields.
- First irrigation should be applied 30-40 days after sowing and the second just before flowering. However, 3 irrigations (35, 55 and 75 days after sowing) have proved very effective.

Weed Control

Weed management is important in linseed crop. Initially crop suffers from a severe weed competition and the crop growth is suppressed which reduces the yield. It is essential to do hand weeding 21 days after sowing and second after 35-40 days of sowing.

Harvesting and threshing

The crop should be harvested when the leaves are dry, capsules when turned brown and seeds become shiny. In the month of April crop is ready to harvest.

CONCLUSION

Linseed is the multipurpose crop grown since pre-historic times for its nutritive value and health benefits. Use of improved production technologies can play an important role in achieving higher yield of linseed.

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Panchagavya: An eco-friendly growth promoter with insecticidal properties in organic farming

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Shalendra Pratap Singh
Research Scholar, Department of Entomology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (UP) India.

anchagavya is an organic material prepare by mixing of five product of cow like- Cow dung, cow milk, curd, cow ghee and cow urine. These all component mix together and applied to the organic farming which helps in better growth of plant and protect against insect pest of various crops. The component of *panchagavya* like cow dung and cow urine helps in reducing the insect population. Chemical insecticides are hazardous to animals can replaced by using *panchagavya* in organic farming.

INTRODUCTION:

Organic agriculture is a comprehensive management system which promotes and enhances health of agro ecosystem, environment and biodiversity and soil biology of cultivated as well as non-cultivated land Raghavendra et al. (2014a). *Panchagavya* is an organic product prepared by using five product of cow viz- Cow dung, cow ghee, cow milk, cow curd and cow urine including certain other product which helps in growth, development and crop protection against insect and pests of plants. *Panchagavya* as such or after addition of *neem* leaves become an excellent bio pesticide. These types of bio pesticides are not harmful to environment and animals but useful against insect pest by reducing their increasing population.

1.1 - Preparation method of *panchagavya*

Panchagavya is prepared by using five product (Cow dung, cow ghee, cow curd, cow milk and cow urine) of cow and mixing them in a fix ratio. There is a technique which helps to prepare *panachgavya* at farmer field.

1.2 - Ingredients used for preparation of *panchagavya* are as follows:

- ✓ Fresh cow dung - 10 kg
- ✓ Cow urine - 10 litre
- ✓ Cow milk - 2 litre
- ✓ Cow curd - 2 litre
- ✓ Cow ghee - 1 kg
- ✓ Sugarcane juice - 3 litre or jeggery 200 gm or coconut water 3 litre
- ✓ Ripened banana - 12 numbers
- ✓ Yeast - 100 gm

Sugarcane juice and coconut water are used to accelerate the fermentation which also help in minimizing the bad odour. Ajay Alias Mangtu Ram (2017)

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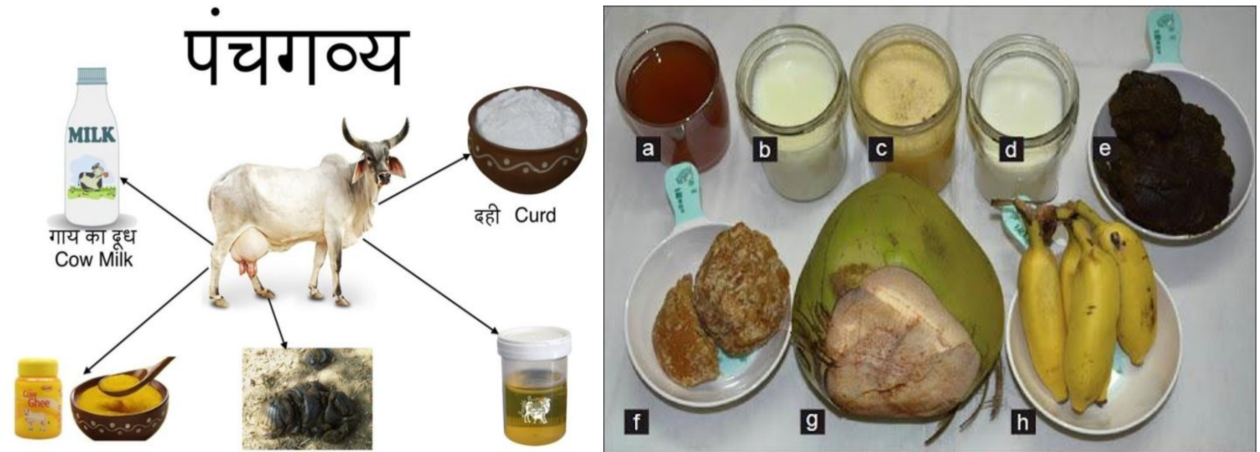

a- Cow urine, b-Cow's, milk, c-Ghee prepared from cow's milk, d-Curd prepared from cow's milk, e- Cow-dung, f-Jaggery, g-Tender coconut and h-Banana

Fig - Products of cow used in *panchagavya* preparation.

1.3 - Method of Preparation of *panchagavya* for soil application:

Ingredients used for preparation of *panchagavya* are Cow dung (7 kg) and Cow *ghee* (1kg) mix well and incubate for two days, after incubation add cow urine (3 litre) and 10 litre of water, stir properly in morning and evening hour for one week. After one week add sugarcane juice (3 litre) or jegerry (200 gm) or coconut water (3 litre), cow milk (2 litre), cow curd (2 litre), yeast (100 gm) and ripened banana (12). All the above materials are mixed thoroughly in a plastic bucket. The container is keep open under shade for two weeks and then the preparation should be filtered through double layered muslin cloth and stored in plastic bottles under dry and shade condition. At that place where direct sunlight is not occurring and use when require for spray.

2. - Properties of *panchagavya:*

Panchagavya contains several nutrients i.e. macronutrients, micronutrients, amino acids, vitamins, growth regulators like Auxins, Gibberellins and also beneficial microorganisms like pseudomonas, azatobacter and phosphorus bacteria etc. Raghavendra et al. (2014b)

It is a mixed culture of naturally occurring, beneficial microbes' mostly lactic acid bacteria (Lactobacillus), yeast (*Saccharomyces*), actinomyces (*Streptomyces*), photosynthetic bacteria (*Rhodopsuedomonas*) and certain fungi (*Aspergillus*) which promotes the growth and yield in different crops and provides high B:C ratio. So, *panchagavya* can be an effective organic growth-promoter for small and marginal farmers. Shailaja et al. (2014)

3 - Schedule for application of *Panchagavya:*

- First spray of *panchagavya* at 15 days after germination of crop
- Second spray at pre flowering stage of crop
- Third spray after fruit or pod formation

4 - Recommended doses/ methods of *panchagavya* application

4.1- Flow System: it can be used with irrigation water at 48-52 litre per hectare or by droping through drip irrigation.

4.2 - Seed or seedling treatment: seed or seedlings can be treated by dipping in *panchagavya* at 3% solution for 30 minutes.

4.3 - Spray method: For spraying, 3% solution of *panchagavya* is best suitable for proper growth of plants. Three litre of *panchgavya* is sufficient for 100 litre of water for spraying in the field crops.

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5 - Effect of *panchagavya* on soil fertility and productivity

- It improves fertility status increase by beneficial microorganisms.
- It improves water holding capacity of soils because it acts as organic manure.
- It encourages growth and reproduction of beneficial soil microorganisms
- Increases nutrient uptake in plants and enhances plant growth.

6 - Advantages of *Panchagavya*

- It increases yield and quality of produce due to increase in size and density of leaf.
- *Panchagavya* treated plant produce deeper root system which helps in up taking maximum quantity of fertilizer from the soil.
- It is used against insect and pest population because cow urine and cow dung work as insect repellent. Its insecticidal properties can be increased by using botanical bio pesticides from different plants.
- It improves soil health and fertility because various beneficial microorganisms are present in *panchagavya.*
- It is used as growth promoter and as fertilizer in organic farming.
- *Panchagavya* improves water holding capacity after adding in the soil.
- It is an eco-friendly approach because there is no any chemical ingredient used for preparation of *panchagavya.*
- It is a low cost and high effective, farmer friendly method of crop production in organic farming.

7 - Difficulties in adopting *panchagavya:*

- Lack of knowledge about *panchagavya*
- Market availability of *panchagavya* is limited at farmer level.

CONCLUSION

In this study we conclude that the panchagavya is very cheapest, ecofriendly, farmer friendly and easily available approach at farmer field. This can be applied in organic farming as biofertilizer, biopesticide and growth regulator for proper growth and development of plants. It provide higher yield after using low cost of inputs.

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Siderophores & its importance in modern science

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Diptanu Datta[1] and Prajjal Dey[2]
[1]Ph.D. Scholar, Department of Plant Pathology, Odisha University of Agriculture and Technology, Bhubaneswar, India-751003
[2]Assistant Professor, Faculty of Agriculture, Sri Sri University, Cuttack, India-754006

INTRODUCTION

The surface iron gets oxidized to insoluble oxyhydroxide polymer and reduced the level of free iron due to aerobic nature of the planet, therefore a new path has been developed by microorganism for acquisition of iron by producing iron chelating molecule i.e. siderophore. Siderophores are low molecular weight i.e. less than 10 KD iron chelating compounds synthesized by many bacteria (*Pseudomonas, Azotobacter, Bacillus, Enterobacter, Serratia, Azospirillum*) and fungi belong to Zygomycotina (Mucorales), Ascomycotina (*Aspergilli, Penicillia, Neurospora crassa*) and Deuteromycotina (*Fusarium dimerum*), *Rhizobium* in large quantity when there is scarcity of iron .The membrane receptor molecules helps siderophore forms complex with free iron and transport it into the cell, these receptor molecules are encoded by five genes in operon which is turned off when sufficient iron has been taken into the cell (Lewin, 1984). Siderophores produced by some bacteria can be utilized by other microorganism for iron and acquisition of other metals. This property of siderophore increased their application but some siderophore have been found to have virulence effect in microorganism harmful to both animals and plants. In addition, they have applications in clinical, agriculture and environmental fields. Currently almost 500 siderophores are reported from selected microorganisms. Variation can be seen in siderophore structure from one species to another.

Classification of siderphores

A great variation is seen in siderophore structure produced by many bacteria. Siderophores are generally classified on the basis of co-ordinating groups that chelate the Fe (III) ion. The most common co-ordinating groups are catecholates (*Azotobacter vinelandii*), hydroxamates (Aspergilli, Penicillia, *Neurospora crassa*) and carboxylates. A minority of siderophores have chemically distinct Fe (III) ion binding group, including salicylic acid, oxazoline or thizoline nitrogen. Some siderophores including pyoverdines are classified as 'mixed ligands' having co-ordinating groups that fall into chemically different classes. Mostly siderophores were characterised by mass spectrometry, proton nuclear magnetic resonance spectroscopy, electrophoretic mobility, spectrophotometric titration, acid hydrolysis and biological activity.

There are two major pathways for siderophore biosynthesis:

A. Non-ribosomal peptide synthetases (NRPSs) multienzymes dependant.
B. NRPS independent.

Transport of Fe by siderophores

Siderophore trap traces of iron in the form of very stable complexes as they are excreted by iron-starved microorganisms,and after formation of complexes they are incorporated into the cell by specific cell receptors. For fulfilling the iron requirements microorganisms including bacteria and fungi use siderophores. Bacteria capture iron-loaded siderophores at the cell surface and transport them into the cytosol to transport iron in the cytoplasm, The binding constants of siderophores for Fe (III) are extremely high, implying that these compounds can effectively scavenge Fe (III) from a variety of complexes found in natural environment (Stintzi *et al.* 2000; Bernd & Rehm 2008).In gram-negative bacteria, this typically requires a combination of protein pattern:

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I. An outer membrane receptor that specifically binds the ferric–siderophore complex on the outer membrane and transfer it into the periplasm.
II. A protein complex containing TonB trans-duces energy from the proton motive force into transport-proficient structural changes of the receptor.
III. A binding protein located in the periplasm transfers the siderophore bound iron to cytoplasmic-membrane-associated trasporter.

Once released into the periplasm, siderophore are rapidly bound by the specific periplasmic binding protein FhvA (hydroxamate siderophores) (Coulton *et al.* 1986), FepB (Enterobactin) and FecB (ferric dicitrate) (Pressler *et al.* 1988). The membrane-associated transporter or ABC transporter composed of a protein channel in the cytoplasmic membrane coupled with a cytoplasmic ATPase that envolves ferric siderophore internalisation at the expense of ATP hydrolysis in the cytoplasm.The ABC transporter system is assembled of two proteins, one to separate the membrane acting as a permease and a second on which it can hydrolyse to provide the energy for transport. Transmembrane permease Fhu B for hydroximate, FepDG for enterobactins and Fec CA for ferric dicitrate. Ferric siderophores are released from the transport system at the cytoplasmic side of the cytoplasmic membrane. Eventually, iron is rapidly released from the siderophore complex via reduction. Different iron transport mechanism has been suggested for an outer membrane transport of pyoverdine via the FpvA receptor in *Pseudomonas aeruginosa*. The ligand exchange step occurs at the cell surface and involves the exchange of iron from a ferric pyoverdine to an iron-free pyoverdine strongly bound to the receptor FpvA. This mechanism suggest an increase in concentration of iron-free siderophore.

Application of siderophore

1. Application in Agriculture

When soil is inoculated with *Pseudomonas putida,* which produce pseudobactin, increases growth and yield of various plants. They produce HCN, siderophores, protease, antimicrobials, phosphate solubilizing enzymes which inturn increases plant growth. Currently there is a problem of decreased soil microbial activity and soil fertility, and yield losses due to heavy metals is toxicity. In this concern hydroxamate type siderophore which present in most of the soil types play an important role to immobilize the metals.

Fig: Crude siderophore crystals

2. Bio-control agent

Many bacteria suppress the growth of deleterious microorganism by production of siderophore, antibiotics, and cyanide (Edi Husane, 2005). Siderophores acts as growth inhibitors of various phytopathogenic fungi, such as *Phytophthora parasitica, Phythium ultimum, Fusarium oxysporum veri dianthi* and *Sclerotinia sclerotiorum.*

3. Environmental applications

Cd, Cr, Cu, Hg, Pb and Ni. Metals are the most common heavy metal contaminants along with a number of heavy metals present in soil are being required by plants as micronutrients. Severe health and environmental problems can be seen due to heavy metal contamination of soil and water. Siderophores and other naturally occurring ligands may

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therefore affect actinide mobility in waste repositories and also used to treat radioactive waste prior to storage or to decontaminate soils and water (Ruggiero *et al*., 2000; *Von Gunten* and *Benes*, 1995).

4. Medicinal application

I. Iron overload diseases, ß-thalassemia

β-thalassemia and certain other anemias can only be treated by periodic whole blood transfusion. Continued transfusion therapy results in steady buildup of iron as is no specific physiological mechanism for the excretion of iron in man. Removal of iron from the body is essential to cure these iron excesses, as well as the primary iron overload diseases such as hemochromatosis and hemosiderosis, and accidental iron poisoning. Siderophore based drugs are used effectively to cure such diseases. Desferrioxamine B has also found therapeutic application for various pathological conditions due to aluminium overload (Ackrill *et al.,* 1980). Accumulation of this toxic metal is frequently observed in chronically dialyzed patients who have lost the ability to clear via renal excretion. Desferrioxamine B has also been recommended for the diagnosis of such an overload state.

II. Infection

Iron is abundant in the human body, but it is bound to intracellular and extracellular components (transferrin, lactoferrin, ferritin; hemo-proteins). This strict iron homeostasis leads to unavailability of free iron for pathogenic bacteria in host body. Most aerobic, facultative anaerobic, and saprophytic microorganism have ability to produce high-affinity iron binding compounds, termed as siderophores, that are capable of chelating ferric iron and that allow its assimilation through cell surface receptors, therefore siderophore production contribute to bacterial virulence. It is thought that many pathogenic microorganisms acquire their essential iron from their hosts by this means.

III. Trojan horse antibiotics

Siderophores are effective in selective delivery of antibiotics in antibiotic resistant bacteria. It is the potentially powerful application that uses the iron transport abilities of siderophores to carry drugs into cells by preparation of conjugates between siderophores and antimicrobial agents which is also known as "Trojan Horse" strategy. Nature has provided examples for siderophore-antibiotics such as albomycins (Benz *et al.,* 1982). Ferrimycins (Bickel *et al.,* 1966) or salimycins.

IV. Removal of transuranic elements

The development of electricity generation by nuclear energy has led to increased human exposure to transuranic elements such as aluminium. Siderophore can be used to remove such elements from the body. Investigation has been carried out to evaluate the capacity of siderophore in removing such elements from the body. Administration of desferioxamine a form of siderophore lowers the level of aluminum in the body and relives the symptoms of the disease (Arze *et al.*, 1981).

V. MRI

For improved contrast enhancing for magnetic resonance imaging, different paramagnetic ions like $Mn2+$, $Fe3+$, and $Gd3+$ have been used. The $Gd3+$ is particularly well suited as contrast agent in diagnostoc medical MRI due to its high magnetic moment and favorable electronic relaxation rate, However, $Gd3+$ is highly toxic at concentrations required for MRI. Therefore, chelators are required that prevent release of the free cation in vivo. Again, siderophores and synthetic analogs thereof serve as principal models for such chelators.

VI. Iron chelators and cancer

In the treatment of cancers siderophore potential used as iron chelators. For example Dexrazoxane, Otrensox, desferriexochelins, desferrithiocin, tachpyridine, have been found in cancer therapy. Also siderophore used for the clearance of non-transferrin bound iron in serum which occurs in cancer therapy as a result of some chemotherapies.

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VII. Anti-Malarial

Some siderophore have been found to be useful in the treatment of malaria caused by *Plasmodium falciparum*. Siderophore produced by *Klebsiella pneumoniae* act as antimalarial agent. Desferrioxamine B produced by *Streptomyces pilosus* is active against *P. falciparum in vitro* as well as *in vivo*. Siderophore enters inside *P. falciparum* cell and causes intracellular iron depletion. The above mentioned siderophore was found to inhibit the growth of *Trypanosoma brucei* which is a protozoic parasite known to cause sleeping sickness in human.

CONCLUSION

Inorganic iron is extremely insoluble under aerated conditions at neutral to alkaline pH and its concentration is less than optimal for bacterial growth. To acquire iron bacterial cell produce siderophore. As discussed in the above article there is a huge scope for the application of microbial siderophores for the betterment of humans, animals and plants. In this modern era the applications of siderophores in the field of medicine, agricultural and environmental sector are very much limited. So, there is a huge need to explore about siderophores in depth from both normal, extremophiles as well as in the ecosystems like deep sea, desert and forest to bring revolution in the field of modern science.

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Prospects of application of biodiversity in dyeing

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Beenu Singh[1] and Pooja Bhatt[2]
Department of Clothing and Textiles, College of Home Science, G. B. Pant University of Agriculture and Technology Pantnagar, U. S. Nagar, Uttarakhand.

INTRODUCTION

The term biodiversity itself expresses the variety of life on Earth. It is determined at different levels of biological organization like genes, species and ecosystems. The biodiversity term is used to describe all the floral and faunal and microbial species present on the earth. It is also referred as the variety in the different types of species available in a particular region. The biodiversity helps to provide benefits for the survival and livelihood of different species present on the earth. It is the major sources of availability of raw materials for sustaining various life forms. Uttarakhand is the state present at the foothills of the snow-clad Himalayan region. Uttarakhand is abode to diverse range of flora and fauna species. The State is known to have rich and diverse floral, faunal and microbial components including rare and threatened plants and animal species. Generally, the mountains in the lower regions of Uttarakhand are covered with moist deciduous forest. The area is rich in many species of flora and fauna. Some of the fauna in the region are Himalayan Bear, Musk Deer, the wild Goat Ghoral, Bharal or Blue Goat, Wolves, Snow Leopards and varieties of deer such as Barking Deer. Arial fauna life in the region is considered as one of the richest in the sub-continent, with over 500 species of birds.

Sources of dyes

Different dyes available for use are generally produced or obtained from various parts of the plant, i.e. root, rhizome, stem, bark, leaf, flower, fruit, seed or whole plant, resin or gum (*Acacia nilotica*, *Lannea coromandelica* and stem galls (*Terminallia chebula*) also yield dyestuff. The important dyes extracted from roots or underground parts include *Curcuma domestica*, *Rubia cordifolia*, *Hedychium spicatum*, *Rumex hastatus*, *Urtica dioica*, *Berberis asiatica*. etc. Stem or bark is also considered as an important dye source as in *Acacia catechu*, *Lagerstroemia parviflora*, *Myrica esculenta*, *Pinus wallichaina*. Floral dyes are obtained from the flowers of plants which include *Butea monosperma*, *Grevellia robusta, Punica granatum, Rhododendron arboretum*, *Tagetus erecta, Woodfordia fructicosa*. Dyes can also be obtained from the fruit rind of plants like *Acacia nilotica*, *Embilica officinalis Juglans regia*, *Mallotus philippensis* and *Punica granatum* which are commonly used. Occasionally the pulp of fruit is also used to make dyes from plants like *Emblica officinalis*, *Myrica esculenta* and *Princepia utilis*. Some plants are used as a whole plant in the preparation of dyes which commonly includes *Peristrophe paniculata*.

Preparation of dyes

The preparation and application of dyes is an ancient form of human activities. Natural dyes are colorants derived from plants, invertebrates or minerals. The majority of natural dyes obtained are vegetable dyes from plant sources, for example- Indigo, Madder. The dyes that are obtained from animal sources are dyes like Cochineal dye and those obtained from minerals are dyes like Ochre. Dyes have capability of being fixed to materials and do not easily wash out on treatment with detergents and water or fade easily on exposure to light. The major content of natural dyes is made from plant parts such as leaves, flowers, berries, roots, bark, rhizomes, tubers, shoots, sap and wood. Natural dyes have the ability to provide an essential alternative to the complex and widely used chemical dyes. These dyes are environmentally friendly and can be obtained by organic methods. The indigenous knowledge associated with the system of extraction and processing of natural dyes from plants is an ancient process. Earlier people practiced the traditional methods in extraction, processing and preparation of dyes using barks, leaves, fruits and roots of plant. The natural dyes often require the use of mordants for improving the fastness or longevity of dyes. The use of mordants helps to enhance the dye fixation and resulting in improved coloration. Techniques of extraction of dyes are different for the dyes obtained from different parts of the plant resources. For the extraction of dye from underground root or rhizome, stem or bark, the material is first cut into pieces, soaked in water for two to three days and a concentrated paste is yielded. After completing the process of squeezing and filtration of the dye paste, the whole extract is boiled and concentrated by repeating heating.

The ancient practice of dye yielding plants and their extraction has not been explores substantially. The traditional practices have started to loose their significance and popularity by the advent of synthetic dyes and lack of the practice of traditional method of dyeing. The importance of use of the natural dyes is also not understood. The main reason for the traditional practice to loose its significance is the availability of cheap synthetic alternatives for dyeing. Indigenous practices of dye extraction, processing and practice of using of natural dyes has been used since ages and have proved to be fruitful for long period of time. But nowadays the indigenous knowledge is being used by the ethnic groups only and only few people practice the traditional methods of dyeing. Even though, the natural dyestuff poses less or negligible risks to the environment, no serious efforts have been made to continue the traditional practice of dyeing. No attempts have been made seriously to protect and preserve the traditional art of dyeing with natural dyestuff. The practice has been now confined to the indigenous people only. Now its time to document the practices and use them to protect the environment and replace the synthetic dyes which have posed serious threat to the environment and the natural resources. Thus, there is an alarming need to protect and practice the process of natural dyeing, conserve the natural resources through the systematic approach using scientific methods.

CONCLUSION

Traditional knowledge and practice of dye yielding plants and dyeing through natural resources has been limited. Limited efforts have been made to protect, preserve and document the traditional practice of dyeing through natural resources. Efforts need to be made to use the natural resources to yield better results than synthetic dyestuff without harming the environment. Commercialization of the natural dyes could be done to revive the use of natural resources to be used in natural dyeing. It can also be proved as a successful venture if practiced through systematic and scientific approach. Furthermore, the economy will also be enhanced if natural resources are effectively used. Subsequently, the process will also be effective in conserving the natural resources and preserve the traditional indigenous practices confined specifically to the ethnic groups of Himalayan region which is abode to variety of floral and faunal species.

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GEOMICROBIOLOGY: Microbes and geological processes

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Samanyita Mohanty and Shreya Das
Ph.D. Research Scholar, Department of Agricultural Chemistry and Soil Science, BCKV, Mohanpur, Nadia, W.B.

Microbes play a key geoactive role in the biosphere, particularly in the areas of element bio-transformations and bio-geochemical cycling, metal and mineral transformations, decomposition, bio-weathering along with soil and sediment formation. All kinds of prokaryotic and eukaryotic microbes and their symbiotic associations with each other and with 'higher organisms', can contribute actively to the geological phenomena, and central to many such geo-microbial processes is transformations of metals and minerals. The ubiquity and importance of microbes in biosphere processes make geo-microbiology one of the most important concepts within microbiology.

INTRODUCTION

Geomicrobiology can be defined in simple terms as the role of microbes in geological processes. Metal–mineral–microbe interactions are of key importance within the framework of geomicrobiology and microbial bio-mineralization processes. The term bio-mineralization represents the collective processes by which organisms form minerals, a phenomenon widespread in biology and mediated by bacteria, protists, fungi, plants and animals. Most biominerals are calcium carbonates, silicates and iron oxides or sulfides. Bio-mineralization is an important interdisciplinary research area that overlaps with geomicrobiology. While the activities of microbes in transforming organic and inorganic substrates has long been appreciated by microbiologists, there is growing awareness of the geochemical significance of microbes among researchers in geology, mineralogy, geochemistry and related disciplines.

Geological processes affected by microbes

Rock and mineral weathering is a process in which microbes play an important role by promoting mineral diagenesis and dissolution. Their weathering action may be due to formation of metabolic products, especially when the microbes live in a film on the surface of a rock or mineral otherwise, the weathering action may be the result of oxidative or reductive attack of appropriately reactive mineral constituents e.g., Fe, Mn, sulfide, sulfate of a rock or mineral. All types of igneous and sedimentary rocks are susceptible to microbial weathering, including siliceous; silica, silicates, and aluminosilicates and calcareous carbonate rocks. Mobilization of mineral constituents in weathering by microbes can be a selective process, i.e., only one or a few of the constituents of a mineral are dissolved. When this happens, the undissolved residue becomes enriched in the constituents not mobilized by the microbes.

A. Rock weathering by metabolic products of microbes

Some microbes excrete chemical agents that corrode the rock through chemical interaction, or by oxidizing or reducing a rock component that leads to mineral diagenesis or dissolution. These chemical agents may include the inorganic acids HNO_3 and H_2SO_4 and organic acids such as citric, oxalic and 2,4 gluconic acids, produced mainly by fungi and formic, acetic, lactic, pyruvic, succinic, 2-ketogluconic and some other acids produced by bacteria. Microbes may also excrete ligands such as ferric iron-complexing siderophores produced by bacteria and fungi, and lobaric and physolic acids produced by lichens, which promote rock weathering. Oxidative or reductive weathering agents, produced by bacteria, mainly include ferric ion produced by acidophilic iron bacteria, and sulfide produced by sulfate reducing bacteria.

Microbes-bacteria, fungi, lichens that cause rock weathering by excretion of corrosive agents often grow on the surface of the rock in the form of a biofilm or colony. This growth habit can result in accumulation of a relatively

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high local concentration of the corrosive agent. This concentration will be affected by the number of organisms producing it, by the timing and rate of its production, and by the tendency of the reagent to become diluted in the extracellular environment.

B. *Mobilization of metals in metal sulfides*

The chemical reaction in weathering of rocks and minerals by microbial metabolic products does not usually involve direct microbial catalysis. However, some weathering processes involving redox reactions may be directly catalyzed by microbes. An example is the mobilization of metals from metal sulfides.

Since its discovery, a number of acidophilic bacteria have been found, some of which, like *T. ferrooxidans*, grow in a temperature range from around 15–40°C mesophilic, while others grow in a higher temperature range of 40–75°C thermophilic. Among them are the mesophiles like *Leptospirillum ferrooxidans*, and the thermophiles *Sulfobacillus thermosulfidooxidans*, *Acidianus brierleyi*, *Sulfolobus acidocaldarius*, and others. *T. ferrooxidans*, *L. ferrooxidans* and *S. thermosulfidooxidans* are eubacteria, whereas *A. brierleyi* and *S. acidocaldarius* are archaea. One or more of these acidophilic iron-oxidizers can be found naturally at sites where metal sulfides occur, such as in bituminous coal seams with pyrite inclusions, and in metal sulfide ore deposits. Unless the deposits containing metal sulfides are exposed to air and significant moisture, the bacteria are either dormant or only weakly active. But when pyrite-containing coal seams or metal sulfide ore deposits become exposed as a result of a seismic or other natural happening, or in mining activity, the bacteria may become very active and grow, resulting in the formation of acid mine drainage. In the case of metal sulfide ore deposits, this activity is industrially exploited for metal recovery without smelting in a process called biohydrometallurgy.

C. *Mineral deposition*

Microbes play a significant role in authigenic or diagenetic formation of certain minerals or sedimentary rock. Examples of authigenic microbial mineral formation are the oxidation of dissolved ionic species, such as Fe^{2+} to FeO, Mn^{2+} to MnO etc. An example of diagenetic mineral formation is the replacement of carbonate in calcite by phosphate mobilized in the microbial degradation of phosphorus-containing organic matter.

Microbes have been shown to be able to promote the formation of minerals at moderate temperatures and atmospheric pressure, previously thought to be formed only at high temperature and pressure. Biogenic sulfide is formed anaerobically by reduction of sulfate by sulfate-reducing bacteria. The sulfide then reacts chemically with a metal or metalloid to form the corresponding sulfide in the bulk phase.

Microbes can promote the build-up of a metallic mineral at their cell surface by first binding the metal cation to negatively charged groups of the cell envelope. Such bound metal ions may subsequently react with anions to form an insoluble salt. The salt forms because it is more stable than the previous state in which the cation was bound to a cell envelope constituent. In sufficient excess of the required cations and anions, the metal salt on the cell surface nucleates mineral formation. The anion in this reaction may be a product of bacterial metabolism or it may have an abiotic origin.

D. *Microbiology of the deep-subsurface*

As at or near the surface, some microbes in the deep subsurface may inhabit rock faces or the surface of mineral particles, occurring in biofilms, microcolonies, or as individual cells. Other microbes may occur preferentially in pore water. Those found on rock or mineral surfaces are usually attached by slime that they produce. In general, the rate of metabolism in the deep subsurface must be assumed to vary over time depending on fluctuating nutrient availability.

Depending on the nutrient status of any subsurface location, the bacteria may range from heterotrophs (getting their carbon and energy from organic matter) to chemolithotrophs (getting their carbon from CO and energy

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from the oxidation of inorganic matter). Thus heterotrophs would more likely occur in significant number in sedimentary deposits that contain trapped, metabolizable organic carbon or are infiltrated with metabolizable organic carbon- containing groundwater. Chemolithotrophs would more likely occur in rock deposits of igneous origin in which organic carbon would have been destroyed by the heat of the magma from which these rocks formed, but where inorganic energy sources were available. With exception, chemolithotrophs can also be expected in some sedimentary deposits low in organic carbon.

Depending on the oxygen content and the concentration of oxidizable organic matter of the pore water, the bacteria in contact with it may be aerobes, facultative aerobes, or anaerobes. They may reside on the rock or mineral surfaces as biofilm, microcolonies, or individual cells, or they may reside within the pore water. The aerobes can include heterotrophic mineralizers of organic carbon; autotrophic oxidizers of ammonia, nitrite, reduced sulfur, and ferrous iron; and manganous-manganese-oxidizing mixotrophs. The anaerobes includes fermenters, which require no externally supplied electron acceptors in oxidizing their energy source, and nitrate-reducers, ferric iron-reducers, manganese(IV)-reducers, sulfate- and sulfur-reducers, and CO reducers, most methanogens, i.e., methane-forming bacteria, and acetogens, i.e., acetate formers., which do require corresponding externally supplied electron acceptors.

E. Transformation of organic carbon in sediments

A significant portion of natural organic matter trapped in sediment at the time of its deposition may subsequently be only incompletely mineralized by microbes. This may be because of the nature of the organic matter and/or the lack of sufficient external electron acceptors required by microbes for the biodegradation process. Cellulose and, especially, lignins in woody plant residues are difficult for microbes to degrade, especially anaerobically, and are likely to accumulate only partially altered in the form of humic substances. Superficially buried, such organic matter may become peat. Deeply buried and in large quantities, such residual organic matter may be further transformed into coal by physicochemical processes involving heat and pressure.

Cyanobacterial and algal biomass trapped in sediments of shallow inland seas in the geologic past has become gradually converted to petroleum hydrocarbons by physicochemical processes involving heat and pressure while new sediment is accumulated over the original deposit. In other cases, where conditions permit, extensive biodegradation of buried biomass in the absence of oxygen may take place, the final products of the degradation being mainly methane and carbon dioxide, and some hydrogen.

CONCLUSION

All kinds of microbes, including prokaryotes and eukaryotes and their symbiotic associations with each other and ‘higher organisms’, play a wide diversity of geoactive roles in the biosphere. Microbial transformations of metals and minerals include a vital part of natural biosphere processes and plant nutrition which sustains life on earth.

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PRE-BREEDING

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Smrutishree Sahoo[1] and Sanjay Kumar Sanadya[2]
[1]Ph.D. Scholar (GPB), GBPUAT, Pantnagar-263 145; [2] Ph.D. Scholar (GPB), CSK HPKV, Palampur-176 062

INTRODUCTION

Crop improvement through plant breeding is the result of desirable variability created by the plant breeders in the available resources. However, the result of loss of variability due to uniformity in modern varieties replacing the diverse local varieties and landraces, narrow genetic base of the genetic material are genetic erosion, yield stagnation and succeptibility towards the biotic and abiotic stresses. The growing population and climate change demands for the high yielder as well as highly adaptable and stable variety in allthe changing environment. In order to achieve these challenges, presently the plant breeders directing their research efforts towards creating new variability in the genetic resources which they will utilise in widening the genetic base of the crop plants as well as improving the agronomic, quality and stress resistance traits. Pre-breeding comes under such efforts, which uses conserved genetic variations in the wild relatives, germplasms, and gene banks to increase the effectiveness of crop improvement. The aim of pre breeding is to develop new gene pools having higher frequency of useful genes, wider adaptability, and a broader genetic base.

The way pre breeding works:

i) Identifies desirable traits from unadapted materials like wild relatives, which are difficult to be used in breeding.
ii) Transfers the genes to an intermediate set of materials that breeders will utilise producing new varieties.
iii) Links genetic diversity arising from wild relatives and germplasm conservation to the plant breeding activities.

These activities are the combined efforts of germplasms curator and plant breeder.

Pre breeding utilises gene pools: Gene pool is the sum total genetic variation in the breeding population of a species along with wild relatives.

- **Primary gene pool:** cultivated and wild relatives of the species (easy to utilise)
- **Secondary gene pool :** different species than the cultivated (moderately difficult to use)
- **Tertiary gene pool:** distantly related species (difficult to utilise)
- **Quaternary gene pool:** unrelated plant species and/or other organism (transgenic)

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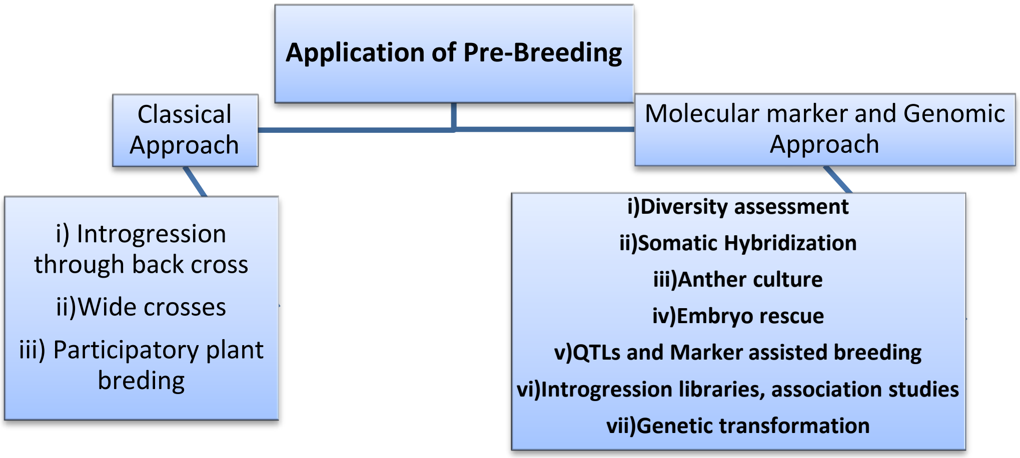

Pre-Breeding and crop plants:

i) Latin American Maize Project (LAMP): LAMP is a pre-breeding program including 12 countries (Argentina, Bolivia, Brazil, Colombia, Chile, U.S., Guatemala, Mexico, Paraguay, Peru, Uruguay and Venezuela), evaluated 15,000 accessions, with cooperation of the public and private sectors(Pioneer Hi-Bred International Company) in the first stage. The project recognised great genetic variability in Latin American maize. Thus, it has become helpful for maize breeders to access to the most promising stocks to expand the genetic base in maize (Nass and Paterniani , 2000).

ii) At ICRISAT, progressing work is undergoing using promising exotic landraces and wild species as donors for pre-breeding activities in chickpea, groundnut, and pigeonpea . genes for resistance against *Ascochyta* blight, *Botrytis* gray mold, and *Helicoverpa* pod borer in chickpea; for sterility mosaic disease, *Phytophthora* blight, and pod borer in pigeonpea; and peanut stem necrosis disease (PSND), and aflatoxin in groundnut has been introgressed in to the cultivated species (Sharma *et al.* 2013).

iii) In Canada, researchers including Gavin Humphreys, a research scientist at Agriculture and Agri-Food Canada, are pre-breeding to make wheat more resistant to fusarium head blight (FHB). Cross between Crocus hexaploid wheat and a hybrid line developed a breeding line that contains chromosomes of *Thinopyrum elongatum*, a type of wheatgrass. The new breeding line, which has segments of *Thynopirum* DNA, showing resistance to FHB, leaf rust and stem rust.

Challenges:

(i) Lack of characterization and evaluation for novel traits in the wild species
(ii) Lack of crossability between the cultivated and wild species
(iii) Linkage drag
(iv) Hybrid inviability and sterility
(v) Time consuming and resource demanding.
(vi) Exchange and accessibility of cultivated species germplasm material has become difficult due to legal restrictions like IPR.

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Future aspects:

Landraces and wild relatives are the reservoirs of ample amount of genetic diversity, which carry several desirable genes for cultivar improvement. Pre-breeding should focus on the continuous supply of useful variability into the breeding pipeline by utilising both classical and marker based genomics approach for the crop wild relatives to develop new high-yielding cultivars with a broad genetic base and agronomic, quality and resistance traits. Genomic-assisted pre-breeding will help to make pre breeding more effective by overcoming the linkage drag by specific transfer of useful genes for genetic enhancement.

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Diagnosis and Management of Mollicutes in Plants

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[1]Chidanandappa, [2]Amoghavarsha Chittaragi and [3]Saddamhusen Alase
[1]University of Agricultural Sciences, Dharwad
[2]University of Agricultural and Horticultural Sciences, Shivamogga
[3]University of Agricultural Sciences, GKVK, Bengaluru

INTRODUCTION

Mollicutes belongs to: Domain- Bacteria, Phylum- Tenericutes, Class- Mollicutes. They have evolved from Gram Positive bacteria by degeneration of Genome. During evolutionary history, multiple reductions in genome size occur, genetic code has been altered and overall rate of evolution is very high. They differ from bacteria by minute size, total lack of cell wall, small genome. Genome size of mollicutes range from 580 – 2200 kb. Plant pathogenic mollicutes include Phytoplasma and Spiroplasma. They inhabit phloem sieve tubes of plant and are transmitted by phloem feeders. They have propagative relationship with the vectors.

Diagnosis of phytoplasmas:

It is difficult to detect and identify phytoplasmas, because of their, Erratic distribution, Low concentration, Seasonal fluctuation, Enzyme inhibitory plant polysaccharides and polyphenolic compounds- The titre of phytoplasma cells in the phloem of infected plants varies according to the season and the plant species, and it is often very low in woody perennial hosts. Cannot be cultured in cell-free media in a laboratory for any purposes. (Preliminary evidence that phytoplasmas can be grown in or on cell free laboratory media has been reported, but non-optimization of the culture system and non-availability in all areas are the constraints).

Therefore, developing a rapid, accurate diagnostic method to detect a phytoplasma infection is important

<u>Several methods are followed to detect phytoplasmas:</u>

A. Biological methods

This involves:

a) Symptomatology b) Plant host range and c) Transmission: Dodder / insect vectors

Symptomatology:

Phyllody: It is the abnormal development of floral parts into leafy structures.

- ✓ Sesamum phyllody: Transmission: Leaf hopper- *Orosius albicinctus*
- ✓ Little leaf of Brinjal: Transmission: *Cestius* (*Hishimonus*) *phycitis*
- ✓ Aster yellows: Candidatus *Phytoplasma asteris*: Transmission: Aster leafhopper- *Macrosteles quadrilineatus*

B. Microscopic techniques:

Direct detection of phytoplasmas is difficult, because they are not visible through a normal light microscope. There are two different methods which can be used to localize and identify phytoplasmas in the infected tissues by means of light microscopy. This involves the use of Dienes-reagent which eventually gives a blue colour and DNA-binding fluorochrome, 4'-6-diamidino2-phenylindole (DAPI), which is the most used stain for phytoplasma diagnosis both in herbaceous and woody host plants such as coconut palms, ash, pear, sandal trees *etc*.

C. Serology-based techniques:

Serological diagnostic methods, primarily enzyme-linked immunosorbent assay (ELISA) employing polyclonal or monoclonal antibodies were applied for phytoplasma detection in the early 1980's.

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The enzyme-linked immunosorbent assay (ELISA) is a test that uses antibodies and color change to identify a substance. Antigens from the sample are attached to a surface. Then, a further specific antibody is applied over the surface so it can bind to the antigen. This antibody is linked to an enzyme and in the final step, a substance containing the enzyme's substrate is added. The subsequent reaction produces a detectable signal, most commonly a color change in the substrate.

D. DNA-based techniques:

1. Molecular hybridization assay:

Dot and Southern blot hybridization assays using cloned fragments of phytoplasma DNA from chromosomal or plasmid (extrachromosomal) DNA as probes facilitated detection and differentiation of various phytoplasmas in a wide range of host plants and insect vectors. Radioactive 32P or nonradioactive biotin and digoxigenin have been used to label these probes.

Eg: Alfalfa witches' broom, clover yellow edge, X-disease, clover phyllody, eastern and western aster yellows phytoplasmas have been detected in different host plants and in aster yellows phytoplasma vector *Macrosteles fascifrons* using biotinylated DNA probes.

2. PCR amplification of phytoplasma-specific DNA:

A) Nested PCR **B)** Real-time PCR **C)** Loop-mediated isothermal amplification (LAMP) assay

Spiroplasma

Spiroplasmas are helical organisms which measures: 0.08-0.2 µm wide and 2-4 µm long. They are wall less cells. They are intracellular parasites inhabiting phloem sieve cells of infected plants and haemolymph of insect vectors. They are transmitted by phloem sapsucking insects. Motility of Spiroplasmas is by translational movement and bending, tumbling motion.

Diagnosis:

1. Corn stunt disease: *Spiroplasma kunkelli*

The initial symptoms of corn stunt show characteristic small chlorotic stripes that develop at the leaf bases of young plants after about 25-30 days. The chlorotic stripes become fused and extend further toward the leaf tips in the older leaves with green spots and stripes on a chlorotic back-ground. The infected plants have much shorter internodes and a proliferation of secondary shoots in leaf axils. Reddening on leaves varies depending on the corn genotype and environmental conditions.

2. Citrus Stubborn Disease: *Spiroplasma citri*

Symptoms of Citrus Stubborn disease are most prominent in immature plants but still appear on established trees. The primary symptom of Citrus Stubborn disease is the irregularity of fruit on the same tree. A tree with citrus stubborn disease will have fruits of differing sizes, shapes and stages of maturity and typically lighter, smaller fruits than its healthy counterpart. Affected fruits will often drop prior to maturity and often have a characteristic acorn-like shape, which is easily seen by cutting the fruit in half. Coloration of the fruit is also affected. The blossom end remains green while the stem end is colored in affected fruits (Saglio *et al.,* 1973).

3. Periwinkle yellows disease: *Spiroplasma phoeniceum*

Infected periwinkle plants show yellowing symptoms.

Management practices:

1. Clean propagation material:

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a. Preventing vector transport to new areas.
Ex: Scaphoideus titanus native to North America and was found in Europe in 1958. This can complete its development only on grapevine. It presumably entered Europe as eggs under the bark of grapevine canes.
b. Preventing the transport of phytoplasma infected plants to new areas where potential vectors may be present.
Ex: Phytoplasma infected Limonium plants were brought into an area where potential vectors were present. Shortly after the seedlings were planted, phytoplasma symptoms were observed in other Limonium plantations throughout the area (Weintraub and Jones, 2010).

2. Resistant cultivars:

- Developing plants that are either resistant to phytoplasma or that deter the vector feeding.
- Rice yellow dwarf - CH-2, CH-45, CH-126-33-11, IR-127-80-1-10, MR-278 (Muniyappa and Ramakrishnan 1976).
- Little leaf of brinjal - Nurki, Hisar Shyamal, H-10, Pusa Purple Long, Pusa Purple Round, Pusa Purple Cluster (Sidhu and Dhatt 2007).

3. Roguing:

a. Roguing: plant removed entirely. Eg: X disease: remove cherry trees around the orchard, upto 150 m from peach
b. Ratooning: only symptomatic shoots are removed

4. Weed control: To manipulate the habitat of the vector

5. Mulching:

- Synthetic mulches: ➢ Prevents the movement of vectors into soil

➢ *H. obsoletus* lays eggs at or just below soil surface
- Reflective mulches: Repels the vector from plant

➢ Eg: carrots- aluminium foil mulch- Macrosteles quadrilineates (Aster yellows)
➢ Maize leaf hopper: *Dalbulus maidis*- higher yield and vector management- plastic reflective mulch than insecticides

6. Barrier sprays:

- Kaolin: particle film - Kills insect by suffocating it or coating the plant and obstructing feeding and oviposition sites.

➢ Eg: Grapevines: less likely to become infected with bacteria and fewer leafhoppers were found in treated fields

7. Antibiotic therapy:

- Tetracycline: temporary effect, banned in some countries

8. Parasitoids/ Predators:

- Eg: Neodryinus typhlocybe- attacks young *M. pruinose* instars- Italy (1987)
- Susceptible to pesticide usage.

9. Induced resistance:

- Stressing plants: severe pruning, pollarding, uprooting or partial uprooting,
- Field trials of grapevine: commercial products of chitosan, phosetyl-Al, glutathione and oligosaccharides (Weintraub and Jones, 2010).

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Sesamum Phyllody: Increase in nitrogen application, reduce the phyllody.

▪ Resistant varieties RJS-78, RJS-147, KMR-14, KMR-79, Pragati, IC-43063 and IC-43236, Rajeswari (highly adoptable female parent).

▪ Spray 2-3 times with monocrotophos (0.03%) or Dimethoate (0.2 %) for control

➢ Spray 500 ppm tetracycline @ flowering

Sugacane grassy shoot (GSD):

• Using of disease free setts

• Remove and burn the infected clumps periodically.

• Avoid ratooning in problem area. • Moist heat treatment at 54^{0}c for 30 min.

• Control vector by spraying malathion and Dimethoate @ 2 ml/lit

Citrus stubborn:

i. Quarantine

ii. Roguing: Removing stubborn affected trees from young orchardsClean propagative material

iii. Vector control

iv. Antibiotics

v. Top working should be done only on trees which are totally free of stubborn.

CONCLUSION

A large diversity in diagnostic tools focusing on sensitive, specific and fast detection of important phytoplasma and Spiroplasma diseases have been developed over time, all trying to resolve the shortcomings of the known detection methods so far. More attention also went to the in-field detection, especially for quarantine pathogens. However, there still is a need for the development of rapid assessment and simultaneous automated quicker detection and quantification procedures for large numbers of plant samples, as they directly impact the management strategies.

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Aerosols and their effect on environment and humans

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Pooja Bhatt[1], Beenu Singh[2] and Smriti Singh[3]
[1&2]Department of Clothing and Textiles, College of Home Science, [3]Department of Agricultural Communication, College of Agriculture, G. B. Pant University of Agriculture and Technology Pantnagar, U. S. Nagar, Uttarakhand.

INTRODUCTION

Aerosols are the colloidal solution of solid or liquid particles in the gaseous medium or air. Some toxicologists define aerosols as the ultrafine, fine or coarse materials or the particulate matter which are clumped together with the chemical compounds like sulphates, nirates, organic carbon, etc. and are suspended in the gaseous medium.

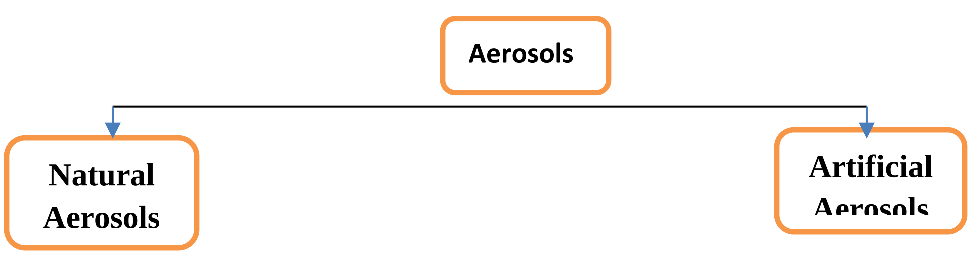
Aerosols

Aerosols term was first used by Frederick G. Donnan during First World War to describe an aero solution, cloud of microscopic particles in air. An aerosol can be defined as the colloidal solution of solid or liquid particles in a gaseous medium i.e. air. It can also be defined as the fine colloid of microscopic size solid or liquid particles of diameter around 0. 001µ to 100µ in the gaseous medium or air. The aerosols mainly comprise of compounds like sulphates, nitrates, organic carbon, sea salt and mineral dust. The aerosols also clump together to form other aerosols like carbon from soot or smoke mix with dust and air and other compounds to form smog. Mostly the aerosols are believed to be of the natural origin.

Classification

The aerosols can be classified into different types based on origin, temperature change and sources. It is believed that around 90 percent of the aerosols are originated from the natural sources like volcanoes. The volcanoes erupt the gases like Sulphur dioxide, ash and other chemical compounds and mixed with air to form aerosol called smoke. The eruptions of Mount Hudson in Chile (Aug 1991) and Mount Pinatuba in Philippines (June 1991) produced large volumes of aerosols. Similarly, the forest fires also release carbon into the atmosphere to form smoke. Other natural sources can be the dimethylsulphide release by the microalgae which is converted into sulphur gas in the atmosphere. Likewise, there are artificial aerosols which are synthesized or prepared by the human activities. These aerosols are manufactured by mixing the chemical compounds with the gaseous medium like perfume, deodorant, hair sprays, etc. The aerosols can also be classified on the basis of change in temperature. The warming aerosols and the cooling aerosols. The warming aerosols are composed of the black carbon or carbon soot which are responsible for warming up the atmosphere. Whereas, the cooling aerosols like dust, sulphate particles and the sea sprays are responsible for cooling up of the atmosphere.

On the basis of origin of source of aerosols



- Volcanoes (major source of aerosols, release H_2SO_4, H_2S, HCl into atmosphere and eventually return as acid rain)
- Sea sprays
- Dust storms
- Forest fires
- Burning of fossil fuels
- Natural geysers
- Solid and liquid particles formed by chemical reactions in the atmosphere

- Deodorants
- Hair sprays
- Liquefied domestic gas
- Pesticides
- Solvent based adhesive
- Pain relief sprays
- Air fresheners
- Petrol
- Paints and paint removers
- Dry cleaning agents
- Plaster remover
- Vehicular emissions
- Atomizer nozzle
- Electro spray
- Electronic cigarettes

On the basis change of temperature

Aerosols

Warming Aerosols

- Black carbon and carbon soot
- Form dark, black coloured clouds

Cooling Aerosols

- Dust, sulfate particles and sea sprays
- Form bright opaque big clouds

Various types of aerosols

Dust- Made of solid particles suspended in gaseous medium usually air. The particle size ranges from about 1µ to 100µ in diameter and can be even larger. These are formed by release of materials like soil, sand, fertilizers, coal dust, cement dust, pollen and fly ash into atmosphere. Because of large size they are usually unstable and settle under influence of gravity. They do not flocculate except under electrostatic forces.

Smoke- Consists of finely divided particles produced by incomplete combustion. Consists of carbon particles and other combustible particles. Size is generally less than 1µ in diameter. The size of coal smoke particles ranges from 0.01-0.2µ. The size of oil smoke particles ranges from 0.03-1µ.

Mist- These are the liquid particles less than 10µ dispersed in low concentration in a gaseous medium like air. For instance, it is formed by tiny water droplets suspended in air. If the concentration is more it can result in fog.

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Fog- The dispersion of water or ice in the atmosphere (particle size- 1-40μ) and reduces the visibility in air.

Smog- It is of two type i.e. photochemical smog and coal/natural gas induced smog. It is formed by interaction of some hydrocarbons and oxidants (such as smoke of other combustible products) with natural moisture in air under the influence of sunlight, resulting in the formation of chemically active materials like PAN (Peroxy Acetyl Nitrate) PBN (Phenyl Benzene Nitrate), etc.

Fumes- These are solid particles of size 0.001μ to 1μ, generated by condensation from gaseous state generally after volatilization from melted substances often accompanied by oxidation. Solid particles of size 0.001μ to 1μ suspended in gaseous medium. They flocculate together and results in the formation of fume clouds.

Sprays- They form when relatively large (10 microns) droplets of liquids are suspended in a gas. It can be natural or artificial. E.g. hair sprays, perfumes, deodorants, etc. Aerosols tend to coagulate or collide and combine with each other to form larger particles, e.g. Cloud consists of tiny droplets of water and ice crystals. These particles move randomly within the cloud and adhere with each other forming larger and heavier particles. This process result droplets of water heavy enough to fall as rain, snow or hails.

Effect of Aerosols

1. Environmental Effects-

- Volcanic eruptions release H_2SO_4, H_2S, and HCl into the atmosphere which results in acid rain. Mist containing these aerosols may be carried hundreds of miles from their original sources before conglomeration takes place.
- **Ozone Depletion-** The aerosols cans often contain CFCs (chlorofluorocarbons) which diffuse into stratosphere and under the effect of solar radiations decompose and release chlorine atoms which react with ozone thus depleting the ozone layer.
- **Aerosols** can influence the climate by scattering the light and changing the Earth's reflectivity, they can also alter the climate via clouds.

It can affect climate in two ways-

- **Direct process-** It is the immediate effect on the radiation absorption. If the aerosol is light in colour it generally reflects solar radiation and causes cooling by reducing amount of incoming solar radiation. If the aerosol is dark in colour e.g. Coal fumes, it absorbs solar radiation and causes warming effect thereby increasing the temperature of the Earth.
- **Indirect process-** The polluted air contains high concentrations of water-soluble particles and scatter lighter thus appear brighter. E.g. a sulphate, sea salts, ammonium salts, etc. The clouds are composed of small number of large droplets of water vapour and thus the clouds are somewhat darker and translucent. But increases in the concentration of aerosols create large number of small particles resulting in dense, very reflective and bright clouds. This influence of aerosol on clouds is known as indirect effect. The sea salt particles release by the phytoplankton result in most marine cloud formation. However, the exhaust from the ship smokestacks, airplane contrails make trails of sulfates that form long bright coloured clouds. The brighter clouds block the sunlight from reaching the earth's surface, thus shading of the planet and resulting in cooling effect. The aerosols tend to suppress precipitation by decreasing the size of water droplets in the clouds. But under some environmental conditions the aerosols can lead to production of larger clouds which causes lightening and heavy downpours. Thus, the aerosols have unpredictable nature which can be rendered as dangerous.

On the contrary, the black carbons from soot either lead to the formation of clouds or suppress the cloud formation. The black carbon tends to warm atmosphere and cause the cloud (water droplets) to evaporate. This is known as semi-direct effect which turns clouds into smoky haze that suppresses the precipitation. Thus, the aerosols can have cooling and warming effect in the atmosphere in different conditions and changes the climate indecisively.

2. **Effect on vegetation-** The carbon soot coats the leaves of the plants and reduces their ability to carry out photosynthesis. The acid rain also damages the vegetation by increasing the acidity of the soil and harming the plant life.
3. **Effect on human life-** The aerosols clog the alveoli and interfere with person's respiration. It results in hallucinations and delusions (causes drunk effects also known as huffing). The person becomes more outgoing and confident, becomes more violent and can harm themselves. It induces sneezing, coughing, vomiting, diarrhea, slurred speech, double vision, drowsiness and muscle pain, and ultimately results in suffocation, heart failures and depression.

CONCLUSION

The aerosols are formed by the suspension of solid and liquid particles in the gaseous medium. They can be natural or anthropogenic according to the source of origin. There are different types of aerosols like dust, mist fog, smoke, smog, sprays, etc. These colloidal particles affect the environment, vegetation and humans. These are also responsible for change in the hot and cold climatic conditions of the environment, depending on the type of aerosols like cooling aerosols and warming aerosols.

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Insight into seed maturation process with physiological and biochemical prospectives

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Soumya Kumar Sahoo[1*], Akankhya Guru[2] and Selukash Parida[3]
[1]Department of Plant Physiology, COA, Indira Gandhi Krishi Vishwavidyalaya, Raipur
[2]Department of Plant Physiology, IAS, Banaras Hindu University, Varanasi
[3]Department of Plant Physiology, COA, Odisha University of Agriculture & Technology, Bhubaneswar

THE SEED:

The Seed stage of Angiosperms (seed forming plants) represents a unique development phase of the spermatophyte life cycle. Seed is defined as a mature ripened ovule consisting of an embryo and its coats. Anatomically seed consists of seed coats (derived from the integuments and nucleus), endosperm (gametophytic tissue or fertilized tissue) and embryo (the new young sporophyte).

IMPORTANCE OF SEEDS:

Seeds are the corner stone of agriculture because when seeds are planted in the soil and given water, nutrients, light and some protection from pests would reproduce plants and ultimately results to produce number of seeds which could be used for food or feed. The seed occupies that sector of an organism life cycle from megasporogenesis (genetic) to the formation of seedling (ecological).

PHASES OF SEED DEVELOPMENT:

After fertilization, the embryo and endosperm goes to a period of rapid growth, differentiation followed by seed maturation. The seed maturation and developmental phase involves different complex biochemical and physiological activity in the embryo, food storage tissues and organs. It involves different sub phases like production of cells, their differentiation into specialized cells, tissue and organs, synthesis and deposition of storage nutrients in the seed, etc. The developmental seed phase also includes the deposition of reserve food in the endosperm (primarily in monocotyledonous), whereas in cotyledons (primarily in dicotyledonous) and occasionally in Perisperm (nuclear tissue). At physiological maturity of the cell, the endosperm and perisperm consist of dead cells. These cells serve as warehouse for the storage of nutrients in the seed.

SEED MATURATION

Seed maturation is a crucial phase of seed development at the time of which embryo growth ceases, storage products accumulate, the protective tegument differentiates and tolerance to desiccation develops, leading to seed dormancy.

METABOLIC STATUS OF SEEDS:

Respiration in Developing Seeds:

Seed utilize more oxygen and stored dry matter during respiration of the developmental phases. At early developmental phases the rate of respiration is high which gradually reduces as the seed matures and ultimately reaching a very low level at seed maturity. The rate of respiration remains relatively constant during the quiescent (dormant) period. The activity of a number of enzymes like glycolytic pathway, pentose phosphate pathway, Krebs cycle and the cytochrome system amino acid activating enzymes and the soluble enzymes of protein synthesis in the seed declines with advancing or final maturation of the seed.

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Changes in Sub- cellular Particles:

During maturation various changes occur in the fine structure of the sub-cellular particles of cells. Usually at 60% moisture level, mitochondrial structure remains more or less intact until the end of the maturation period, after which the mitochondria rapidly lose their elongated shape and become rounded during dehydration. Structural changes also occur in chloroplasts as the seed approaches maturity. They become globular or bell shaped with frequent invaginations; the internal membrane structure is lost and the grana disappear.

Seed Composition:

The reserve materials are accumulated in specialized cell compartments; lipids in spherosomes (lipid bodies, oleosomes), proteins in protein bodies whereas, starch in forms granules originating from disintegrated plastids.

Starch Biosynthesis:

Photosynthesis by leaves is the source of glucose which is rapidly converted to sucrose which translocated to the developing seed for metabolic use or storage. Amylose and amylopectin type starches are synthesized and stored in plastids.

Protein Biosynthesis:

A plant synthesizes the 18 amino acids and two amides that form the constituents of nearly all protein molecules. However, about 100 other amides and amino acids are known to have a limited distribution in higher plants, existing either as amino acids or as low – molecular – weight peptides. Except in rare instances, these compounds are not incorporated into proteins and are conveniently termed non protein amino acids.

Proteins synthesized by maturing seeds are very different from those synthesized by germinating seeds. Maturing seeds contain storage proteins (prolamines, glutelins, and globulins) rather than metabolically active proteins.

There are several storage protein found to endosperm of the monocotyledonous plants (e.g. cereals), which are discuss below.

Zein: In corn, zein (a prolamin) is the major storage protein found to endosperm and contains a relatively large amount of alanine and leucine with little lysine and almost no tryptophan. Consequently, corn as the sole dietary source of protein is a poor quality protein for humans and other monogastrics.

Gluten: It is the major storage protein of wheat and is comprised of many proteins with molecular weight ranging from 25,000, which accounts for the ability of wheat flour to raise and form a leavened loaf of bread. Rye also contains a relatively high concentration of gluten and is also widely used for bread.

Gliadin: It is other major protein class in wheat which does not have the elastic properties like glutein. Thus, it is less valuable in wheat for bread making purposes.

Lipid Biosynthesis in Seeds:

Lipids are insoluble in water and unable to diffuse from cell to cell. They are synthesized and stored in the cells in which they occur. Lipid synthesis in seeds occurs in cells of the embryo, primarily the cotyledons (especially the scutellum of cereals), and endosperm.The site of synthesis of triglycerides is located in the microsomes. The formation of a glycerophosphate from free glycerol and ATP is essential for lipid synthesis. The triglyceride is stored (10 to 50% of the tissue dry weight) in most of the crop seeds. Phospholipid and glycolipids normally represent less than 2% of the total seed lipid. Amount of lipids in crop seeds endosperm varies e.g. in wheat (1 to 2%), 8 to 15% in

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wheat germ and about 6% of the bran, with an average of 2 to 4% in the whole kernel. Wheat germ oil consists primarily of triglyceride, whereas lipid extracts from endosperm and bran contain much higher proportions of phospholipids and glycolipids.

Minerals and Vitamin Composition of Seeds:

The analysis of total ash content of a plant one can find more than 60 elements in its ash. The amount of kinds of elements translocated to the grain are considerably less than those absorbed by the roots and translocated to the vegetative organs of the plant.

The synthesis of vitamins in plants is dependent on the available supply of inorganic nutrient (particularly of macro elements) ions from soil. Deficiency of macro nutrient elements decreases the concentrations of riboflavin. The level of vitamins B and E are high in cereal grains. Vitamin C is notably missing in significant amounts in these seeds.

CONCLUSION:

Understanding of physiological and biochemical processes is important when studying seed maturation. In the present years, many master regulator genes, their interaction, signaling and biosynthesis pathways related to seed maturation were well discovered. However, some new areas will have to be considered for future research work.

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Procedure of Map-based cloning for Blast R genes in Rice

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Sanjay kumar sanadya[1] and Smrutishree Sahoo[2]
[1]PhD Scholar, Department of Genetics & Plant Breeding, CSK HPKV, Palampur 176 062; [2]PhD Scholar, Department of Genetics & Plant Breeding, GBPUAT, Pantnagar 263 145

INTRODUCTION

Rice is an essential source of calories for much of the world's population but decreased yield due to blast is a serious threat to global food security. *Magnoporthe oryzae* causes the rice blast disease, is a hemibiotrophic, ascomycetous fungus that has been reported to infect more than 50 grass species. It is one of the most devastating of all cereal diseases worldwide, losses of 10-30 % of the global yield annually with more than 70 billion dollar economic losses (Scheuermann 2012). Rice blast could be effectively controlled through integrated use of cultural practices, resistant varieties, chemicals and biocontrol agents. This article reviews to study about the techniques used to identify the novel blast R gene and status of molecular basis of gene responsible for blast resistance in rice plants. Several studies indicated that the genetic control of blast resistance is a very complex and involves both major and minor resistance genes having complementary or additive effects, as well as environmental interaction Wu *et al.,* (2005). Blast-resistant rice varieties become rapidly susceptible due to the plasticity of the *M. oryzae* genome, which is able to evolve new race by mutation of the avirulence (Avr) genes that cause a breakdown of the deployed plant resistance conditioned by R genes. Thus, the discovery and use of novel R genes and development of broad-spectrum resistant varieties are urgent goals in breeding for blast resistance in rice (Valent and Khang 2010). Molecular markers are essential for mapping genes of interest, marker assisted breeding, Allele mining and cloning genes using mapping-based cloning strategies. Allele mining method has been used to identify superior alleles of rice blast resistance genes such as Pita Yang *et al.,* (2007), Pi54 Sharma *et al.,* (2005), Pi-2 Zhou *et al.,* (2006) etc. from different cultivated rice varieties and wild species. To date, more than 100 blast resistant R genes and more than 350 QTLs for resistance to blast have been identified and 27 have been molecularly cloned and sequenced.

Procedure of Map-based Cloning

Alfred H. Sturtevant presented the first concept of a genetic map in (1913) by ordering five sex-linked characters of Drosophila on the Y chromosome in a linear fashion. Map-based cloning is the process to recognize the genetic basis of a mutant phenotype with the help of linkage to markers whose physical location in the genome is known. Following steps to be used in map based cloning-

1. Linkage analysis

Linkage analysis is prerequisite step for the identification of resistant (R) gene. Firstly need to development of mapping populations for which one parent should be susceptible to blast disease with yield potential traits and another parent having resistance whether it may be mutant line, wild relatives or cultivars. Different types of mapping populations used for linkage mapping, i.e. F2, F2-derived F3 (F2:3), backcross inbred lines (BILs), doubled haploids (DHs), recombinant inbred lines (RILs), near-isogenic lines (NILs), chromosomal segment substitution lines (CSSLs), multi-parent advanced generation intercross (MAGIC), nested association mapping (NAM), etc. among them mostly used by plant breeder is NILs and RILs. From mapping populations, large number of individuals are randomly selected and tested with the help of flanking PCR markers such as SSR, SNP, RAPD, DArT, SCAR, CAPS etc. Subsequently the selected recombinants can be used to restrict the area containing the gene of interest to a region of approximately 0.025-0.050 cM. Following steps to be used for linkage analysis-

1) Use of molecular markers for parental polymorphism study (preferentially chromosome specific markers)

2) Parents differentiation at molecular level with molecular markers using DNA from the mapping population resistant and susceptible bulks
3) Markers differentiate these bulks to screen segregating population without any error
4) Compare the phenotypic and molecular data for linkage analysis by using software like QTL Cartographer and MAPMAKER etc. and prepare linkage map.

2. Physical mapping

The second step is to physically map the tightly linked marker by physical mapping through screening of the large-insert libraries. Three approaches are used to physical map construction.
In the first approach, low resolution YAC-based physical maps are constructed by DNA marker-based chromosome landing followed by a cosmid sub-cloning from the YAC contiguous clone set.
In the second approach, physical maps are developed from random BAC, cosmid or bacteriophage lambda clones by fingerprinting to identify contiguous overlapping clones.
In the third approach, a physical map may be developed by random sequencing about 10% of the genome, or about 500 bp from the two ends of enough BACs to encompass 15-fold the haploid genome. Among the three approaches, only BAC-based physical mapping is successful in plant species.

3. Gene cloning

Cloning means increasing the multiple copy number of gene of interest that can be done after identification and mapping of disease resistance genes. Success of map-based cloning in crop plants depends on the target gene being localized to a short genetic interval (co-segregates with the gene of interest or 0.1-0.01 cM) that the markers and target gene are separated from regions rich in repeated sequences. DNA fragment between the flanking markers are cloned and introduced into susceptible cultivar by genetic engineering technology called transformation. If transgenic plant expresses resistance, it confirms that the gene of interest is on that fragment.

4. Gene sequencing

After the successfully identification of gene of interest final step is to sequence the gene through several sequencing technique i.e. Illumina, Roche 454 Pyrosequencing, SMRT sequencing etc.

CONCLUSION

Recent advancements in rice genomics, especially the accessibility of complete genome sequences of rice subspecies *japonica* and *indica* and concomitant availability of an array of sequence-based molecular markers, have greatly facilitated detailed genetic analysis of blast resistance in rice. Genetic mapping and molecular cloning of different blast-resistance genes have provided a scale of tightly linked DNA markers for use in marker-assisted breeding. The efforts to achieve durable resistance using major race-specific genes are often vary due to the evolution of new races of the pathogen that negate the effect of resistance genes. Durable resistance against blast has been a priority area in rice breeding that increased durability through widely using Marker-assisted gene pyramiding practice.

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An insight in to the role betasatellite of begomovirus in pathogenesis

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Sumit Kumar[1*] and Sloka Kumari[2]
[1]Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221005, UP
[2]Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad 211007, UP

INTRODUCTION

Geminiviruses (family *Geminiviridae*) are plant-infecting DNA viruses which are considered one of the major threats for crop production worldwide. The *Geminiviridae* family encompasses a large number of plant viruses with circular and single-stranded DNA genomes that are encapsidated in twinned icosahedral particles consisting of two incomplete icosahedra (T = 1) that are approximately 22 × 38 nm. The *Geminiviridae* are currently divided into four genera, *Begomovirus*, *Mastrevirus*, *Curtovirus*, and *Topocuvirus*, on the basis of their genome organizations, host ranges, and insect vectors. Viruses in the genera *Mastrevirus*, *Curtovirus*, and *Topocuvirus* have a single genomic component, whereas those in the genus *Begomovirus* have either one or two components (Brown, 2012). The genome of begomoviruses consists of either monopartite or bipartite single-stranded circular DNA, with each component around 2600-2800 nucleotides in length (BD Harrison and DJ Robinson,1999) encapsidated in twinned icosahedral particles. In addition to the genomic components, satellite-like DNA molecules, of about 1350 nucleotides in length, called betasatellites, are widely associated with the diseases caused by some of the monopartite and bipartite begomoviruses occurring in the Old World (Briddon *et al*., 2003), DNA A of the Old World begomoviruses has six ORFs, designated AC1, AC2, AC3, AC4, AV1 and AV2, coding for proteins associated with replication, suppression of post-transcriptional gene silencing (PTGS) and the viral coat protein; DNA B has two ORFs, BC1 and BV1, encoding a movement protein and a nuclear-shuttle protein, respectively (CM Fauquet, 2008). The betasatellite molecules have a single ORF, bC1, encoding a multifunctional protein (Cui, 2005).

Betasatellites

Betasatellites are small circular single-stranded DNA molecules, each about 1.3 kb, primarily associated with the monopartite begomoviruses. This molecule has emerged as a serious threat to crop ecosystems of the tropical and subtropical regions of the world. Betasatellites have been found to be essential for inducing severe symptoms and to cause enhanced accumulation of helper virus in the host plants. In recent years, associations of betasatellites have also been observed with bipartite begomoviruses in the Indian subcontinent. Although this molecule does not share substantial sequence similarity with its helper virus, it solely depends on the helper virus for replication, cell-to-cell and long-distance movement in the host, encapsidation and insect transmissibility. Association of the betasatellite with the begomovirus disease complex aggravates the induction of symptoms and pathogenesis in the infected host plants. bC1, the pathogenicity determinant encoded by this satellite molecule, plays an inevitable role in the pathogenesis. The multitasking bC1 protein functions as a suppressor for both post-transcriptional gene silencing and transcriptional gene silencing, attenuates the host proteasomal machinery and suppresses the jasmonic acid response (Yang, 2008).

Betasatellite Functions

Betasatellites are essential for induction of typical disease symptoms and also have important roles in suppression of TGS and PTGS and in virus movement.

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1. **Suppression of posttranscriptional gene silencing**

Geminiviruses are both inducers and targets of PTGS. Virus-derived small-interfering (si) RNAs can be found in cells after infection of plants, and the levels of the siRNAs are negatively correlated with symptom severity. To counteract host defense systems, geminiviruses have evolved suppressors of RNA silencing (Bisaro, 2006). Like many other viral pathogenicity determinants, the βC1 proteins can function as RNA silencing suppressors. The reported βC1 suppressors include TYLCCNB-βC1, CLCuMuB-βC1, and βC1 proteins of betasatellites associated with *Bhendi yellow vein mosaic virus* (BYVMV), *Tomato leaf curl Java virus* (ToLCJAV), and *Tomato leaf curl China virus* (ToLCCNV) (Amin *et al*., 2011). The TYLCCNB-βC1 protein can bind single-stranded (ss) DNA and double-stranded (ds) DNA in vitro in a sequence nonspecific fashion, and a βC1 nuclear localization motif is required for suppressor activity. Nuclear localization of the βC1 protein of Tomato leaf curl China betasatellite is absolutely indispensable for silencing suppression, and the central portion of βC1 (amino acids 44 to 74) is critical for suppression silencing and nuclear localization (Yang *et al*., 2011). The CLCuMuB-βC1 protein has substantial nucleic acid binding activities that include DNA binding, dsRNA binding, and both long and short RNA binding with preferences for long RNAs (Tiwari *et al*., 2013). CLCuMuB-βC1 is also capable of suppressing systemic gene silencing, and co-inoculation of CLCuMuB- βC1 with a heterologous helper virus, ToLCV, resulted in reduced levels of ToLCV siRNAs. It is possible that the CLCuMuB-βC1 protein blocks the long-distance spread of PTGS signals by sequestering dsRNAs and/or siRNAs and preventing their incorporation into RNA-induced silencing complexes (Eini *et al*., 2012).

2. **Suppression of transcriptional gene silencing**

Geminivirus genomic ssDNAs replicate in the nucleus through dsDNA intermediates associated with cellular histones that form minichromosomes. The minichromosomes are potential targets for epigenetic repression, and plants employ RNA-directed methylation, which leads to TGS as a plant defense system against geminiviruses (Raja *et al*., 2010). As a counter-defense response, the AC2/AL2 protein of bipartite begomoviruses (e.g., CabLCV and TGMV) and the closely related curtovirus (e.g., BCTV and *Beet severe curly top virus*) C2/L2 protein have been implicated in suppression of methylation and thus TGS (146). We recently provided the first detailed analysis of the contributions of βC1 to methylation inhibition and suppression of TGS. Unlike most geminiviruses studied, TYLCCNV is susceptible to cytosine methylation and is not effective in suppressing TGS of a green fluorescent protein transgene in plants. In contrast, βC1 from TYLCCNB is able to mediate TGS suppression. Thus, coinoculation of TYLCCNB with TYLCCNV or BCTV *L2*-mutants, which are also deficient in methylation inhibition and TGS suppression (Hormuzdi and Bisaro 1995), can reverse established TGS, substantially reduce viral genome methylation, and reduce global cytosine methylation in host genomic DNAs.

3. **Movement**

Begomoviruses replicate in the nucleus and need to cross the nuclear envelope to reach the plasmodesmata (PD) in cell walls and from there they move into neighboring cells. DNA B of bipartite begomoviruses encodes a nuclear shuttle protein (NSP or BV1) and a movement protein (MP or BC1) required for local and systemic spread. The NSP functions in transport of viral DNA across the nuclear envelope, whereas the MP is required for cell-to-cell movement through the PD (Noueiry *et al*.,1994). For monopartite begomoviruses, the CP and V2 have been reported to function in these processes (93, 112). The CLCuMuB can also replace the movement functions of the DNA B component of ToLCNDV, and a CLCuMuB mutant containing a disrupted βC1 ORF is unable to mobilize ToLCNDV DNA A. Because the CLCuMuB-βC1 protein accumulates at the cell periphery and around and inside the nucleus, and colocalizes with the endoplasmic reticulum network, it has been suggested that the protein has an important role in intracellular transport from the nucleus to the cell periphery (Saeed *et al*., 2007).

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CONCLUSION

The βC1 proteins encoded by distinct betasatellites are multifunctional proteins that participate in induction of disease symptoms, in suppression of PTGS and TGS, and in virus cell-to-cell movement in host plants. The mechanisms by which βC1 suppresses TGS and PTGS are well documented.

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Genetically Modified (GM) Crops and Biosafety Evaluation

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Akankhya Guru[1*], Selukash Parida[2], & Soumya Kumar Sahoo[3]
[1]Department of Plant Physiology, IAS, Banaras Hindu University, Varanasi
[2]Department of Plant Physiology, COA,Odisha University of Agriculture & Technology, Bhubaneswar
[3]Department of Plant Physiology, COA, Indira Gandhi Krishi Vishwavidyalaya, Raipur

Genetic Modification – It is a technology that involves insertion of a specific stretch of DNA into the genome of an organism, giving it a new or different characteristic.

Genetically modified (GM) crops- Type of plants whose DNA has been altered through genetic engineering for imbedding a new trait to the plant which does not occur naturally in the species.

Area of genetically modified (GM) crops worldwide in 2018:

Country	Area (in million hectares)	Crops
United States	75	Maize, soybean, cotton, canola, sugarbeet, alfalfa, papaya, squash, potato
Brazil	51.3	Soybean, maize, cotton
Argentina	23.9	Soybean, maize, cotton
Canada	12.7	Canola, maize, soybean, sugarbeet
India	11.6	Cotton
Paraguay	3.8	Soybean, maize, cotton
China	2.9	Cotton, papaya, poplar
Pakistan	2.8	Cotton
South Africa	2.7	Maize, soybean, cotton
Uruguay	1.3	Soybean, maize
Bolivia	1.3	Soybean
Australia	0.8	Cotton, canola
Philippines	0.6	Maize
Myanmar	0.3	Cotton
Sudan	0.2	Cotton
Mexico	0.2	Cotton, soybean
Spain	0.1	Maize
Columbia	0.1	Cotton, maize

Advantages of GM crops

1. It eliminates the application of chemical pesticides and insecticides.
2. It reduces the market price of a crop.
3. It improves production and raise farmer's income.
4. It can produce more in a small area of land.
5. It provides more nutrition in terms of vitamin or mineral content.
6. It can feed a rapidly growing population due to increased yields.
7. It reduces global warming by decreasing the proportion of carbon dioxide in the atmosphere.

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8. There is the possibility of an increased shelf life.
9. It can save core crops from extinction.
10. It helps in conservation of energy, soil and water resources.

Disadvantages of GM crops

1. It may increase risk of allergies.
2. It can affect animal proteins.
3. It can be toxic to some organisms in the ecosystem leading to lowered level of biodiversity.
4. It may pose a threat to human health by creating new diseases.
5. It increases the cost of cultivation and more inclined towards marketization of farming that work on immoral profits.

Potential application of GM crops

- nutritional enhancement
- stress tolerance
- disease resistance
- biofuels
- phytoremediation

GM crops regulation

- GM crops are regulated at the federal level by the U.S. Department of Agriculture, Environment Protection Agency and Food and Drug Administration, each with authority to oversee specific aspects of crops and their products.
- Presently there are six competent authorities for implementation of regulation and guidelines in our country. Out of these, three agencies are involved in approval of new transgenic crops:
  1. Institutional Biosafety Committee (IBSC) –This type of committee is established at each institution for monitoring institute level research in Genetically Modified Organisms (GMOs).
  2. Review Committee on Genetic Manipulation (RCGM) - This type of committee is established at DBT to monitor ongoing research activities in GMOs and small scale field trials.
  3. Genetic Engineering Appraisal Committee (GEAC) – This type of committee is established in Ministry of Environment, Forest & Climate Change to authorize large - scale trials and environmental release of GMOs.

Major challenges for GM crops

- Biosafety concerns
- impact on environment
- ethical issues

What is biosafety?

Biosafety describes the principles, procedures and policies to be adopted to ensure the environmental and personal safety.

Biosafety concerns

1) Biosafety of human and animal health, for example, risk of toxicity due to the nature of the product or the changes in metabolism and composition of organisms resulting from gene transfer.

2) Ecological concerns – The gene flow due to cross-pollination for the traits involving resistance can result in development of tolerant weeds that are difficult to eradicate.
3) Environmental concerns – The gene escape into the environment, effect of transgenic plants on population dynamics of target and non-target pests, environmental influence on gene expression, development of resistance to herbicides.
4) Public attitude – The media, individuals, scientists, politicians and NGOs have the responsibility to educate the people about the benefits of GM foods.

Biosafety evaluation

Different technologies have been developed for evaluating GM crops:

- Targeted analysis – used to detect primary or intended but not unintended effects of genetic modification
- Profiling techniques – useful for evaluation of unintended effects. Transcriptome profiling has been used to characterize several GM crops including maize, barley and rice.
- Proteomics and metabolomics – complementary tools for GM crops evaluation.

Challenges for farmers for adoption of GM crops

- Higher price of GM seeds
- Lack of information about application of GM technology
- Limited global market due to growing skepticism towards GM foods

How to deal with these problems?

- Field testing of crops should be done due to fitness to agro-ecological features and suitability for farming condition prior to their introduction to farmers.
- Risks/benefits associated with GM crops should be carefully assessed with respect to the conditions of farmers who suffer the most in case of crop failure.

CONCLUSION

GM crops offer a promising solution to meet the world's food security needs in the foreseeable future. The government should provide access to use more GM crops to have a great recognition not only for scientists but also render greater service to farmers. With improvement in gene-integration technologies and emerging research in biofortification and stress tolerance, GM crops are expected to increase productivity as well as profitability in commercial agriculture in future.

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Nematode - Viral disease complexes in plants

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Mouniga. R *, Subasri. M and Srimathi. K
Research Scholars, Department of Nematology , Microbiology and Agronomy
Tamilnadu Agricultural University ,Coimbatore- 641003.

Plant parasitic nematodes favor the establishment of secondary pathogens viz., fungi, bacteria, virus etc. The nematodes alter the host in such a way that the host tissue becomes suitable for colonization by the secondary pathogens. In nematode – virus complex, nematode serves as a vector. They transmitting mostly RNA virus. Numerous virus – nematode complexes have been identified after the pioneer work by Hewit, Raski and Goheen (1958) who found that *Xiphinema index* was the vector of grapevine fan leaf virus. Mostly Dorylaimida group transmits the virus particle to the plants. Dorylaimids includes *Xiphinema, Longidorus, Trichodorus* and *Paratrichodorus.*

Characteristics of Dorylaimids:

- Odontostylet is present. Odontostylet is defined as there is no knob is present in their stylet region.
- All these nematodes have modified bottle shaped oesophagus with glands connected by short ducts directly to the lumen of the oesophagus.

Two types of virus transmission by nematodes:

- NEPO virus
- NETU virus or TOBRA virus

NEPO virus:

- NEPO viuses are abbreviated as Nematode Emitted Polyhedral Virus.
- NEPO viruses all possess polyhedral particles about 25-28 nm in diameter
- *Xiphinema* and *Longidorus* nematodes are main responsible for transmitting NEPO virus.

NETU virus:

- NETU viruse is abbreviated as Nematode Emitted Tubular virus.
- It is also called as TOBRA virus.
- Particle size is tubular and about 180-210 nm in size.
- *Trichodorus* and *Paratrichodorus*- transmitting the NETU virus.

Steps involved in virus transmission:

1. Acquisition
2. Retention
3. Dissociation
4. Transmission

Acquisition:

- It is the first step of virus transmission .
- Nematode feed on virus infected plant roots.

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Retention:

- Virus particles are present in a few days in a nematode body.
- Virus is retained in the inner surface of the guiding sheath of *Longidorus,* cuticle lining of the lumen of oesophagus in *Trichodorus* and *Paratrichodrous*, cuticle lining of stylet extension and oesophagus in *Xiphinema.* The virus particles are released into plant cell with the help of oesophagus.

Dissociation and transmission:

- The virus particles are dissociated from oesophagus to stylet region.
- Some enzymes will be secreted in the oesophageal gland, the virus particles were combined with enzymes and moves to the stylet region
- Finally secrete their saliva to the plant roots.

Examples for NEPO virus transmission:

Nematode species	Viral disease
X. americanum	Tomato ring spot, Tobacco ringspot
X. californicum	Cherry leaf mottle
X. diversicaudatum	Arabis mosaic virus
X. index	Grape fan leaf

Examples for NETU virus transmission:

Nematode species	Viral disease
Trichodorus viruliferous	Tobacco rattle and Pea early browning
Paratrichodorus minor	Corky ringspot of potato

Major Symptoms:

Grape fan Leaf virus

Tobacco Rattle Virus

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Sugarbeet -Docking Disorder

Corky Ringspot of Potato

CONCLUSION

Nematode- Virus disease complex plays a vital role in transmission of diseases. To manage the nematodes with nematicide to reduces the virus transmission in plants.

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Mango leafhoppers and their management

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Niranjana G N* and Kuldeep Sharma**
*Division of Entomology, ICAR-Indian Agricultural Research Institute, New Delhi 110012
**Department of Entomology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001

INTRODUCTION: Mango (*Mangifera indica* Linn.) is a popular and important tropical fruit crop in the world. It is the most preferred fruit of the sub-continent and is known as king of all fruits. Its popularity is mainly due to its excellent flavor, delicious taste, and high nutritive value being rich in vitamins A and C. It is a commercially cultivated important fruit of Indian sub-continent particularly India, Bangladesh, and Pakistan. However, the production of mango is enormously handicapped by the ravages of insect pests from seedling to their maturity. More than 300 insect pests have been recorded to attack mango crop. Amongst, mango leafhoppers are one of the most serious and widespread pests throughout the country, which causes heavy damage to mango crop. There are three species of mango leafhoppers present in India namely, *Amirtodus atkinsoni* Lethierry*, Idioscopus clypealis* (Leth) and *Idioscopus niveosparasus (nitidulus)* (Leth.) and are serious pests in the entire mango growing regions of India.

Biology: They remain active throughout the year but the incidence is severe during the months from February to April. Egg laying starts from February to March. Each female lays around 150 eggs, singly by inserting its ovipositor into florets and stalk of the inflorescence. The eggs hatch in 4 to 7 days. Freshly hatched nymphs are white and gradually turn yellowish-green and move rapidly on the plant. They undergo 4-5 moultings in 10-13 days and become adults which are light greenish-brown in color with black and yellow markings. Adult mango leafhoppers are golden-brown or dark brown, wedge-shaped insects about 4-5 mm in length. When disturbed, the adults jump off the plant with a clicking sound, fly a short distance and then quickly resettle on the plant. There may be 2-3 generations during the blossoming period. Adult hoppers are found all through the year hiding on the bark of the tree.

Damage symptoms: Both the nymphs and adults of the leafhoppers puncture and suck the sap from tender shoots, inflorescences, and leaves of mango, which affect development of flowers and dropping of immature fruits, thereby reducing the yield. The leafhoppers oviposit in the midrib and veins of leaves resulting in crinkling of leaves. Infested flowers shrivel, turn brown and ultimately fall off. Besides feeding injury, the leafhoppers also excrete honey dews on which black mould develops that interferes with photosynthesis and arrests new shoot development. In moist weather, it encourages the development of fungi like *Meliola mangiferae* (Earle), resulting in growth of sooty mould on dorsal surface of leaves, branches, and fruits. This black coating interferes with the normal photosynthetic activity of the plant, ultimately resulting in non-setting of flowers and dropping of immature fruits. On heavily infested trees, these damages result in weakening of the plants, reduction in fruit set and premature dropping of fruits, leading up to 60 per cent yield loss.

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Management:

- ✓ Avoid closer planting and prune dense orchard during winter for better light interception.
- ✓ Keep the orchard clean by regular ploughing and removal of weeds.
- ✓ Collect and destroy affected inflorescence.
- ✓ Spray any of the one insecticide during the incidence of leafhoppers *viz.,* Carbaryl at 2 gm/lit, Phosalone 1.5 ml/lit, imidacloprid 0.2 ml/lit twice in February and March. The first spray should be given during flower formation stage and the second, two weeks after the first spray.

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Bordeaux mixture, Bordeaux paste, Bordeaux paint

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Patil A. C[1] and Navale M. D[2]
[1,2]PhD Scholar, Department of Plant Pathology, VNMKV, Parbhani.

INTRODUCTION

In 1882, Millardet in France (Bordeaux University) accidentally observed the efficacy of the copper sulphate against the "downy mildew of grapes" caused by *Plasmopara viticola*. When copper sulphate was mixed with lime suspension, it effectively checked the disease incidence. The mixture of copper sulphate and lime was named as "Bouillie Bordelaise" (Bordeaux Mixture), Bordeaux mixture also called Bordo Mix. The original formula developed by Millardet contains (5 lbs of $CuSO_4$ + 5lbs of lime + 50 gallons of water). The chemistry of Bordeaux mixture is complex and reaction is ($CuSO_4 + Ca(OH)_2 = Cu(OH)_2 + CaSO_4$). The ultimate mixture contains a gelatinous precipitate of copper hydroxide and calcium sulphate, which is usually sky blue in colour.

Preparation of Bordeaux mixture (1%):

Materials required

1. Copper sulphate powder - 1 kg
2. Lime - 1 kg
3. Water - 100 litres

Methodology

- 1 kg of copper sulphate powder is dissolved in 50 litres of water.
- 1 kg of lime is powdered and dissolved in another 50 litres of water.
- Then copper sulphate solution is slowly added to lime solution with constant stirring or alternatively, both the solutions may be poured simultaneously to a third contained and mixed well.

Preparation of 0.5% Bordeaux mixture

Reducing the copper sulphate and lime half of the amount but keeping water same as 1% mixture preparation.

Use:

- 1% Bordeaux mixture is applied to hardy plant parts such as roots, stem.
- 0.5% of mixture is applied on leaf/foliage.

Tests to determine pH of mixture:

The mixture prepared gives neutral or alkaline mixture. If the quality of the used materials is inferior, the mixture may become acidic. If the mixture is acidic, it contains free copper which is highly phytotoxic resulting in scorching of the plants. Therefore, it is highly essential to test the presence of free copper in the mixture before application.

Several methods to test the neutrality of the mixture:

i. **Field Test**: Dip a well polished knife or a sickle in the mixture for few minutes. If reddish deposit appears on the knife/sickle, it indicates the acidic nature of the mixture.
ii. **Litmus paper test:** The colour of blue litmus paper must not change when dipped in the mixture.
iii. **pH paper test :** If the paper is dipped in the mixture, it should show neutral pH.

iv. **Chemical test**: Add a few drops of the mixture into a test tube containing 5 ml of 10% potassium ferrocyanide. If red precipitate appears, it indicates the acidic nature of the mixture.

v. If the prepared mixture is in the acidic range, it can be brought to neutral or near alkaline condition by adding some more lime solution into the mixture.

Precautions during preparation and application of Bordeaux mixture:

- Prepare solution in earthen or wooden or plastic vessels. Avoid using metal containers for the preparation, as it is corrosive to metallic vessels.
- Always copper sulphate solution should be added to the lime solution, reverse the addition leads to precipitation of copper and resulted suspension is least toxic.
- Bordeaux mixture should be prepared fresh every time before spraying.
- Bordeaux mixture is sometimes phytotoxic to apples, peaches, new shoots/leaf.

Advantages of Bordeaux mixture

- Farmers themselves can prepare it.
- Can act as fungicide, bactericide and algaecide.
- Applicable to tomato, potato, chilli, other vegetables, fruits (orange, lime, lemon), betel vine, ginger, flower and ornamental plant against various diseases such as foot rot, stem rot, leaf spot, leaf blight, anthracnose, canker, damping off, black spot, downy mildew, late and early blight etc.
- Copper sulphate and lime which is easily available in the market.
- It is less toxic to human as compare to other commercial fungicides.

Disadvantages

- Use the Bordeaux mixture soon after preparation.
- It causes phytotoxicity to plants when applied during the cold and cloudy weather.
- Do not use the Bordeaux mixture in combination with any other chemical or pesticide
- Bordeaux mixture should not be sprayed particularly on newly emerged tender foliage

Bordeaux paste

- It is mostly used while pruning as it is regular horticultural operation used of removing dead, diseased parts and to give shape to the fruit tree.
- Cut ends created during pruning need to be protected against infection by different pathogens by sealing with suitable fungicide pastes.
- As paste is the most effective wound dressing material.
- The fine layer formed on the cut ends kills the pathogen from subsequent invasion and rapid healing of the wounds.

Preparation of paste (1:1:10)

- Copper sulphate 1kg, quick lime 1 kg and water 10 litres
- Crush the copper sulphate crystals into powder and dissolve in 5 litres of water in a mudpot or plastic bucket.
- Prepare milk (solution) of lime in another 5 litres of water. Pour the copper sulphate solution into the milk of lime, slowly stirring the mixture all the while with wooden stick.

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- Test the mixture before use for the presence of free copper which is harmful to the plant by dipping a polished knife in it. If the blade shows a reddish brown colour add more lime till the blade is not stained on dipping
- Apply the paste on cut ends of trees with a brush

Bordeaux paint

- Bordeaux paint is applied for curing the deep and deformed wounds caused by cankers. gummosls, collar rot/root rot and to wounds resulting from surgical removal of crown gall or hairy roots from the stem of infected plants during dormant period.
- Protection of the treated plant part of the host against water for longer period, which ultimately ensuring rapid healing of wounds.

Preparation of paint:

- Copper sulphate 1 kg, quick lime 2 kg and boiled linseed oil 3 lit litres.
- Heat the copper sulphate crystals on an iron sheet or in frying pan till it crumbles into a white amorphous form.
- Ground the heated crystals into a fine powder
- Boil the linseed oil and allow it to cool
- Mix the Copper sulphate powder thoroughly with lime dust and homogenised in 3 litres of cooled oil to make a thick paste
- Apply the paint to the plant parts with the help or a brush up to 1m from the base of the tree
- Apply the paint during Feb-March, Sep-Oct. and Dec-Jan to protect the plant from soil borne pathogen.

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Diseases of banana and their management

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Rupeshkumar J. Choudhari
Assistant professor, Department of Plant Pathology
Kewalramji Harde College of agriculture, Chamorshi, Gadchiroli (MS)-442603.

INTRODUCTION

Banana (*Musa* sp.) is third important crop after mango and citrus occupying 5 per cent of fruit area in the state. It is a very important agricultural product viewed as breakfast cereal in most developed countries. After rice, wheat and milk products, it is considered to be the fourth most important food crop in world, based on gross value. Banana is being cultivated in India from antiquity; it has a great socio-economic significance and is closely interwoven in our national heritage. Banana is staple food that represent major dietary sources of carbohydrates, fiber, vitamins A, B_6, C and also potassium, phosphorus and calcium.

Bunchy top - viral disease

Banana is much more vulnerable to diseases than to the insect pests. The disease often occur in epidemic proportions and brings about catastrophic losses. Among the diseases, the banana wilt ranks first, in addition to fungal diseases, the bunchy top virus has created a situation of a dismal future for the banana industry.

Etiology of bunchy top virus:

The disease is caused by a virus named BBTV Banana Virus I or Musa Virus 1. The virus is systemic. The incubation period in the vector may range from 90 min. to 48 hrs. and the vector remains infective for about 13 days. The aphid attacks basal portion of pseudostem, upper leaf sheaths and petioles. The aphid may spread by (i) contact transfer from plant to plant (ii) movement over the soil (iii) fight (iv) movement of aphis-infected suckers.

Symptoms:

- ✓ Symptoms appear at stage of growth associated with occurrence of prominent dark green streaks on petioles and along leaf veins (Magee, 1953).
- ✓ In badly diseased plants leaves, bunch together, margins of lamina become wavy and slightly roll upwards.
- ✓ In case of secondary infections, irregular, dark green streaks occur along the secondary veins from series of dark green dots to a continuous dark green line.
- ✓ Severe stunting, non-elongation of leaf stalks, more erect leaves, non-production of bunches are other external symptoms.

Control:

- Regular inspection, roughing of diseased plants and planting virus free corms have reduced bunchy top disease in Australia.
- Adoption of strict quarantine measures.
- The diseased plants along with rhizomes should be destroyed as soon as they are detected (Capoor, 1967).

- Injection of monocrotophos solution diluted with water at 1:4 ratio at 30 day interval twice or thrice at 2-3 months after planting has been found effective.
- Anonymous (2005-06) initiated the development of transgenic Hill banana plants resistant to BBTV.

Panama disease or banana wilt

C.o. – *Fusarium oxysporum* f.sp. *cubense*

The first major disease which attacked banana was called Panama disease from the area where it first becomes serious.

Epidemology

Banana wilt is a soil borne fungal disease and gets entry in the plant body through roots and wounds caused by nematodes. It is most serious in poorly drained soil. Disease spreads through infected suckers. Warm soil temperature and bad drainage favours the spread of the disease (Stover, 1953).

Etiology of panama disease:

The fungus is a soil inhabitant. It can also survive saprophytically for a long period in the rhizome and other parts. The fungus, however, does not spread in the soil of banana plantations by vegetative growth. It's survival is influenced by soil moisture (Stover, 1953), soil texture, soil pH, etc. Significant infection takes place at or near root cap of lateral rootlets.

Symptoms:

- ✓ Initial symptoms appear in older leaves as characteristic yellowing which ultimately wither, break at petiole and hang down along the pseudostem.
- ✓ Young leaves may not dry immediately but are erect and also get affected later. If severe, entire foliage wilt within 2-3 days.
- ✓ Splitting of pseudostem, discoloured vascular region in rhizome are also seen.
- ✓ Longitudinal splitting of pseudostem, emittance of rotten fish smell when cut, stunting of plants, wilting and death of suckers are other symptoms of the disease.

Control:

- Selection of healthy suckers, avoiding injury to roots.
- The diseased plant should be uprooted and burnt.
- Basrai is immune (Kamat, 1941) and Poovan, Moongil, Peyladen, Rajabale, Vamanakeli are resistant variety (Ramkrishnan and Damodaran, 1956)
- Anonymous (1977) reported the use of resistant variety was the most effective way to manage the disease.
- Fernandez *et al.* (2003) suggested that the exogenous application of indoleacetic acid (IAA) to banana plants induce resistance to panama disease.
- Shamarao *et al.* (2003) research on the management of panama disease of banana using modified "Panchagavya mixture" (Mixture of cow milk, curd, ghee, dung and urine supplement with yeast and common salt) is reviewed.

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- Thangavelu *et al.* (2004) suggested that the soil application of *Trichoderma harzianum* (Th-10) as dried formulation effectively controlled fusarium wilt with an efficacy comparable to that of the carbendazim.
- Xu Wen Yao and Wu Gang (2004) studied the inhibitory effects of the mixture of hymexazol and bromothalonil on *Fusarium oxysporum* F. sp. cubense growth and spore germination.

Sigatoka or leaf spot

C.O. - *Mycosphaerella muscicola* (Sexual stage) *Cercospora musai* (asexual stage)

Sigatoka is the name of the valley where the disease first attracted attention. A monograph has reviewed information of leaf spot disease. It is a fungal disease. Causes severe economic losses. Attacks mostly leave.

Epidemology:

- ✓ Three components of weather, usually, determine the production and movement of sigatoka inoculum, rainfall, dew and temperature.
- ✓ Conditions favouring mass infection are most common during the rainy season with temperature above 21°C (Waller, 1976).
- ✓ Other factors, which influence the rate of disease developed and intensity of spotting, include amount of inoculum on the leaf, age and position of the leaf, plant growth, sun and shade effects on leaf tissue, etc.
- ✓ All triploid AAA desert banana of commerce are highly susceptible to sigatoka.

Etiology of sigatoka leaf spot:

Both conidia and ascospores can cause infection but conidia predominate for most of the period. Sporulation occurs principally on the upper surface of the leaf. Production, release and germination of both types of spores depends on free moisture and need temperatures above 21°C (Waller, 1976). Conidia produce germ tube in distilled or tap water within 48 hrs. at 20 or 25°C. Germination, germ tube growth and sporulation decline below 22°C (Stover, 1965). ascospores survive longest the shade with moderate temperatures.

Symptoms:

- ✓ Spots are concentrated towards the leaf edges.
- ✓ Streaks enlarge and form small spindle or eye shaped spots with greyish centre and dark brown or black borders and chlorotic halo around them.
- ✓ Disease first appears as pale yellow or greenish yellow streaks running parallel to leaf veins on both the leaf surfaces.
- ✓ Leaves present a scarched appearance, petioles collapse and leaves hang down from pseudostem. If severe, bunch maturity is affected.
- ✓ Early diseased plant produces poor fruits.

Control:

- ✓ Removal and burning infected leaves.
- ✓ Proper drainage, spacing, weed management are very important.
- ✓ Spraying of 1 per cent Bordeaux mixture + 2 per cent linseed oil for the control of disease (Raychaudhari *et al.*, 1972).
- ✓ Elango *et al.* (1997) studied the control of black sigatoka disease by using effective microorganism.
- ✓ Washington *et al.* (1998) studied the control of black sigatoka with Chlorothalonil.

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- ✓ Vargas *et al.* (2001) used a mixture of alternate systemic (Propiconazole) and protectant (mancozeb) fungicide is an effective option against black sigatoka in False Horn plantain.
- ✓ Mehta *et al.* (2005) studied the evaluation of hexaconzole against sigatoka leaf spot and leaf blight disease of banana.

Banana streak virus (BSV)

Symptoms:

- ✓ A prominent symptom exhibited by BSV is yellow streaking of the leaves, which becomes progressively necrotic producing a black streaked appearance in older leaves.
- ✓ The symptom expression is highly influenced by weather conditions and becomes severe in ratoon crops.
- ✓ The virus is transmitted mostly through infected planting materials, though mealy bugs (*Planococcus citri*) and more probably *Saccharicoccus sacchari* are also believed to transmit it.
- ✓ Shoot tip culture does not eliminate it from vegetatively propagated materials.

Control:

- ✓ Adoption of strict quarantine measures.
- ✓ Use of clean planting materials.
- ✓ Eradication of infected plants and control of vectors are effective in controlling the severity of the disease.

Bacterial wilt or moko disease

C.O. *Pseudomonas solanecearum*

Bacterial wilt is now know to occur in many countries in the tropics. In India, the disease was first observed in 1968 in West Bengal (Chattopadhya and Mukhopadhyay, 1968).

Epidemiology:

Bacteria are soil born. Spreads through use of diseased suckers for planting. In field disease spreads through irrigation water, implements and insects. Infection is favoured by root injury.

Etiology:

The disease can occur in poorly drained soils. The primary infection occurs through injured roots. The root and pseudostem wounding are important in direct infection of Musa species. The disease may not spread only by transporting infected planting material but also by agents that more infested soil, debris, etc. The bacterium can also be transmitted by insects.

Symptoms:

Affected plants show more or less rapid wilting and collapse of leaves with a characteristic discoloration of vascular bundles, wilting and blackening of suckers. If pseudostem and rhizomes are cut, a characteristic bacterial oozing as shiny drops can be noticed for besides vascular discoloration. In Cavendish varieties, lower leaves develop a yellowish tinge which soon spreads to other leaves of the plant, which subsequently droop and petioles break at the junctions of lamina or pseudostem. Production of yellow fingers, discolored vascular bundles of fruit stalks and internal dry rot of fruit can also be noticed.

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Control:

- ✓ Disease can be minimised by exposing soil to sunlight.
- ✓ Selection of healthy planting material, eradication of infected plants.Disinfecting cutting knives and providing better drainage.
- ✓ Flower visiting insects are main agents for transmitting the disease and this is a good reason for following the practice of removing the bud from the male axis before the bunch matures.
- ✓ Herbicides, e.g. 2, 4-D and 2, 4, 5-T can be used to kill infected plants *in situ* and dieldrin sprayed onto a chopped down mat will prevent insects transmitting the disease to the unaffected plants.

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Atlas of stress in rice crops

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Selukash Parida[1]*, Akankhya Guru[2] & Soumya Kumar Sahoo[3]
[1]Ph.D. Scholar, Department of Plant Physiology, COA, OUAT, Bhubaneswar,
[2]Ph.D. Scholar, Department of Plant Physiology, IAS, BHU,Varanasi
[3]Ph.D. Scholar, Department of Plant Physiology, COA, IGKV, Raipur

Mainly abiotic stresses compromises plant performance and yield in many habitats and in agriculture. In addition to survival under such stress period, depends on plant-genotype-specific characteristics, stress intensity and duration, also the efficiency of plant performance. An abiotic stress enhances production of reactive oxygen species (ROS) and reactive nitrogen species (RNS) which in turn affect the redox regulatory state of the rice plants. Strong correlative and analytical support assigns a major role in stress tolerance to the redox regulatory and antioxidant system. This article compiles the response and function of cells under different stress in diverse species. The meta-analysis of reported changes in transcript and protein amounts, and activities of components of the antioxidant and redox network support the tentative conclusion that stress tolerant is more tightly linked to up-regulated ascorbate-dependent antioxidant activity than to the response of the thiol-redox regulatory network. The significance of the antioxidant system in surviving severe phases of stresses is further supported by the strong antioxidant system usually encountered in resurrection rice crops.

INTRODUCTION

During their ontogenesis, rice crops face a dynamically changing environment defined by abiotic factors (e.g., light/dark, temperature, nutrient and water availability, and toxic compounds such as heavy metals) and biotic interactions (e.g., beneficial and pathogenic microbes, fungi, insects, and other herbivores). Environmental perturbations which extensively disturb metabolism, development and yield, are considered as stress situations and cause stress responses in biological system. Such imposed stress is frequently accompanied by an increase in the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS) that guide to a disparity between their production and scavenging. ROS and RNS are also key components of signal transduction pathways that activate stress responses. Furthermore, ROS and RNS are involved in plant developmental processes and plant-microbe interactions. However, excessive ROS and RNS production must be counteracted by the antioxidant system to prevent damage of cell death. Generally water stress triggers water loss and a decrease in water potential, which concomitantly leads to a reduction in cell turgor. These responses include osmotic, decreased shoot-root ratio, cell wall modifications, reprogramming of metabolism and activation of the antioxidant system.

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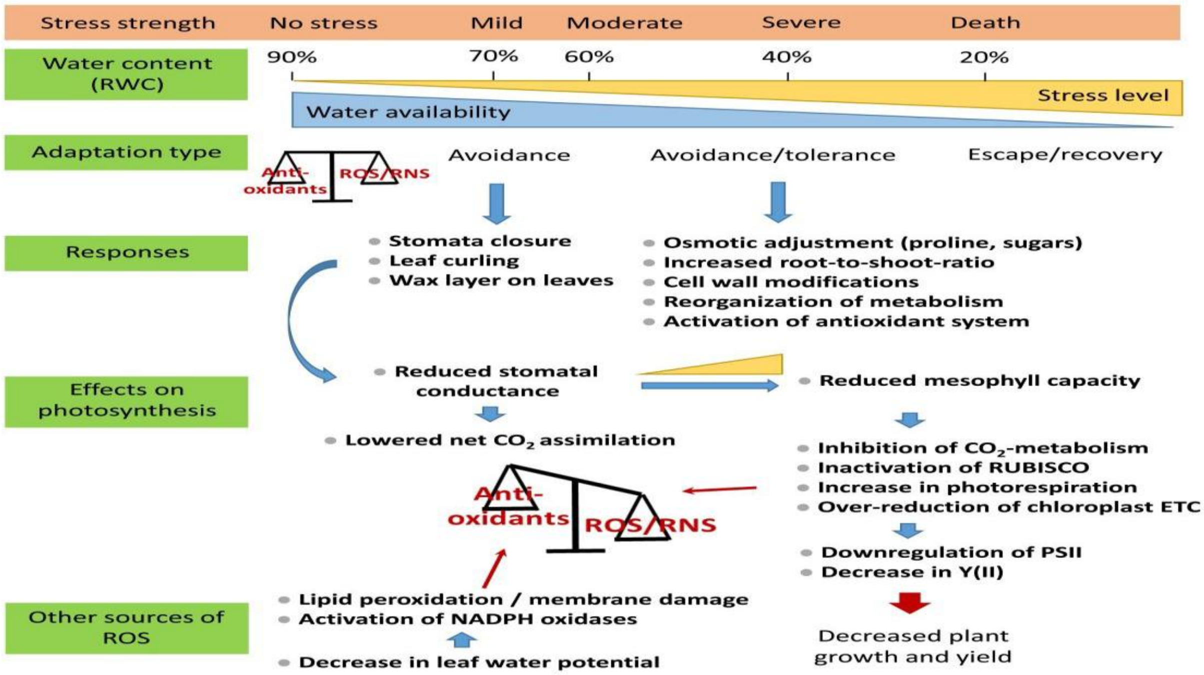
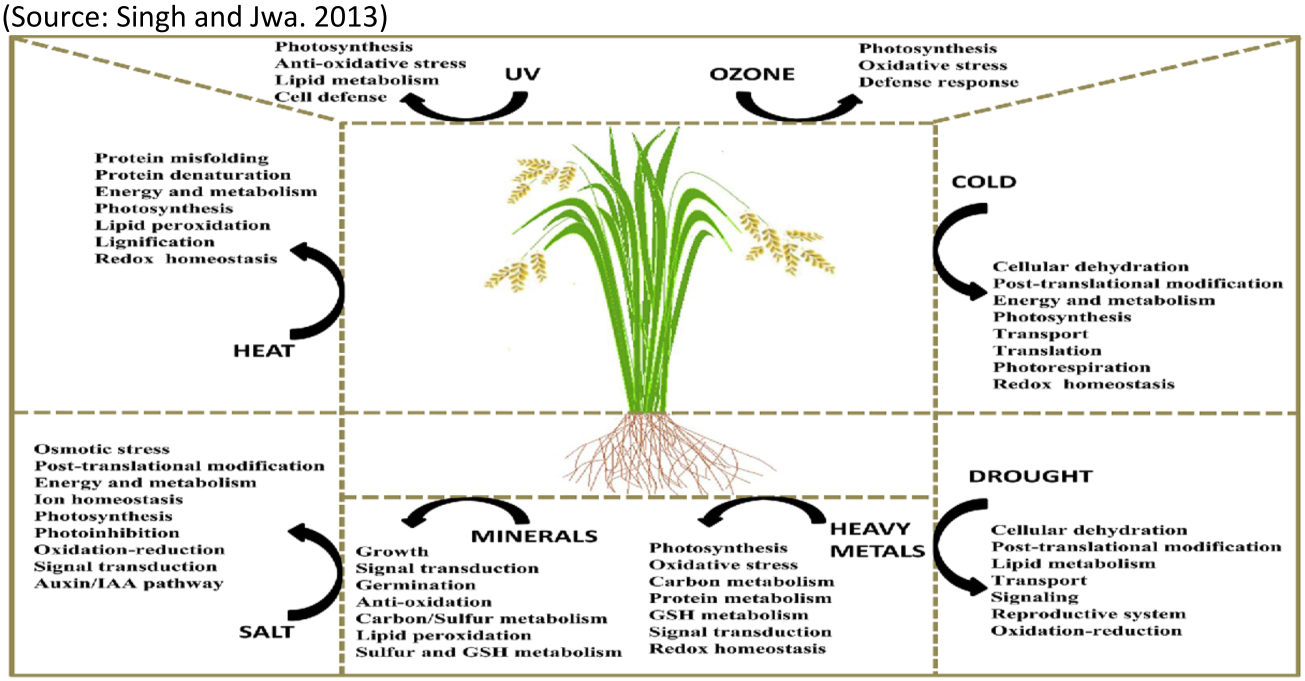


Measurable traits are, for example, the stomatal and mesophyll conductance, net photosynthesis, and photorespiration, abundance of osmoprotectants, tissue water potential, ABA content and membrane integrity. Water stress avoidance includes morphological adaptations, like leaf curling and increased wax deposition on the leaf surface.

(Source: Singh and Jwa. 2013)



Common Abiotic Stress Responses in Rice

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Perspectives in designing climate resilient rice

- Implementing approaches to improve yield along with the enhancement of grain number per panicle and also an alteration in spike architecture.
- Source-sink relationships under stress environments require adjustment.
- Activation of the chalky phenotype may also be due to unevenness in the finer modifications with the starch degradation pathway during grain filling.
- Retaining systems biology approaches such as regulatory networks and flux balance analysis, in addition to systems genetics techniques, can assist in interpreting the complete assessment of grain quality perturbations to numerous types of abiotic stress factors (high day and night temperature stress with drought, humidity, salinity, and augmented carbon dioxide), which co-occur in nature.
- Use marker-assisted assortment approaches for selection of tolerant genotypes that appropriate for stress prone atmospheres.
- Choose superior germplasm with higher ability to crop yield under numerous environmental conditions as a source of in-breds.
- Produce hybrids having stress resistance with greater yield ability as a main target

CONCLUSION

To feed the growing population, we need to solve the abiotic stress problem in rice and this is the principal challenge for agriculturist. The different types of abiotic stresses are affecting plant growth, development, productivities, and their survivability. Those crops and plants sustain in stress conditions which can change their physiological and biological properties due to an expression of cold, heat, drought, salinity and alkalinity were called as tolerant. The hormonal imbalance, nutrient mobilization, ion toxicity and susceptibility are continue affect the plant growth and development due to various stress under the current scenarioDespite the discovery of lots of genes, still it is a bigger challenge to meet the demand. Taking everything into account, to bolster the regularly developing populace, we have to tackle the abiotic anxiety issue in rice and this is the central test for plant biotechnologist. In spite of the disclosure of heaps of qualities, still it is a greater test to take care of the demand. We can express that examining anxiety reaction in rice remains a striking, remunerating and animating contention of examination, with vital results at both natural and social levels as a result of the progressing worldwide environmental change and the anticipated increment of the world population..

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Soil solarization an ecofriendly approach to control harmful soil inhabiting organisms

Article id: 23560

Venkatesh Iddumu[1], Vineeth Vijayan[2], Sahil Mehta[3]
Ph.D. Scholar 1,2, ICAR-Indian Agricultural Research Institute, New Delhi-110012 Ph.D. Scholar3, Crop Improvement Group, International Centre for Genetic Engineering and Biotechnology, New Delhi-110067

INTRODUCTION

Panic over environmental hazards and increased public consciousness on human health issues caused by pesticides resulted in directed towards alternative practices for chemical pest control. Soil solarization is an advanced technology for control of soil borne diseases. This technology first time developed in Israel for the management of plant diseases. Soil solarization is a non-chemical disinfestation practice. It increases the availability of soil mineral nutrients, reduces crop fertilization supplies and results in improved plant growth and yield. Solarization was originally developed to control soil-borne pathogens but it was soon found as an effective treatment against a wide range of other soil-borne pests and weeds including fungal plant pathogens, a few bacterial pathogens, nematodes and many weeds. The intrinsic worth of solar energy is not a new thing; however, the innovation in developing soil solarization is the use of plastic sheets. Thus, discharge of this technology is easy to accomplish under a wide range of crop production systems. Soil solarization is based on utilizing the solar energy for heating soil mulched with a transparent Polythene (PE) sheet, reaching a level of 40-55ºC in the top 5 cm soil layer. During day time it increases 13-16 ^{0}C than in night normal temperature. There is a temperature gradient from the upper to lower soil layer during the appropriate season. The temperature increase is facilitated by wetting the soil before and/or during mulching with the PE sheet. The main factor implicated in the pest control process is the physical mechanism of thermal killing. In addition, chemical and biological mechanisms are also involved in the pest control process. Successful example of soil solarization is reported in Jharkhand to control of damping off of chilli, tomato and brinjal.

Pathogens to be managed by Soil solarization technique

Fungal pathogens

Fusarium, *Verticillium*, *Pythium* and *Phytophthora*

Bacterial pathogens

Clavibacter michiganensis

Nematode pathogens

Ditylenchus
Pratylenchus

Soil solarization: Attempt to reduce or eliminate pathogen populations in the soil by covering the soil with clear plastic so that sun rays will raise the soil temperature to levels that kill the pathogen.

Principles of soil solarization

The fundamental principle of soil solarization is to lift up the temperature in a moist soil to a level that directly lethal to harmful disease causing organisms. The heating process also induces other environmental and biological changes in the soil that indirectly influence soil-borne pests as well as survival of beneficial organisms. The values of the maximum soil temperature and amount of heat accumulated decide the potential of the thermal killing effect on soil-borne pests and weed seeds. At present, the most common practice of soil solarization is based on mulching moistened soil with transparent PE. The duration of soil mulching that is essential for successful effect is generally four to six weeks, depending on the pest, soil characteristics, climatic conditions and the PE properties. Pest population and environmental conditions are uncontrollable variables, while soil moisture and PE properties could be modified as needed. Soil pre-treatment and suitable PE technology may beat unfavorable environmental conditions

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existing in some regions or in certain seasons, increasing weed (or pest) sensitivity and soil, shortening soil mulched duration. Soil moisture improves temperature conductivity in soil and the sensitivity of microorganisms to toxic agents. Hence, pest control is better under "wet heating" than "dry heating". This applies also to weed control, presumably because moist seeds are in a more advanced metabolic activity. Therefore, all soil pretreatments that improve water capacity, such as soil cultivation or drip irrigation during mulching, may improve soil solarization efficacy. Drip irrigation during the solarization process is vital for maintaining a wet soil surface, enabling the heat transfer to deeper layers. Moreover, good soil preparation that leads to a smooth soil surface facilitates plastic mulching and prevents tearing.

Use of organic amendments for Bio-fumigation

The use of organic amendments such as animal manure or cover crop residues combined with soil solarization may further lift up the soil temperature by an additional 1–3ºC. This amplify is a outcome of the improved thermal conductivity in moist soil, exothermic microbial activity or a combination of both. Combining soil solarization with organic amendments leads to the generation of toxic volatile compounds that build up under the plastic mulch and consequently increase the vulnerability of soil organisms to soil solarization. The nature of these volatiles may differ with respect to the origin of the organic matter, in particular when a high soil temperature is employed. The type of plant residues or manure incorporated into solarized soil may produce quantifiable amounts of volatiles such as ammonia, methanethiol, dimethyl sulfide, allylisothiocyanates, phenylisothiocyanates and aldehydes. These compounds build up under the PE to the level at which toxic to soil flora and fauna. The high soil temperature also increases the sensitivity of soil pests to the toxic effect of the captured volatiles. For example iso-thiocyanates released by turniprape in mulched soil curb weed infestation in the field. High concentrations of isothiocyanates in soil strongly suppressed the germination of several weeds and crops, such as scentless mayweed, smooth pigweed, barnyardgrass and blackgrass.

Plastic mulch used for soil solarization

All types of transparent PE sheet used in agriculture are appropriate for solarization purposes. Part of the solar radiation is passed through the transparent PE, absorbed by the soil surface and changed to conserved heat. Some PE sheets vary in their chemical and physical properties such as thickness, colour and wavelength transmission, UV protection and durability. The PE largely prevents the escape of long-waves radiation and water evaporation from the soil to the atmosphere, consequently exerting a greenhouse effect. In addition, the water vapours accumulated on the inner surface of the PE sheet further improve the greenhouse effect, resulting in higher soil temperatures. Black PE absorbs most of the solar radiation and heats up but does not transmit the radiation, due to the insulating air layer between the plastic mulch and soil surface. Thus, black plastic mulch usually provides a lower soil temperature and poorer pest control. Thin PE is economically cheaper and reflects less radiation than the thicker sheet, resulting in a slight increase in soil temperature. Unfortunately, thin PE tends to deteriorate faster than the thicker layer under field conditions. Previously used PE for soil solarization is more efficient in temperature increase than new PE due to improved radiation influx at the soil surface.

Advantages of soil solarization

1) Antagonistic microbes population increased in the soil
2) Increase the release of mineral nutrients
3) Solarized soils are less prone to diseases and checks the weeds growth
4) Stimulate the plant hormones resulted in improves the crop growth

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Limitations of soil solarization

1) This process takes longer time
2) It can be done during April-May months
3) Depends on the country, the crop type
4) solar radiation availability
5) Land should be level and irrigate to create moist heat
6) Adding of bio-control agents after the completion of soil solarization process only
7) The soil is occupied for at least one month with the mulch
8) It is difficult to protect the PE sheets from damage caused by wind and animals
9) There is no full environmentally-accepted solution for the used PE
10) Not all soil-borne pests and weeds are sufficiently controlled
11) Not cover the large area

CONCLUSION

The worldwide changes and the stable increase in the erosion of the natural ecosystem highlight the importance of soil solarization as a viable environmental IPM tool in crop production systems. The effectiveness of soil solarization to control soil-borne pests is well confirmed under a range of agro-ecosystems, especially in regions of elevated solar radiation. Upcoming research should aim at the development of better technology which is cheaper and more environmentally accepted mulching technology; large-scale application technologies; and new plastic formulations for improved soil temperature transmission in the soil. These improvements should expand the use of this technology beyond the season limitations and make soil solarization suitable for marginal climatic regions and for less valued crops. In addition, these improvements will enlarge the range of the controlled pests and lessen the duration of the process.

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Studying fungi as tools of biological research

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Venkatesh Iddumu[1], Vineeth Vijayan[2], Sahil Mehta[3]
Ph.D. Scholar1,2, ICAR-Indian Agricultural Research Institute, New Delhi-110012 Ph.D. Scholar3, Crop Improvement Group, International Centre for Genetic Engineering and Biotechnology, New Delhi-110067

INTRODUCTION

Most of us read on a daily basis about the implications associated with fungi on human health. As per the definition, fungi are usually filamentous eukaryotic, spore bearing, achlorophyllous organisms having cell wall with absorptive mode of nutrition that generally reproduce with both asexual and sexual reproduction. This group includes yeasts, mushrooms and molds. However, the remarkable members of this big eukaryotic kingdom deserve a respect because of their beneficial contribution to the human society. For example, the fungi have been a source of food for numerous generations; as a result, today there is a massive range of edible mushrooms that are being cultivated in a multiple parts of the world. Furthermore, many other food products of regular use such as soy sauce, blue cheese are produced by *Saccharomyces rouxii* and *Penicillium roquefortii*, respectively. In the same way, fungi are being employed to control pests, make bread and produce alcohol, beer. Most importantly, they are being used in manufacturing of million-dollar valued drugs/antibiotics like cyclosporin A, amoxicillin, pravastatin, simvastatin and lovastatin. Apart from this, they are employed as leavening agent for bread, fermentation of beer as well as in detergent making. They perform essential roles like organic matter decomposition, nutrient cycling/exchange and biological control of weed and pests**.**

Fungi as Research Tools

A model organism is a non-human species that is extensively studied to understand particular biological phenomena, with the expectation that discoveries made in the organism model will provide insight into the workings of other organisms. Model organisms are widely used to explore potential causes and treatments for human disease when human experimentation would be unfeasible or considered less ethical. This strategy is made possible by the common descent of all living organisms and the conservation of metabolic and developmental pathways and genetic material over the course of evolution. Studying model organisms can be informative, but care must be taken when generalizing from one organism to another.

Because of their small size, ease of culture and manipulation, and their short life cycle, many members of fungi have been great tools for various kinds of research. Several articles are already there in the literature regarding the role of fungi in medical and industrial research, however, in order to get the desired products like foods, medicines and beverages in a optimum manner, the most important thing is to understand the genome. As a result, the common bakers or brewer's yeast, *Saccharomyces cerevisiae* was the first eukaryote to have its complete genome mapped.

Similarly, several pivotal discoveries were made by using fungi as model organisms, for example, one gene-one enzyme hypothesis (*Neurospora crassa*). Other important model fungi are *Aspergillus nidulans*, *Schizosaccharomyces pombe*, *Ashbya gossypii*, *Coprinus cinereus*, *Schizophyllum commune* and *Ustilago maydis*. Few of the model fungi have been discussed as following:

1. *Neurospora*

It is particularly well suited for genetic studies because

- Quick growth on simple culture medium
- Any recessive mutations show up in its phenotype

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- Meiosis I->Meiosis II->Mitosis is followed in the ascus.
- No crossing over occurs during meiosis I, as a result, the ascus will finally have four spores at one end containing one allele (a) and four spores at the other end containing the other allele (A).

It was used by Edward Tatum and George Wells Beadle to propose the "one gene, one enzyme" hypothesis that specific genes code for specific proteins. Similarly, the spore colour segregation has been also deduced in *Neurospora*. It clarified the doubt that segregation for a single gene produces equal frequencies of the two types of spores (or gametes). Additionally, the circardian clock mutants showing a gene-dosage effect on period length have been also reported in *N. crassa.*

2. *Aspergillus nidulans*

Aspergillus nidulans (Teleomorph = *Emericella nidulans*) is one of important homothallic fungal research species of phylum Ascomycota for over 50 years. It have been used to study a wide range of subjects including recombination, DNA repair, mutation, cell cycle control, tubulin, chromatin, nucleokinesis, pathogenesis, mitochondria evolution and metabolism. It is well-suited for genetic studies as

- Able to form sexual spores through meiosis which allowing crossing of strains in the laboratory.
- Able to self-fertilize and form fruiting bodies in the absence of a mating partner.
- Genome size=30 million bp in size, Total chromosomes=8.

3. Yeast

Saccharomyces cerevisiae is a perhaps a most useful yeast that owe to usage in baking and brewing since the ancient times. It was originally isolated from the skins of grapes and plums. It is one of the most intensively studied eukaryotic model organisms in molecular and cell biology. Multiple proteins of human biology importance such as cell cycle proteins, signaling proteins, and protein-processing enzymes were first discovered by studying their homology in yeast; these proteins.

CONCLUSION

Fungi used as food for example mushrooms. Fungi used in production of antibiotics, commercially valuable enzymes, bio-herbicides and alcohol etc. Fungi like *Saccharomyces cerevisiae, Neurospora crassa* are used in genetics to study the valuable functions of the genes. One gene one enzyme and gene for gene hypothesis are also observed in fungi. So that fungi is very important in studies of biological research.

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Vertical Farming - More Sustainable Agriculture

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M. Nithish Kannan
B.Sc.(Hons) Agriculture, Undergraduate Student, Imayam Institute of Agriculture and Technology (Affiliated to TNAU), Trichy, Tamil Nadu - 621206

INTRODUCTION

Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled environment agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics, and aeroponics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned mine shafts. The main advantage of utilizing vertical farming technologies is the increased crop yield that comes with a smaller unit area of land requirement. The increased ability to cultivate a larger variety of crops at once because crops do not share the same plots of land while growing is another sought-after advantage. Additionally, crops are resistant to weather disruptions because of their placement indoors, meaning fewer crops lost to extreme or unexpected weather occurrences. Lastly, because of its limited land usage, vertical farming is less disruptive to the native plants and animals, leading to further conservation of the local flora and fauna.

Techniques of vertical farming

Hydroponics

Hydroponics refers to the technique of growing plants without soil. In hydroponic systems, the roots of plants are submerged in liquid solutions containing macronutrients, such as nitrogen, phosphorus, sulphur, potassium, calcium, and magnesium, as well as trace elements, including iron, chlorine, manganese, boron, zinc, copper, and molybdenum. Additionally, inert (chemically inactive) mediums such as gravel, sand, and sawdust are used as soil substitutes to provide support for the roots. The advantages of hydroponics include the ability to increase yield per area and reduce water usage. A study has shown that, compared to conventional farming, hydroponic farming could increase the yield per area of lettuce by around 11 times while requiring 13 times less water. Due to these advantages, hydroponics is the predominant growing system used in vertical farming.

Aquaponics

The term *aquaponics* is coined by combining two words: *aquaculture*, which refers to fish farming, and *hydroponics*—the technique of growing plants without soil. Aquaponics takes hydroponics one step further by integrating the production of terrestrial plants with the production of aquatic organisms in a closed-loop system that mimics nature itself. Nutrient-rich wastewater from the fish tanks is filtered by a solid removal unit and then led to a bio-filter, where toxic ammonia is converted to nutritious nitrate. While absorbing nutrients, the plants then purify the wastewater, which is recycled back to the fish tanks. Moreover, the plants consume carbon dioxide produced by the fish, and water in the fish tanks obtains heat and helps the greenhouse maintain temperature at night to save energy. As most commercial vertical farming systems focus on producing a few fast-growing vegetable crops, aquaponics, which also includes an aquacultural component, is currently not as widely used as conventional hydroponics.

Controlled-environment agriculture

Controlled-environment agriculture (CEA) is the modification of the natural environment to increase crop yield or extend the growing season. CEA systems are typically hosted in enclosed structures such as greenhouses or buildings, where control can be imposed on environmental factors including air, temperature, light, water, humidity, carbon dioxide, and plant nutrition. In vertical farming systems, CEA is often used in conjunction with soilless farming techniques such as hydroponics, aquaponics, and aeroponics.

Types of vertical farming

1. Building-based Vertical Farms

Abandoned buildings are often reused for vertical farming. However, new builds are sometimes also constructed to house vertical farming systems.

2. Shipping-container Vertical Farms

Recycled shipping containers are an increasingly popular option for housing vertical farming systems. The shipping containers serve as standardized, modular chambers for growing a variety of plants, and are often equipped with LED lighting, vertically stacked hydroponics, smart climate controls, and monitoring systems. Moreover, by stacking the shipping containers, farms can save space even further and achieve higher yield per square foot.

3. Deep Farms

A “deep farm” is a vertical farm built from refurbished underground tunnels or abandoned mine shafts. As temperature and humidity underground are generally temperate and constant, deep farms require less energy for heating. Deep farms can also use nearby groundwater to reduce the cost of water supply. Despite low costs, a deep farm can produce 7 to 9 times more food than a conventional farm above ground on the same area of land.

Advantages

- **Agricultural Efficiency**

Vertical farming also allows for the production of a larger variety of harvestable crops because of its usage of isolated crop sectors. As opposed to a traditional farm where one type of crop is harvested per season, vertical farms allow for a multitude of different crops to be grown and harvested at once due to their individual land plots.

- **Resistance to Weather**

Crops grown in traditional outdoor farming depend on supportive weather and suffer from undesirable temperatures, rain, monsoon, hailstorm, tornado, flooding, wildfires, and drought. As with disruption to crop growing, local container-based farms are also less susceptible to disruption than the long supply chains necessary to deliver traditionally grown produce to remote communities.

- **Environmental Conservation**

Deforestation and desertification caused by agricultural encroachment on natural biomes could be avoided. Producing food indoors reduces or eliminates conventional plowing, planting, and harvesting by farm machinery, protecting soil, and reducing emissions.

CONCLUSION

Vertical farming has the potential to significantly increase food production while reducing the environmental footprint of the agricultural sector by reducing land, water, chemical and fertilizer use and increasing overall efficiency. The main barriers to vertical farming implementation are the large upfront costs. While vertical farming can help improve a community's economic and social bases, most of the debate surrounding its sustainability is centered on its environmental base. Sustainability also depends on the efficient use of local resources such as water and land. Vertical farms also achieve a higher crop yield.

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Stevia as potential cash crop in Haryana

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Ravi Kumar[1*] and Reetika
[1*]Research Scholar, Department of Processing and Food Engineering, COAE&T,
[2]Research Scholar, Department of Horticulture, College of Agriculture,
CCS Haryana Agricultural University Hisar-125 004, Haryana

INTRODUCTION

The world is fighting with several health issues of which, diabetes is more common among individuals aged over 50 years. India has over 70 million diabetic people, second only to China's 11 crore. In addition to this, the new class of health-conscious people emerging out of every stratum of society. Artificial sweeteners-like aspartame, sucralose, and saccharin (85% of the global sugar substitute pie) are being questioned for possible traces of carcinogenicity. Stevia on the other hand is an alternate to artificial sweeteners (Singh *et al*., 2015). Stevia is also known as meethi tulsi by Indians. Stevia is 300 times sweeter than sugar and its sweetness is derived from a class of compounds called steviol glycoside. Like sugar, it is a compound of carbon, oxygen, and hydrogen, but much more complex (Goyal *et al*., 2010). The human body is unable to metabolize it. When added to food it does not add to the calories, while sweetening the taste.

Stevia extract is now imported at the price of Rs 5.5-6.5 lakh for 1 Quintal consignment. A local produce would be a big help. The stevia products market is expected to grow upto 500 crore by 2022 (Yadav *et al*., 2013). To help farmers, the National Medicinal Plants Board (NMPB) has also announced a 20% subsidy on the cost of production to farmers.

The stevia plant have little water requirement (5% of sugarcane). While, over 100 stevia-based products are already on Indian shop-shelves (Halli *et al*., 2016). Brands like Amul, Mother Dairy, PepsiCo (7Up), Coca-Cola (Fanta) are also in the game as are a few stevia focused start-ups. Malaysian PureCircle, a stevia supplier, has said to invest 1,200 crore in India over five years and is working with Dabur, Frooti and Haldiram to create their stevia-based variants (Maitra *et al*., 2015). It also supplies for Zydus's stevia based sweetener SugarFree Green.

Cultivation: Stevia is relatively easy to cultivate. It requires 1500 mm rainfall. The best time to grow stevia is the months of February-March. Stevia is propagated by stem cuttings. The stem length should be 15 cm and it should be from leaf axil and that too of current year's growth. Seedlings become ready for transplant after one month. Plant the seedlings at a spacing of 30 cm plant to plant and 45 cm row to row. This way 20,000-25000 plants can be grown in 1 acre. A fertilizer dose of 28:113:113 kg/ha of NPK is recommended (Ahlawat *et al*., 2019). This crop requires frequent light irrigation in the summer months and very less water in winter months. Avoid water stagnation. Spray NSKE in case of some disease or pest.

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Harvest: Stevia becomes ready for harvest when the stem length becomes 50-60 cm usually after 4-5 months of planting. The plant should be harvested just before flowering and either the leaves or the whole plant is cut leaving 15 cm portion above the soil part of the plant. It can be harvested for 3 months in 3 years. 25-27 quintals per acre yield can be obtained. After harvesting, dry the plant part in shade for 2 days, separate the leaves and store the powdered form of leaves in dry containers (Goyal *et al*., 2010).

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High-Tech Nursery rising of Horticultural Crops

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Reetika[1*] and Ravi Kumar[2]
[1*] Research Scholar, Department of Horticulture, College of Agriculture,
[2] Research Scholar, Department of Processing and Food Engineering, COAE&T,
CCS Haryana Agricultural University Hisar-125 004, Haryana

INTRODUCTION

India is supplied with an amazingly heterogeneous region characterized by an extraordinary decent variety of agro climatic zones, taking into consideration of an assortment of horticultural crops, for example fruits, vegetables, flowers, spices, plantation crops, root and tuber crops, and medicinal and aromatic crops. Under farming sector, horticultural crops assume an exceptionally urgent job to Indian economy (Meena *et al*., 2016). During the year 2017-18, area under horticultural crops was 25.43 Million Hectares with a production of 311.71 Million Tonnes (Saxena, 2018). A nursery is characterized as a zone where plants are raised for inevitable planting out. It contains nursery beds, ways, and watered channels and so on. The expanding weakness of horticultural crops to different biotic and abiotic stresses and extremely significant expense of hybrid seeds have justified the consideration of cultivators to improve their nursery raising innovation. Nursery is pre imperative for satisfying the quality seedlings need and nursery management is a potential instrument to action in effective manner (Krishnan *et al*., 2014). The point of good nursery management is to make accessible planting material of the most noteworthy conceivable quality for new advancement territories and replanting. Poor planting materials lead to low yield and superfluous diminishing cost in planted field. These days, high tech nursery has become undeniable industry for fruitful secured cultivation. Acing the methods of nursery activities, high tech nursery management is fundamental method to achieve potential income (Mbora *et al*., 2008). High- tech nursery can be set up as a small- scale industry in significant fruit-vegetable growing zones particularly in peri – urban regions. By thusly the producers can get virus free, healthy and off season seedling according to their necessity creating additional work to rural youth.

Plug – Tray Nursery raising

Crop seedlings or nursery can be brought up in various containers. Plastic trays are standard ones utilized around the world. For the most part, plastic trays or protrays having various sizes of cells are utilized for raising seedlings. These plate helps in appropriate germination, give free area to each seed to sprout, lessen the death rate, keep up uniform and sound development of seedlings, are simple in taking care of and putting away, solid and affordable in transportation. These nursery trays might be be fixed in thermocol base plate having same number and size of cavities before filling media. In the event that thermocol base is not accessible just trays set on floor or firm base might be used. Generally artificial soilless media is utilized for raising healthy and vigorous seedlings in plastic protrays. Essentially three ingredients- cocopeat, vermiculite and perlite are us utilized as root medium for raising nursery. These fixings are blended in a 3:1:1 proportion before filling in plastic pro trays.

Root Medium

Coco peat: It is totally liberated from infestation of any pest or pathogen. It is commonly utilized as a mode for raising nurseries of horticultural plants.

Perlite: It is light rock material of volcanic eruption. It is essentially heat- expended aluminium silicate rock. It improves air circulation and drainage. Perlite is neutral in reaction and gives basically no supplements to the media.

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Vermiculite: It is heat exhausted mica. It is extremely light in weight and has minerals for enriching the blend (magnesium and potassium) for advancing the mixture as well as good water holding capacity. Neutral in reaction (pH), it is accessible in grades as indicated by sizes.

Planting and after consideration:

Seeds true to type and of good quality ought to be bought new for each growing season. Seeds are typically planted in shallow depth in the wake of squeezing the media with finger in a delicate manner into the potting plugs or cells which loaded up with media. Subsequent to planting of seed, a thick layer of vermiculite is given to cover for better germination as this media has water holding capacity. These portrays are kept in germination room at ideal temperature for early and better germination. Water is applied in the wake of planting of seeds in each tray. Hundred percent humidity is kept up and when level comes down water is applied. For raising good and healthy seedlings, ideal EC of irrigation water ought to be 1.6 to 1.7 with pH of 6.6 to 6.7.

Nutrients are applied in form of water soluble N:P:K (1:1:1) @ 140 ppm once a week through the fine sprinkler to keep up the consistency. Hardening of vegetable seedlings before transplanting in the main field is very essential for reducing transplanting shock and also to have better crop stand. Plants should be gradually hardened or toughened by acclimatizing them to anticipated growing conditions of fields, at least a week before planting them in main field. This is finished by slowing their pace of development to set them up to withstand such as chilling, drying winds, shortage of water or high temperature. Generally, seedlings become ready for transplanting 28-30 days after sowing in plug tray.

Advantages of high tech nursery rising:

- Seedling can be raised under adverse climatic conditions where, it is absurd in any case.
- Healthy seedlings can be raised.
- Protection of seedlings from pests and diseases
- Advantageous to take care of the delicate seedlings
- There is no chance of soil-borne fungus or virus infection to seedling as the nursery is grown in soilless sterilized media.
- Drastic reduction in mortality in transplanting of seedlings as compared to traditional nursery raising.
- Significant and extremely little seeds can be raised adequately with no wastage
- Early / offseason planting is accomplished by raising such nursery.
- Simple transportation
- Weed free
- Better root development
- Approximate cost of nursery raising in a year is 3 to 4 lakhs and net profit of 4 to 6 lakh / 1000 m^2
- Economy of land usage
- Uniform crop stand in the main field
- In this technology seed rate can be reduced to the 30 -40%as compared to open field.
- Saving the fertilizer and water of use of plug tray nursery.
- Focal points of innovative nursery raising:

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Atal Bhujal Yojana: A Step for Augmenting Groundwater

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Neha Singhal
PhD Scholar, ICAR- Indian Agricultural Research Institute, New Delhi

INTRODUCTION

Groundwater is the water that is present beneath the surface of the Earth in soil pore spaces and the fractures of rock formation. The largest use for groundwater is to irrigate the crops. In now-a-days era, groundwater is an important source of water in India that accounts for 63% of all irrigation and over 80% of the rural and urban domestic water supplies. India is in a severe state of groundwater exploitation. Groundwater exploitation is one of the most critical issues in India.

Need for Ground Water Management

According to World Water Development Report published by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), India is the largest extractor of groundwater in the world. Annually, India extracts around 245 Billion Cubic Meter (BCM) groundwater that is nearly 25% of the total global groundwater abstraction. Out of this 245 BCM, about 222 BCM is used annually for irrigation and remaining 23 BCM is consumed by the domestic and industrial sector. Thus, in massive scale groundwater is used for irrigation. Around 54% of India's groundwater wells have declined over the past seven years.

Reason behind the decline of groundwater

India is the second most populous country in the world. India holds 16% of world population but only 4% of global water. As population is increasing, demand for food is also increasing. To satisfy the increasing demand, farmers have to grow more food and further need water for irrigation which results in the decline of groundwater. Moreover, crops like sugarcane and rice need more water to grow and the huge commercial production of these crops makes the situation even worse. Therefore, the index of water is poor due to bad management. According to NITI Aayog, about 75% of households do not have access to drinking water. Nearly 84% rural households do not have piped water supply and about 70% of India's water is contaminated. Currently, India ranked 120 among 122countries in the water quality index.

The demand of water in India will increase many times more than the available supply which will create severe water scarcity for hundreds of millions and an eventual loss of around 6% of the country's GDP. As per the Central Water Commission, per capita availability in the country will decrease from 1,434 cubic metres in 2025 to 1,219 cubic metres in 2050. Thus the increased demand for water is the reason for the decline of groundwater. Moreover, limited surface water further leads to the over-exploitation of groundwater resources. Also, there is limited storage facility and groundwater replenishment in hard rock terrain.

Atal Bhujal Yojana

To solve the problem of groundwater, Government of India launched a scheme to conserve groundwater in regions where there are low water tables. Atal Bhujal Yojana (ATAL JAL) is a scheme to deal with groundwater problems of India. This was launched on the 95th birth anniversary of former Prime Minister Atal Bihari Vajpayee, on 25 December 2019 under the *Jal Jeevan Mission. It* is a Central Sector Scheme of the Ministry of Jal Shakti to improve ground water management through community participation. The scheme has a total outlay of Rs.6000 crore and is to be implemented over a period of 5 years from 2020-21 to 2024-25.

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Atal Bhujal Yojana is an initiative for ensuring long term sustainability of ground water resources in the country. The Department of Water Resources, River Development & Ganga Rejuvenation, Ministry of Jal Shakti is adopting a mix of 'top down' and 'bottom up' approaches in identified ground water stressed blocks in seven states. These states have been chosen representing a range of geomorphic, climatic and hydrogeological and cultural settings. This yojana will promote panchayat led groundwater management and behavioural changes with primary focus on demand side management. This also reflects Mahatma Gandhi's Gram Swarajya ideology.

Coverage

The scheme aims to improve ground water management through community participation in identified priority areas in seven States, viz. Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. These states have been selected for implementing this scheme based on their level of exploitation. These states represent about 25% of the total number of over-exploited, critical and semi-critical blocks in terms of ground water in India. Implementation of the scheme is expected to benefit nearly 8350 Gram Panchayats in 78 districts in these States.

Components of Atal Bhujal Yojana

1. Sustainable groundwater management in the states: institutional strengthening and capacity building including improvement of monitoring networks, capacity building, strengthening of water user associations.
2. Improving groundwater management practices: incentivising the states like dissemination of data, generating water security plans, adopting demand side management practices, etc.

Funding of the scheme

The scheme has a total outlay of Rs.6000 crore. A total of half of this amount is extended by the World Bank as a loan that is repayable by the central government. The remaining 50% shall be through Central Assistance from regular budgetary support. The entire World Bank’s loan component and Central Assistance shall be passed on to the States as Grants. To encourage community participation, 50% of the money is to be given to gram panchayats and states as incentives for achieving the groundwater management targets.

Expected results:

Atal Jal will result in:

- Institutional strengthening for improving ground water monitoring networks.
- Capacity building of stakeholders at different levels.
- Enhancement of ground water data storage, exchange, analysis and dissemination.
- Improved and realistic water budgeting based on an improved database.
- Preparation of community led Water Security Plans at Panchayat level.
- Implementation of Water Security Plans through convergence of various schemes
- Judicious and effective utilization of funds for sustainable ground water management.
- Efficient use of available ground water resources with emphasis on demand side measures such as micro-irrigation, crop diversification, electricity feeder separation etc.

Expected Impact

- Source sustainability for Jal Jeevan Mission in the project area with active participation of local communities
- Contribution towards the goal of doubling the farmers' income.
- Promotion of participatory ground water management.
- Improved water use efficiency on a mass scale and improved cropping pattern.

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- Promotion of efficient and equitable use of ground water resources and behavioural change at the community level.

CONCLUSION

When there is a shortage of water at some place, groundwater use rate is increased than its replenishment. Groundwater comes to the surface through wells with the help of pump. Government urged farmers to switch over to those crops that use less water and also not to waste the precious natural resources in daily household needs. Several start-ups are being encouraged to come up with technology to ensure minimal use of water for various needs. Close to 80% of the urban and rural domestic water supplies in India rely on groundwater. According to a World Bank Report, India accounts for about 25% of the total groundwater abstraction, globally. Therefore, Atal Bhujal Yojana will be a solution for low water table regions for helping in the replenishment of the groundwater. Atal Jal Yojana and Jal Jeevan Mission are big steps in proving the resolve to deliver water to every household in the country by 2024. This will help India to deal with water crisis.

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Effect of climate change on the productivity of cereal crops

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Sanjeev Singh[1*], Mohammad Hasanain[2], Deepak Kumar Meena[3], Durgesh Kumar Maurya[4], Sandeep Kumar Verma[5], and Pradeep Kumar Singh[6]

[1]Ph.D. Scholar, & [4, 5, 6] M.Sc. Scholar, Department of Agronomy, Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut 250110;*

[2], Ph.D. Scholar, Division of Agronomy, ICAR-IARI, New Delhi 110012;

[3] M.Sc. Scholar, Department of Agronomy, G.B. Pant University of Agriculture and Technology, Pantnagar-263 145 Uttarakhand

Through the world cereal crops like wheat, paddy and maize are considered as primary crop as they are the staple food for most of the population. There is requirement of food supply of about 70-100% by 2050 to a world predicted population of about 9.8 billion (Godfray *et al*., 2010). To feed this much of population we have to use high yielding varieties, use of inorganic fertilizers, insecticides, and pesticides in a very large quantity, good irrigation facilities and intensive use of capitals for farm management. But also due to injudicious us of inputs there is bad effect on soil as well as on the environment. Contamination of ground water, soil and soil air will take place which will ultimately have a bad impact on the production of food grain which we want to achieve to feed a huge population.

Many researches revealed that global climate change may have drastic impact on the production and yield of crops which may be proved to be hurdle in attaining the food security. As we know earth is warming day by day with average increase in the surface temperature at the rate of 0.2 °C per decades over next 30 years. It has also been estimated that there will be global temperature increase by 2.5 to 4.5 °C by the end of 21st century due to continuous increase in greenhouse gases (Co_2 and CH_4) in atmosphere (Solomon, 2007). Due to Global warming, plant respiration rates increases which will result in the reduction of net carbon gain, which in turn would reduces the production yield of various crops and in the invasion of weed, insect, pest and pathogens (Asseng *et al.,* 2011). For example, in wheat cultivation, an increase in atmospheric temperature by 1°C there could be reduction in the yield by 3 to 10% (You *et al*., 2009). The climate change will also affect agricultural production, such as changes in farming practices and technology. Due to high temperature crop's optimum temperature will increase and thus the yield will decrease. In some areas, warming may benefit the types of crops that are typically planted there, or allow farmers to move to crops that are presently grown in warmer areas.

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Impact on crops

- Crop yield can be affected by higher level of CO_2. Experiment suggests that increasing co2 levels can increase plant growth but other factors such as changing temperature, water, ozone and nutrient constrains, may produce neutralize these potential increase in yield (Hatfield *et al*. 2014)
- High temperature and precipitation may check the growth of crops. Natural calamities like flood and drought can harm crops and may reduce the yield.
- In summer season temperature rises which may cause soil to dry, although, irrigation might be possible in few places, but area where supply in scanty, more irrigation might be needed.
- There are many weeds which thrive well in high temperature, moistened climate and increased CO_2 level. Many countries are spending lots of money for the eradication of these weeds.
- Rising level CO_2 not only stimulate the plant growth but there is also decrease in the nutritional value of most food crops because with increasing CO_2 concentration of protein and essential minerals are reducing in many plant species such as soybean, wheat and rice which ultimately have bad effect on human health (Ziska *et al.,* 2014).

Impact of Climate Change on Crops Yield and Food Security

Paddy

Research has shown that there is negative impact of global warming on yield of the paddy crop. The average global temperature has increased by 0.5 to 0.6 ℃ in last century. There is increase in the respiration in the paddy crop due to increasing temperature and subsequent rise in carbon metabolism and a decrease in the paddy yield. Due to increasing temperature paddy flowers become sterile, disturbing the reproduction process. IFPRI reported that there is reduction in paddy yield by 19-15% due to increase in the temperature resulting in the hike in the market price by 37% (Nelson *et al.*, 2009). In various part of Asia the impact of increasing CO2 on productivity is that there is reduction in yield by 4%. Though in the cooler region with increase in global temperature the yield will increase due to double-cropping but will not be sufficient to compensate the yield losses in various parts of Asia.

Maize

With increase in temperature by 1.32 ◦C there will be decrease in maize production by 35% in 2030 as compared to productivity in 2008 (Bassu *et al.,* 2014). On the basis of a report by precipitation modeling that there is decrease in corn yield by 20 to 50% by 2050. Moisture is a vital factor needed for the production of corn. The results showed that the raised bed system is beneficial in comparison to drip irrigation system for increasing plant height, biological yield and grain by 1%, 5% and 21 respectively. Researchers report that the there is slight increase in the yield when atmospheric co2 level doubles from 360 ppm to 720 ppm.

Wheat

Wheat being most widely consumed cereals in the world has a huge impact on the production of due to global climate change. Different models predict that there is reduction in wheat yield by 3.5% to 12.9% in medium term from 2037 to 2065 and in winter wheat there is reduction by 14.6% to 17.2% by the end of the century. 3 to 10% reduction can been seen with the increase in 1℃ temperature (Gammans *et al.,* 2017).

CONCLUSION

With increasing industrialization and poisonous gases released from different sources ultimately disturb the global environment. It has a very devastating impact on the growth and production of crops. To tackle these problem different steps should be taken to minimize emission of their poisonous gases. Further different breeding and agronomic practices should have to adopt to meet the future challenge

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CRISPR/Cas9 and its application in plant protection

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Sachin Gangwar[1] & Asharani Patel[2]
[1]Division of Nematology, Indian Agricultural Research Institute, New Delhi
[2]Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi

INTRODUCTION:

CRISPR/Cas9 is an adaptive immune system of prokaryotes providing protection against viruses. CRISPR stand for Clustered Randomly Interspaced Short Palindromic Repeat. CRISPR basically is an array of nucleotides. These short DNA fragments have originated from foreign genetic elements (plasmids and bacteriophages) and perform a role of "molecular memory". CRISPR loci along with the CRISPR associated Cas endonuclease denote prokaryotic molecular immune system. When foreign DNA enters a cell, RNA molecules transcribed from the CRISPR loci along with the Cas endonuclease recognize and bind this foreign DNA, while Cas protein cuts it. Target DNA cleavage occurs at a specific site upstream of the protospacer associated motif (PAM) that represents a trinucleotide sequence (NGG for the Cas9 protein) recognized by the Cas protein and required for its binding to the target DNA.

Recently, the CRISPR/Cas9 technology has emerged as a breakthrough among the approaches of targeted eukaryotic genome alternation. The use of recombinant Cas9 endonuclease with synthetic sgRNAs (developed using bioinformatics tools) complementary to the target DNA region and functionally similar to the spacers makes it likely to introduce mutations in any gene. CRISPR/Cas9 provides efficient genome editing using directed breaks in both DNA strands that initiate repair mechanisms by either homologous recombination or nonhomologous end joining (NHEJ), leading to the generation of the indels (insertions or deletion of nucleotides) and the loss of function of the target gene. At present, the CRISPR/Cas9 technology is used not only as a tool of eukaryotic genome editing, but also to influence the transcriptome, as well as for epigenetic modulation. An important field for the application of this technology is developing plant resistance to viruses and other pathogens and pests.

Scope of CRISPR/Cas9 in plant protection:

The plants are attacked by various pest and pathogen such as viruses, fungi, bacteria, insect, plant parasitic nematode and so on. Different strategies can be taken up for managing different pathogen or pest. In 2015, for the first time the use of the CRISPR/Cas9 system was used for the generation of plants resistant to geminiviruses. 43 potential sites within both coding and non-coding regions of the BSCTV (Beet severe curly top virus) genome were chosen for the generation of efficient sgRNA. *Nicotiana benthamiana* leaves were agroinfiltrated with the constructs containing sequences of the *Streptococcus pyogenes Cas9* gene and sgRNAs. The construct expressing the Cas9 protein gene only was used as a control. After two days, the agroinfiltrated leaves were inoculated with BSCTV, and the control and experimental plants were examined for the symptoms of viral infection and for the presence of viral DNA by qPCR on the 10th day post infection. Results showed that control plants developed typical symptoms (shoot tip leaf curling), while experimental plants showed no symptoms of viral infection and reduced amounts of viral DNA.1-10 nucleotide long deletions in the target region was shown upon the viral genome sequencing. The generated transgenic *N. benthamiana* plants constitutively expressed the *Cas9* gene and the sgRNAs that reduced virus accumulation by more than 90% in preliminary experiments.

Above strategy cannot be applied for managing the pathogen like bacteria and fungi since their nucleic material are not exposed as in viruses so CRISPR/Cas9 cannot act directly. The strategy against fungus, bacteria, nematodes and insects can be increase in resistance of plant against the specific pathogen or pest by the deletion of genes responsible for susceptibility.

Peng *et al.* (2017) created transgenic orange plants (*Citrus sinensis* Osbeck) with improved resistance to citrus canker caused by *Xanthomonas citri* subsp. *citri* (Xcc) bacterium. *X. citri* develops typical lesions on fruit, leaves and stem. Symptoms like brown pustules with characteristic water soaked yellow margins are caused on infection. The pustules dry up and thicken into corky cankers as the time pass. Using the CRISPR/Cas9 technology, the promoter of the *CsLOB1* (*lateral organ boundaries 1*) gene responsible for the plant susceptibility to the bacterium was modified. This promoter contains the effector binding element (EBE) PthA4, which is a binding site for the main bacterial effector PthA4 protein, whose interaction with the promoter triggers *CsLOB1* gene expression resulting the pustule formation. Five sgRNAs targeting EBE PthA4 were used in this work. Plasmids, expressing the

Cas9 gene from the 35S promoter and sgRNAs from the AtU6 promoter were obtained. Transgenic plants were generated by agrobacterium mediated transformation of the epicotyl segments. Primary selection of the transformed explants was carried out on kanamycin containing selective medium. Mutations in the targeted region were detected in 11.5 -64.7% transgenic plants, depending on the sgRNA used. Twenty_eight chimeric, 2 biallelic, 2 homozygous, and 2 heterozygous plants were identified among the mutants. Deletions (from 1 to 50 nucleotides) prevailed (60.5%), while the number of plants with insertions (20.9%) and substitutions (18.6%) in the targeted genomic region was almost identical. Several lines with mutations in the promoter region and low levels of the *CsLOB1* gene expression were selected for further work. These plants showed an improved resistance to *X. citri* manifested as smaller area of lesions and later rupture of pustules that did not have the appearance characteristic of citrus canker lesions.

Wang *et al*. (2016) produced rice plants with the edited *OsERF922* gene showing resistance to the ascomycete *Magnaporthe oryzae*. *M.oryzae* is a filamentous parasitic fungus that mostly affects cereal crops. The initial symptoms of infection are white to light green spots with darker borders. Older lesions are elliptical or spindle shaped, they enlarge and coalesce to damage the entire leaf. *M. oryzae* is one of the major rice pathogens causing economically significant crop losses. The *OsERF922* gene belongs to the superfamily of ethylene dependent transcription factors (ethylene responsive factors, ERF) involved in the modulation of plant response to biotic and abiotic stresses. It was shown earlier that the *OsERF922* gene is a negative regulator of rice resistance to *M. oryzae.* In this work, the authors constructed the binary vector expressing the *Cas9* gene from the 35S promoter and sgRNAs targeting the 5 terminal region of the *OsERF922* gene from the OsU6a promoter. Rice callus was transformed using agrobacteria, and the regenerants were initially selected on the hygromycin containing medium. Fifty transgenic sprouts were obtained; in 21 plants, the site of genome editing was analysed in detail. Among the analysed plants, 16 (76%) contained biallelic mutations, 3 were homozygous, 1 was heterozygous, and 1 was chimeric. More than a half of all mutations (64%) were deletions, 24% were insertions 12% contained both deletion and insertion. Analysis of the progeny obtained by two consecutive self-pollinations showed that modifications in the *OsERF922* gene made with the CRISPR/Cas technology were stable and inheritable. Using genetic analysis, six homozygous lines containing the edited *OsERF922* gene but lacking the Cas9–sgRNA sequences were selected. The mutant lines showed high resistance to *M. oryzae* infection: the area of lesions on leaves was much smaller than that on wild type plant leaves, in which almost entire leaf was damaged with further necrosis. The mutant plants were further examined for important agronomic traits. It was found that plant height, flag leaf length and width, number of productive panicles, panicle length, number of grains per panicle, and seed weight did not differ significantly from the same parameters in healthy wild type plants

Path ahead: The advance in science of CRISPR/Cas9 may increase its specificity by controlled HDR and may decrease the off target effects in near future. CRISPR/Cas9 can be a wonderful tool to increase the plant resistance against various pathogen and pest like viruses, bacteria, fungus, insects and the plant parasitic nematodes provided minimum off target effects.

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Biofortification: A Remedial Tool of Micronutrient Malnutrition

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Kamlesh Yadav[1], Govind Kumar Yadav[2]
[1]Department of Soil Science and Agricultural Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur-313001
[2]*Ph.D.* Scholar, Department of Soil Science and Agricultural Chemistry, Sri Karan Narendra Agricultural University, Jobner-303328

INTRODUCTION

With the increased production there is continuous depletion of nutrients from agricultural soils, and existing fertilizers primarily supply plants with the nutrients they need to grow, and not necessarily with the nutrients that are essential to humans and animals eating the plants. Soils of India are deficient in available micronutrient and therefor low uptake in grains causes their deficiency in human beings. It is therefore possible that through continual cropping elements essential to humans (but not to plants) could become depleted from agricultural soils. Around 792.5 million people across the world are malnourished, out of which 780 million people live in developing countries. Apart from this, around two billion people across the world suffer from another type of hunger known as "hidden hunger," which is caused by an inadequate intake of essential micronutrients in the daily diet.

What is Biofortification of grains?

Our agricultural system has not been designed to promote human health; instead, it only focuses on increasing grain yield and crop productivity. This approach has resulted in a rapid rise in micronutrient deficiency in food grains, thereby increasing micronutrient malnutrition among consumers.

Types of bio-fortification

1. Agronomic Biofortification: -

Agronomic Bio-fortification is the deliberate use of micronutrient fertilizers to increase the concentration of targeted micronutrients in edible portions of crops to increase dietary intake of the essential micronutrients. Biofortification of crop plants by foliar spray of micronutrient fertilizers is an effective way to promote increase nutrient concentration in grains. Similarly, fortifying germinating rice plantlets with ferrous sulphate lead to increase iron concentration in germinated brown rice (Garg *et al*; 2018). Foliar application of zinc has been reported as an effective agronomic practice to promote rice grain zinc concentration and zinc bioavailability. On the other hand, application of zinc to soil as fertilizer in addition to a foliar spray proves to be an important strategy to increase the grain zinc content of rice grown in soils with low background levels of zinc. Agronomic biofortification provides temporary micronutrient increases through fertilizers or foliar sprays and is useful to increase micronutrients absorbed directly by the plant.

2. Biofortification through genetic breeding: -

In this method, plant breeders search seed or germplasm banks for existing varieties of crops which are naturally high in nutrients. They then crossbreed these high-nutrient varieties with high-yielding varieties of crops, to provide a seed with high yields and increased nutritional value. Crops must be breed with sufficient amounts of nutrients to have a measurable positive impact on human health. As such, they must be developed with the involvement of nutritionists who study whether the consumers of the improved crop can absorb the extra nutrients, and the extent to which storage, processing, and cooking of the crops affect their available nutrient levels. Bread wheat with high grain iron and zinc has been developed through radiation breeding.

3. Biofortification through Genetic engineering-

Genetic engineering allows the transfer of heritable traits between completely unrelated species. In staple grains such as rice, improvement of some complex traits such as vitamin A is not possible using conventional breeding strategies, as there are no natural rice varieties rich in this vitamin. Genetic engineering is the obvious alternative to enhance the β-carotene levels in crop plants. The development of the 'golden rice' proved that, it is possible to redirect a complete biosynthetic pathway of carotenoids by genetic engineering of multiple genes encoding key enzymes of the pathway (Bhatnagar *et al*., 2011).

Myths with farmers about biofortified grains

There are two main behavioral myths with farmers related to biofortification: one for the farmer and one for the consumer. Farmers are interested in planting new varieties that are agronomically superior to the current varieties they plant, for example cultivars that are more drought resistant, have more yield or less susceptibility to diseases. Crops with improved micronutrient concentration with the same or poorer agronomic performance will not be accepted and adopted by farmers. Therefore, biofortified varieties must be agronomically equivalent or preferably superior to the less nutrient dense market and traditional varieties with which they will compete.

CONCLUSION: - There is very compelling global human health and nutritional evidence to convince agricultural scientists that micronutrient density traits should be primary objectives in their work targeted to the developing world. Furthermore, doing so should also improve crop productivity when micronutrient-dense seeds and grains are planted to micronutrient-poor soils, thus ensuring farmer adoption of the micronutrient-enriched seeds once they are developed.

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Maximum page limit: 2-5 pages

Times New Roman, 12 font, 1 spacing

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[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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Recipe for Barbados cherry pickle preparation

Article id: 23569

[1]Arghya Mani, [2]Sourav Roy and [3]Surajit Mitra
[1]Department of Post-Harvest Technology, BCKV, Mohanpur, 741252
[2] Department of Vegetable Sciences, BCKV, Mohanpur, 741252
Arghyamani14@gmail.com

Just ripened fresh tropical cherry/barbados cherry was harvested washed properly and used for pickling. Ripe fruits are also rich in acid and is free of major tannins

Spice Preparation:

1st set of spice: Mustard is washed and pressed in separate container.
2nd set of spice: Fenugreek is grinded and kept in a separate container.
3rd set of spice: Ginger paste is kept in another container.
4th set of spice: Rest other spices are pasted and kept separately in each container.

Flowchart for Pickle Preparation	
Selection of just ripened Barbados cherry pieces ↓ 40 g salt should be mixed with 250 g fruit ↓ It is kept in a container filled with water for 2 days at 30-40^{O}C ↓ Take out the fruits after 2 days ↓ Pieces are washed with warm water ↓ Then these fruits are mixed with citric acid and acetic acid (2 ml and 20 ml respectively) ↓ This mixture is kept for 30-45 minutes in one separate lidded container ↓	
Pickle preparation in oil	**Pickle preparation in water**
Oil is heated in a container. ↓ 1 spoon of sugar is added with it to impart colour. ↓ When the oil is heated we add the 4th spice to it followed by the 1st and the 3rd. ↓ 2nd spice should be added at last. ↓ Then we add all the cured fruits in the spice-oil mixture ↓ We cook it for 5 minutes and add salt to it ↓ We cool the pickle and fill it in glass container which are properly sterilized by boiling ↓ Often we have put the prepared pickle to sun	We take a container and heat in gently ↓ Then we add 100 ml of water ↓ Then we put spice mixture and cook gently ↓ Then 250 g fruits are added ↓ Then we add salt to it ↓ The pieces are cooked gently for 2-3 minutes ↓ We cool the pickle and fill it in glass container which are properly sterilized by boiling ↓ Often we have put the prepared pickle to sun

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[1]. Mani A., Patil P., Tiwary A.K. and Bukya K., (2018), The science and art of pickling. Trends & Prospects in Processing of Horticultural Crops. Today & Tomorrow's Printers and Publishers. ISBN: 9788170196389. Vol 1: Pp: 59-80. https://www.researchgate.net/publication/328073558_The_science_and_art_of_pickling