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Land Degradation and its Remedial Measures in Malwa Region of Madhya Pradesh

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Introduction

A large portion of the Malwa region of the State of Madhya Pradesh shows clear evidences of advanced and continuing degradation of arable and nonarable lands. However, the magnitude of degradation and the area need to be quantified. Visual observations and discussions with farmers of the region clearly reveal that during the last 3- 4 decades, groundwater table of the area has declined very fast, good quality cultivable lands have been turned into unproductive due to soil erosion resulting in drying up of many traditional surface water sources, open wells and tube wells.

Characterization of Lands

The black soils in the region vary in depth ranging from a few centimetres to more than 2 meters having clay content of 45 to 65 per cent. These soils are highly erodible, particularly when they are without plant cover. The infiltration rate of these soils under saturated conditions is generally low ranging from 0.2 to 29.0 mm/hour. The soils have high moisture retention capacity of about 350 to 410 mm per meter of soil profile and favourable water release characteristics due to high clay content dominated by montmorillonite clay mineral. Soils are characterized by high degree of plasticity and stickiness when wet, low organic matter content, high cation exchange capacity, and often of calcareous nature. Dominance of montmorillonite clay mineral in black soils cause high degree of swelling on wetting and shrinkage on desiccation due to which arise the problems of poor infiltration, narrow workable moisture range, high runoff potential and soil erosion during rainy season and enhanced evaporative losses of soil profile stored moisture due to development of shrinkage cracks during prolonged dry spells. High intensity and erratic temporal and spatial distribution of rainfall frequently results in water-logging on flat lands and runoff and severe soil erosion on sloppy lands. Although, black clay soils have enormous crop productivity potential but large hectarage remains underutilized owing to inherent management problems during rainy season apart from limited supply of irrigation water during post rainy season period.

Rainfall and Runoff

The average rainfall in the region is about 1000 mm with different kind of aberrations. Rainy season extends from mid-June to September when about 90% of annual precipitation occurs. Rainy season is characterized with erratic and intense rains. High intensity of rainfall coupled with low infiltration rate of soils lead to a considerable amount of runoff. A considerably high runoff potential ranging from 21 to 54 per cent on medium depth and up to 24 per cent on deep black soils has been reported. Fallowing of large areas of deep black soils is inevitable for certain reasons.

Soil and Nutrient Losses

Erosion of top fertile soil during the rainy season are the main problems in Malwa region soils. The major factors contributing to severity of soil erosion and loss of essential plant nutrients are land slope, high runoff and bare land surface during rainy season. Soil erosion and nutrient loss, particularly nitrogen, are the serious problems where land slope is greater than 0.8%, while on flat lands, sheet erosion as well as water logging are the serious problems. Depending upon rainfall characteristics and crop cover about 2 t /ha soil, 18 kg N and 8.5 kg S per hectare may be lost every year due to runoff even on comparatively flat lands.

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Reasons of Land Degradation

Main reasons of land degradation are natural and men made. Some of these are summarized as below. The major causes of land degradation have been attributed to:

1. Land clearance, such as clear cutting and deforestation.
2. Agricultural depletion of soil nutrients through poor farming practices.
3. Livestock including overgrazing and over drafting.
4. Inappropriate irrigation and over drafting.
5. Urban sprawl and commercial development.
6. Soil contamination.
7. Vehicle off-roading.
8. Quarrying of stone, sand, ore and minerals.
9. Changes in field size due to economies of scale, reducing shelter for wildlife, as hedgerows and copses disappear.
10. Exposure of naked soil after harvesting by heavy equipment.
11. Monoculture, destabilizing the local ecosystem.
12. Dumping of non-biodegradable trash, such as plastics.

Deforestation

Deforestation in some areas has led to serious water erosion problems, particularly of marginal and sub marginal lands. Such land degradation and associated socio-economic factors in the areas is contributing to the slow desertification process. The main physical manifestations of the process causing degradation are removal of fertile top soil and erosion of essential plant nutrients through water erosion, reduced capacity of soils to retain water and support flora growth, increased susceptibility to run off and gradual increase in the accumulation of salts in the root zone and on the surface in a few areas.

Socio-Economic Factors

Apart from climatic factors, some socio-economic factors also have direct bearing on the initiation of degradation and desertification processes. Continuing and increasing population pressure on the land resources has further contributed to the process and added fuel to fire. The major cause of rapid disappearance of vegetal cover is the overgrazing on private, community and Government land and cutting of forests for fuel purposes.

Abuse of Land Resource

Land use not based on its capability, lack of adoption of protection, conservation and preservation measures of natural resources e.g. soil, rain water and forests have further aggravated the situation. Some developmental activities, e.g. construction of roads, uncontrolled and unscientific farming practices and poor management of land and rainwater are also responsible for land and environment degradation.

Land Degradation Status in Madhya Pradesh

The state has 14.095 M ha of degraded and wastelands which is about 45.73% of the state's geographical area. Districts with large areas of degraded lands are Khargone (7.85 Lac ha), Chhindwara (6.48 Lac ha), Dhar (6.43 Lac ha), Khandwa (5.81 Lac ha), Mandsaur (5.25 Lac ha) and Shahdol (5.08 Lac ha). The total area affected by water erosion (including open forest areas) accounts for 13.465 M ha (44% of TGA). Worst affected districts are Khargone, Dhar, Chhindwara and Shivpuri. Ujjain, Balaghat, Bhind, Bhopal, Damoh, Datia, Gwalior and Tikamgarh districts have less than 2.00 Lac ha soil erosion affected areas. Soil acidity is localized, and affected districts by it are Mandla (2.16 Lac ha), Balaghat (0.83 Lac ha), Chhindwara ().58 Lac ha), Sagar (0.15 Lac ha) Vidisha (0.13 Lac ha). Sodic soils are found in Vidisha (0.28 Lac ha), Bhind (0.12 Lac ha), Morena (0.11 Lac ha), and Datia (0.04 Lac ha) [Ref: Degraded and wastelands of Madhya Pradesh Source: NBSS&LUP].

Measures for Minimizing Land Degradation Processes

Measures for minimizing land degradation processes may be preventive measures and curative measures. Selection of conservation measure and use of land based on land capability class lead to satisfactory results.

Afforestation, controlled grazing of pastures, judicious use of natural resources viz. land water and forests, renovation of old tanks and open wells are some of the ways to tackle the problem and minimize the land degradation process. Basic information regarding types of measures and land uses required for different land slope conditions is presented in Table 1.

Table 1: Soil and water conservation practices (SWCP) under different land categories.

Land slope %	Type of land.	Soil, Water Conservation Practices (SWCP) and Example.
0 to 2	Arable land, no crop limitation	Cultural Practices: e.g. Furrow-bed system, mulching intercropping, contour strip cropping.
2 to 3- 12	arable land, some limitation on crops, if mechanized	SWC: e.g. Contour bunding on slopes less than 6% and rainfall less than 500 mm.
12 to 20-25	Mostly suitable for pasture, reforestation.	SWCP: e.g. Graded bunding, grassing waterways and drops structures.
Greater than 20-25	Pasture, woodlots. ravines, gullies	SWCP: e.g. Bench terracing on permanent grass or forest land, graded ditching.

Capability Based Land Use

Land use should be planned based on its capability classes as any abuse of land at any point of time would be the beginning of land deterioration at a very faster rate.

Table 2: Appropriate crop planning according to suitability of land.

S.N.	Type of land	Crop plans
1	Bare hill slopes.	Trees of fuel, fodder and fruits and grasses. Species and varieties may be chosen according to local experience.
2	Shallow soil with slope < 3%.	Grasses with legumes including fodder shrubs.
3	Shallow soil with slope ranging from 1 to 3% or light soil.	Must be cropped in rainy season with sorghum fodder, maize, short duration pulses on 0.3% across slope.
4	Shallow soil with slope < 1%.	Improved varieties of soybean, maize, sorghum .
5	Deep soil with slope > 3% (gullies).	Grass plantation and stabilisation works.
6	Deep soil with slope ranging from 1 to 3%.	Improved crops and cropping systems on 0.3% grade across slope. Inter-cropping of soybean, pigeonpea with sorghum or maize are preferable.

Alternate Land Use Systems

A number of options of alternate land use systems have been identified for different locations. Different high value crops like medicinal plant, spices etc, trees, Pastures and Livestock have got their own importance to find place for making alternate land uses. Trees, shrubs and native pastures are the most important natural vegetation sources. Several multipurpose tree species yielding timber, fodder and fuel wood can be grown on field bunds and scattered in the fields. Recent research has focused upon systematic integration of trees, crops and grasses through Agri silviculture, horticulture and silvi-pasture.

Agri-Horticulture

In medium soil areas receiving annual rainfall of more than 750 mm, agro- horticultural systems consisting of a fruit trees intercropped with annual arable crop is recommended. Ber, Custard apple, Aonla, drumsticks, plums, and pomegranate are some of the species suitable for dry lands, both for pure plantations and mixed with crops. Cluster bean, cowpea, horse gram, and other grain legume have been found useful. Results of a long-term experiments conducted at AICRPDA, Indore, have proved the advantages of agro-horti system. Results revealed tremendous scope of alternate land use of combining fruit trees and prevalent crops of Soybean, Pigeon pea and their intercrop combinations.

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Small Scale Conservation Measures

Curative measures may be grouped into mechanical, biological and agronomic practices and these may be further classified into small scale level, Medium scale level and Large-scale level measures depending upon the cost. The measures for conserving rain water in-situ and its safe disposal which are cost effective and can be adopted at individual farmers' level, as summarized below.

1. Ridge and Furrows: An array of ridges and furrows are made and seeds are sown on ridges and furrows remain blank. All the operations are done simultaneously with tractor driven seed drill. The system has proved highly effective in medium to high rainfall areas (rainfall ranging from 700 to 1200 mm).

2. Graded Furrows: In areas moderate rainfall (less than 1000 mm), productivity of upland rainy season crops can be substantially increased simply by providing graded furrows of 0.2 to 0.3% slope which can conveniently carry runoff water to drainage channel. Spacing between such furrows may vary from 8 to 10 m depending upon slope and rainfall characteristics.

3. Broad Bed and Furrows (BBF): This system is a series of broad beds and furrows accommodated in 90 - 150 cm wide parallel running strips. These are developed with the help of two furrow openers and a bed former attached to a bullock drawn or tractor drawn tropi-culture. In this system beds and furrows are created on a grade of 0.5%. Furrows drain into grassed waterways. This system permits collection of runoff water in a tank provided down the slope. The system facilitates safe disposal of runoff, conserve soil and water in-situ, reduces soil and nutrient losses and increase crop productivity.

4. Broad Bed and Tied Furrows (BBTF): This system is similar to BBF except that furrows are tied with small cross section earthen bunds at a regular interval of 10 m in mid-August month to retain runoff, if any. BBTF configuration can be very useful for alleviating adverse effect of prolonged dry spells, which are commonly encountered during late Kharif season.

5. Raised and Sunken Bed System (RSB): This system consists of series of raised and sunken beds of 6-8 m and 3- 4 m widths respectively, with elevation difference of 15 - 30 cm. The system is created by mechanically shifting soil from demarcated 3- 4 m wide strips, later on designated as sunken beds to adjoining 6 - 8 m wide strips called raised beds. Sunken beds are tied with small cross section earthen bunds of about 10 cm height at 20 m distance interval to ensure uniformity in runoff retention. Raised beds provide surface drainage and water is retained in sunken beds. This system encourages in-situ rain water conservation and retards soil erosion and nutrient losses to a considerable extent. The runoff from raised beds, planted to any upland crop, is arrested in the adjacent sunken beds supporting a relatively water tolerant crop such as upland rice.

Large Scale Level Soil Erosion Control Measures

There are certain large-scale level measures which are relatively costly and individual farmers cannot afford but these measures may be employed at community level, village Panchayat level or at some higher levels. These are given below.

Mechanical Measures

Runoff induced soil erosion losses can be minimized through employment of any appropriate land treatments and water disposal systems. Some of the cost effective and promising erosion control measures are given below.

1. Gabion Structures: A "gabion" is a flexible structure of loose boulders packed into prefabricated galvanized iron wire netting. Drop structures of various sizes and shapes can be made by placing a number of such boxes (gabions) together at the top of one another as per requirement. Gabions have been found more effective as they are porous, flexible and allow the runoff water to pass through while retaining the silt upstream. Owing to their flexible nature, gabions are highly suited to black soils which exhibit swelling and shrinkage during wetting and drying.

2. Graded Bunds: Mechanical bunds of 0.3 m¬¬3 cross section is laid along a grade of 0.3% have been reported to minimize soil erosion from lands up to 6% slope.

3. Conservation Ditches: In vertisols, conservation ditches can also be adopted, which serve the dual purpose of terrace and a small water storage structure.

4. Water Diversion Bunds: Runoff water coming off a hillock or upper land reaches into cropped fields and cause inundation, erosion and degradation. Diversion bunds lead this water safely into a natural drain or into a grassed waterway either constructed or available for this purpose.

5. Bench Terracing: Bench terracing coupled with plantation of trees and grasses on lands having more than 6% slope is an effective measure of erosion control.

6. Grassing of Waterways: Grassing of waterways are required at suitable sites to lead water diverted by storm drains or water diversion bunds and graded bunds to natural stream.

7. Stabilisation of Washes: Washes formed in the cultivated fields may develop into gullies if not controlled in initial stages. Stabilization of washes can be achieved by leaving that strip of land uncultivated over which water flows so that grasses may be planted initially and some may develop naturally.

8. Provision of Drainage Between Waterways: Construction of open drainage channels on a grade at suitable intervals from ridge to grassed waterway has been found effective for safe disposal of runoff water from areas between waterways is essential.

9. Gully Control: Stabilization and reclamation of gullies is very essential as otherwise gullies go on widening and deepening with time due to falling of banks and bed erosion. The menace continues forever as side gullies start developing from secondary and tertiary washes resulting into the formation of a network of small shallow-narrow and big wide and deep gullies. In this way in long run a lot of cultivable and fertile land turns into waste and unproductive lands. Construction of drop structures in the gully at appropriate points would help in controlling them. Planting or seeding of suitable grass species at the bed and on the sides of gullies help in stabilizing them. Fast growing locally available grass species may be useful for this purpose. Repeated seeding / planting of grass species in the beginning, middle and end of rainy season is essential to ensure good vegetative cover.

Biological Measures

Biological measures are generally used as preventive measures. These include appropriate plant cover, straw mulching, vertical mulching with stalks of maize or sorghum or any other crop residues and vegetative barriers.

1. Planting of a Cover Crop: A rainy season crop which tends to develop a thick canopy, intercepts rainfall and dissipates energy of falling rain drops is helpful in reducing soil erosion. Soybean, maize and sorghum crops are quite effective in this regard as they develop canopy at fast rate.

2. Mulching with Crop Residues: Moderate rates of plant residue application in between crop rows enhance the infiltration and reducing runoff and ultimately increased water use efficiency of crops. Surface residues mulch has their greater values for water conservation when soils are wet. The immediate advantage of incorporation of crop residues in soil is to enhance infiltration and retard runoff losses. Later on, upon decomposition, it adds nutrients for the benefit of crops and enhances water use efficiency. Plant residues and weed biomass or any other locally available crop residues which have very little or no fodder values may be utilized for mulching.

3. Vegetative Barriers / Hedges: Vegetative barriers/ hedges have been found useful in reducing the rain water runoff water and conserving soil and plant nutrients. These are also helpful in stabilizing the earthen bunds, particularly in black soil regions where masonry structures have limited utility due to swell shrink nature of these soils. For this purpose, a number of grass species have been identified. Grasses such as vetiver, *Cymbopogon martinii* have proved to be useful. Vegetative hedges are established at 0.5 to 0.75 m vertical interval. Two rows planted 30 cm apart make a good hedge which should be regularly cut to maintain 30 cm height.

Agronomic Measures

Agronomic practices which encourage conservation of soil, rain water and plant nutrients and enhance use efficiency and thereby tend to reduce the losses. These practices are:

1. Soil Mulching / Shallow Inter-culture / Shallow Tillage.
2. Deep Tillage Practices.
3. Soil Mulching, Green biomass mulching, Plastic Mulching, etc.
4. Contour Farming.
5. Strip Cropping and Intercropping.
6. Rain Water harvesting and recycling.
7. Minimum Tillage practices.
8. Integrated Nutrient Management i.e. conjoint us se of organics and chemical fertilizers.

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Farmers Producer Organizations: Boon for Small and Marginal Farmers

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Farmers Producer Organizations (FPO) are groups of farmers coming together on the basis of principle of membership, to pursue specific common goal and developing farming as economic activities that benefit their members and maintaining relations with partners working with them. The main aim of FPO is to ensure better income for the farmers through an organization of their own.

Small and marginal farmers do not have the volume individually (both inputs and produce) to get the benefit of economies of scale. Besides, in agricultural marketing, there is a long chain of intermediaries who very often work non-transparently leading to the situation where the producer receives only a small part of the value that the ultimate consumer pays. Through group formation, the farmers can avail the benefit of economies of scale. They will also have better bargaining power vis-à-vis the bulk buyers of produce and bulk suppliers of inputs.

Essential Features of an FPO

1. It is formed by a group of farmers for farm activities.
2. It is a registered body and a legal entity.
3. Farmers are shareholders in the organization.
4. It deals with business activities related to the agricultural produce/product.
5. It works for the benefit of the member farmers.
6. A part of the profit is shared amongst the farmers.
7. Rest of the surplus is added to its owned funds for business expansion.

Ownership of FPO

The ownership of the FPO is with its members. It is an organization of the farmers, by the farmers and for the farmers. One or more institutions and/or individuals may have promoted the FPO by way of assisting in mobilization, registration, business planning and operations. However, ownership control is always with members and management is through the representatives of the members.

Promotion of FPO

Any individual or institution can promote an FPO. Individual persons or institutions may promote FPO using their own resources out of goodwill or with the noble objective of socioeconomic development of producers. If, however, the facilitating agency wishes to seek financial and other support, then they have to meet the requirements of the donor/financing agency.

Support for Promotion of FPO

NABARD, SFAC, Government Departments, Corporates and Domestic & International Aid Agencies provide financial and/or technical support to the Producer Organisation Promoting Institution (POPI) for promotion of the FPO. Each agency has its own criteria for selecting the project/promoting institution to support.

Important Activities of an FPO

The farmers have skill and expertise in producing farm produce. However, they generally need support for marketing of what they produce. The FPO will basically bridge this gap. The FPO will take over the responsibility of any one or more activities in the value chain of the produce right from procurement of raw material to delivery of the final product at the ultimate consumers' doorstep.

In brief, the FPO could undertake the following activities:

1. Procurement of inputs.
2. Disseminating market information.
3. Dissemination of technology and innovations.
4. Facilitating finance for inputs.
5. Aggregation and storage of produce.
6. Primary processing like drying, cleaning and grading.
7. Brand building, Packaging, Labelling and Standardization.
8. Quality control.
9. Marketing to institutional buyers.
10. Participation in commodity exchanges.
11. Export.

Advantages of FPO

An FPO will support the members in getting more income by undertaking any/many/all of the activities listed above. By aggregating the demand for inputs, the FPO can buy in bulk, thus procuring at cheaper price compared to individual purchase. Besides, by transporting in bulk, cost of transportation is reduced. Thus, reducing the overall cost of production. Similarly, the FPO may aggregate the produce of all members and market in bulk, thus, fetching better price per unit of produce. The FPO can also provide market information to the producers to enable them hold on to their produce till the market price become favourable. All these interventions will result in more income to the farmers.

Membership in an FPO

The minimum number of memberships depends on the legal form of the FPO. For example, 10 or more farmers can incorporate in a Farmer Producer Company under Section 581(C) of Indian Companies Act 1956. There is no restriction on the maximum number of memberships. Generally, the FPO will require certain minimum scale of operation to remain in business. This operation scale/volume is known as break-even level. Studies have shown that an FPO will require about 700 to 1000 active producers as members for sustainable operation.

Support for FPO from SFAC

Mainly two types of support are available to the FPOs from the Small Farmers Agribusiness Consortium (SFAC).

1. SFAC operates a Credit Guarantee Fund to mitigate credit risks of financial institutions which lend to the Farmers Producer Companies without collateral. This helps the FPCs to access credit from mainstream financial institutions for establishing and operating businesses.

2. SFAC provides matching equity grant up to Rs. 10 lakhs to the FPCs to enhance borrowing power, and thus enables the entities to access bank finance.

Financial Support for FPO from NABARD

NABARD provides financial support to the FPOs only through project mode through two financial products.

1. Lending to FPOs for contribution towards share capital on matching basis (1:1 ratio) to enable the FPO to access higher credit from banks. This is a loan without collateral which will have to be repaid by the FPO after specified time. The maximum amount of such assistance is Rs. 25 lakhs per FPO with a cap of Rs. 25,000 per member.

2. Credit support without collateral security for business operations to FPCs which are eligible under Credit Guarantee scheme of SFAC. The credit product can be customised as per requirement of the business. In general, credit support is available for business activities and creation of assets like building, machinery, equipment, specially designed vehicles for transportation etc. and/or working capital requirements including administrative and other recurring costs connected with the project as composite loan. Capital expenditures like purchase of land, vehicles for general transportation & personal use, etc., will not be considered for support.

Other Support to the FPO from NABARD

NABARD also provides technical, managerial and financial support for capacity building and market intervention efforts of the FPO. Such support is available in the form of grant, loans, or a combination of the two based on the need of the situation, and is available only to those FPOs which avail credit from NABARD. Capacity building support will not be given in isolation in general. It would essentially be a part of the overall project having loan component. Capacity building should broadly cover any activity relating to functioning of a farmer producer organization.

Some such activities are given below:
1. Skill development in order to enable members to improve production / productivity.
2. Business planning.
3. Technological extension through classroom training.
4. Exposure visits, agricultural university tie ups, expert meetings, etc.
5. Any other capacity building initiative which directly benefits the FPO.
6. NABARD through its Farm Sector Promotion Fund (FSPF) is providing financial assistance to various institutions including Farmers clubs for:
    a. Facilitating adoption of appropriate technologies by the agriculturists through the provision of training cum exposure visits, organizing for demonstrations on the use of the various technologies.
    b. Organizing financial credit counselling.
    c. Providing support for financial literacy.
    d. Dissemination of appropriate technologies to the various people in need thereof.
    e. Promotion of Farmer Producer Organisation.

NABARD Help the FPOs in Marketing their Produce

NABARD also provides support to the FPOs to access markets for their produce. Some of these activities are as below:
1. Credit and/or grant support for setting up of marketing infrastructure facilities for sale of produce.
2. Support for marketing through rural haat and rural mart which had already been established through NABARD support.
3. NABARD may facilitate tie-ups with buyers for Farmer Producers Organization's produce.
4. Through existing schemes of National Horticulture Mission and Ministry of Agriculture, NABARD may support creation of infrastructure wherever possible.

Steps in Establishing FPO

1. Understanding the village community
2. Identifying potential leaders in the community
3. Talking to the identified leaders and seeking cooperation from other agencies
4. Helping community leaders to call community meetings
5. Nominating core group leaders to develop the FPO
6. Developing an organizational structure and management for the FPO
7. Motivating groups for action
8. Implementing selected programmes
9. Regular follow up through monitoring and evaluating the progress of FPO

The Government of India has approved formation of ten thousand new FPOs during 2019-20 to 2023-24 and granted Rs.5000crores for promoting these organizations. These FPOs will be registered under Indian Company Act. FPOs working in plain areas should have at least 300 farmers as member to get benefit of above mentioned granted funds. Similarly, FPOs in hilly areas should have at least 100 members for realizing this benefit.

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Seed Dormancy

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Introduction

Dormancy could be a condition wherever seeds won't germinate even once the environmental conditions like water, temperature and air are favourable for germination.

1. It is determined that seeds of some fruit plants (mango, citrus) germinate directly when extraction from the fruit below favourable conditions of moisture, temperature and aeration.

2. However, in others (apple, pear, cherry) germination doesn't present itself even below favourable conditions. This development is termed as dormancy.

3. This is a very important survival mechanism for a few species as a result of these species don't germinate unless adverse weather conditions finish.

4. In some species, chilling temperature sure amount helps within the termination of dormancy. Usually, dormancy is thanks to many factors and will persist indefinitely unless sure specific treatments square measure given.

Types of Dormancy

Differing types of dormancy present:

1. Exogenous Dormancy:

a. This variety of dormancy is obligatory by factors outside the embryo.

b. In exogenous dormancy, the tissues enclosing the embryo will have an effect on germination by inhibiting water uptake, providing mechanical resistance to embryo growth and anatomical structure emergence, modifying vaporous exchange (limit element to the embryo), preventing leach of matter from the embryo and activity matter to the embryo. it's of 3 types:

i. Physical dormancy (seed coat dormancy): reproductive structure or seed covering could become arduous, fibrous or gluey (adhesives gum) throughout dehydration and ripening as a result they become impermeable to water and gases, that prevents the physiological processes initiating germination this kind of dormancy is incredibly common in drupe type of fruits i.e. olive, peach, plum, apricot, cherry etc. (hardened endocarp), walnut (surrounding shell). In numerous plant families, such as, Leguminoceae, the outer reproductive structure gets hardened and becomes suberized and impervious to water.

ii. Mechanical dormancy: In some fruits seed covering restricts radicle growth, leading to the dormancy of seeds. Some seed covering structures, like shells of walnut, pits of stone fruits and stones of olive are too robust to permit the dormant embryo to expand throughout germination. The water could also be absorbed however the issue arises within the cementing material as in walnut. Germination in such seeds doesn't occur till and unless the seed coats are softened either by making moist and warm conditions throughout storage or by microorganism activity.

iii. Chemical dormancy: In seeds of some fruits chemicals that accumulate in fruit and seed covering tissues throughout development and stay with the seed when harvest. it's quite common in fleshy fruits or fruits whose seeds stay in juice as in citrus, cucurbits, stone fruits, pear, grapes and tomatoes. A number of the substances related to inhibition are numerous phenols, coumarin and abscisic acid. These substances will powerfully inhibit seed germination.

2. Endogenous dormancy: This type of dormancy is obligatory by rudimentary or undeveloped embryo at the time of ripening or maturity. This could be of various varieties like morphological, physiological, double dormancy and secondary dormancy.

a. Morphological dormancy (Rudimentary and linear embryo): Dormancy happens in some seeds during which the embryo isn't totally developed at the time of seed dissemination. Such seeds don't germinate if planted directly after harvesting. Plants with rudimentary embryos produce seeds with very little over a pro-embryo embedded in an exceedingly large reproductive structure at the time of fruit maturation. Enlargement of the embryo happens when the seeds have imbibed water, however, before germination begins. Formation of a rudimentary embryo is common in numerous plant families like Ranunculaceae (Ranunculus), Papaveraceae (poppy). Some plants of Temperate zone-like holly and honeysuckle family have conjointly rudimentary embryos.

b. Physiological dormancy:

i. Non-deep physiological dormancy: when ripening time is needed for seeds in dry storage to lose dormancy. this kind of dormancy is commonly fugacious and disappears throughout dry storage. Temperate fruits like apple, pear, cherry, peach, plum and apricot, cultivated cereals, vegetables and flower crops, have this kind of physiological dormancy which can last for one to 6 months and disappears with dry storage.

ii. Photo dormancy: Seeds that either need light or dark condition to germinate is termed as photo-dormant seeds. it's thanks to photo-chemically reactive pigment referred to as phytochrome wide gift in some plants. once imbibed seeds square measure exposed to red light (660-760 nm), the phytochrome changes to red type (Pfr), thereby subbing the germination method. However, once seeds are exposed to far-red light (760-800), Pfr is modified to Pf that inhibits germination method.

iii. Thermo dormancy: Some seeds have specific temperature demand for their germination, otherwise they continue to be dormant. Such seeds referred to as thermo dormant. As an example, seeds of lettuce, celery and pansy don't germinate if the temperature is below twenty-five-degree celsius.

Physiological Dormancy is of Three Types

1. Intermediate physiological dormancy: The seeds of some species need a selected number of one-to-three months of chilling, whereas in imbibed and aerated state, normally referred to as moist chilling. As an example, most of the temperate fruit seeds need moist chilling to beat seed dormancy. This demand led to the standardization of world illustrious, agriculture observes of stratification. During this method, the seeds are placed between layers of moist sand in boxes and exposed to chilling temperatures (2-7 0C) for the amount varied from 3-6 months to beat dormancy.

2. Deep physiological dormancy: Seeds, that sometimes need a comparatively long (>8 weeks) amount of moist chilling stratification to alleviate dormancy as in peach.

3. Epicotyl dormancy: Seeds having separate dormancy conditions for the anatomical structure hypocotyl and epicotyl, is termed as epicotyl dormancy e.g. Lilium, *Hepatica antiloba* and liliaceous plant.

Double Dormancy

1. In some species, seeds have dormancy thanks to arduous seed coats and dormant embryos.

2. For instance, some tree legumes seed coats are impervious and at same time, their embryo also are dormant.

3. Such seeds need 2 years for breaking of dormancy in nature. inside the first spring, the microorganisms influence the seed making it weak and soft then embryo dormancy is broken by chilling temperature inside the winter next year.

4. A combination of two or many types of dormancy is assumed as double dormancy. Its square measure usually morpho-physiological i.e. combination of the below-developed embryo and physiological dormancy or exo-endodormancy.

Secondary Dormancy

Secondary dormancy is owing to germination conditions. it's an additional adaptation to prevent germination of associate imbibed seed if various environmental conditions are not favourable. These conditions can embody unfavourably high or cold, prolonged darkness and water stress. it's of two types:

1. Thermo dormancy: Heat elicited dormancy.

2. Conditional dormancy: Modification inability to germinate related to the time of the year.

Advantages

1. Permitting germination solely environmental conditions favour seed plant survival as in fruit plants of temperate region.
2. Helpful in creating a seed genotype reservoir.
3. Dormancy will even synchronize germination to a specific time of the year.
4. Seed disposal square measure usually accelerated by specialised dormancy conditions as an example modification of seed covering through channel of a bird or various animals.

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Functional Components of Fruits and Vegetables

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Abstract

Regular consumption of fruits, vegetables, whole grains, and other plant foods has been negatively correlated with the risk of the development of chronic diseases. The key is to encourage consumers to increase the total amount to 9 to 13 servings of fruits and vegetables in all forms available. Fresh, processed fruits and vegetables including frozen and canned, cooked, 100% fruit juices and 100% vegetable juices, as well as dry fruits are all considered as servings of fruits and vegetables per day. A wide variety of fruits, vegetables, whole grains, and other plant foods provide a range of nutrients and different bioactive compounds including phytochemicals, vitamins, minerals, and fibres. More and more evidence suggest that the health benefits of fruits, vegetables, whole grains, and other plant foods are attributed to the synergy or interactions of bioactive compounds and other nutrients in whole foods. Therefore, consumers should obtain their nutrients, antioxidants, bioactive compounds, and phytochemicals from a balanced diet with a wide variety of fruits, vegetables, whole grains, and other plant foods for optimal nutrition, health, and well-being, not from dietary supplements.

Keywords: Functional components, fruits, vegetables, health benefits.

Introduction

A functional food is any food that has a positive effect on health, physical performance or state of mind beyond the benefit of nutrition. An emerging interest in phytochemicals has spawned the development of functional foods. Functional foods are sometimes also called nutraceuticals, pharmafoods, or designer foods. Functional foods may be defined as any food that has a positive impact on an individual's health, physical performance, or state of mind in addition to its nutrient value.

Three additional conditions that need to be met in order for a food to be classified as a functional food:

1. The ingredient is a food derived from a naturally occurring source.
2. The product can and should be consumed as part of a daily diet.
3. The product has specific function when eaten, promoting one or more of the following:
    a. Prevention or retardation of a specific disease.
    b. Improvement in cognition.
    c. Enhancement of immunological response.
    d. Retardation of the ageing process.

Fruits and Vegetables as Functional Foods

Fruits and vegetables as sources of phytochemicals, phenolic compounds (or polyphenols), and antioxidants.

1. Red colour fruits and vegetables: The phytochemicals present in red coloured fruits and vegetables are carotenoids and anthocyanins. One of the most abundant carotenoids present in fruits is Lycopene, which helps reduce damage from free radicals in body and it prevents heart diseases, cancer, prostrate problems and reduces the skin damage from the sun. Red fruits and vegetables are also often very high in vitamin C, which helps in cellular renewal in the body.

2. Orange colour fruits and vegetables: Carotenoids are the powerful phytochemicals in orange coloured fruits and vegetables and they give the fruits the bright colour. Carotenoids repair DNA and help prevent cancer and heart disease, as well as strengthening vision. These orange foods also give the requited amount of potassium, vitamin A, B complex vitamin which keeps eyes and skin healthy and protects against infections. They also boost the immune system because of the high content of vitamin C.

3. Yellow colour fruits and vegetables: Yellow foods are high in antioxidants like vitamin C and phytosterols. Vitamin C keeps teeth and gums healthy, helps to heal cuts and wounds improves the mucus membranes (like when we have colds), helps to absorb iron, prevents inflammation, improves circulation, and therefore prevents heart disease.

4. Green colour fruits and vegetables: These foods have the phytochemicals like Terepenes, Sulforaphane and Indoles, which both prevent cancer. They are also good for the circulatory system and are good sources vitamin B and minerals. Yellow green vegetables like figs, grapes, cucumber etc have carotenoids and lutein that help to prevent cataracts and eye disease, as well as osteoporosis.

5. Greenish/White colour fruits and vegetables: The strong phytochemical in these whitish/greenish vegetables is called allicin and allium, which give an anti-bacterial, anti-fungal, and anti-viral chemical environment in the body. It also contains Theols, the sulphur containing class of phytonutrients. All phytochemicals in the greenish/white list of fruits and vegetables helps maintain low cholesterol levels in the body preventing heart diseases.

6. Blue/Purple colour fruits and vegetables: The blue and purple coloured fruits and vegetables are known for their anti-aging properties. These foods are loaded with of antioxidants, specifically anthocyanins and phenolics which prevents free radical damage. Some blue and purple fruits and vegetables are also high in vitamin C. They improve memory function and urinary tract health.

Table 1: Colour of fruits and vegetables and health benefits:

Color group	Fruits and Vegetables	Health benefits
Red	Tomatoes, pomegranate, red peppers, beets, red radishes, red apples, red potatoes, grapefruit, cherries, raspberries, strawberries, watermelon, red cabbage	Reduce risk of cancer and heart disease, decreased blood pressure increase immunity, eyes & skin protection, hair health and decrease inflammation, helps cell renewal and they support joint function
Green	Brocolli, cabbage, brussel sprouts, cucumber, green peppers, dark leafy greens, peas, asparagus, green beans, zucchini, avocados, kiwi, green apples, green grapes, green grapes, green pears	Green foods are good for bones as well as detoxing the body and strengthening immune system, improves digestion, promote eye health, lung health, liver function, healthy cell production, reduce risk of cancer, increase blood clotting, lower blood pressure
Orange	Carrots, orange, squash, sweet oranges, apricots, cantaloupe, peaches	Orange foods help prevent cancer and reduce the risk of heart disease, promotes eye, skin protection, healthy skin, strengthening immune system, Antioxidants, decrease inflammation
Yellow	Mango, pineapple, bananas, pumpkin, potatoes, yellow peppers, nectarines, lemon, corn	Yellow foods are good for skin, healthy heart and eyes, improve digestion and immune system, lowers cholesterol, healthy joints, supports eye sight, healthy skin
Blue/purple	Eggplant, figs, red onions, purple cabbage, purple potatoes, blueberries, blackberries, plums, purple grapes, raisins, manathakali	Blue and purple foods help with mineral absorption and can improve memory and brain function, reduce risk of cancer and heart disease, protects cells from damage, antiageing, healthy blood vessels, healthy urinary system, longevity

White	Cauliflower, garlic, ginger, mushrooms, onions, turnips, potatoes, rutabagas, jicama.	White foods support immunity, and the circulatory system and can reduce the risk of cancer and heart disease, healthy colon, prevent ulcers, lowers cholesterol, protect cells from damage, promote eye, skin, bone health.

Functional Foods from Plant Sources

1. Citrus fruits: Cancer protection.
2. Cranberry: Treatment of urinary tract infections, as it causes acidification of the urine.
3. Cruciferous vegetables: Cancer risk.
4. Flaxseed: Reduce total and LDL cholesterol.
5. Garlic: Cancer risk.
6. Oats: Cholesterol, coronary heart disease.
7. Soy: Cancer, cardiovascular disease (CVD), osteoporosis, and lessening negative menopausal symptoms.
8. Tea: Inconclusive results from epidemiological studies. (The FDA stance on green tea is that it does not reduce breast, prostate or any other type of cancer.
9. Tomatoes: Lycopene as the primary carotenoid may benefit for some cancers, myocardial infarction.
10. Wine and grapes: Reduce the risk of cardiovascular disease.

Functional Foods from Animal Sources

There are a number of animal products that contain various physiologically active components, and thus play a potential role in health. Animal sources: fish, dairy, beef.

Table 2: Heart healthy functional foods and their biologically active components:

Functional Food	Possible Biologically Active Component
Black tea	Polyphenols
Blueberries	Anthocyanin
Cocoa	Flavanols
Dairy foods	Proteins, calcium, potassium, conjugated linoleic acid
Fish	Omega - 3 fatty acids
Flaxseed	Omega - 3 fatty acids
Garlic	Sulphur-containing compounds
Nuts	Unsaturated fatty acids, vitamin E, selenium
Olive oil	Monounsaturated fatty acids, phenolic compounds
Psyllium	Soluble fibre
Red wine and grapes	Resveratrol, quercetin
Soy	Proteins and flavonoids
Stanol-sterol-fortified foods	Plant stanols and sterols
Tomatoes	Lycopene, lutein
Whole grains	Soluble fibre, folate, Antioxidants
Whole oats	β-glucan, soluble fibre

Source: Hasler et al., (2004).

Table 3: Strength of evidence for functional foods:

Functional food	Bioactive component	Health benefit
Fortified margarines	Plant sterol and stanol esters	Reduce total and LDL cholesterol
Psyllium	Soluble fibre	Reduce total and LDL cholesterol
Soy	Protein	Reduce total and LDL cholesterol
Whole oat products	B-Glucan	Reduce total and LDL cholesterol

Cranberry juice	Proanthocyanidins	Reduce urinary tract infections
Fatty fish	(n-3) Fatty acids	Reduce Triglyceride, reduce heart disease, cardiac deaths and fatal and non-fatal myocardial infarction
Garlic	Organo sulphur compounds	Reduce total and LDL cholesterol
Green tea	Catechins	Reduce risk of certain types of cancer
Spinach, kale, collard greens	Lutein/zeaxanthin	Reduce risk of age-related macular degeneration
Tomatoes and processed tomato products	Lycopene	Reduce risk prostate cancer
Lamb, turkey, beef, dairy	Conjugated Linoleic Acid	Reduce breast cancer
Cruciferous, vegetables	Glucosinolates, indoles	Reduce risk of certain types of cancer
Fermented dairy products	Probiotics	Support GI health, boost immunity

Source: Clare M. Hasler (2002).

Conclusion

It is clear that functional foods play a role in good health when combined with balanced food choices and physical activity. Many fruits, vegetables and grain products have plant substances that may help reduce the risk for certain health diseases such as heart disease and some cancers. Foods rich in antioxidants (β- Carotene, Vitamin C and E) protect the body from the detrimental effect of free radicals that cause coronary heart diseases and cancer. β- Carotene is present in green leafy vegetables and yellow-orange coloured fruits and vegetables. Vegetable oils, dark green leafy vegetables, nuts and whole grains are a good source of vitamin E and help to maintain the integrity of cells and reduce thrombus formation. Citrus fruits, guava and vegetables such as cabbage and drumstick leaves are a good source of Vitamin *C. Hypocholesterolemic* agents such as garlic, fenugreek, soya protein, guargum in cluster beans and phytochemicals (pigments and flavouring substances in fruits and vegetables) are functional foods as they protect from heart diseases and cancer. Herbs and spices such as black pepper, thyme, and turmeric have shown to possess anti-oxidant property and are therefore known as functional foods.

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The Declining Entomofauna: It's Driving Forces

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Introduction

Biodiversity is an inherent part of ecosystem. It is the variability among living organisms inhabiting in all types of ecosystems, including diversity within species, between species and of ecosystems. Biodiversity reduction is a current topic of global significance, but that of invertebrates, especially of insects has been overlooked by the ecologists. It is because these mini creatures constitute the world's most abundant and specious group in animal kingdom and providing critical services within ecosystems, which cannot be ignored (May, 2010). Globally there are approximately 5.5 million species of insects found with only 1 million of these have been named and 80% still need to be discovered (Stork, 2018). Ecological importance of insects is due to their greater biomass, diversity, role in agriculture and human health. Insects play important roles in the ecosystem by aiding in pollination of flowers, seed dispersal, nutrients cycling, controlling other organisms' population and forming crucial links in food webs. But recently the insect fauna has observed a declining trend due to several driving forces. The declining in entomofauna not only represents the reduction in abundance in a geographical area but also it represents the first steps towards its extinction. Hence the effort is made to present the current state of knowledge about insect declines, i.e., the changes in species richness (biodiversity) and population abundance through time, and points to the likely drivers of the losses so that conservation strategies to mitigate or even reverse them may be implemented.

Causes of Insect Biodiversity Reduction

Insect species are getting declining since the time they appeared in this planet, but this process has gained a momentum in the last few years due to several factors. It also seems that insect declines are substantially greater than those observed in birds or plants over the same time periods (Thomas et al., 2004). The reduction in population has been observed both in terrestrial as well as aquatic ecosystems.

The crucial driving forces triggered to declining of entomofauna are discussed here:
1. Intensive agricultural practices (the major driving force).
2. Deforestation and Urbanisations.
3. Indiscriminate use of chemical pesticides having negative impacts on several non-target species.
4. Pollution, a major anthropogenic driving force.
5. Climate change.
6. Natural causes like forest fires, volcanic eruptions, etc.
7. Increased competition due to introduction of foreign pests.
8. Biological factors.
9. Genetic characters of the species.

Deforestation, urbanisation and landscape fragmentation are the main causes for the species decline of several Lepidoptera, Coleoptera and Hymenoptera due to loss of their habitat. Intensive agricultural practices include higher usage of chemical pesticides which are proved to be toxic to non-target organisms most of the time. The diversity of soil inhabiting and leaf feeding insects are greatly affected by broad spectrum insecticides while the species of butterflies, bees and wasps, hoverflies are affected by the systemic insecticides. Pollution, mainly contamination of water reservoirs with pesticides runoff, impairs the survival capacity of aquatic organisms like nymphs of dragonflies, damselflies and other insects. Species diversity of invasive pests either decreases due to poor adaptation to the new ecosystem or impose severe competition on the local insect species which leads to competitive exclusion. Climate change mainly causes shifting of habitats of the insects. The range of occurrence in case of Odonates (Dragonflies and Damselflies) has been decreased due to climate change (Ball-Damerow et al., 2014). Biological factors include the action of predators, parasites and disease-causing microbes which affect the biodiversity of many insect species. Sometimes overexploitation of some predators or parasitoids leads to the extinction of a species.

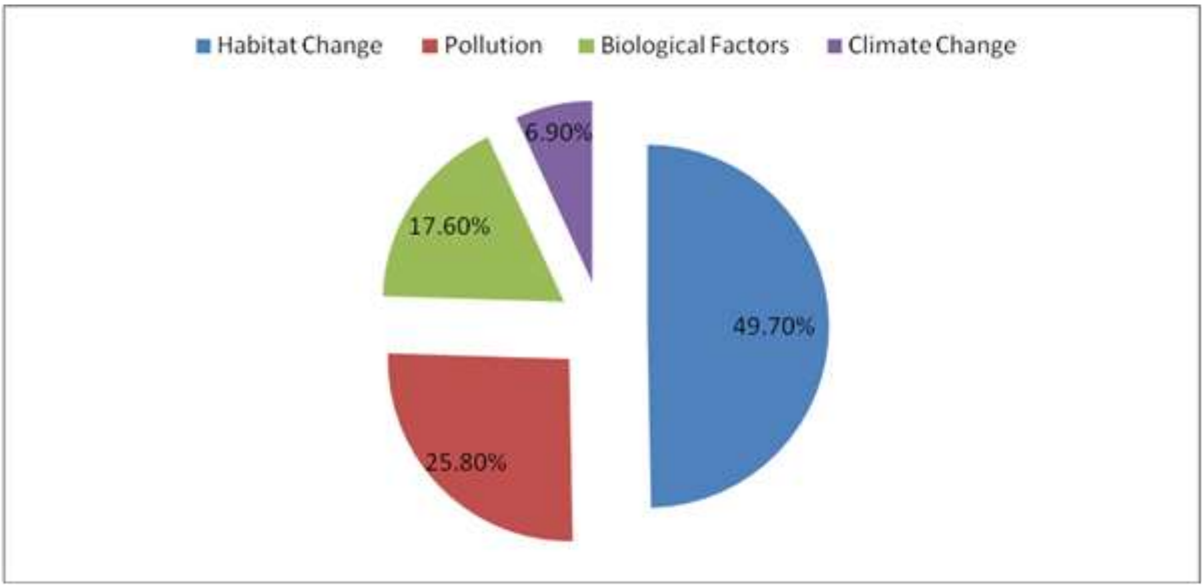

Fig 1: Critical factors responsible for insect declines (Sánchez-Bayo and Wyckhuys, 2019)

Conclusion

Entomofauna, the most diversified fauna, is declining since past few years for which the major driving forces are found to be intensive agriculture and pollution. Hence, habitat restoration, coupled with a drastic reduction in agro-chemical inputs and agricultural 'redesign', is probably the most effective way to stop further declines, particularly in areas under intensive agriculture which can be coupled with ecological engineering tactics to favour and conserve pollinators and insect natural enemies. In addition, effective remediation technologies should be applied to clean polluted waters in both agricultural and urban environments. As the insects are indispensable in maintaining biological cycle and provide safeguard to the vital ecosystem, so the awareness of major driving forces against declining insect fauna and suitable mitigation strategy is the need of hour, otherwise it is not too far to see insect species facing the problem of major extinctions.

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Quorum Sensing and Regulation of Flagellar Motility

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Introduction

The term Quorum sensing (QS), was introduced by Fuqua and Winans. It was used to describe density dependant cell-to-cell communication. Bacteria employs QS for understanding the changes in their immediate environment and to adapt to these changing environmental stresses using varies strategies. Adaptation is a continuous process affected by microbial communications; either intraspecies or interspecies. Indeed, it is predicted that most of the bacterial behaviours are dictated signal response or QS systems, which may include; enhanced nutrient access, secretion of toxic or virulent compounds, morphological differentiation, survival in hostile environments, sporulation and biofilm formation etc.

Intraspecies Communication

1. Gram-negative bacteria: The cell-to-cell signalling results from the production of small, diffusible signal molecules called autoinducers. A great number of Gram-negative bacteria synthesize multiple Acyl-homoserine lactone (AHLs). The N-acyl chain may vary in length, saturation level, and oxidation state. Typically, the acyl chains range from 4 to 18 carbons, may contain double bonds, and often contain an oxo or hydroxyl substituent at the C-3 position. AHLs are synthesized with the reaction of S-adenosylmethionine (SAM) (an essential metabolite in the central metabolism) with an acyl-acyl carrier protein, which is typically carried out by an enzyme of the LuxI family of the AHL synthases, and sensed by the response transcriptional regulators of the LuxR family. The LuxR/AHL complex is responsible for up- or down-regulation of multiple target genes. Bacterial species may synthesize more than one type of AHL, while the same type of AHL may be produced by representatives of different bacterial genera. Short-chain AHLs are generally diffusible throughout the bacterial membrane, while long-chain AHLs seem to be actively transported in and out of the cells via efflux and influx systems. Several factors may influence the concentration and type (.e., the length and substitution of the C-3 of the acyl chain) of AHLs, including temperature, pH, NaCl, growth medium, inoculum size, and bacterial growth phase.

2. Gram-positive bacteria: Cell-to-cell communication is accomplished via peptides or modified peptides (autoinducing peptides). AIPs are characterized by a small size (.e., ranging from 5 to 26 amino acid residues), high stability, specificity, and diversity and can be linear or cyclic. These peptides are ribosomally synthesized as precursor peptides, subsequently processed to form the active mature peptide autoinducer signal molecule. Secreted via an ATP-binding cassette (ABC) transporter. Depending on whether the sensor is on the cell surface or cytoplasm, the peptides can exert their function either intercellularly or extracellularly.

3. Interspecies cell-to-cell communication: The only currently known family of signal molecules shared by more than 70 species of both Gram-negative and Gram-positive bacteria is autoinducer-2. AI-2 signal molecules are considered to be a universal language because they allow bacteria to respond not only to endogenously produced AI-2 but also to AI-2 produced by other bacterial species in the vicinity. AI-2 is synthesized in three enzymatic steps from SAM. The exact structure of AI-2 furanone has not yet been determined. AI-2 production may be influenced by temperature and growth medium.

Quorum Sensing in Regulation of Flagellar Motility – A Case Study

An organism's ability to sense and move toward a favourable environment or away from a hazardous one provides it with a substantial and often crucial advantage over nonmotile competitors. More than 70% of microorganisms are motile and chemotactic, and much of the ground-breaking work in this field has been derived from the studies of such bacteria as Escherichia coli, Pseudomonas aeruginosa, and Serratia marcescens.

1. Positive regulation: In *S. marcescens, Vibrio cholerae*, and *E. coli*, production of the motility machinery is upregulated as the population density increases. In these organisms, activation of motility at a high population density probably serves to disperse the bacteria from a nutrient-depleted environment or to initiate the search for a new host.

Vibrio harvey is gram-negative bacteria that are ubiquitous in the marine environment, either free-living in the sea or associated with marine organisms. These bacteria are considered to be among the most significant pathogens of aquatic organisms, which can affect a wide range of cultured marine organisms, including fish, crustaceans and molluscs. Diseases caused by Harvey clade vibrios include vasculitis, eye-lesions, gastro-enteritis and luminous vibriosis. Bacterial motility is considered as an important virulence factor in many pathogens. It is essential for pathogenic bacteria during the initial phases of infection as it helps them to overcome repulsive forces between the bacterial cell and the host tissues and hence, facilitates attachment to the host. Some Vibrio species (including *V. harvey*) possess dual flagellar systems that are suited for movement under different conditions. A single polar flagellum is involved in swimming in liquid environments, while the numerous lateral flagella enable swarming over surfaces or movement in more viscous environments. In the whole genome sequence of *V. harvey*, approximately 50 polar and 30 laterals flagellar genes have been identified to encode components of the flagellum and its export structure in *V. harvey.*

2. The quorum-sensing circuit of *V. harvey:* The LuxM, LuxS and CqsA enzymes synthesize the autoinducers HAI-1, AI-2 and CAI-1 respectively. These autoinducers are detected at the cell surface by the LuxN, LuxQ and CqsS two-component receptor proteins respectively. Detection of AI-2 by LuxQ requires the periplasmic protein LuxP. At low signal molecule levels, the LuxN, LuxPQ and CqsS receptors function as kinases. LuxO is phosphorylated, the Qrr1-5 sRNAs are transcribed and LuxR protein is not produced. At high signal molecule levels, the LuxN, LuxPQ and CqsS receptors function as phosphatases. LuxO is unphosphorylated, Qrr1-5 sRNAs are not transcribed and LuxR protein is produced. LuxR is the quorum-sensing master regulator and controls the expression of target genes by binding to their promoter regions.

The study reports that QS positively regulates flagellar motility. The autoinducer synthase mutants showed significantly lower swimming motility than the wild type, and the swimming motility could be restored by adding synthetic signal molecules. The motility of a luxO mutant with inactive QS (LuxO D47E) was significantly lower than that of the wild type and a luxO mutant with constitutively maximal QS activity (LuxOD47A). Furthermore, they found that the expression of flagellar genes (both early, middle and late genes) was significantly lower in the luxO mutant with inactive QS when compared with wild type and the luxO mutant with maximal QS activity. Motility assays and gene expression also revealed the involvement of the quorum-sensing master regulator LuxR in the QS regulation of motility. Finally, the motility inhibitor phenamil significantly decreased the virulence of V. harvey towards gnotobiotic brine shrimp larvae.

3. Negative regulation: Although equipped with an extremely useful ability, motile organisms must expend large amounts of energy to synthesize, assemble, and activate the machinery for motility and chemotaxis. As much as 2% of the energy expenditure in the cell can be attributed to the maintenance of such activities; therefore, it is often in the bacterium's best interest to strictly regulate its ability to move toward those conditions most favourable for survival. Many factors can influence an organism's movement including, but not limited to, temperature, pH, on concentration, and the availability of metabolites. There is increasing evidence that connects the mechanism of quorum sensing, a population density-dependent mode of gene regulation, to the control of motility.

A successful symbiotic relationship between *Sinorhizobium meliloti* and its host Medico sativa (alfalfa) depends on several signalling mechanisms by *S. meliloti. S. meliloti*, a soil bacterium from the alpha-proteobacteria family, is capable of fixing atmospheric nitrogen for its leguminous alfalfa host under nitrogen limiting conditions. This symbiotic interaction involves multiple complex signalling mechanisms between both partners. The *S. meliloti* genome contains at least 41 motility- and chemotaxis-related genes that are chromosomally located in a 45-kb region commonly referred to as the "flagellar regulon". These genes are categorized into three main classes and are expressed hierarchically. Class I genes (visN and visR) lie at the apex and consequently control the expression of the genes in class II and class III. Mutation in either visN or visR is sufficient to dramatically decrease the expression of representative flagellar and chemotaxis. Class II is subdivided into class IIA (fliM and orf38) and class IIB (mot) genes, which participate in flagellar assembly and motor functions, respectively. Only the class IIA genes exert control over the expression of the genes in class III. The third group of genes (fla and che) includes those encoding the flagellin subunits and chemotactic proteins. Through the use of DNA microarray expression profiling, it was showed that motility genes are among those that rely on the ExpR/Sin quorum-sensing system. These genes encode many of the components of the motility apparatus, including the basal body, hook, and filament structures, and two transcriptional regulators. In the present study, it was demonstrated that the ExpR/Sin quorum-sensing system and the ExoR/ExoS/ChvI pathway both control motility gene expression via the visN/visR operon.

The microarray analysis of the whole-genome expression profile of *S. meliloti* revealed that the ExpR/Sin quorum-sensing system regulates additional physiological processes that include low-molecular-weight succinoglycan production, nitrogen utilization, metal transport, motility, and chemotaxis. Nearly half of the flagellar genes and their dependence on quorum sensing are prominently displayed in microarray analyses. The findings were confirmed by real-time PCR expression analysis of selected genes, including the flaF, flbT, flaC, cheY1, and flgB genes, involved in motility and chemotaxis. These genes code for regulators of flagellum synthesis, the chemotactic response, or parts of the flagellar apparatus. Gene expression analyses and visualization of flagella by electron microscopy performed at different points in the growth phase support our proposed model in which quorum sensing down-regulates motility in *S. meliloti*. They demonstrate that the ExpR/Sin quorum-sensing system controls motility gene expression through the VisN/VisR/Rem relay. We also show that the ExoS-dependent two-component system suppresses motility gene expression through VisN and Rem in parallel to quorum sensing. This study contributes to our understanding of the mechanisms that govern motility in *S. meliloti*.

Conclusion

Most bacterial species have the ability to sense changes in the environment and rapidly direct their movement accordingly. However, this useful ability comes at a great cost since ca. 2% of the cell's energy expenditure is applied toward the assembly and maintenance of the motility apparatus. Quorum sensing, or population density-dependent gene regulation, is among the many strategies used by bacteria to control the process of motility and chemotaxis. Many laboratories have reported, through a series of analyses, that the expression of many motility- and chemotaxis-related genes are regulated by the quorum-sensing system.

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Hydroponics is a Bright Farming Technique for a Better Tomorrow

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Introduction

Plants transform light energy to chemical energy by the process of Photosynthesis. They need light, water, CO_2, and certain minerals. Plants derive water and the nutrients essential for the growth from soil. In 1860, Von Sachs, a German botanist demonstrated that plants can grow without soil if they are provided with a nutrient-rich solution and fulfil their oxygen demand. This technique of growing plants without soil is known as hydroponics. It may sound weird to grow plants without soil but there are many plants like tomatoes that are already being grown hydroponically. We are so accustomed to seeing plants growing in the soil that it is quite difficult to visualize plants thriving without soil. When most people think about hydroponics, they visualize plants grown with their roots dipped directly into the water without the growing medium. This is just one method of hydroponic horticultural identified as N.F.T. (nutrient film technique). There are numerous variants of N.F.T. used around the globe and is a very prevalent method of growing plant life hydroponically.

Hydroponics

The word “Hydroponics” is derived from the word “hydros” meaning water and “ponos” meaning toil or labour. It is an agriculture technique where plants are grown in a nutrient solution in the complete absence of soil. Here soil is substituted by sterile mediums such as Rockwool, vermiculite, sand, gravel, clay pellets and perlite to give stability to roots. Nutrients are passed through roots differently, based on the type of hydroponic system used and oxygen is pumped through pH level is regulated and sufficient light is provided to carry out photosynthesis. In the areas where natural light is not available, artificial lighting is provided. It is an innovative method of farming and is being widely used now for food production.

There are Six Hydroponic Systems, Based on Different Ways by which these Requirements are Fulfilled

1. Ebb and Flow System: It requires a medium such as perlite to give stability. Water and mineral solutions are periodically pumped into the tray containing plants. Plants absorb the solution and the remaining solution drains back to the reservoir. This method is simple and used in home gardens. Herbs are grown by this method.

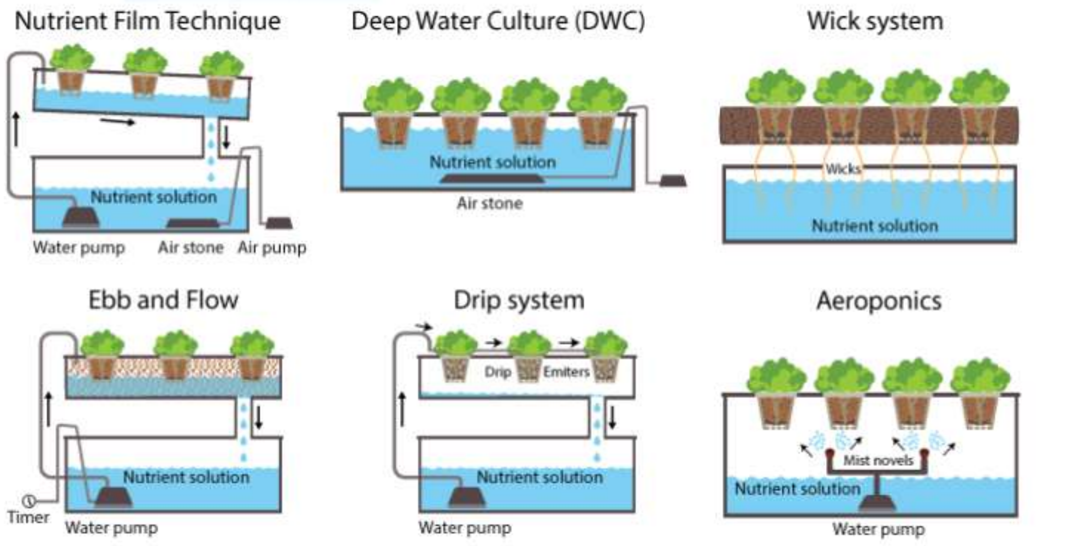
2. Nutrient Film Technique (NFT): No medium is required. Plants are kept in wooden channels having a slope. The mineral solution is pumped to the high end of the channel and slope down water is collected and reused. Plants with large roots are grown by this method.

3. Drip Systems: It is similar to ebb and flow but here water goes through smaller tubes and drain on top of plants. Small plants having less developed root system is grown using this method.

5. Wick Systems: This is a medium-based system where perlite or Rockwool is used. Nylon rope is placed at the base of each root, which extends to the reservoir. It takes up mineral, water, and releases in the medium, which makes it available for plants. It is an economical method because no pumps are required.

6. Aeroponics: This is a water-based system similar to NFT and does not require a medium. The mineral solution is sprayed onto the plants in the form of mist. This is difficult to set up but is beneficial in the large commercial setting.

7. Deep Water Culture (DWC): In a container, the plant’s root is suspended in oxygenated water containing minerals. An air pump is used. This is an easy method and requires low maintenance.



How does Hydroponics Function so Well?

If plants are provided precisely with what and when it requires to the quantity that is needed, the plant would be as vigorous alike its genetic potential. This task is far more challenging in the soil and is made easy by hydroponics.

In hydroponics, the plants mature in an inactive growing medium and an impeccably balanced pH with the nutrients delivered to the roots in an extremely soluble form. This permits the plant to carry its food with a very little exertion in contrast to the soil when the roots must grab the nutrients and obtain them. This is accurate even while making use of rich organic soil and premium nutrients.

What is a Growing Medium?

The substance in which the roots of the plant are emerging is known as a growing medium, which comprises of a gigantic variety of materials including sand, gravel, perlite, coconut fibre, rock wool, vermiculite and much more. The plants derive required nourishment from the nutrient solution (fertilizer and water collectively). One could thus, easily control the growing environment of the plants. The pH and strength of the nutrient mix are simple to regulate so that the plants obtain just the exact quantity of food. A cheap timer could organize the feeding/watering cycles so that the flora is irrigated on a schedule as necessary.

Hydroponics: A Method to Study the Mineral Requirements of Plants

The soil could be defined as an organic matter, liquids, a mixture of minerals, and many organisms, which support the possibilities of life on the earth. This is a statement worthy of a mighty proclamation, one wonders if the soil is as indispensable as it seems from the first statement then how it is possible for the plants to survive without it. Let us venture to comprehend better.

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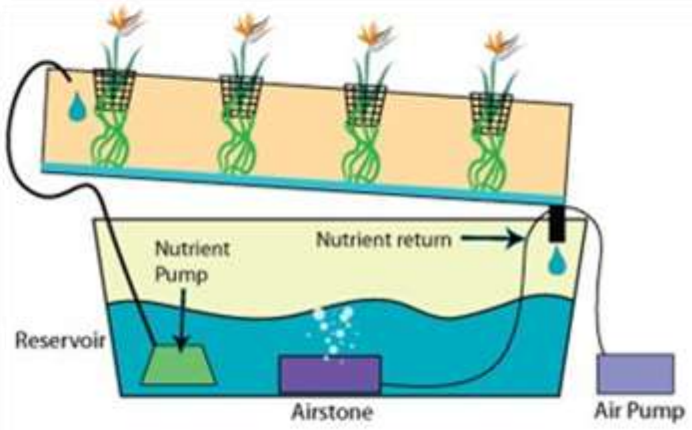
The soil, under normal conditions, manages to capture and store nitrogen, potassium, and other necessary mineral nutrients that the plant roots eventually absorb. While hydroponics immerses the roots directly into a nutrient-rich liquid solution, thus removing the necessity of soil. There are various methods for immersing the roots- either by placing the plant in the solution and submerging its roots in the solution or by placing the plant in the sand or a sterile growing medium and regularly flooding it with mineral nutrients.

The study of mineral requirements and chemical elements essential for plant growth and metabolism is called plant nutrition. The essentiality of an element in plants is determined based on two criteria. Firstly, the role of the element in the normal life cycle of the plant. Secondly, whether the element forms a part of the plant metabolite.

During, mid-19th century, a German botanist named Julius von Sachs came forward with a method to study the mineral requirements of plants. The technique is called hydroponics. In this technique, plants are grown in a nutrient solution viz. water containing dissolved nutrients. In hydroponics, plants are grown completely in the absence of soil. All we need is purified water and mineral nutrient salts where the solution is sufficiently aerated. Later many experiments were conducted for the improvisation of the method. Researchers made nutrient solutions for different elements in different proportions and studied the variations. Based on the observations, they determined and identified the essential elements and their deficiency symptoms. Nowadays, hydroponics is widely employed in horticulture and other commercial productions.



The Main Advantage of Using Hydroponics Method is

1. Conservation of water and nutrients.
2. No more use of fertilizers, pesticides, and other chemicals.
3. It can be grown anywhere as it requires very less space for growing and involves a soil-free condition.
4. It minimizes the loss of nutrients and has a lot more accurate control over the nutrients required by the plants.
5. Plant growth is completely dependent on the nutrient solution provided. Thus, there is controlled plant growth.
6. No soils needed.
7. Make better use of space and location.
8. Climate control.
9. pH control of the solution.
10. Better growth rate.
11. No weeds.
12. Fewer pests & diseases.
13. Less use of insecticide, and herbicides.
14. Labour and time savers.
15. Hydroponics is a stress-relieving hobby.

The Disadvantages Associated with Hydroponics is

1. It is a supplement to traditional growing methods, which requires high technical knowledge and training before starting the process.
2. It is a time-consuming process.
3. Requires technical knowledge.
4. It can be misused to grow banned products like marijuana.
5. Water and electricity risks.
6. System failure threats.
7. Initial expenses are more.
8. Long return per investment.

Conclusion

In the recent years, hydroponics is very much essential and seen as promising strategy for growing different crops. As it is possible to grow short duration crops like vegetables round the year in very limited space with low labour, so hydroponics can play a great contribution in areas with limitation of soil and water and it is helpful for the poorer and landless people. In India, the hydroponic industry is expected to grow exponentially in near future. To encourage commercial hydroponic farm, it is important to develop low cost hydroponic technologies that reduce dependence on human labour and lower overall start up and operational costs.

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First Generation of DNA Sequencing Methods

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Introduction

Millions to billions of DNA nucleotides can sequence in parallel, yielding substantially more throughput and minimizing the need for the fragment-cloning methods that used with Sanger sequencing. DNA sequencing refers to methods for determining the order of the nucleotide's bases Adenine, Guanine, Cytosine and Thymine in a molecule of DNA. The first generation of sequencing technology has the read-length ability of 1000bp with the 99.999% accuracy, which are the main feature.

Chemical Degradation Method

In 1977, A.M. Maxam and W. Gilbert firstly established a DNA sequence determination method, which also called Maxam-Gilbert chemical degradation method. This method may analyse the DNA sequence up to 500bp. At first, the double stranded fragment separated into two single strands by applying high Temperature or high PH. Run the single stranded fragments on gel. Take one of fragment band from the gel. Now put all the radioactively labelled fragments in four different tubes.

Tube1: Increase Temperature and PH (by adding NAOH), that would cause fragments to break down. Dimethyl sulphate will add that would make cuts at Adenine and Guanine positions.

Tube2: Dimethyl sulphate and dilute HCL will add that would cut the fragment at Adenine position.

Tube3: Reagents Hydrazine and Piperidine add that would cuts the fragment at position Cytocine and Thyamine.

Tube4: In the last tube, Hydrazine, Piperdine and NaCl add that would cuts the fragment at Cytocine position.

All of the fragments from each four tubes are pour in Gel. Four wells will be making on Gel, in 1st well, fragments from 1st tube is pour, in 2nd well fragments from 2nd tubes and so on. Fragments would separate on Gel according to size. After placing radioactive film on top of gel, radioactive labelled fragments would emit a spot at their position.

Advantages

1. Purified DNA can be read directly.
2. Homopolymeric DNA runs are sequenced as efficiently as heterogeneous DNA sequences.
3. Can be used to analyse DNA protein interactions (i.e. footprinting).
4. Can be used to analyse nucleic acid structure and epigenetic modifications to DNA.

Limitations

1. It requires extensive use of hazardous chemicals.
2. It has a relatively complex set up / technical complexity.
3. It is difficult to "scale up" and cannot use to analyse more than 500 base pairs.

Chain Termination-Sequencing Method (Sanger Sequencing Method)

Sanger in 1977 judged the first genome sequence belonging to Phage X174 with the whole length of 5375 bases. It based on the chain termination by the use of Dideoxynucleotides (ddNTPs). The chain termination method is the method more usually used because of its speed and simplicity.

1. Firstly, DNA sample divided into four separate sequencing reactions, containing all four of the standard deoxynucleotides (dATP, dGTP, dCTP, dTTP) and the DNA polymerase.

2. In each reaction add only one of the four dideoxynucleotide (ddATP, ddGTP, ddCTP, ddTTP) which are the chain terminating nucleotides, resulting in DNA fragments of varying length.

3. The newly synthesized and labelled DNA fragments are heat denatured, and separated by size by gel electrophoresis with each of the four reactions run in one of the four individual lanes (lanes A, T, G, C).

4. Bands visualized by autoradiography or UV light, and the DNA sequence can directly read off the gel image.

5. The relative position of the different bands among the four lanes then used to read (from bottom to top) the DNA sequence.

Advantage

Chain termination methods have greatly simplified DNA sequencing.

Limitations

1. Non-specific binding of the primer to the DNA, affecting accurate read-out of the DNA sequence.
2. DNA secondary structures affecting the fidelity of the sequence.

Automated DNA Sequencing

The procedure is very similar to Sanger's chain termination. Automated data collection in an easy way and in lesser time. Florescence technique is use for detection of DNA bands. Automated DNA sequencing involves four fluorophores, one for each of the four-nucleotide bases (Martin and Davis 1986).

1. Each of the dideoxy nucleotides used in the reaction labelled with a different fluorescent marker. The chain-termination sequencing is performing in one tube and this tube contains four fluorescent-labelled dideoxy nucleotides.

2. The numbers in front of each nucleotide chain represent the length of that corresponding nucleotide chain in each reaction.

3. After the extension reactions, the mixture is loaded into a well of a polyacrylamide slab gel, or into a tube of a capillary gel system, and electrophoresis is carried out to separate the molecules according to their lengths.

4. After separation, the molecules run pass a fluorescent detector capable of discriminating between the labels attached to the dideoxy nucleotides.

Significances of DNA Sequencing

1. DNA sequencing help to understand the function of genes.
2. To analysis demonstrates regulatory regions that control gene expression.
3. Evolutionary relationships.
4. Allow laboratory determination of microbial sequences for identification of microbes.

Limitations of First-Generation DNA Sequencing

Its high cost, low throughput and other disadvantages result in a serious impact on its real large-scale application. Therefore, the first generation of sequencing technology is not the good for DNA sequencing.

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Valuable Uses of Weeds

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Weeds are plants that are unwanted in a given situation and may be harmful, dangerous or economically detrimental and to cause health hazards. Weeds are a serious threat to primary production and biodiversity. They reduce farm and forest productivity, displace native species and contribute significantly to land and water degradation. The costs of weeds to the natural environment are also high, with weed invasion being ranked second only to habitat loss in causing biodiversity decline.

In spite of all the difficulties caused by weeds, they can offer some beneficial properties, particularly when occurring at low densities. These aspects should be utilised in the farming system, although this may make organic management more complicated than chemical-based systems. Some of the potential benefits of weeds are listed below:

1. Use in human food as leafy vegetables: Some of the weeds are used as vegetables such as Bathua (*Chinopodium album*) is cooked and consumed. Similarly, other weeds include *Amaranthus viridis, Digera arvensis Amaranthus polygamus*, nuniashak (*Portulaca* sp.) and Letuce (*Lactuca runcinata*) also used as vegetable.

2. Use as fodder for animal: Many weeds have good palatable taste and are used as fodder for milch animals and other domesticated animals. Common weeds used as fodder are *Convolvulus arvensis* (field bind weed), *Clitoria ternatea* are good fodders for animals.

3. Use as green manure: Most of the times field is irrigated for preparation and weeds are allowed to grown in the fields and when the weeds appear, they are ploughed down. This not only culminates the weeds but also add the organic matter to the soil. Some of the leguminous weeds have high nitrogen contents which are very helpful in this regard. Many weeds have luxuriant leafy growth and when buried in the soil as green manure add considerable amount of organic matter and plant nutrients. Weeds add about 5 to 15 tonnes of green matter per hectare depending upon weed species and their growth. *Calotropis gigantea*, *Tephrosia purpurea* and *Croton sparsiflora* make excellent green manure for rice fields.

For example, *Datura* sp. contains 3% nitrogen on dry weight basis. Bichu (*Xanthium strumarium*) – 3 to 3.5 % N, habchu (*Psoralea corylifolia*) – 3 to 3.5 % N, leguminous weeds– 1.5 to 6 % N.

Decaying roots- especially deep taproots- add organic matter to the soil. They provide channels for rain and air to penetrate. Decaying roots also create tunnels for worms and other beneficial soil microbes. They help improve the no-till garden.

4. Weeds may fertilize soil: Many weeds are said to accumulate vital nutrients from the subsoil and bring the nutrients into their leaves. As the weed leaves die back, they make a healing medicine (fertilizer) for damaged topsoil. Their presence can indicate the need to enrich your soil with amendments such as worm castings or compost. That’s because each time you harvest vegetables, you extract nutrients from the soil.

5. Weeds attract beneficial insects: Weeds are usually quick to sprout, yet short-lived. For this reason, they flower frequently in order to set seed for the next generation. The flowering and their dense foliage can attract beneficial insects or other organisms which benefit plants looking for habitat or nectar. Some weeds attract lady beetles or the good types of nematode or provide ground cover for predatory beetles.

6. Use in medicine: Weeds are perhaps the oldest medicines available and many records exists predating to ancient history which tells about the use of weeds for making extracts for different diseases in ancient civilization. The practice of traditional medicine is still bases on weeds.

a. Swetodron (*Leucas aspera*) – used in snake bite.
b. Oil of piwals dhotra– useful against skin disease.
c. Kesuriya (*Eclipta erecta*)- useful against cough and as hair oil.

7. Helpful against soil erosion: Weeds and specially grasses are good soil binders in the fallow land. Helping to conserve soil moisture and prevent erosion. *Panicum repens* is a common weed grass and it binds the soil with its dense root system. Similarly, *Pennisetum clandestinum* and *Cenchrus* sp. are also effective against soil erosion. A ground cover of weeds will reduce the amount of bare soil exposed helping to conserve nutrients, particularly nitrogen which could otherwise be leached away, especially on light soils. Weeds growing on desert lands, waste lands and sloppy fields lower wind and water erosion and also help for protection of the environment.

Weeds are fast growing, so they can quickly cover bare ground to protect it. Their roots hold soil together and keep it from eroding away in the wind or rain. Their presence can indicate the need for mulch to protect soil, i.e. more mulch can often mean fewer weeds.

8. Use as fuel: One example of use as fuel is the use of *Prosopis juliflora* which is a tree weed. People use it as fire wood.

9. Use in making mats and screens: The stems of some weeds are also used in making mats and screens, *Cyperus corymbosus* and *Cyperus pangorei* stems are used for mats and *Typha angustata* stems are used for screens.

10. Indicators of soil nutrients: Different types of weeds are present under specific soil conditions. *Echinochloa colona* grows in nutrient rich soils, *Cymbopogon* sp. grows in light soil and sedges are present in soils with drainage problems.

11. Reclamation of soils: The application of powder of the weed Mexican poppy (*Argemone mexicana*) @ 2.5 t ha^{-1} is useful for reclamation of alkali soils.

12. Some of the weeds have economic importance: Kans (*Saccharum spontaneum*)– used for thatching purpose and breeding sugarcane varieties for including hardiness. Nutgrass or nutsedge used for making essence sticks.

13. Some of the weeds serves as ornamental and hedge plants: Lantana (*Lantana camara*) and cactus used as ornamental and hedge plants. timeful (*Portulaca* sp.) used for beautiful flowers.

14. Weeds have nematicidal properties: *Crotalaria* sp., Calotropis sp., *Parthenium hysterophorus* etc. when incorporated in to the soil help for control of nematodes.

15. Use as pest prevention: Many weeds protect nearby plants from insect pests. Some beneficial weeds repel insects and other pests through their smell, for example alliums and wormwood. Some weeds mask a companion plant's scent or the pheromones of pest insects, as with ground ivy, as well as oregano and other mints. Some also are unpleasant to small animals and ground insects, because of their spines or other features, keeping them away from an area to be protected.

16. Use as trap crop: Some weeds act as trap crops, distracting pests away from valued plants. Insects often search for target plants by smell and then land at random on anything green in the area of the scent. If they land on an edible weed, they will stay there instead of going on to the intended victim. Sometimes, they actively prefer the trap crop.

17. Use as green mulch: Conversely, some intercropped plants provide living mulch effect, used by inhibiting the growth of any weeds that are actually harmful and creating a humid, cooler microclimate around nearby plants, stabilizing soil moisture more than they consume it for themselves. Plants such as ryegrass, red clover and white clover are examples of weeds that are living mulches.

18. Use as herbicide: Repel plants or fungi through a chemical means known as allelopathy. Specific other plants can be bothered by a chemical emission through their roots or air, slowing their growth, preventing seed germination or even killing them.

19. Use as permanent ground cover: White clover is often used as a permanent ground cover in orchard areas. It covers and protects soil and the shallow fruit tree roots. In the vegetable garden, white clover is often used in pathways, fertilizing nearby garden soil.

20. Other economic uses:

a. Useful in production of fragrance like *Cyperus rotundus.*

b. Aromatic oils are extracted from *Cymbopogon citratus* (citronella oil) and *Cymbopogon martinii* (Palmrosa) are used for manufacturing aromatic oil.

c. Weeds growing in bushy habit are used for fencing purposes.

d. *Lantana camara* is has beautiful inflorescence and it is plant now for landscaping.

e. Food and shelter can be provided for natural enemies of pests and even alternative food sources for crop pests. The actual presence of weed cover may be a factor in increasing effectiveness of biological control of pests and reducing pest damage.

f. Weeds can also be valuable indicators of growing conditions in a field, for example of water levels, compaction and pH of soil.

g. Weeds can be an important source of food for wildlife, especially birds. Bird populations have been declining on farmland over the last few decades and leaving weeds as a resource has been shown to help revive bird populations.

h. Weeds can be used for paper pulp, bio-gas and manufacture of edible proteins.

i. Some of the weeds are used for religious purpose like durba (Cynodon dactylon), kansh (*Saccharum spontaneum*) etc.

j. Chickweed is said to accumulate potassium and phosphorus.

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Multi-Layer Horticulture Farming

Article ID: 32009

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Introduction

Multi- layer farming means nourishment and production of plants or crops of different heights on the same piece of land at same time. In reference to this concept we need to think about utilization of cultivable land in vertical manners by using cultivation of different horticultural crops mainly plantation, vegetables and spice at a same time throughout the year. This concept is also called multi-Tire cropping or multi storied cropping. The growing of plants of different height in the same field at the same time called Multi-Layer farming. It is simple but yet effective technique in resource-poor settings is the use of multilayer cropping.

The objective of the multi-layer farming technique is:
1. To utilize the vertical space effectively.
2. To utilize the limited natural resources like land and water which is very scare recourses now a days.
3. Cultivation of more than 3-4 crops in a single piece of land at same time.
4. To reduction of cost of cultivation of crops and which is the ultimate cause of doubling of farmer's income.
5. Improve of soil moisture and nutrient dynamics in the vegetables farming.
6. Solve the problem of feeding the growing population due to less availability of cultivable land.

Background of this Concept

In west Bengal condition the farming community is divided into different categories on the basic of land holding capacity i.e., Marginal, small, medium, semi-medium and large. For the rules and regulation most of the farmers belongs to small (1-2 ha) and marginal (<1 ha) categories as per land holding capacity and it is noticed that production is less due to increasing trend in population. So, it is necessary to effective utilization of natural resources i.e., land, water, capital and wealth which fulfil our basic needs of living.

Multilayer farming refers to growing different vegetables on the same plot at a time. This helps smallholder farmers grow various seasonal vegetables and horticultural crops throughout the year while ensuring food and nutritional security for the household. Vulnerable families are provided with an additional income from the sale of surplus produce.

Multi- Layer Vegetables cultivation is an excellent example of judicious utilization of soil, water and different layers of height to take full advantage of limited land recourses.

Basics Principles of Multi-Layer Farming

In a small piece of agricultural land growing initially, vegetables such as carrot, colacasia, green leafy vegetables and spices e.g. spinach, coriander, turmeric, garlic etc. were cultivated in this land as sole plantation.

In lands where Turmeric or garlic being grown conventionally as a sole crop, there was no possibility of reaping another crop harvest. The crop duration of turmeric, garlic is about 10-12 months, starting from the month of April-May, each year. Also, the seed tubers of turmeric and garlic took 45-60 days to emerge above the ground.

Realizing that the top soil layer in the turmeric, garlic fields remain unused for a significant period of time due to late germination of the crop, farmers explored ways of utilizing the resources in a better way for improved production.

Farmers first started cultivating short duration green leafy vegetables on the top soil layer, until the sown crop (i.e. Turmeric, garlic) germinated and emerged above the ground. Since Turmeric, garlic is late germinating crop and completes its crop cycle in 10-12 months, farmers made further experiments in the Turmeric, Garlic fields.

Eventually, farmers came up with a multilayer seed sowing technique in which seeds/seed-tubers of three different vegetable crops i.e. Turmeric, garlic, and green leafy vegetables are now being sown in the middle and top soil layers, respectively and simultaneously in a single crop field. By using this new technique, popularly called as multilayer cultivation, farmers tried to maximize production from a unit area

Now for using different height from the ground in the turmeric garlic field by cultivating climber crop like pointed gourd which usually grows up to 8-10 fit from the top soil and will take 6 months to produce fruit.

Finally, in upper layer we will be utilized by cultivating papaya above pointed gourd which will give output for long run duration.

By using these multi-layer techniques of vegetables and fruit cultivation we use the different height from ground Laval which is the proper utilization of recourses.

1. Underground-Turmeric: Garlic.
2. Ground Laval: green leafy vegetables (Duration 60-70 Days).
3. 8-10 fit from ground Laval: Cucumber, pointed gourd.
4. Above 10 Fit: papaya.

Examples of Some Multi-Layer Farming

1. Coconut + Coffee + Pineapple.
2. Coconut +Papaya + Banana.
3. Mango+ Pineapple.
4. Pigeon Pea +Sesame+ Ground Nut.
5. Spinach + Radish +Onion.
6. Brinjal + Lady's Finger + Basella + Colocasia.
7. Amaranths + Lady's Finger + Colocasia.
8. Sugarcane + Mustard +potato.

Conclusion

Multilayer vegetable cultivation is an excellent example of judicious utilization of soil and water resources to take full advantage of limited land resources. Also access to markets has been one of the major drivers of this innovation in farming practice. Soil moisture and nutrient dynamics in this vegetable farming technique should be of interest to further investigation.

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Plant Quarantine System and Quarantine Weeds and their Importance in India

Article ID: 32010

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Background

1. Enforcing Plant Quarantine Regulations issued under the 1914 Destructive Insects & Pests Act, as amended, to prevent the introduction and spread of exotic pests.
2. Fulfilling international commitments and obligations on pest control and phytosanitary measures.
3. Imparting training in areas of Plant Protection technology, Pesticide quality testing, Pesticide residue analysis etc.
4. Coordinating with State and Union Territory Governments on all matters relating to plant protection.

The PQ Order has Following Schedules

Schedule I: Points of Entry for Imports of plants/plant materials and other articles.

Schedule II: List of Inland Container Depots and Container Freight Stations for import of plants and plant products.

Schedule III: List of Foreign Post Offices for import of plants and plant products.

Schedule IV: List of plants/planting materials and countries from where import is prohibited along with justification.

Schedule V: List of plants and plant materials imports of which are restricted and permissible only by authorized institutions with additional declarations and subject to special conditions.

Schedule VI: List of plants/plant materials permitted import with additional declarations and special conditions.

Schedule VII: List of plants/planting materials where imports are permissible on the basis of phytosanitary certificate issued by the exporting country, the inspection conducted by Inspection Authority and fumigation, if required, including all other general conditions.

Schedule VIII: List of Quarantine Weed Species.

Schedule IX: Inspection Fees; B-Fumigation/disinfection/disinfestations/supervision charges.

Schedule X: List of Permit Issuing Authorities for Import of Seeds, Plants and Plant Products and other articles

Schedule XI: List of Inspection Authorities for Certification of Post-Entry Quarantine facilities and inspection of growing plants

Schedule XII: Quantities of seeds permitted for trial purpose/accession to gene bank of National Bureau of Plant Genetic Resources

Plant Quarantine Regulations for Weeds in India

1. Plant Quarantine (Regulation of Import into India), Order, 2003.
2. Clause 3(12) & Schedule VIII of PQ Order, 2003.
3. 57 weed species are listed as Quarantine Weeds in the Order.
4. No consignment of seed or grain contaminated with Quarantine weeds is permitted unless PQM.
5. Weed Risk Assessment.

Detection and Identification of Weed Seeds

1. Objectives:

a. To detect and mechanically remove the weed seeds.
b. To release the material free from weeds.

2. Methodology:

a. Visual examination
b. Microscopic examination
c. Removal & collection of weed seeds
d. Segregation of weed seeds on the basis of their shape, size, colour, texture and presence of any attachment.

3. Identification of weed seeds: On the basis of morphological characters of weed seeds by consulting identification keys Grow-out test.

Quarantine Measures to Prevent the Introduction of Exotic Weeds into India

Introduction of exotic weeds in to India should be prevented by suitable phytosanitary regulations. Imported seeds/planting materials should be subjected to thorough inspection by weed specialists at all point of entry. All imported used vehicles and agricultural machinery should be inspected and must be cleaned if contaminated with soil, straw, and chaff or plant debris.

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Genome Wide Association Studies: A Novel Tool to Dissect Complex Traits

Article ID: 32011

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Presently 150 plant species cultivated in agriculture, twelve provide about 75% of human food and four produce 50% of human diet. According to FHO report, ~ 800 million people are suffering from food deficiency. An attention to improve agricultural productions to reduce the feeding problems. So, there is a need of technique to exploit the available genetic variations within the germplasm and need to identify a marker governing that particular variable trait which can be used in the present breeding approaches to develop new cultivars.

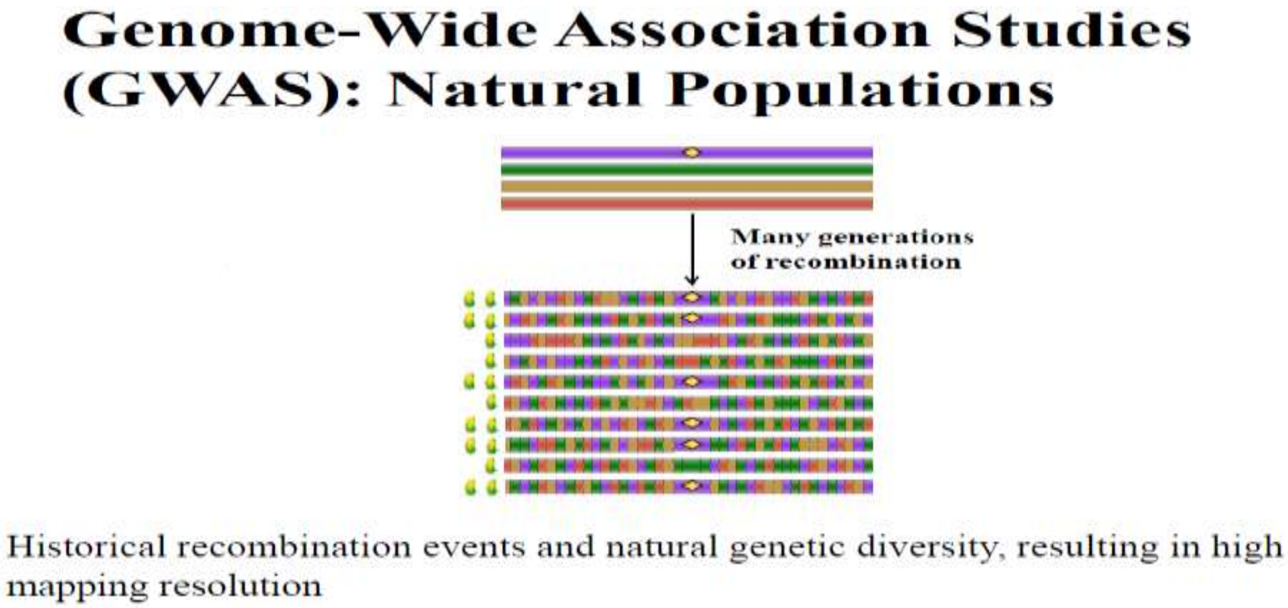
Some of the modern breeding tools now a days utilized to exploit the available genetic resources among the germplasm are; Mapping studies (QTL mapping), Association mapping, Candidate gene mapping, Genome wide association mapping (GWAS).

Association Mapping

Association mapping, a high-resolution method for mapping quantitative trait loci based on linkage disequilibrium. Association refers to covariance of a marker polymorphism and a trait of interest.

The first association study to attempt a genome scanning plants was conducted in sea beet (*Beta vulgaris* ssp. *maritima*), a wild relative of sugar beet (*Beta vulgaris* ssp. *vulgaris*).The first association study of a quantitative trait based on a candidate gene was the analysis of flowering time and the *dwarf8* (d8) gene in maize. Association mapping is based on the principle of Linkage disequilibrium (LD) and is based on the entire population.

Genome-wide association studies (GWAS) are projects to investigate the statistical association between phenotypes and a dense set of genetic markers (Genetic Marker) that capture a substantial amount of genetic variations in the genome, using a large number of markers and matched samples.



Why are they Possible Now?

Genotyping Technology:

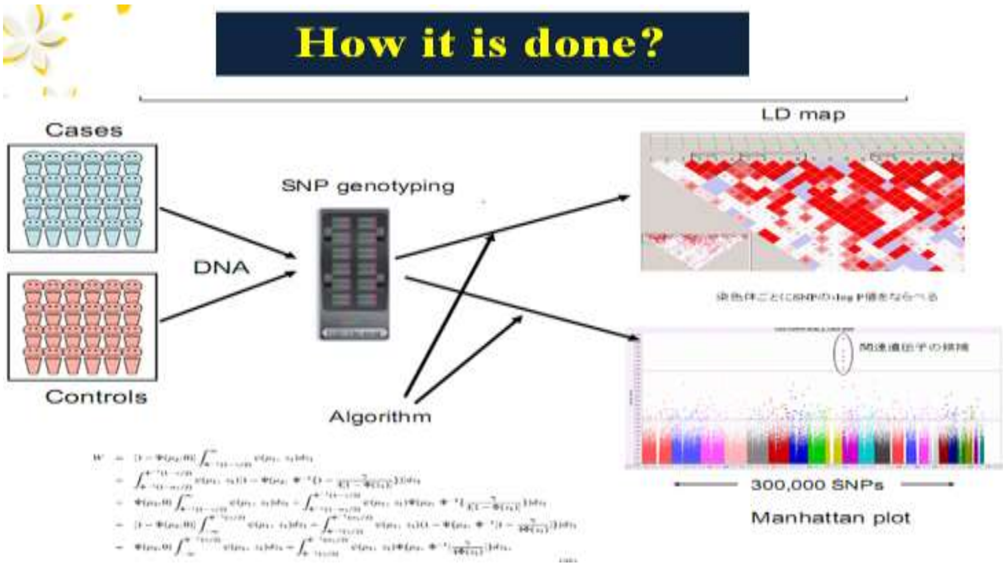
a. Now we have ability to type 100 or 1000 (or millions) of SNPs in one reaction on a SNP chip. The cost can be as low as possible
b. Two primary platforms: affymetrix and illumine.

Design and analysis:

a. Availability of SNP databases, sources to identify the SNPs and design SNP chips.
b. Faster computers to carry out the millions of calculations make implementation possible.

How to Conduct a GWAS?

1. Obtain DNA from people/plant with disease/phenotype of interest (cases) and unaffected controls.
2. Run each DNA sample on a SNP chip to measure states of ~1,000,000 SNPs.
3. Identify SNPs where one allele is significantly more common in cases than controls.
4. We say this SNP is associated with disease/phenotype.



Advantages of GWAS

1. Biological pathway of the trait does not have to be known.
2. Potential to discover novel candidate gene, not identified through other methodological approaches.
3. Encourage the formation of collaborative consortia to recruit sufficient number of participants for analysis, which tend to continue their collaboration with subsequent analysis.
4. Rules act at specific genetic association.
5. Provides data on ancestry of each subject, which assists in matching case subject with control subject.
6. Provides data on 2 types of structural variants-sequence and copy number variations- which provides more robust data.
7. It is large enough to identify mutations explaining a few percent of phenotypic variance.

Linkage Disequilibrium Concept

1. Linkage equilibrium: LE is a random association of alleles at different loci and equals the product of allele frequencies within haplotypes.
2. Linkage disequilibrium: Jennings (1917) – Described the LD concept where, LD is a non-random association of alleles at different loci, describing the condition with non-equal frequency of haplotypes in a population.

Lewtonin (1964) - Developed Quantification of LD

1. LD is difference between the observed gametic frequencies of haplotypes and the expected gametic haplotype frequencies under linkage equilibrium.
2. $D = P_{AB} - P_A P_B = (P_{AB}P_{ab} - P_{Ab}P_{aB})$
3. D is informative for comparisons of different allele frequencies across loci and strongly inflated in a small sample size and low-allele frequencies.

4. Verified with the r^2 (0 to 1) before using for quantification of extent of LD in case of low allele frequency.

Pre-Processing

1. Genotype:

a. Imputing of missing value.
b. Hidden Mankov models and related approaches.
c. Beagle, IMPUTE
d. In GWAS based on full sequencing data some alleles may be rare or even private.

2. Phenotype: eg. Growth rate, generation doubling time etc.

a. Most parametric models are based on Gaussian assumptions.
b. Phenotypic residues are often non-Gaussian.
c. Phenotypic transformation on suitable scale.
d. Use of prior knowledge.
e. Variance stabilization.

Challenges We are Going to Address while Conducting GWAS

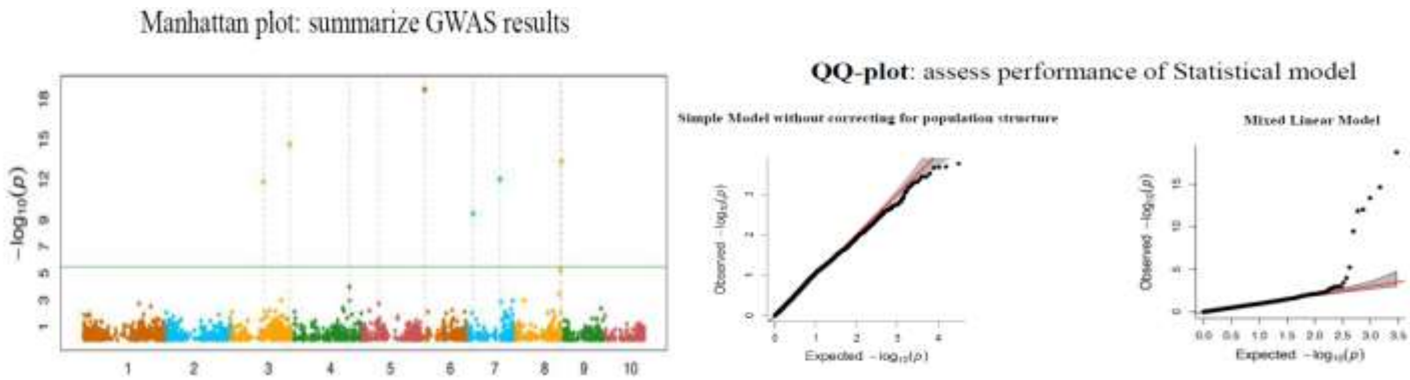
1. Multiple hypothesis testing:

a. In GWAS the number of statistical tests is commonly is on the order of 10^6.
b. At significance level of 0.01we would expect 10,000 false positive. Thus, individual p-value <0.01are not significant anymore.
c. Correction of multiple hypothesis testing is critical.

2. Population structure: Confounding structure leads to false positive.

3. Statistical power and resolution:

a. Small samples, large number of hypothesis.
b. Increased power.
c. Testing compound hypothesis.



Genome-wide Association Mapping Results

4. Software for GWAS: TASSEL, STRUCTURE, GAPIT, PLINK, GEMMA, FARMCPU, JMP Genomics.

Imputation of SNP Genotype

1. Estimation of unmeasured or missing genotypes.
2. Based on measured SNP's and external information eg: haplotype structure of Hapmap
3. Increase GWAS power.
4. Allow for combining data across different platforms eg: Affymetrix and Illumina for replication /meta-analysis.

Disadvantages

1. Results need replication in independent samples in different population.
2. A large study of population is required.
3. GWAS detect association not causation.

4. Identifying specific location not complete gene. Many variants identified are nowhere near a protein coding gene or are within genes that were not previously believed to associate with a trait or condition.
5. Falls on common variants.
6. Detect any variant that are common(>5%) in a population.
7. Typically for any particular trait, the cumulative effect of multiple SNPs only explains a small function of an individual risk of a strain.

Conclusion

A major benefit of GWAS is one-time genotyping and repeated phenotyping in different environmental conditions which helps to study ́n' number of traits within a short period over a large area. Rapid development of high throughput sequencing technology in recent years imply that, population choice for GWAS studies will no longer be restricted to current model organisms but will slowly become more forced on those species are more relevant for answering biological questions.

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Fertigation Technology for Enhancing Vegetable Production

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In India, around 83% water is being used in agricultural sector, covering 80 million hectares land under irrigation. Due to water demand in industrial as well as domestic sectors, there is an increasing pressure on the availability of water for agricultural sector. As per estimate of Central Water Commission, the utilizable water from surface structure is about 690 cubic km and replenishable ground water potential is 452 cubic km. Ground water should not be observed as a long-run depletable resource. Over the years, due to frequent incidence of drought and over exploitation of ground level, the water table has been declining in many parts of the country. In India per capita availability of water will be reduced from 2500 m3 at present to 15000 m3 per year by the year 2025. Considering its scarcity in future, the planning and management of this resource and its optimal, economical and equitable use has become a matter of utmost urgency. Give such a challenges task the only alternative remain is to use this resource judiciously and most efficiently to sustain the availability of water forever. Micro-irrigation may be an effective tool serving the purpose, considerably saves water, besides enhancing quality and yield of the produce. It was estimated that the potential for use of micro-irrigation system in India is about 27 Mha as against present area of about 0.5 Mha.

Basic Principles of Irrigation in vegetables

Vegetable are quick growing with shallow rooted crop and tools rarely goes below 60cm. Furthermore, the useful product of vegetable is usually leaf storage (roots or stem) and fruit rated on its freshness and appearance that largely depends upon continuous supply of water. There are no exact formulas for watering, because of many variations in soil, climate and crop types. The basic rule of thumb is to water thoroughly, to moisten the soil to a depth of 20-30cm. Then let the soil dry out bit, and water again as per need of the crop. Irrigation can be schedule by feeling the soil a couple of interest below the surface. If it feels cool to touch but does not wet or muddy the figure, it's just the right time to water. If it is dry and dusty, irrigation is delayed too long. If it wets the figure, it is too soon to water.

The irrigation requirement of vegetables varies and depending upon the duration of the crop, type of soil and growing season. The aim of irrigation schedule in vegetable should be to maintain a continuous high soil moisture level in root zone. The soil moisture level at about 15cm depth should not be allowed to drop below 70% of total available soil moisture. Most of vegetables crops require up to 4-5cm of water each week during hot periods at plants spread of 30cm or more. This need decreases to about 2.0-2.5cm per week during cooler season. Irrigation rate depends on soil type but application rate should not exceed 0.40inches per hour for sandy soil, 0.30inches per hour for loamy soil or 0.20inch per hour for clay soils. High application rates will result in irrigation water running of the field, contributing to erosion and fertilizer runoff.

Fertilization and irrigation are two of the most important factors in crop production, as they strongly affect the yield and quality of cultivated crops. The total area cultivated by micro-irrigation worldwide increased from 1.1 million ha in 1986 to roughly 11.1 million in 2015.

This astonishing growth in the use of micro-irrigation is mainly due to:

1. Its high irrigation efficiency (up to 95% of applied water), which partially contributes to solving the water shortage problems associated with both poor quality and low quantity in some cultivated areas.

2. The progressive development of irrigation technologies that have substantially reduced the cost of equipment for micro-irrigation systems. Horticultural crops are generally high-value, so irrigation is fundamental for obtaining high yield and quality for open-field-vegetable crops, and it is required for protected vegetable crops. Fertigation is the agronomic operation in which fertilizer is dissolved in the irrigation water and delivered to the root zone by the irrigation system [8]. This combination provides the technical capacity for

precise mineral nutrition, both spatially and temporally. The first scientific application of fertigation was in 1958 in the USA using sprinklers while the combination with drip irrigation was first applied in Israel on tomato crops. Fertigation generally allows for a significant increase of nutrient use efficiency in terms of plant nutrient recovery, with much higher results (up to 90%) than in other fertilizer application systems (40–45%). As a consequence, the use of fertigation has been found to reduce the run-off of mobile nutrients such as N by up to 70% compared with conventional fertilizer applications.

What is Fertigation?

Applying plant nutrient by dissolving them in irrigation water (termed as fertigation) particularly with the micro irrigation system is the most efficient and precise way of nutrient application close to the crop root zone. In vegetable production, nutrient and irrigation must be provided to reduce nutrient and moisture stress and to maximize production.

Fertigation is a technique of fertilizer application in which fertilizer is incorporated within the irrigation water by the drip system where timing, amounts and concentration of fertilizers applied are easily controlled. Fertigation ensures saving in fertilizer (40-60%), due to "better fertilizer use efficiency" and "reduction in leaching". Water and fertilizer are costly input, every effort must be taken to enhance the water and fertilizer use efficiency by reducing their wastage. In this method both water and fertilizer are delivered precisely and uniformly to the crop root zone as per the crop needs and according to crop developmental phase. By adopting drip fertigation, it is possible to increase the yield potential of vegetable crops by three-fold with the same quantity of water. Besides, it has also been found to improve the quality of crop produce, helps the grower to get better price of their produce. The water and fertilizer saving through drip fertigation have been reported to be 40-70 and 30-50 per cent, respectively. Drip irrigation is one of the efficient methods of irrigation having about 90 per cent water use efficiency. It is a type of micro-irrigation that has the great potential to save water and nutrients by allowing water to drip slowly to the roots of plants minimize evaporation. Fertigation through drip irrigation reduces the wastage of water and chemical fertilizers, optimizes the nutrient use by applying them at critical stages and at proper place and time, which finally increase the water and nutrient use efficiency. Moreover, it is well recognized as the most effective and profitable means of maintaining optimal nutrient level and water supply according to crop development stage, specific needs of crops and type of soil.

Fertilizer Use Efficiency in Different Methods of Applications

Nutrient	Fertilizer use efficiency, %		
	Soil application	**Drip**	**Drip and fertigation**
N	30-50	65	95
P	20	30	45
K	50	60	80

Advantages of Fertigation

1. In drip fertigation, fertilizer application is synchronized with plant need which varies from plant to plant. In drip fertigation, the amount and form of nutrient supply is regulated as per the need of the critical stages of plant growth.
2. Due to better water and fertilizer use efficiency and reduction in leaching there are considerable water and fertilizer saving in fertigation.
3. Optimization of nutrient balance in soils by supplying the nutrients directly to the effective zone as per the requirement.
4. Reduction in labour and energy cost by making use of water distribution system for nutrient application.
5. Better yield and quality of products obtained.
6. Timely application of small but precise amounts of fertilizers directly to the root zones, this improves fertilizer use efficiency and reduces nutrient leaching below the root zone.
7. Ensures a uniform flow of water and nutrients.
8. Improves availability of nutrients and their uptake by crop.
9. Less infestation of weeds and pest due to limited area wetting.

10. Soil and water erosion are prevented.
11. Ability to "microdose", feeding the plants just enough so nutrients can be absorbed and are not left to be washed down to storm water next time it rains.
12. Reduction of fertilizer, chemicals, and water needed.
13. Reduced leaching of chemicals into the water supply.
14. Reduced water consumption due to the plant's increased root mass's ability to trap and hold water.

Effect of Fertigation on Fertilizer Saving and Yields

Sl. No.	Crop	Saving in fertilizer %	Increase in yield %
1.	Okra	40	18
2.	Onion	40	16
3.	Banana	20	11
4.	Castor	60	32
5.	Cotton	30	20
6.	Potato	40	30
7.	Tomato	40	33
8.	Sugarcane	50	40

Fertigation System

Fertilizer tank: It is most common system for fertigation. In this system fertigation employs a tank into which dry or liquid fertilizers are kept. The tank is connected to the main irrigation line by means of a by- pass so that some of the irrigation water flows through the tank and dilutes the fertilizer solution. This by-pass flow is brought about by a pressure gradience between the entrance and exit of the tank, created by permanent constriction in the line or by a control valve. It requires approximately 4 tanks volume displacement to empty the tank of liquid fertilizer. At least 10 volume displacement or needed to deserve all the material in case of solid fertilizer used. The rate of low through the by-pass is determined by the pressure head reference between entrance and outlet. It is usually in the order of 1-5-meter water. Size of fertilizer tank varies from 50-1000 litres, and choice of tank size is decided on the basis of area being irrigated. The pressure difference needed in order to gradually empty the tank during each irrigation has to be determined empirically. Its advantage lies in its simplicity, low cost, insensitive to change in pressure and independent of electricity of power. The main disadvantage of using this method is that concentration of nutrients reduces with time; and tank must be refilled with fertilizer for each irrigation cycle. It cannot be used for automation purpose in large areas.

Ventury Injector

Ventury injector works on the principles that a constriction in the main water flow pipe increase the water flow pipe increase the water flow velocity thereby causing a pressure difference and creates a partial vacuum. Because of this partial vacuum fertilizer solution is sucked from an open reservoir into the water stream. The precise regulation of flow is difficult because the rate of injection is sensitive to the pressure and rate of flow in the system. This is a simple and relatively inexpensive method of fertilizer application. The fertilizer concentration remains almost constant throughout the application time. It is suitable areas. It is not suitable for use in automation.

Direct Injection System

The injection rate of fertilizer solution is proportional to the flow of water in the system. It has flow range from 1-30 lph and operated under 0.3-5 kg/cm2. A high degree of control over the injection rate is possible. The water flow and the fertilizer flow are independently control. Changes in water flow rate, power failure or mechanical failure may cause serious deviations from planned concentrations. The system needs an external power source. Its cost is relatively high. Not much head loss occurs and operating cost is low. If the flow of water stops in the irrigation system, fertilizer injection also automatically stops. This is the most perfect equipment for accurate fertigation.

Future Thrust

Fertigation studies revealed significant fertilizer savings of 20-60% and 8-41% increase in yield of horticultural and vegetable crops such as onion, okra, tomato etc. Fertigation is a very vital part of drip irrigation system. Fertilizer scheduling such as, quantity and frequency with crop stage needs to be optimize to realize the full potential and benefits of drip fertigation. Use of fertigation for applying fertilizer in small doses at high frequency will ensure a continuous supply of nutrients to crops even in areas of sufficient rainfall where irrigation is not required frequently. This method meets the crops growth requirements without leaching the fertilizers below the root zone. As, area under drip irrigation is increasing in India, there is tremendous opportunities of using fertilizer through fertigation system for many crops. There is need to standardize the precise application of nutrients as per crop needs through automation. This would help to enhance vegetable productivity, and water and nutrient use efficiency in vegetable crops.

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Important Diseases of Green Gram and their Management

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Introduction

It is grown in about 36 lakh hectares with the total production of about 17 lakh tonnes of grain with a productivity of about 500 kg/ha. The important green gram growing States in the country are Orissa, Maharashtra, Andhra Pradesh, Madhya Pradesh, Gujarat, Rajasthan and Bihar.

Powdery Mildew

Erysiphe polygoni.

1. Pathogen: The fungus is ectophytic, spreading on the surface of the leaf, sending haustoria into the epidermal cells. Conidiophores arise vertically from the leaf surface, bearing conidia in short chains. Conidia are hyaline, thinwalled, elliptical or barrel shaped or cylindrical and single celled. Each cleistothecium contains 4-8 asci and each ascus contains 3-8 ascospores which are elliptical, hyaline and single celled.

2. Favourable Conditions: The pathogen has a wide host range and survives in oidial form on various hosts in offseason. Secondary spread is through air-borne oidia produced in the season.

3. Disease Cycle: The fungus is an obligate parasite and survives as cleistothecia in the infected plant debris. Primary infection is usually from ascospores from perennating cleistothecia. The secondary spread is carried out by the air-borne conidia. Rain splash also helps in the spread of the disease.

4. Management: Use resistant varieties. The seeds must be sown early in the month of June to avoid early incidence of the disease on the crop. Spray Carbendazim 500g or Wettable sulphur 1.5 kg or Tridemorph 500 ml/ha at the initiation of disease and repeat 15 days later.

Anthracnose

Colletotrichum lindemuthianum - (Sexual stage: *Glomerella lindemuthianum*).

1. Symptoms: The disease appears on all aerial part parts and at any stage of plant growth. Circular, black, sunken spots with dark centre and bright red orange margins on leaves and pods. In severe infections, the affected parts wither off. Seedlings get blighted due to infection soon after seed germination.

2. Pathogen: The Disease appears on fungus mycelium is septate, hyaline and branched. Conidia are produced in acervuli, arise from the stroma beneath the epidermis and later rupture to become erumpent. A few dark coloured, septate setae are seen in the acervulus.

The perfect stage of the fungus produces perithecia with limited number of asci, which contain typically 8 ascospores which are one or two celled with a central oil globule.

3. Favourable Conditions: The disease is more sever in cool and wet seasons.

4. Disease cycle: The fungus is seed-borne and cause primary infection. It also lives in the infected plant tissues in soil. The secondary spread by air borne conidia produced on infected plant parts. Rain splash also helps in dissemination.

5. Management: Hot water treatment at 54º for 10 min. Use disease free seed. Follow crop rotation. Remove and destroy infected plant debris in soil. Treat the seeds with Carbendazim at 2 g/kg. Spray Carbendazim 500g or Mancozeb 2kg/ha soon after the appearance of disease and repeat after 15 days.

Leaf Spot

Cercospora canescens

1. Symptoms: This is an important disease of green gram and is usually occurs in a severe form, causing heavy losses in yield. Spots produced are small, numerous in numbers with pale brown centre and reddish-brown margin. Similar spots also occur on branches and pods. Under favourable environmental conditions, severe leaf spotting and defoliation occurs at the time of flowering and pod formation.

2. Pathogen: The fungus produces clusters of dark brown septate conidiophores. The conidia are linear, hyaline, thin walled and 5-6 septate.

3. Favourable conditions: High humidity favours disease development. Disease cycle the fungus survives on diseased plant debris and on seeds. The secondary spread is by air-borne conidia.

4. Management: Cultivate resistant varieties. Intercrop the moong with tall growing cereals and millets. Follow clean cultivation. Use disease free seed. Maintain low crop population density and wide row planting. The crude extracts of cassava, garlic, and zinger are applied for controlling the disease effectively. Mulching reduces the disease incidence resulting in increased yield. Spray Mancozeb 2kg/ha or Carbendazim 500 g/ha.

Rust

Uromyces phaseoli typica (Syn: U. appendiculatus).

1. Symptoms: The disease appears as circular reddish-brown pustules which appear more commonly on the underside of the leaves, less abundant on pods and sparingly on stems. When leaves are severely infected, both the surfaces are fully covered by rust pustules. Shrivelling followed by defoliation resulting in yield losses.

2. Pathogen: It is autoecious, long cycle rust and all the spore stages occur on the same host. The uredospore is unicellular, globose or ellipsoid, yellowish brown with echinulations. Favourable Conditions: Cloudy humid weather, Temperature of 21-26˚C. Nights with heavy dews.

3. Disease Cycle: The pathogen survives in the soil as teliospores and as uredospores in crop debris. Primary infection is by the sporidia developed from teliospores. Secondary spread is by windborne uredospores. The fungus also survives on other legume hosts.

4. Management: Remove the infected plant debris and destroy. Spray Mancozeb 1 2 kg or Carbendazim 500 g or Propiconazole 1L/ha kg/ha, immediately on the set of disease and repeat after 15 days. Use tolerant varieties.

Dry Root Rot

Rhizoctonia bataticola (Pycnidial stage: *Macrophomina phaseolina*).

1. Symptoms: The disease symptom starts initially with yellowing and drooping of the leaves. The leaves later fall off and the plant dies within week. Dark brown lesions are seen on the stem at ground level and bark shows shredding symptom. The affected plants can be easily pulled out leaving dried, rotten root portions in the ground. The rotten tissues of stem and root contain a large number of black minutes sclerotia.

2. Pathogen: The fungus produces dark brown, septate mycelium with constrictions at hyphal branches. Minute, dark, round sclerotia in abundance. The fungus also produces dark brown, globose ostiolated pycnidia on the host tissues. The pycnidiospores are thin walled, hyaline, single celled and elliptical.

3. Favourable conditions: Day temperature of 30˚C. Prolonged dry season followed by irrigation. Disease cycle: The fungus survives in the infected debris and also as facultative parasite in soil. The primary spread is through seed-borne and soil-borne sclerotia. The secondary spread is through air-borne pycnidiospores.

4. Management: Treat the seeds with Carbendazim + Thiram at 2 g/kg or pellet the seeds with Trichoderma viride at 4 g/kg or Pseudonomas fluorescens @ 10g/kg of seed. Apply farm yard manure or green leaf manure (Gliricidia maculate) at 10 t/ha or neem cake at 150 kg/ha.

Yellow Mosaic Disease

Mung bean yellow mosaic virus (MYMV).

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1. Symptoms: Initially small yellow patches or spots appear on green lamina of young leaves. Soon it develops into a characteristics bright yellow mosaic or golden yellow mosaic symptom. Yellow discoloration slowly increases and leaves turn completely yellow. Infected plants mature later and bear few flowers and pods. The pods are small and distorted. Early infection causes death of the plant before seed set.

2. Pathogen: It is caused by Mung bean yellow mosaic India virus (MYMIV) in Northern and Central region and Mung bean yellow mosaic virus (MYMV) in western and southern regions. It is a Begomoviral belonging to the family geminiviridae. Germinate virus particles, ssDNA, bipartite genome with two gemonic components DNA-A and DNA-B.

3. Disease cycle: Transmitted by whitefly, *Bemisia tabaci* under favourable conditions. Disease spreads by feeding of plants by viruliferous whiteflies. Summer sown crops are highly susceptible. Weed hosts viz., Croton sparsiflorus, Acalypha indica, Eclipta alba and other legume hosts serve as reservoir for inoculum.

4. Management: Rogue out the diseased plants up to 40 days after sowing. Remove the weed hosts periodically. Increase the seed rate (25 kg/ha). Grow resistant green gram variety like Pant Moong-3, Pusa Vishal, Basanti, ML-5, ML337, PDM-54 and Samrat. Cultivate the crop during rabi season. Follow mixed cropping by growing two rows of maize (60 x 30 cm) or sorghum (45 x 15 cm) or cumbu (45 x 15 cm) for every 15 rows of black gram or green gram. Treat the seeds with Thiomethoxam-70WS or Imidacloprid-70WS @4g/kg. Spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml in 500 lit of water.

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Powdery Mildew of green gram

Rust of green gram

Anthracnose of green gram

Leaf Spot of green gram

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Dry Root Rot green gram	**Yellow Mosaic of green gram**

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Climate Change and Plant Pathogen Evolution

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Introduction

Recent years have witnessed a steady increase in national and international concern over the sustainability of the global environment. It has emerged as the most prominent of the global environmental issues. Global climate has changed ever since industrial revolution and by now it is ascertained that major greenhouse gases especially CO2 increased by 30%. According to IPCC'S latest report, global mean temperature would rise between 0.9 and 3.5oC by the year 2100 (IPCC, 2014).

1. Effects of elevated CO_2 level on pathogens: It promotes the development of biotrophic fungi such as rust, as increased CO_2 level encourages the production of plant biomass and enhances the carbohydrates concentration in the plant tissues that make it more suitable for biotrophic fungi. Affects the growth of the pathogens and accelerates the evolution of pathogens, which can affect the virulence. Muleherin *et al.* (2000) evaluated the response of tobacco grown under elevated CO_2 to inoculation with TMV in two CO_2 concentration (360 & 720 ppm) and found that plants grown at 720 ppm, produced fewer lesions on leaf as compared to plant grown at 360 ppm. According to them, elevated CO_2 alters endogenous foliar salicylic acid levels and affects plant response to TMV inoculation. Chakraborty (2013) reported that elevated CO_2 also increases fecundity in pathogen because following penetration, established colonies of *Erysiphe graminis* grew faster and sporulation/unit area of infected tissues was increased several-fold. Elevated CO_2 alter the disease expressions and plant responses to the diseases as Eastburn *et al.* (2010) evaluated the effects of elevated CO_2 and O_3 on three soyabean diseases: Downy mildew (*Peronospora manshurica),* septoria brown spot (*Septoria glycines*) and sudden death syndrome (*Fusarium virguiliforme*). They observed significant reduction in severity of downy mildew at elevated CO_2. Whereas CO_2 level, alone or in combination with high O_3 increased the severity of *S. glycines.* They concluded that high CO_2 and O_3 induced changes in the crop canopy density and leaf age, likely contributed to disease expression modification.

2. Effects of elevated temperature on pathogens: It promotes the spread of pathogens in new geographical area. Richerzhagen *et al.* (2011) reported that in Southern Germany, there was a northward shift of *Cercospora beticola* causing leaf spot of sugarbeet was due to increasing annual mean temperature by 0.8 to 1.0^{o}C. Increases the spore germination of the rust pathogen as the spore germination of the *Puccinia substriata* (infecting pearl millet) was increases with increase in temperature (Tapsoba and Wilson, 1997). Increase in fecundity of pathogens as *Monosporascus cannonballus* reproduces very quickly at higher temperature (Garret *et al.,* 2006). Modifies the host physiology and increase disease resistance because lignifications of cell wall in forage crops increased with high temperature and enhanced resistance to fungal pathogens such as rust (Coakly *et al.,* 1999).

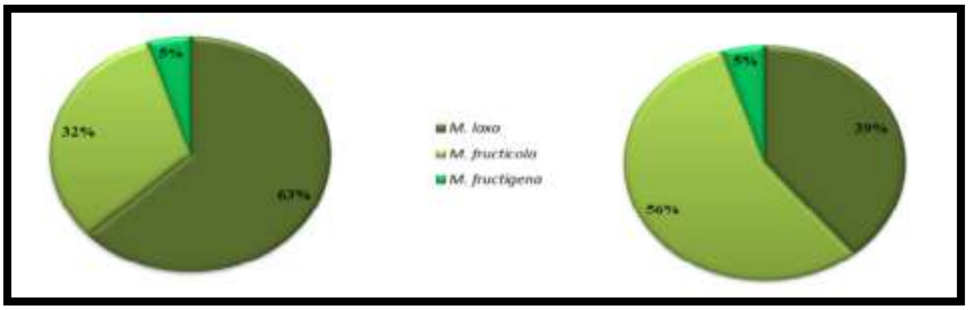

Figure 1. Monitoring of Italian population of Monilinia spp. in 2010 (on the left) and 2013 (on the right)

This figure shows how climate change has enhanced the aggressiveness of *Monilinia* spp. Until 2002, *Monilinia laxa* and *M. fructigena* were the only pathogens responsible for brown rot in stone and pome fruit in Europe, when another species *M. fructicola* was detected in France causing brown rot on stone fruits. After this first report, *M. fructicola* spread in several European countries including Italy. The reason for its dissemination could also attributed to faster capacity to grow at higher temperature than the two *Monilinia* spp, confirming moreover the overtaking of *M. laxa* by *M. fructicola*. From the annual monitoring data of *Monilinia* spp. it was found that Italian population, in 2010 *M. laxa* was the main species (63%) followed by *M. fricticola* (32%). After 3 years, the percentage of *M. fruticola* increased to (56%) and the incidence of *M. laxa* consequently decreased (39%) (Mari and Martini, 2015).

3. Effects of higher moisture on pathogen: High moisture favors foliar disease and soil borne pathogens such as *Pythium, Phytophthora, R. solani, S. rolfsii*. It also helps in dispersal of bacterial pathogens, mainly by water in the form of rain splash and insects.

4. Effects of elevated ozone on pathogens: Elevated ozone concentration may change the structure and properties of leaf surfaces in a way that affects inoculation and infection process (Karnosky *et al*., 2002). It also enhances the senescence processes, necrosis, and seems to promote attack on plants by necrotrophic fungi. Ozone as effective abiotic elicitors that influences the secondary metabolism, as well as hypersensitive response and systemic acquired resistance (Sandermann, 2000).

Plant Pathogens Adapt to a Changing Environmental Conditions Through

1. Exploitation of the existing phenotypic plasticity.
2. Migration to new areas with suitable climate.
3. Evolution of new attributes.

1. Phenotypic Plasticity: It is the capacity of a genotype to exhibit variable phenotypes in different environments, enables individual genotypes to adapt to changed environments without the need for novel mutations. This ability can play a major role both in ecological distribution of organisms and patterns of evolutionary diversification. Phenotypic plasticity is not studied in fungi except in *Phytophthora ramorum* and *P. infestans* and some yeasts.

2. Migration: Latitudinal and altitudinal shifts in the distribution of many species have been observed in response to warming temperatures as organisms, including plant pest and pathogens generally follow temperature optima. The spread of plant pathogens is greatly facilitated by human transportation, and there is a growing concern that climate change may enable the establishment of alien pathogens in hitherto unsuitable regions.

3. Evolution of Adaptive Mechanisms: The rate of reproduction of many plant pathogens is strictly related to temperature and moisture. In longer growing seasons, such as those predicted to result from global warming, the time available to pathogens for reproduction and dissemination will be extended. A moderate increment in temperature may increase the rate of sexual reproduction in plant pathogens, and fecundity may be increased also in the presence of elevated CO_2 levels, thereby accelerating evolution in response to climate change.

Historically, Major Pathogens have Emerged Through Three Principal Mechanisms

1. Host jump.
2. Hybridization.
3. Horizontal gene transfer.

The probability of these events is greatly increased by the movement of plant pathogens to new geographical areas, through natural migration with host communities or by human transportation (Santini and Ghelardini, 2015).

1. Host jump: Introduction to a new environment is a great opportunity for plant pathogens to evolve through colonizing new wild hosts (host jump). This is frequently observed in fungal pathogens with congeneric, but geographically isolated, plant species. Among many examples, the rust pathogen *Puccinia psidii* jumped from native *Myrtaceae* to introduced Eucalyptus trees in South America.

2. Hybridization: Immigration of fungal pathogens into new areas brings them into contact with resident, related species, especially those with similar host or vector types. The sudden contact between closely related, but previously geographically isolated pathogens may produce episodic selection. Theoretically, this process presents an opportunity for rapid emergence of new pathogens *via* interspecific gene flow by natural hybridization. The pathogenicity issue is further illustrated in case of *Phytophthora alni* (a hybrid species), killing riverside alders in Europe. These are hybrids between *P. cambivora*, a common pathogen of hardwood trees, and a *Phytophthora* species close to *P. fragariae*, a pathogen of strawberry and raspberry. *Phytophthora* had never been recorded on alder before the rise of the hybrids, which, therefore, may have acquired the ability to exploit a different host compared with parental species.

3. Horizontal Gene Transfer (HGT): It involves the exchange of genetic material between phylogenetically distant organisms surpassing the normal reproductive barriers. In filamentous fungi, occurrence of HGT was demonstrated in several instances, and is involved in the acquirement of important characters, such as virulence, which may drive the acquisition of pathogenicity towards new hosts or drive the emergence of new pathogens. For instance, *Pyrenophora tritici-repens* has acquired the capability to infect wheat through gene transfer from *Stagonospora nodorum*. Transferred gene was ToxA that was encoding for critical virulence factor which enhanced the ability of *P.t. repens* to cause new tan spot disease in wheat.

Potential Effect of Climate Change on Microbial Interactions: Increased levels of CO_2 in the atmosphere are expected to have major consequences on carbon cycling and the functioning of various ecosystems. The concentration of CO2, temperature levels, and nitrogen deposition are important factors affecting soil microbial communities. Therefore, these microbial communities are likely to be affected by climate change. Elad (2009) studied the short-term impact of climate modifications on plants, focusing on interactions between crop plants, antagonistic and beneficial microflora most likely to be affected by climate change in the short term. They sprayed microbial suspensions (bacterium-B71 and yeast-Y16) onto strawberry plants and monitored the changes in the populations of indigenous and introduced microorganisms on the strawberry leaves. Plants kept under conditions in which the temperature fluctuated only mildly during the day harbored fewer indigenous bacteria than plants exposed to more extreme temperature fluctuations, and the presence of powdery mildew also affected the natural microflora. Irradiation was associated with smaller populations of the introduced yeast. Plants exposed to both higher RH and the wider range of temperatures shown smaller populations of the introduced bacterium.

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Changes that have Already Occurred

Climatic changes have been measured for several decades, and some plant-related phenomena may already be associated with these changes.

1. Evans *et al*. (2008) found that recent climatic changes have affected the geographical range and severity of Phoma stem canker of oilseed rape in the southern United Kingdom. They point to changes observed in disease values from 1960-1990 and from 1975-2005 at Rothamsted, UK; the calculated start of the outbreaks was 10 days earlier between 1975 and 2005 than it was between 1960 and 1990, and canker severity was found to be 18% greater during the latter period. These major effects on the start date and severity of epidemics were related to increases in temperature, especially during the winter, which greatly affect this stage of epidemic development (Sun *et al.,* 2000).

2. Epidemics of *Cercospora* leaf spot of sugar beet require warm and humid conditions, specifically temperatures between 20°C and 30°C and a RH above 90% (Wolf and Verreet, 2005). In Germany, the annual mean temperature increased by approximately 0.8°C–1.0°C between 1900 and 2000. It could be assumed that there might be a northward shift in the area with heavy damage from this disease. Data collected between 1998 and 2007 indicate that the first signs of this disease appeared 2–12 days earlier (on average) than they did during the last decade of the twentieth century (Richerzhagen *et al*., 2011).

Disease patterns may also be affected by agricutural practices and the use of different crop cultivars. Although it can be difficult to distinguish the causes of some changes in pathosystems, particularly between farmer- and environment-related changes, it is clear that some changes in the timing of the appearance of disease and disease severity can be linked with climatic changes that have already occurred.

Effects of Climate Change on Plant Disease Management

Climate change adds an extra layer of complexity to plant protection. Unfortunately, there are almost no studies on how climate change may affect chemical control. However, because of changes in the relative importance and distribution of different pathogens, the fungicide market will certainly change. Under worst-case scenarios, several crops may require more fungicide spray treatments or higher application rates, thus increasing costs for farmers, prices for consumers, and the likelihood of development of fungicide resistance. Agronomic practices, such as crop rotation, tillage, fertilization, irrigation, selection of the production site, use of resistant/tolerant varieties, and sanitation to reduce the amount of overwintering inoculum, can be used to prevent or reduce the increased disease risks associated with the predicted climate change (Juroszek and Tiedemann, 2011). Changes in duration, intensity, and frequency of precipitation events will affect the efficacy of chemical pesticides and how quickly the active molecules are washed away. Temperature can directly influence the degradation of chemicals and alter plant physiology and morphology, indirectly affecting the penetration, translocation, persistence, and modes of action of many systemic fungicides (Coakley *et al*., 1999). Biocontrol agents can serve as alternatives to chemical fungicides when applied alone or in combination with other control methods. Because they are living organisms, these biocontrol agents are also affected by the abiotic environment. For example, the biocontrol of the fungal foliar disease gray mold (*Botrytis cinerea*) in greenhouse cucumber crops is affected by climate. Suppression of gray mold by the biocontrol agent *Trichoderma harzianum* T39 is more pronounced at higher temperatures and lower RH levels (Elad *et al*., 1993). Soil borne pathogens will remain more difficult to control than foliar pathogens, because some soil borne pathogens can survive in soil for several years and effective pesticides for the control of these pathogens are not yet available (Ghini *et al*., 2011a).

Predictive Models Developed for Some Plant-Pathogen System

1. *Phoma* stem canker (*Leptosphaeria maculans*) of oilseed rape in the UK.
2. *Fusarium* head blight of wheat (*F. gramanearum*) in USA.
3. Downy mildew (*Plasmopara viticola*) and Powdery mildew (*Uncinula necator*) in North Italy.
4. Coffee rust (*Hemilea vastatrix*) in Brazil.
5. *Cercospora* leaf spot (*C. beticola*) of sugarbeet in Germany.

Complexity in Predicting the Effect of Climate Change on Pathogens

Not all parameters are considered that cause climate change. It is difficult to predict the effect of climate change because, to date experiments in this area have considered only one or a few of the parameters that are predicted to change. Most of the experiments are conducted under controlled conditions and experiment under controlled condition may vary greatly from those in the field, and have been carried out on a small scale for relatively short period of time. Interaction with other changing climatic variables may directly influence, mask or amplify the effects of a specific factor. Prediction is complicated by multi-faceted relationship between crops, pathogens and climate change. There is lack of suitable data on existing epidemics to construct good empirical models. Predictions should be carried out at regional level, because large differences may be present within individual countries.

Conclusions

The implications of climate change for plant pathogens cannot be easily summarized. Plant pathogens have a broad array of adaptive mechanisms that enable them to generally exploit new opportunities. Specific predictions are difficult because of the complex multi-trophic relationships, which involve many other microbes, vectors and host plants beside pathogens. Climate change and introduction to new environments are extraordinary forecasting on evolution of plant pathogens. A likely outcome of this evolution is the emergence of new diseases.

To face this likely threat, there is urgent need for:
1. New predictive tools to identify potential but still unknown pathogens for a certain region.
2. Deeper knowledge about the risk of introducing pathogens that are spreading in other parts of the world, by using self-organizing maps or through hierarchical clustering analysing and the development of models of potential spread of pathogens.
3. Routine use of molecular techniques, such as next generation sequencing and/or real-time PCR, and other molecular tools for rapid screening of plant material and accurate diagnosis of dangerous, but hardly detectable, pathogens.

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Pseudomonas in Bioremediation

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Introduction

The unprecedented pollution increases and industrial development during the twentieth century has not only increased conventional solid and liquid waste pollutants to critical levels but produced a range of previously unknown for which society was not prepared. For various purposes chemical industries are now manufacturing many xenobiotic compounds that greatly differ in their structure and properties from natural organic compounds. Some of these xenobiotic halosubstituted and nitrosubstituted organics such as refrigerants, solvents, plastics, polychlorinated compounds, detergents, pesticides, herbicides and explosive differ in their bioavailability and biodegradation from recalcitrant to easily degradable form and some of the recalcitrant xenobiotic compounds leads to biomagnification in the food web. Bacteria/Microorganisms has got history of inhabiting the Earth science evolution of life. They have developed varied survival strategies along with the diverse metabolic activities. *Pseudomonas* sp. is of special interest because of its ability to inhabit range of ecological conditions and utilizing most of the natural organic compound. It can utilize nearly hundreds of compounds as carbon and energy source thus contributing towards bioremediation of contaminated waste lands, agricultural soils and water bodies into which a large amount of industrial effluents is released every year reducing its aesthetic and economic value.

Bioremediation Employing Pseudomonas

Bioremediation is the mechanism of decontamination of polluted sites with the use of biological agents such as bacteria to restore them to their original condition. It leads to conversion of pollutant in to another form that can be used by other microorganisms, this commensal nature of microbes' results in bioremediation. The bioremediation potential of *Pseudomonas sp.* came into picture when the "Super bug" pseudomonas developed through genetic engineering by Dr. Chakraborty was used for clearing the oil spills in oceans. *Pseudomonas alcaligenes*, *P. mendocina P. putida* and *P. veronii* have been successfully used for remediation of hydrocarbon compounds like, Petrol, diesel and polycyclic aromatic hydrocarbons toluene. *Pseudomonas putida* has been implicated in decontamination of monocyclic aromatic hydrocarbons, e.g. benzene and xylene. Pollutants like phenolic compounds have been remediated by *P. aeruginosa*. *P. cepacia, P. aeruginosa* KH6 *P. putida* along with *Arthrobacter sp.* plays important role in the bioremediation of oil. *Pseudomonas aeruginosa* cells immobilized into wool entrapped silica-alginate beads resulted into 83.01% degradation of adsorbed engine oil after 3 months of biodegradation process, have potential application in purification of water from petroleum hydrocarbons. *P. aeruginosa* is well established player in the degradation of industrial and textile azo dyes and sulfonated di-azo dye, Reactive Red HE8B, RNB dye. Heavy metals cannot be destroyed biologically, but only transformed from one oxidation state or organic complex to another. Besides, Pseudomonas sp. are also efficient in heavy metals bioremediation, have developed the capabilities to protect themselves from heavy metal toxicity by various mechanisms, such as adsorption, uptake, methylation, oxidation and reduction. Microorganism's uptake heavy metals actively (bioaccumulation) and/or passively (adsorption). Microbial methylation plays an important role in heavy metals bioremediation, because methylated compounds are frequently volatile. For example, Mercury, Hg (II) can be biomethylated by a number of different bacterial species. Likewise, Fe^{2+}, Zn^{2+}, Pb^{2+}, Mn^{2+} *and* Cu^{2+} and U, Cu, Ni, Cr are biotransformed actively by fluorescent pseudomonads like *P. fluorescence* and *P. aeruginosa*. Recent reports have revealed the role of Pseudomonas sp. in remediation of RDX and other explosive contaminant sites. Approaches used in the bioremediation processes are biostimulation, bioaugmentation, bioattenuation, bioventing and biopiles. The controlling and optimizing of bioremediation processes is a complex system due to many factors such as existence of a microbial population capable of degrading the pollutants, the availability of contaminants to the microbial population and environment factors (type of soil, temperature, pH, the presence of oxygen or other electron acceptors, and nutrients).

Conclusions

Pseudomonas species are the most versatile organisms which shares diverse niches and have varied nutritional requirements, in addition to their complex enzyme system which are actively involved in remediation of pollutants like pesticides, PAH, plastics, oils and various dyes along with some explosive like RDX. It can be exploited as a potential agent for bioremediation contaminated soils and water bodies.

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Roof Garden

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Roof garden is nothing but gardening on roof. This kind of garden is becoming very popular now days as there is limited or no space available around the dwelling. It is laid out similar to patios except that these gardens are quite exposed to sun and wind. However, Balconies are more shaded where pots and troughs of trailing plants are kept.

Important Features

1. Roof garden does not occupy much space.
2. They are created in small open spaces, balconies, verandas and on the roof.
3. A wonderful means for increasing the living space.
4. Vegetation on roof top garden reduces pollution.
5. Improve in micro climate.
6. Reduce the heat island effect.
7. Leisure and functional open space.
8. Serves the health and therapeutic value.
9. Preserve the habitat and wildlife.
10. Improve air quality.
11. Improve water quality.
12. It acts as sound insulation.

Types of Roof Garden

1. Intensive: These gardens are developed to be accessible and may involve elaborate landscaping requirements such as water features and hardscapes including paving stones and seating, such type of garden requires regular maintenance that includes mowing, fertilizing, watering and weeding.

2. Extensive: This type of gardens is light weight in designs and developed mainly for aesthetic and environmental / ecological benefits. The planning medium consists of volcanic stones and pumice with average thickness of about 10-15 cm.

Suitable Plant Species

1. Flowering plants: Antirrhinum, Stock, Sweet pea, Pansy, Dahlia, Chrysanthemum, Marigold, Phlox, Verbena, Tuberose, Rose, Carnation etc.

2. Herbaceous perennials: Daisy, Cannas, Portulaca, *Vinca rosea* etc.

3. Shrubs: Bougainvillea, Hibiscus, *Ixora coceinia*, *Murraya exotica*, *Vinca rosea*, Acalypha, Camellia, Croton, Jasmine, Lantana etc.

4. Bulbous plants: Football lily, Daffodils, Gladiolus, Canna, Tulip, Tuberose, Dahlia etc.

5. Water plants: Lotus, Water lily, Water hyacinth, Yellow flag, Typha, *Victoria regia* etc.

6. Climbers: Antigonan, Begnonia, Gloriosa, Ipomoea & Passiflora.

7. Cactii and succulents: Sedum, Agaves, Aloe etc.

8. Fruits: Gooseberry, Strawberry, Peach, Pear, Pineapple, Pomegranate, Citrus etc.

9. Vegetables: Brinjal, Lettuce, Chillies, Tomato, etc.

Advantages

Roof gardening has many advantages .since the roof has an open atmosphere, air and sunlight are available in plenty, plants grow healthy in such environment. The high elevation of a roof garden along with the open situation helps to minimize the occurrence of pests and diseases .The beauty of the garden can be enjoyed from a close range, during day and night .The therapeutic value of gardening in physical and mental health can be utilized to its fullest advantage in such gardening. Roof gardening is out of bound for pilferage and depredation by stray animals.

Disadvantages

The quantity of growing media is much less here. Hence, the supply of moisture and nutrients to the plants is limited. Shallow depth of soil results in poor root anchorage subjecting the plants to lodging, specially by wind, the velocity of which is greater on an open roof. However, with the increased problems of space in cities and towns for growing plants, the importance of roof gardening cannot be ignored and though there are limitations, by applying imagination and visualization an attractive garden can be made on roof top.

Suitability of the Roof

A roof garden puts considerable weight on the roof .The strength of the roof to bear this load is the first consideration before making a start .The best thing is to plan the engineering aspects of a new building to impart enough strength so that the load of the roof garden can be carried through without the danger of damage .since ,the concept of gardening on the roof is comparatively new in India ,this aspect had not been considered while constructing the old buildings .the planning of gardening under these two different situations will be different to larger extent.

Drainage and Waterproofing

In every roof, the drainage aspect is taken care of during the construction of the building. Hence, drainage should not pose a problem unless it is disturbed during garden construction. Roofs are made waterproof also during construction. But this waterproofing takes care mainly of the rain water. But if gardening is done on the roof directly, the constantly moist soil is likely to damage the roof. Hence, arrangement for additional waterproofing should be done. Where the building is constructed with a view to make a garden on the roof, appropriate waterproofing material is used to make it impervious. Where this has not been done, precautions must be taken against seepage. A thick layer of asphalt may be spread after melting the material. Spreading of asphalted canvas or thick polythene sheet may also serve the purpose of waterproofing for a few seasons.

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Prominent Bio-Fertilizer in Organic Farming: Neem De-Oiled Cake

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Neem (*Azadirachta indica*): Indian lilac, known as the "Free Tree of India" is also called '*arista*' in Sanskrit- a word that means 'perfect, complete and imperishable'. The Sanskrit name '*nimba*' comes from the term '*nimbatisyasthyamdadati*' which means 'to give good health'. As per the literature, the oil cake obtained from the neem seed after oil extraction has numerous benefits. It is rich in proteins, carbohydrates, minerals and is a suitable material for the formulation of nitrogenous fertilizer (Ramchandran *et al.,* 2007). It is excellent organic manure with insecticidal properties significantly reducing the number of soil insects and nematodes (Antony *et al.,* 2011). Jha and Rathore (1984) also stated it as 100% organic manures as it has dissolution of minerals mainly phosphorus and increased rate in soil detoxification on harmful substances. It is bio-degradable and eco-friendly, nourishes the soil and plants by providing all the macro and micro-nutrients. It reduces the alkalinity in soil, as it produces organic acids on decomposition. It is nitrification inhibitor and helps in eliminating bacteria responsible for denitrification. Being totally natural, it is compatible with soil microbes, improves and rhizosphere microflora and hence ensures fertility of the soil. It also improves the organic matter content, soil texture, water holding capacity and soil aeration for better root development. It increases the yield of crops by prolonging the availability of nitrogen to both short and long duration crops. It helps to reduce the usage of fertilizers thus reducing the cost of cultivation. It has antifeedant properties that help to reduce the number and growth of insects and pests (Subbalakshmi et al., 2012). The bitter principles of the soil and cake have been reported to have seven types of activities such as antifeedant, attractant, repellent, insecticide, nematicide, growth disruptor and antimicrobial. Neem de-oiled cake have adequate quantity of NPK in organic form for plant growth. Being totally botanical product, it contains 100% natural NPK content and other essential micro nutrients as N (Nitrogen 1.5% to 5.0%), P (Phosphorus 0.25% to 1.0%), K (Potassium 1.0% to 2.5%), Ca (Calcium 0.5% to 3.0%), Mg (Magnesium 0.3% to 1.0%), S (Sulphur 0.2% to 3.0%), Zn (Zinc 15 ppm to 60 ppm), Cu (Copper 4 ppm to 20 ppm), Fe (Iron 500 ppm to 1200 ppm) and Mn (Manganese 20 ppm to 60 ppm). It was found to be best substrate for supporting the microbial population, improves and ensures fertility of the soil. Due to its residual limonoids, it protects the plant roots from nematodes, soil grubs and white ants. Neem de oil cake contains salannin, nimbin, azadirachtin and azadiradione as the major components.

Dosage

In general, 10 kg of per tree in Horticultural crop and 200-400 kg per hectare in another crop is recommended. It is widely used in India to fertilize paddy, cotton and sugarcane.

Note

As the above-mentioned details are from literature reviewed, so research activities need to be done for specific recommendation of the dose in hilly and plains crop.

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Soil / Land Degradation

Article ID: 32018

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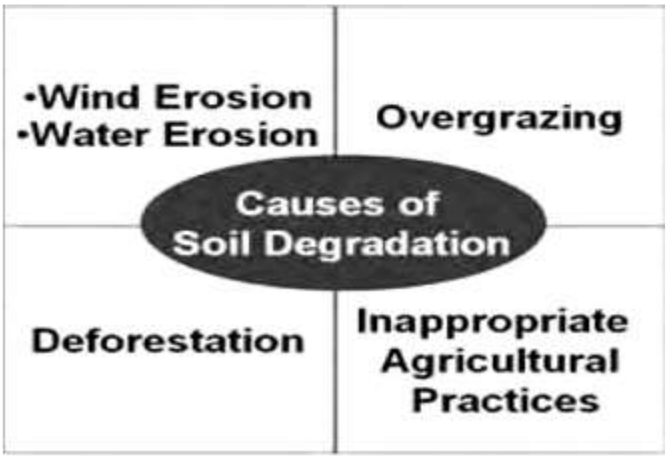
Soil degradation is a global process. Land degradation is a composite term; it has no single readily-identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, relief) has changed for the worse. Land degradation generally signifies the temporary or permanent decline in the productive capacity of the land (UN/FAO definition). Land degradation is any change in the condition of the land which reduces its productive potential. This includes the loss of topsoil, the loss of vegetation and increasing soil salinity.

Soil degradation can be defined as a process by which one or more of the potential ecological functions of the soil are harmed or destroyed. Soil degradation is a process that lowers the current and /or future capacity of the soil to produce goods and services. Soil degradation can be either a result of natural hazards or due to unsuitable land use and inappropriate land management practices. Mismanagement of arable areas by farmers, cultivation practices that are not adopted to local environments and overgrazing by livestock are seen as the major causes of soil degradation.

Soil degradation has been defined as a process that leads to decline in the fertility or future productive capacity of soil as a result of human activity (United Nations Environment Programme, 1993).

Causes of Degradation and the Role of Population

If natural hazards are left aside, the causes of land degradation can be divided into direct and underlying causes. Direct causes are inappropriate land use and unsuitable land management practices, e.g. the cultivation of steep slopes without soil conservation measures. Underlying causes are the reasons why these inappropriate practices take place, e.g. the slopes may be cultivated because the landless poor need food, and conservation measures not taken because farmers lack security of tenure.

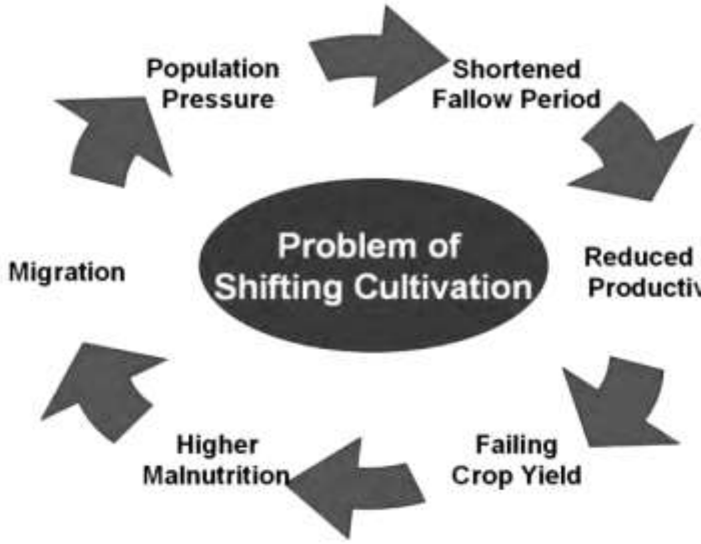


The GLASOD assessment addressed the direct causes of land degradation for each map unit, recognizing four causes:

1. Deforestation and removal of natural vegetation.
2. Over-exploitation of wood cover for domestic use.
3. Overgrazing.
4. Agricultural activities.

Deforestation

Deforestation is a cause of degradation when the land that is cleared is steeply sloping or has shallow or easily erodible soils, and when clearance is not followed by good management.



Overcutting of Vegetation

Overcutting of vegetation occurs when people cut forests, woodlands and shrub lands--to obtain timber, fuel wood and other products--at a pace exceeding the rate of natural regrowth. This is frequent in semi-arid environments, where fuel wood shortages are often severe.

Overgrazing

Overgrazing is the grazing of natural pastures at stocking intensities above the livestock carrying capacity; the resulting decrease in the vegetation cover is a leading cause of wind and water erosion.

Agricultural Activities

Agricultural activities that can cause land degradation include shifting cultivation without adequate fallow periods, absence of soil conservation measures, and cultivation of fragile or marginal lands, unbalanced fertilizer use, and a host of possible problems arising from faulty planning or management of irrigation. For example, shifting cultivation is practiced in many north eastern states and when adequate fallow period is not allowed or proper conservation practices are not adopted, it can cause severe soil degradation.

The role of population factors in land degradation processes obviously occurs in the context of the underlying causes. In the region, in fact, it is indeed one of the two major basic causes of degradation along with land shortage, and land shortage itself ultimately is a consequence of continued population growth in the face of the finiteness of land resources. Population pressure also operates through other mechanisms. Improper agricultural practices, for instance, occur only under constraints such as the saturation of good lands under population pressure which leads settlers to cultivate too shallow or too steep soils, plough fallow land before it has recovered its fertility, or attempt to obtain multiple crops by irrigating unsuitable soils.

Types of Land Degradation Assessed

For the purpose of study, the many and varied processes of land degradation have been grouped into six classes: water erosion, wind erosion, soil fertility decline, salinization, water logging, and lowering of the water table.

Water erosion covers all forms of soil erosion by water, including sheet and rill erosion and gullying. Human-induced intensification of land sliding, caused by vegetation clearance, road construction, etc., is also included.

Wind erosion refers to loss of soil by wind, occurring primarily in dry regions. Soil fertility decline is used as a short term to refer to what is more precisely described as deterioration in soil physical, chemical and biological

properties. Whilst decline in fertility is indeed a major effect of erosion, the term is used here of cover effects of processes other than erosion. The main processes involved are:
1. Lowering of soil organic master, with associated decline in soil biological activity.

2. Degradation of soil physical properties (structure, aeration, water holding capacity), as brought about by reduced organic master.

3. Adverse changes in soil nutrient resources, including reduction in availability of the major nutrients (nitrogen, phosphorus, and potassium), onset of micronutrient deficiencies, and development of nutrient imbalances.

4. Build-up of toxicities, primarily acidification through incorrect fertilizer use.

Water logging is the lowering in land productivity through the rise in groundwater close to the soil surface. Also included under this heading is the severe form, termed ponding, where the water table rises above the surface. Water logging is linked with salinization, both being brought about by incorrect irrigation management.

Salinization is used in its broad sense, to refer to all types of soil degradation brought about by the increase of salts in the soil. It thus covers salinization in its strict sense, the build-up of free salts; and codification (also called alkalization), and the development of dominance of the exchange complex by sodium. As human-induced processes, these occur mainly through incorrect planning and management of irrigation schemes. Also covered is saline intrusion, the incursion of sea water into coastal soils arising from over-abstraction of groundwater.

Lowering of the water table is a self-explanatory form of land degradation, brought about through tube well pumping of groundwater for irrigation exceeding the natural recharge capacity. This occurs in areas of non-saline ('sweet') groundwater. Pumping for urban and industrial use is a further cause.

Other Types of Degradation Included

Other types of land degradation are treated briefly, treated as causes. This is because they are localized or of small extent on a regional scale, or because they are more fully treated elsewhere. Four further classes are recognized as types of land degradation.

1. Deforestation: The occurrence of deforestation is widespread and extremely serious. It cannot independently assess, in view of more detailed treatment in the current FAO (Forest Resources Assessment) 1990 project. Deforestation is also discussed as a cause of erosion.

2. Forest degradation: This is the reduction of biotic resources and lowering of productive capacity of forests through human activities.

3. Rangeland degradation: This is the lowering of the productive capacity of rangelands. It is considered in generalized terms, but no quantitative data have been identified.

Types of Degradation which are Excluded

Other types of degradation are excluded, either because they are of small extent on a regional scale, or they are more fully treated elsewhere. These are:
1. Acid sulphate formation, a serious but localized form of degradation, which may occur on drainage of coastal swamps.

2. Soil pollution, from industrial or mining effluents, to the atmosphere, rivers or groundwater. This is an important concern, but is strongly localized.

3. Soil destruction through mining and quarrying activities, the failure to restore soil after extraction.

4. Urban and industrial encroachment onto agricultural land. With the projected increase in urbanization, this will continue to be a substantial cause of loss of agricultural land, but it is a different problem from land degradation.

5. Effects of war. Land degradation on a substantial scale through effects of war has been reported from Iran (western borderlands) and Afghanistan, in the latter case including the destruction of irrigation schemes.

6. Potential effects of global climatic change. It is beyond question that the composition of the world's atmosphere is being substantially altered as a result of human activities. A small but significant global warming

has already been observed and is projected to continue. It is possible that this may lead to modifications to the general atmospheric circulation with consequent changes in rainfall.

7. These changes could be beneficial or adverse to land productivity or human welfare: specifically, in semi-arid regions, rainfall might become higher or longer, more reliable or less, or with longer or higher incidence of droughts. There is, however, no firm evidence of what such changes may tee.

8. If adverse changes occur in some areas, then these will certainly constitute a most serious form of human-induced degradation of natural resources. It is accepted that, for a range of reasons, action should be taken to reduce emissions of 'greenhouse gases'. However, until there is clearer evidence, its potential effects upon climate must remain a master of research, and these will not be further considered.

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A Research Note on Chlorosis (Yellowing) in Plants: A Serious Problem and its Remedy

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Introduction

There has been a tremendous progress in the field of agriculture and credit goes to farmers of the country for practicing scientific agriculture. There arise still few confusions regarding the identification of few problems and in want of clear-cut diagnosis of the problems true solution to the problems are not implemented many a times. Yellowing of plant leaves is one of the examples which need to be tackled very wisely and carefully. In case of soybean growing tracts, farmers' perception is that whenever there is yellowing of soybean or any other plants leaves there starts a lot of tension mounting on farmers and in hurry, they start applying urea without any specific diagnosis. Top dressing of urea in standing pulse crops is strictly prohibited due to its adverse effects on crop growth and productivity. Thus, it becomes very essential that first there must be a proper diagnosis of the reasons of this problem and then go for remedial measures. The yellowing of plans leaves, also known as chlorosis, may arise due to various reasons at any point of time. The yellowing or chlorosis of plant leaves may occur due to various reasons in any of the three different stages of plant life that is during initial vegetative growth phase, secondly during growth and development stage and finally during reproductive growth phase. Thus, it becomes very essential to first diagnose the problem and then only go for preventive or remedial measures.

What is Chlorosis or Yellowing of Plant Leaves?

It is the chlorophyll which imparts green colour to plant leaves and in presence of sunlight and carbon dioxide it participates in the process of photosynthesis, a process of food manufacture in plants. During the process of photosynthesis, the light energy is converted into chemical energy and is stored in the organic matter, which is usually the carbohydrate. One molecule of glucose contains about 686 K Calories energy. CO_2 and water constitute the raw material for this process and oxygen and water are formed as the by-products during photosynthesis. Any decline in chlorophyll content from normal results in chlorotic leaves showing pale, yellow, or yellow-white colour. This adversely affects the process of photosynthesis and ability of plant or decreased ability to manufacture carbohydrates. If preventive or curative measures are not taken then this may lead to plant diseases and ultimately plants may die.

Crop Growth Stages and Yellowing of Plant Leaves

Generally, for all practical purposes broadly the whole plant life can be divided into 3 stages.

1. Initial primary growth stage up to 25- 30 days after sowing.
2. Vegetative growth and development stage between 25- 30 to 50- 55 days after sowing. This stage includes vegetative growth, flower initiation / flowering stage and in pulses pod formation and filling stage.

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3. Grain filling, grain development, pod filling, grain development and maturity stage after 50- 55 days of sowing. During above referred 3 stages, there may be considered a deviation of +/- 5 days period which can be considered as transition stage or mixed growth stages. Depending upon weather, management and other conditions chlorosis or yellowing in plant leaves may usually occur at any time during any stage of plant growth due to various reasons. Loss of chlorophyll in plant leaves may be due to one or due to combined effects of different reasons.

Reasons of Chlorosis

Loss of chlorophyll followed by chlorotic symptoms or yellowing of plant leaves is attributed to different factors. Chlorosis is typically caused when leaves do not have enough nutrients to synthesize all the chlorophyll they need. It can be brought about by a single factor or a combination of more than one factors. These factors may be manmade reasons, land, water and crop management related factors, deficiency of one or more plant nutrients or poor and imbalanced plant nutrition, infestation of insects, pests and diseases, excessive use of plant protection chemicals like fungicides, pesticides, herbicides / weedicides, etc. It has been observed that almost all plants when they attain advanced vegetative growth stage and reproductive growth phase then older plant leaves start showing yellow or pale-yellow symptoms or seem to be chlorotic and ultimately dry. This happens naturally due to aging of plants which is known as drying of leaves due to the process of senescence and it is not harmful and therefore one should not worry for this kind of chlorosis. Some of the important reasons of chlorosis in plant leaves are summarized below:

1. Soil reaction: Soil pH is a measure of soil acidity or alkalinity. It is an important indicator of soil health. It affects crop yields, crop suitability, plant nutrients availability, and soil micro-organism activity which influence important soil processes. For most of the crops, soil pH range of 6 to 7.5 is best for the growth of plant roots and growth and development of aerial plant parts. A gradual decrease in soil pH below 7.0 increases soil acidity and a progressive increase in soil pH beyond 7.0 increases soil salinity or alkalinity or both and under such situations availability of plant nutrients from soil is adversely affected resulting in chlorosis of plant leaves.

2. Damage of plant roots: Plant roots may be damaged due to shrinkage cracks in black soil, tillage operations, soil compaction, insects, pests and diseases. During inter-culture operations done either mechanically or manually plant roots are exposed and damaged significantly resulting in the development chlorotic symptoms on plant leaves. Although in due course of time some plants recover naturally.

3. Oxygen Stress: During rainy season water logging conditions, poor surface and internal drainage cause oxygen stress in root zone due to which root respiration is hampered and plant leaves show chlorotic symptoms. The remedy for this is the provision of surface drainage. Many a times if water stagnation persists for longer period then whole plant may become pale yellow and the symptoms resemble to nitrogen deficiency.

4. Soil Moisture Stress: During rainy season long and intermittent dry spells and during Rabi season non-availability of irrigation water leads to soil moisture stress and due to improper water supply cause chlorosis of whole plants. Under such situation irrigating the crops is only the remedy. For this purpose, under limited water availability conditions micro-irrigation systems like sprinkler, alternate furrow methods may be employed.

5. Insects, Pests and Diseases: Presence of any number of bacterial pathogens, for instance Pseudomonas syringae pv. tagetis that causes complete chlorosis on Asteraceae. Fungal infection in roots and different aerial parts of plants also causes severe decline in chlorophyll and ultimately chlorosis in plants. Plant roots are also damaged due to nematodes, root rot disease and damping off diseases.

Infestation of different kinds of biting, chewing and sucking type of insects e.g. mites, aphids, jassids, millibugs, thrips, scale insets, leafhoppers, leaf miners and whitefly etc also damage plants and may cause chlorosis in plants. In cotton Jassids lay eggs into leaf veins. Nymphs and adults suck cell sap from under side of leaves and release toxins resulting into leaf curling, yellowing and reddening of lamina. Yellow and brown coloured nymphs and adults of thrips (*Thrips tabaci*) lacerate leaf tissues and imbibe the oozing sap causing brown colouration of leaf near veins. In soybean and some other crops occurrence of yellow mosaic disease is most common. The leaves of yellow mosaic affected plants become yellow in colour with green patches here and there. In case of severe attack, all the leaves turn yellow and in affected plants there are no flowering and fruiting. Whitefly acts as an agent for the dissemination of this virus. Yellow mosaic is the most common disease of almost all the vegetable crops like chilies, okra, and tomato. etc and pulse crops. For the control of this disease application of urea is not the proper measure but the measures for controlling whitefly must be adopted very timely.

These problems are further aggravated when substandard fungicides and pesticides are used in excessive quantity to control the pest and diseases.

6. Weedicides / Herbicides: Use of herbicides to control weeds in different crops may also cause chlorosis if due care is not taken before use with respect to their quality, dose, proper methods, time of use and other precautions.

7. Imbalanced Nutrition of Plants: Up till now only 17 elements have been recognized as essential to plant growth. The availability of these nutrients to plant must be in optimum amount. The deficiency of any single nutrient or a group of nutrients lead to imbalanced nutrition and their deficiency symptoms results in chlorotic leaves showing pale, yellow, or yellow-white colour. Few examples of the deficiency symptoms of nutrients are given below:

a. Nitrogen deficiency (N): Gradual loss of chlorophyll and yellowing of lower leaves. Colour of the older leaf's changes from green to light yellow and in acute deficiency, the leaves become white in colour. Symptoms appear on older leaves in the form of light green to pale yellow coloration (through proteolysis). In maize nitrogen hunger signs start at tips of old leaves and moves along midrib causing a V-shaped yellow area. Plant having less than 1% N-content is usually regarded deficient in N.

b. Phosphorus deficiency (P): Purple colorization of leaves and stem. In maize phosphorus shortage makes tips of leaves reddish purple, particularly on young plants. Under conditions of continuous deficiency older leaves become bronzed or develop reddish- purple tips and leaf margins. Plants having less than 0.1 % or 1000 ppm P content are deficient in P.

c. Potassium deficiency (K): Sometimes leaves become brownish and spots are visible on the leaves.

d. Magnesium deficiency (Mg): Magnesium (Mg) is mobile within the plants with its symptoms of deficiency appearing on the older leaves. In its deficiency, there is a general loss of green colour starting from lower leaves to stalk. Yellow green or light yellow or white streaks on the leaves. Chlorosis (loss of green colour) appears in between veins of the leaves. Interveinal chlorosis with tints of red, orange and purple colour is observed in some of the vegetable crops. In maize magnesium deficiency causes the leaves to have alternate green and white strips. Plant having Mg concentration less than 0.1 % is Mg deficient.

e. Sulphur deficiency (S): S is immobile in plants; deficiency first occur on younger growths. The fading of normal green colour of the leaves followed by Chlorosis is most common deficiency symptom. Plants having less than 0.1 to 0.2 % S content are deficient in S.

f. Iron deficiency: As iron is necessary for synthesis and maintenance of chlorophyll in plants therefore its deficiency results in inter-veinal chlorosis appearing first on the younger leaves with leaf margins and veins remaining green. Stem portion of plants becomes thin and stunted. A continuous deficiency may result in the total bleaching of leaves and whole plant turning necrotic. Plants having less than 50 ppm of Fe are usually classified as iron-deficient.

g. Manganese deficiency (Mn): As the Manganese helps in chlorophyll formation and therefore its deficiency in plants cause yellowing of interveinal portions and development of chlorotic leaf areas which soon become necrotic and turn red, reddish-brown or brown. Deficiency symptoms of Mn are more severe on middle leaves than on the younger ones because Mn is preferably translocated to the younger tissues. Symptoms of Mn deficiency are popularly known as grey speck of oats, peckled yellow of sugarbeet, marshy spot of peas, pahala blight of sugarcane. Its deficiency symptoms appear visibly in high pH soils. Manganese deficient plants contain less than 25 ppm Mn.

h. Zinc deficiency (Zn): Zinc plays a role in chlorophyll formation, protein synthesis, in the formation of some growth hormones, and in the reproductive process of certain plants. The commonest symptoms of zinc deficiency are chlorosis between veins; reduction in size of young leaves. The pigmentation which first appears in the middle of the leaf intensifies and covers the entire lamina. Under conditions of acute deficiency, whole mass collapses with arresting of the plant growth. Khaira disease of rice is caused by its deficiency. Plants containing less than 15 ppm Zn are regarded deficient in Zn.

i. Copper deficiency (Cu): A copper deficiency results in first young leave exhibiting chlorosis and drying and a distortion of the terminal leaves. The shoot apex may die prematurely, resulting in the development of several auxiliary buds. Young leaves permanently wilt without chlorosis. Plants having less than 5 ppm Cu are regarded as Cu-deficient.

j. Boron deficiency (B): Deficiency symptoms appear first on the younger leaves. Growth of terminal bud is stopped shortly followed by death. Younger leaves become pale green losing mere colour at the base than the tip. Older leaves have one sided or twisted appearance. Plants having concentration of the order of 5 to 30 ppm are suspected to be B deficient.

k. Molybdenum deficiency (Mo): Deficiency of molybdenum results in inter-veinal chlorosis in leaves. Young leaves wilt and die. Leaves become folded in deficiency of molybdenum. Severely affected leaves show scorching. The Mo-deficient cauliflower plants exhibit chlorotic mottling and cupping of the middle leaves, "Whiptail" like appearances develops in cauliflower. Molybdenum deficiencies resemble the N-deficiencies. Critical concentration of Mo deficiency in plants is usually less than 0.1 ppm.

8. Pollution: Exposure of plants to sulphur dioxides and some other poisonous gases emitting in the proximity of industries generally cause yellowing of plant leaves. Harmful effluents from industries may pollute water resources and use of this polluted water when use for irrigating the crops lead to severe damage to crop plants.

Thus, it may be concluded that chlorosis or yellowing in plants may arise may arise at any point of time due to different reasons and therefore its thorough diagnosis is very essential before taking up any corrective measures.

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High Density Planting Systems in Fruit Orchards

Article ID: 32020

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Abstract

High density planting is a latest concept of orchard planting across the world, involving maximum utilization of the available space by accommodating maximum number of fruit plants per unit area for achieving maximum yield and quality within a stipulated time.

In this system of planting. Fruit plants grown under this system of planting, attains bearing stage in 2-3 years as compared to conventional methods with 5-6 years after planting. Maximum utilization of land and solar energy can be done by accommodating a greater number of plants per unit area through different systems of density planting.

On the basis of degree of dwarfness or tallness of plants and agronomical factors, planting densities may be of following types: low density planting, medium density planting, high density planting, and ultra-density planting. Adoption of precise methodologies such as pruning, thinning, modern harvesting operations etc would definitely facilitate the farmers to maximize their income levels substantially.

Keywords: High Density Planting, Orchard, dwarfness, yield maximization.

Introduction

High density planting is one of the important methods to achieve high productivity per unit area both in terms of short duration and perennial horticultural crops. High density in fruit crops has been pioneered for temperate fruits in Europe. First planted in Europe at the end of 1960.

High density planting is more efficient since it is precocious, easily manageable, has higher yield capacity with best quality fruits and higher income per unit area. It can be defined as planting of a greater number of trees per unit area to achieve maximum crop yield through manipulation of tree size. High density planting focuses both on yield and quality simultaneously by maintaining a striking balance between vegetative and reproductive growth without compromising on the plant health.

The success of this technology is mostly dependant on the use of methods to control shoot growth and maximize the light interception as the trees starts bearing (Menzel and Lagadec, 2014). The adoption of high-density planting systems is revolutionizing fruit growing industries throughout the world thereby achieving nutritional security among the growing population.

Where was it Conceived?

The conceptual background of High-Density Planting (HDP) reveals that it was pioneered for temperate fruits in Europe. High density orchards were first planted in Europe at the end of the nineteen sixties since then there is a decline in traditional orchards with low densities and with the development of Malling and Malling - Merton rootstocks in apple. Dwarfing rootstocks in apple facilitated HDP to go up to 10000 plants/ha thereby, the method was also called as meadow orchard in UK. HDP refers to planting of a greater number of plants per unit area at a closer spacing than recommended to maximise crop yield through scientific manipulation.

Principles of HDP

To exploit the vertical and horizontal space per unit time:

1. To strap up maximum possible returns per unit of inputs and resources.
2. To capture maximum sunlight per unit area.
3. To optimize the land use efficiency.

4. To achieve appropriate vegetative reproductive balance of the plants

The conceptual background of high-density planting in fruit growing was pioneered in temperate fruits and first planted at the end of the nineteen sixties, since then there is rise in establishment of commercial high-density orchards throughout the world. In India, high density plantings have successfully been demonstrated in guava (Lal et al. 2007), litchi (Mishra et al. 2003), mango and papaya (Ram,1996).

Comparison Between Traditional System and HDP/Meadow System of Fruit Growing

S. No.	Attributes	Traditional system	HDP/Meadow system
1.	Tree numbers	Few large trees/ha (150- 200 trees/ha).	Many small trees/ha (500- 1,00,000 trees/ha).
2.	Bearing	After two years.	From first year.
3.	Production	Lower yield.	Higher yield.
4.	Management	Difficult to manage due to large tree size.	Easy to manage due to small tree size.
5.	Labour requirement	Requires more labour.	Requires less labour.
6.	Production cost	Higher cost of production.	Lower cost of production.
7.	Harvesting	Difficult.	Easy.
8.	Quality	Large canopy, poor sunlight penetration and Poor-quality fruits.	Small canopy, better air and Sunlight penetration, mini. disease incidence and high-quality fruits with good colour development.

Merit of HDP Over Normal Planting

High density orcharding appears to be the most appropriate answer and need of the hour to overcome low productivity and long gestation period for early returns and export quality fruits.

1. High density planting facilitates better utilization of solar radiation and increase in bearing surface per unit land area.
2. HDP plants are precocious, easily manageable and fetch higher return per unit area.
3. High density orchards have better amenability to modern, input saving horticultural techniques such as drip irrigation, mechanical harvest etc.
4. The use of dwarf trees and managing excessive vegetative growth gives higher productivity and harvest index as well as early economic returns.
5. High density planting system is more amenable to horticultural operations such as pruning, plant protection measures and harvesting which reduces the labour cost involved.

Demerits of HDP

1. HDP does not perform well in resource constraint areas.
2. Canopy management under tropical conditions ie., in evergreen plants is more complicated and require more skill.
3. Lack of standardization of production technology and extension of technical- know-how to the farmers.
4. High initial establishment cost.
5. Lack of promising dwarfing rootstock in mango, guava, sapota, peach, sweet cherry etc.
6. In apple, commercial utilization of dwarf rootstocks for tree size control in HDP is restricted due to their poor anchorage, occurrence of sloppy, shallow and rainfed lands and low fertility.
7. High incidence of some diseases in HDP e.g. Sigatoka leaf spot & fingertip in banana.

Different Methods of HDP

There are five different methods of high-density planting viz., low density, moderate density, high density, ultra-high density and super high-density plantings or meadow orcharding.

In mango, low density planting accommodates 100 plants/ha at a spacing of 10 x 10 m (40 plants/acre). Moderate density accommodates 204 plants/ha at a spacing of 7 x 7 m (82 plants/acre). High density can accommodate 400 plants/ha at a spacing of 5 x 5 m (160 plants/acre).

Ultra-high density in apple accommodates 1111 plants/ha at a spacing of 3 x 3 m (444 plants/acre). Super high-density planting or meadow orcharding is followed in apple and accommodates nearly 10000 plants/ ha at a spacing of 1 x 1m (4000 plants/acre). Recently, super high-density planting system accommodates 20,000 trees per ha in apple orchards. In some orchards, still closer, planting of apple trees is followed (say 70,000 trees/ha).

Approaches for Establishing High Density Orchards

HDP can be achieved with the suitable use of following components; they are (a) Dwarf scion varieties, (b) Dwarfing rootstocks and inter-stocks, (c) Training and pruning, (d) Use of growth regulators and (e) Planting Systems. These components are harnessed in HDP which helps in attaining the goal of high yield and quality.

1. Use of genetically dwarf scion varieties: It is generally understood that use of dwarf scions has a predominant role in establishment of a high-density orchard. Genetically dwarf cultivars have the potential for higher yield and increased returns compared to traditional plantings.

2. Use of dwarfing root stocks: Root stocks are known to have a profound effect on the tree vigour, precocity, productivity, quality of fruits and longevity of varieties grafted on them. Attempts have made to standardize dwarfing rootstocks especially in the fruit crops like ber, citrus and grape. Use of graft incompatible scion and rootstock induces dwarfness in the composite plant.

3. Training and Pruning: Training and Pruning are effective tools in HDP and meadow orcharding by virtue of their impact on shape and size control of the tree. Slow growing trees respond more favourably to pruning and training and can be maintained at a given size and shape without sacrificing yield. The training begins when the tree is first planted and continues throughout its productive life. Proper tree forms, branch angle and limb spacing in it aids in growth control. Spray of 01% urea combined with 0.2% Blitox-50 or any other copper fungicide should be done soon after pruning. Pruning is applied to regulate crop in guava, ber and fig, and rejuvenation of old orchards in mango. Tree size control through pruning is limited to grape, apple and some other temperate fruits. Spindle bush raised on M9, M7 and M4 rootstocks is a promising training system for HDP.

4. Use of growth regulators to control tree growth: Use of growth regulators can prolong dormancy, reduce vegetative growth, delay flowering, reduce fruit drop etc. Plant growth regulators such as Paclobutrazol, Alar, Uniconazole, prohexadione- calcium have been used to restrict vegetative growth. Of these Paclobutrazol treatments in mango at Pantnagar induced flowering and fruiting in new shoots produced in July after pruning without any loss in fruit quality. September to November treatment was highly effective in increasing flowering and fruiting besides reducing vegetative growth (30-35%). Thus, paclobutrazol treatments induced flowering and fruiting and helped in reducing the vegetative growth required for high density orcharding.

5. Planting Systems: Planting Systems play a major role in achieving higher yield through assimilated production of inputs. Among the different planting systems adopted for fruit crops, square and triangular systems are followed for HDP in mango, Kinnow, banana, papaya and Hedge row system in apple and pineapple in India (Singh et al, 2011).

Conclusion

It is understood that though there are many researches attempted on HDP in fruit crops with variable success, commercial adoption for the benefit of the farming community is still in infancy. For a country like India, most of the tropical and sub-tropical fruit crops like mango, litchi and guava which by nature are vigorous and fast growing, canopy management through pruning is not well practiced both manually or through machineries. The ultimate solution would be to screen varieties having less canopy area and erect growth. Likewise, modern training and pruning systems adopted in temperate fruit crops can be experimented in our conditions for achieving better yield and quality within a confined area.

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Infestation of Ambrosia Beetle on Avocado at Kodaikanal Hills, Tamil Nadu

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Introduction

Kodaikanal region farmers were cultivating temperate fruits and this region was consider as one of the highest productions of warm temperate fruit crops viz., Apple, Peach, Pear, Plum, Avocado and Kiwi in Tamil Nadu. In the hills of Kodaikanal Avocado consider as major fruit crop. However avocado in Tamil Nadu was grown in a limited scale more as shade crop in coffee plantation in Lower and upper Palani Hills which are a mountain range in Tamil Nadu state of South India and eastward extension of the Western Ghats ranges made up of hills 1,000- 1,500 m of Altitude.

Avacado *(Persea americana)*

The avocado, a tree likely originating from south-central Mexico, is classified as a member of the flowering plant family Lauraceae. The fruit of the plant, also called an avocado, is botanically a large berry containing a single large seed. Avocado was introduced in India from Sri Lanka in the early part of the twentieth century. In a very limited scale and in a scattered way it is grown in tropical or semitropical areas experiencing some rainfall in summer, and in humid, subtropical summer rainfall areas of Tamil Nadu, Kerala, Maharashtra, Karnataka in the south-central India and in the eastern Himalayan state of Sikkim (Ghosh, 2000).

Pest Status of Avacado

Avocado still recently was rarely affected by pests though sporadic occurrence of minor pests like tea mosquito bug, *Helopeltis* spp. (Miridae) attacking shoots, red banded thrips, *Solenothrips rubricinctus* (Giard) (Thripidae) infesting leaves, nipa mealybug, *Nippacoccus nipae* (Mask.), striped mealy bug, *Ferrisia virgata* (Ckll.) (Pseudococcidae) infesting stem, coconut scale *Aspidiotus destructor* Sign. and trilobite scale *Pseudaonidia trilobitiformis* (Green) (Diaspididae) on fruits and twigs had been reported in India.

Ambrosia Beetles

Recently wilting of avocado trees was reported by the planters in Kodaikanal region. Based on the information of serious loss caused by the death of trees from one of the planters in this region, a onetime roving survey was undertaken in the fields. Observations were made on the total number of trees and trees affected by the beetles showing bore holesand wilting of branches in each holding. The shot hole borer attacked apparently healthy plants resulting in wilting of the branches. When the population is more, the wilting of the tree was observed Ambrosia beetles (Coleoptera: Curculionidae: Scolytinae and Platypodinae) bore into tree xylem to complete their life cycle, feeding on symbiotic fungi. Most ambrosia beetles in temperate regions infest cut timber, wind-thrown trees, wind-broken limbs or boles of trees, and/or suppressed or diseased trees. Woody timber dead for more than a year is seldom infested. However, temperate-region ambrosia beetles of the genus *Corthylus* and warm temperate-, semitropical-, and tropical-region members of the scolytine beetle tribe Xyleborini (*Xyleborus* and *Xylosandrus*) are capable of attacking apparently healthy and undamaged woody hosts. Ambrosia beetles infest the bole of the tree, boring directly through the bark into the xylem. The entrance hole is seldom more than 1 mm in diameter; the boring frass is light in color initially, but darkens as the primary symbionts begin to grow or as it is contaminated with larval fecal pellets. By comparison, scolytine bark beetles typically produce brownish boring frass because they mine the inner bark as they construct galleries.

Insect and Fungi Interaction

Ambrosia beetles are a threat to avocado where they have been found to vector a symbiotic fungus, *Rafaelea lauricola*, the causal agent of the laurel wilt disease. The adult female redbay ambrosia beetle carries in a special pouch in its mouth - called a mycangia - the spores of the fungus that causes laurel wilt *(Raffaelea lauricola)* (Fraedrich et al., 2008; Harrington et al., 2008). As the beetle bores into the wood, forming galleries, the spores carried in its mycangia and on its body inoculate the tree, germinate and grow, colonizing the outer wood (sapwood) of the host plant . The fungal hyphae and colonized sapwood block the movement of water and nutrients in the tree. Ambrosia beetles are more attracted to physically wounded host trees than to non-wounded host trees (Hanula et al., 2008). As a result, pruned avocado trees may be at greater risk of attack from this beetle than are non-pruned trees.

Damage Symptom

Small strings of compacted sawdust (ejected wood fibre) protrude from small bore holes along the tree trunk and limbs. However, these strings of compacted sawdust may not always be present because they disintegrate easily. Removing the tree bark reveals very small-bore holes (~2 mm in diameter) in the wood at the point of attack from the beetle, as well as dark staining caused by the fungus as it extends into the surrounding, water-conducting tissues (xylem). Leaf and young stem wilting in sections of the tree show signs of attack (sometimes the entire tree shows signs of attack if the trunk is infested). Subsequently, leaves in part of the tree canopy or the whole canopy may drop or desiccate and remain attached to the stems. Leaf, stem, and limb dieback; eventual tree death.

Damage symptoms

(Courtesy: Dr. K. Elango, Entomologist, TNAU)

Conclusion

Once the beetle and fungus are detected in the commercial avocado production area: Do not move infested trees or tree parts; this may spread the infestation. Burn infested tree parts or trees in the grove to destroy larvae and adults inside the wood. Chipping the infested wood will eliminate the wood from being used for breeding beetles. However, because of the very small size of the pest, chipping will not destroy these beetles or larvae. The stumps of dead or dying trees should be burned in-place to prevent further spread of the ambrosia beetle and larvae. Until it is known whether the laurel wilt pathogen can be spread mechanically, consider requiring disinfection of mechanical and hand pruning equipment prior to pruning a grove.

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A Glance at Black or Stem Rust of Wheat

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Introduction

Black rust is the most serious and fearful disease of wheat in all the wheat growing areas of world. In India, the Central and Peninsular southern parts are prone to infection of stem rust where the warmer favourable temperature prevails in growing season but the climatic conditions prevail in wheat belt of Northern Hill Zone and Northern Plain Zone doesn't favours the infection of black rust (Joshi and Palmer, 1973). The epidemic development of black rust has been reported in many years with a great loss of wheat production.

Pathogen

Black/stem rust of wheat is caused by *Puccinia graminis* f.sp. *tritici* Eriks which is an obligate parasite or biotroph that can survive only in presence of living host or require alternate host in absence of host plant. The pathogen belongs to family *Pucciniaceae*, order *Uredinales* and class *Basidiomycetes* of subdivision *Basidiomycotina.* The fungus is heteroecious in nature, having a telial host in *Poaceae* family and an aecial host survived in *Berberidaceae* family and macrocyclic producing five types of spores. The life cycle of basidial, pycnial and aecial stages occurred on common barberry as alternate host while the uredial and telial stages occurred on wheat. Among the different spores, urediospores are the main repeating spore which is characterized with orange red colour, spiny and oblong measuring about 25-30 x 17-20 µm with four germ pores. The teliospores are the resting spore which is black in colour and help in survival during off season on alternate host plant.

Symptoms

The symptom occurs mainly on stem portion but can also be visible on leaves, sheaths, glumes and awns in severe infection. The initial symptoms appear as oval to elongate lesions with reddish brown in colour having typical small chlorotic fleck, which appears a few days after infection. As infected plants mature, uredinia change into telia; changing its colour from reddish brown to black hence it is also called as black rust as shown in fig 1. The pathogen on the alternate host barberry produces basidiospores with raised yellow orange colour lesions on leaves, petioles, blossoms and fruits (Singh et al., 2012). The heavy infection on stems interrupts the transportation of nutrients to the developing heads, resulting into formation of shrivelled grains and weakened stems prone to lodging (Roelfs et al., 1992).

Fig 1: Typical symptoms of black rust of wheat

Disease Cycle

The life cycle starts by the introduction of either aeciospores or urediniospores to wheat then teliospores with diploid nucleus which overwinter on plant refuse and soil undergoes meiosis and germinates into four celled promycelium which produce basidiospores which are carried by wind and infect on barberry. Then, arise pycnial fertilize receptive hyphae of opposite mating type developing into aecia as shown in fig 2.

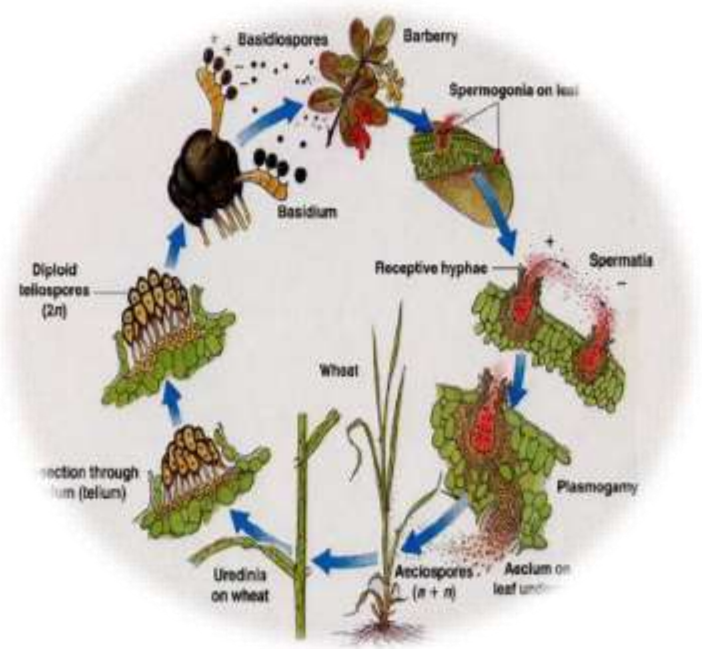

Fig 2. Life cycle of black rust of wheat

Puccinia Pathway in India

But under Indian condition, barberry has no role as alternate host in the completion of life cycle, since in southern part i.e. Nilgiri and Pulney Hills, susceptible hosts remains round the year and from where urediniospores are blown to other parts of India with cyclonic winds and completes its dissemination as depicted in fig 3 (Mehta 1940; Nagarajan and Joshi, 1985).

Fig 3. Puccinia path in India

Epidemiology

The initial work on epidemiological studies on wheat rusts was started by K.C. Mehta in India, who identified that during the summer months due to presence of intense summer heat, any form of inoculum of rusts was completely destroyed in the plains but survives in the hilly areas of North and South India. The study on different foci for infection has denoted the primary source of stem rust lays mainly in the hills of South India namely Nilgiri and Pulney hills. The minimum, optimum and maximum temperature requirements for urediniospore germination are 2, 15-24 and 30°C respectively and for sporulation 5, 30 and 40°C respectively (Roelfs et al., 1992).

Management

1. Genetic resistance: Use of resistant variety recommended in each agroclimatic zone of India is the most efficient and cost-effective measure to combat wheat rust.
2. Gene pyramiding and deployment of genes: Stacking of different durable form of resistant genes into a variety and later on its deployment on different areas based on the prevalence of different pathotypes in the different agroclimatic zones.
3. Sanitation: Removal of infected volunteer plants from the field.
4. Chemical control: Spraying of fungicide like propiconazole or tebuconazole or hexaconazole or azoxystrobin @ 0.1%.

Ug99 and its Impact

An alarming threat has emerged with detection of highly virulent race of stem rust i.e. Ug99 in Uganda in 1999 (Pretorius et al., 2000) and designated as TTKSK in North American nomenclature. Till now, seven races under Ug99 lineage has reported (Singh et al., 2008; Hodson, 2010). It has now spread from eastern to Southern Africa, Kenya, Ethiopia, Zimbabwe, South Africa, Sudan, Yemen, Iran, etc. (Singh et al., 2011) and Tanzania (Hale et al., 2013).

The primary threat is the susceptibility of nearly 90 per cent of world's commercial wheat and breeding materials in the pipeline. Since, it has a great potential to breakdown many important resistance genes such as Sr31, Sr24 and Sr36 which poses a new threat to global wheat production. Further, its wind-borne dispersal of spores to various wheat growing regions is prominent as the majority of varieties in the migration path could be found to be susceptible.

Preparedness to Combat Ug99 in India

India is an active member in Borlaug Global Rust Initiative programme as its core member is keeping track on movement of Ug99. ICAR in collaboration with CIMMYT have continued in testing program of wheat germplasms in hotspot areas such as Kenya and Ethiopia since 2005 to deal with the striking threat of Ug99 in Indian Territory.

But, fortunately according to extensive survey and surveillance conducted in the country has reported that Ug99 has not been detected from anywhere in India till now. Moreover, there is no immediate threat as India had twenty two wheat resistant varieties such as Super 152, Super 172, DBW 17, PBW 550, Lok 1, Baj, HD 2781, DL 153-2, NI 5439 and HI 8498 etc. which were reported to possess various resistance genes such as Sr2, Sr13, Sr22, Sr25, Sr26, Sr27, Sr28, Sr29, Sr32, Sr33, Sr35, Sr39, Sr40, Sr44, SrTmp etc. (Singh et al., 2011).

Conclusion

On the present perspective, black rust of wheat has a great potential to affect global wheat production mostly in the developing countries. Besides, the detection of Ug99 has enhanced the risk into another fearful level. In the meantime, many wheat researchers are focussing in exploration and intensification of new sources of resistance genes from across the genera and species to combat wheat rust. But, pyramiding of gene by using conventional method may took long time and difficult so relaying on exploitation of marker assisted selection (MAS) programme could be a powerful alternative to facilitate new gene deployment and gene pyramiding for quick release of race non-specific resistant varieties against black rust of wheat in near future.

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Biotechnology - CRISPR/Cas9 System: A Powerful Method for Genome Editing

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The development of effective and consistent ways to make accurate, targeted modifications to the genome of living organisms is an established objective in biological research. In recent times, a new method for genome editing based on a bacterial CRISPR-associated protein-9 nuclease (Cas9) from Streptococcus pyogenes was developed which created a buzz in the scientific world. The main purpose of CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and cas9 in some bacteria and archaea is to develop defense mechanism towards invasion of plasmids and viruses through adaptive immunity. It was proved that S. thermophilus acquired resistance towards a bacteriophage through incorporating a genomic part of a virus into its CRISPR locus (Barrangou et al., 2007). This technology enables the researchers to manipulate the genome by adding, removing or varying the DNA sequence. It can be used to control gene expression in plants, animals, and even humans; potential to delete detrimental traits and add desirable traits with more accuracy, effortlessly than before. Not only CRISPR can be used to “silence” genes by removing them but also to substitute desired genes by harnessing repair enzymes. So, for instance, Cas9 enzyme can be modified to snip out disease causing genes and insert a “good” gene to replace it.

Types of CRISPR/ Cas Systems

Three different types of CRISPR/Cas systems are present:

A) type I, B) type II and C) type III.

Types I and III are found in both bacteria and archaea while, type II is unique in bacteria. The type II CRISPR/Cas system is the most studied and best characterized in which Cas9 protein is the critical component. The Cas9 endonuclease is a four-component system that includes two small RNA molecules named CRISPR RNA (crRNA) that is specific to the targeted DNA, and trans-activating CRISPR RNA (tracrRNA) sequence that interacts with the Cas9 protein, that has DNA endonuclease activity. This complex will affect target-specific double-stranded DNA cleavage and will be repaired by the DNA repair mechanism by non-homologous end joining (NHEJ) or homology directed repair (HDR). Cas9 endonuclease was re-engineered into a more controllable two-component system by joining the two RNA molecules into a “single-guide RNA”(sgRNA) that, when united with Cas9, could find and cut the DNA target specified by the guide RNA (Jinek, et al., 2012). Thus, by manipulating the nucleotide sequence of the single-guide RNA, the synthetic Cas9 system could be programmed to target any DNA sequence for cleavage. It can also be reprogrammed to target a site of their choosing by changing the sequence of its crRNA (Mojica, et al., 2016). A recent improvement is the use of the modified version of CRISPR/Cas9 system i.e., Cas9 to target protein domains for transcriptional regulation and epigenetic modifications.

CRISPR/Cas9 expertise has altered the outlook of genome editing, allowing an earlier unachievable stage of genome targeting, high efficacy, easiness and flexibility of the system. Many laboratories around the world are using the technology for variety of applications including use as a basic biology research tool, development of biotechnology products, and potentially to treat diseases in plants, animals and humans. Following initial demonstration of genome editing by CRISPR-Cas9 by Feng Zhang’s and George Church’s groups simultaneously, in human cell cultures for the first time. It has since already been successfully adopted to target important genes in many cell lines and organisms, including yeast, Xenopus tropicalis, Candida albicans, zebrafish, fruit flies, ants, mosquitoes, nematodes, mice, rabbits, monkeys, pigs, human embryos and plants (Arabidopsis, rice, wheat, sorghum, tobacco). Though, initial success was achieved by the use of CRISPR/Cas9, it takes time for routine use of this technology in humans, plants and animals. To a large extent, research is still focusing on its use in plant and animal models or isolated human cells with the objective to treat diseases. The CRISPR/ Cas9 system is widely used in biomedical research to edit the human genome and try to knock out genetic diseases like Huntington's disease or cystic fibrosis, breast and ovarian cancers (BRCA-1 and 2 mutations), hypertrophic cardiomyopathy, Down Syndrome and HIV infections out of T cells.

Emerging Challenges in Agriculture

CRISPR/Cas9 so far showed the greatest promise for addressing emerging challenges in agriculture especially in Rice and Wheat [Zhou, et al. (2016); Wang, et al. (2016); Li, et al. (2016); Zhang, et al. (2016)]. It is a resourceful latest tool to employ in plant research that can facilitate to identify genes associated with desired traits in crops much more quickly. It could also allow researchers to introduce desired traits into crops more accurately than conventional breeding, which is a much-disordered way of exchange of genes. Plant researchers are already considering to use CRISPR to modify the genes of various crops to improve yield, nutritional properties or to trim out the allergens in peanuts and to develop abiotic tolerant crops. Korean researchers are using CRISPR/cas9 system for banana fungal disease.

On the other hand, CRISPR-Cas9 is not devoid of its disadvantages. The limitation of CRISPR is, it is not yet hundred percent efficient and problem of off-target effects, where DNA is cut at a different site to the one that was intended to be edited. The effectiveness of gene editing in rice, showed to be 50 percent that received the cas9 complex (Doudna and Charpentier, 2014). While, other analysis has revealed that based on the target gene or trait, editing efficiencies can achieve as high as 80 percent or more which leads to the unintended mutations and development of new diseases.

Conclusion

Even though, modifications to CRISPR have been made to minimize the possibility of off-target effects, it has yet to be proven. There is even a chance of genome vandalism viz., the system cuts on target without a precise edit. Once the precise and deeper mechanism underlying how the CRISPR/ Cas9 system works was understood, it could be harnessed for applications in molecular biology and genetics that were not previously envisioned. Still, ethical issues raised by genome editing have to be addressed by researchers. Regulatory agencies will also need to regulate how best CRISPR-Cas9 technology can be exploited without hindering applicable research and development.

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Impact of Ready-Mix Insecticides on Insect Pests of Cotton and Paddy

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Introduction

The pest management strategy in India is mainly relying on chemical pesticides. The quick and effective control of pests by insecticides convinces the farmers against the non-chemical methods of pest management. More often insecticides form the only solution to sudden outbreak of insect pests.

The knowledge regarding the most susceptible stage of the pest and actual impact of pest populations on yield loss is crucial for economical and successful pest management. The lack of knowledge in these aspects, led the Indian farmers to use insecticides indiscriminately, which resulted in the development of resistance against major agricultural insect pests.

The development of resistance and resurgence has limited the application of single insecticides and resort to ready mix insecticides (Das, 2014). A mixture may give best control of complex insect pests with varying susceptibilities to the different components of the mixture. Insects that are resistant to one or more insecticides may be susceptible to a combination of toxicants and synergism may be exhibited by the components. How best these mixtures can be utilized to overcome the problem of resistance and how can such mixtures be screened for crop protection is our concern (Cloyd, 2011).

Classification of Insecticide Mixtures

Two types of insecticides mixtures: Tank mixtures (Insecticides are mixed in the field directly by the farmers). This mixture may curdle, precipitation of flakes, crystals, gel, or become sludge like due to physical incompatibility and ready-mix insecticides (It is scientifically developed and tested products based on their compatibility study). In this final product is “ready to use” material. CIBRC on October 14, 2019, has registered 70 ready mix insecticides in India (Anon., 2019).

Mechanism of Ready-Mix Insecticides

The insecticides are mixed either for synergism or potentiation. Synergism refers to the toxicity of a given pesticide being enhanced by the addition of a less or non-toxic pesticide (Ahmad, 2004). Potentiation refers to an increased toxic effect on an arthropod pest population when mixing two compounds together, which by themselves are harmful to arthropod pests (Ahmad, 2004).

Efficacy of Ready-Mix Insecticides on Insect Pests of Cotton

Bollworm complex damage in green fruiting bodies of cotton was effectively managed by spraying of indoxacarb 14.5% + acetamiprid 7.7% SC @ 1 ml/l (Borude *et al*., 2018). Chlorantraniliprole 8.8% + thiamethoxam 17.5% SC @ 150 g a.i./ha was found to be most effective against bollworm complex in cotton (Rambhau *et al.,* 2018). Padaliya *et al.* (2018) reported that acephate 50% + imidacloprid 1.8% SP 0.1% effectively controlled the *Scirtothrips dorsalis* infesting *Bt* cotton.

Diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha was found effective in managing *Aphis gossypii* and *Amrasca biguttula biguttula* in *Bt* cotton (Thumar *et al*., 2018). Spinetoram 10% + sulfoxaflor 40% WG @ 140 g a.i./ha was effective in managing the bollworm complex and sucking pests in cotton (Hanchinal *et al*., 2018). Soil drenching against termite in cotton with imidacloprid 40% + fipronil 40% WG @ 10 ml/l effectively managed the pest (Chennabesava, 2019).

Efficacy of Ready-Mix Insecticides on Insect Pests of Paddy

Rice stem borer and rice leaf folder were effectively managed by broadcasting of chlorantraniliprole 1.2% + thiamethoxam 1.2% DT @ 2.5kg/ha in paddy (Balamurgan et al., 2017). Acephate 50% + imidacloprid 1.8% SP @ 1200 g/ha was found to be most effective against rice stem borer in paddy (Kalyan et al., 2017).

Foliar application of buprofezin 23.1% + fipronil 3.85% SC @ 875 ml/ha was proved to minimize the infestation of brown plant hopper in paddy (Chakraborty et al., 2017). Ghosal et al. (2018) reported that buprofezin 15% + acephate 35% WP @ 1500 ml/ha was found to be effective against the brown plant hopper and white backed plant hopper in paddy. Brown plant hopper and white backed plant hopper were effectively managed by spraying of fipronil 5% + buprofezin 20% SC @ 62.5+250 g a.i./ha in paddy (Sharma et al., 2019).

Efficacy of Ready-Mix Insecticides on Natural Enemies

Borude et al. (2018) found that ready mix insecticides were less detrimental to natural enemy's population like spiders, chrysoperla and coccinellids in cotton ecosystem. Balamurgan et al. (2017) propounded that chlorantraniliprole 1.2% + thiamethoxam 1.2% DT was safe to natural enemy's population like spiders, mirids and ichneumonids in paddy ecosystem.

Pros of Ready-Mix Insecticides

1. Delay the development of insecticide resistance.
2. Reduction in the number of applications and Decreases labour costs.
3. Controlling pests in a broad range.
4. More efficacy and less dosage.

Cons of Ready-Mix Insecticides

High cost and less awareness among the farmers

Conclusion

Ready mix insecticide is an integral component of pest management programs due to the continual need to deal with a multitude of arthropod pests associated with cotton and rice. Spinetoram 10% + sulfoxaflor 40% WG was effective in managing the bollworm complex and sucking pests in cotton.

Chlorantraniliprole 8.8% + thiamethoxam 17.5% SC & diafenthiuron 25% + pyriproxyfen 5% SE were effective in managing the bollworm complex and sucking pests in cotton, respectively. Stem borer, leaf folder, brown plant hopper and green leaf hopper were effectively managed by application of chlorantraniliprole 1.2% + thiamethoxam 1.2% DT and acephate 50% + imidacloprid 1.8% SP in paddy. Ready mix insecticides had a less detrimental effect on natural enemy's population.

Future Thrust

1. Need not divert attention from the implementation of alternative pest management strategies.
2. The concept of mixtures may be extended to botanicals and other insect growth regulators for effective pest management.
3. Need to test different combinations of insecticides for its resistance and persistence.
4. Need to monitor residue levels of ready-mix insecticides in different crops.
5. Need to develop antidotes for ready mix insecticides.

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Soil-Less Farming- An Innovative Way Towards Sustainability

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Summary

In this turbulent century the more we move forward the more we face environmental pollution, land degradation, food security like issues. Population is increasing and fertile soil is decreasing day by day. Under these circumstances, soil-less farming or, controlled environment agriculture can ensure food security in those places where land is limited or, does not exist or, is heavily contaminated and unfit for agricultural practices. Despite the rise within the constituent cost of soilless culture, however the massive quantity of production offset this value in an exceedingly short time.

Introduction

Soil is the infinite source of life.It is the most abundant growing medium which contains the typical macro and micro nutrients essential for plant growth and development. When water travels through soil, these nutrients become available to the plant roots by means of mass flow, diffusion and root interception. In the world of climate change and intensive farming, fertile soil is disappearing fast.A third of global arable soils are degraded with 25% severely degraded (FAO, 2015). In this grim scenario, soil-less farming may change the face of agriculture by providing a more sustainable and productive alternative to traditional cultivation. This includes Hydroponics, Aquaponics, Aeroponics as well as agriculture using supportive mediators. The soilless agricultures can be accessed on various kinds of places such as balconies, roofs, greenhouses and lands unsuitable for cultivation. In order to obtain higher productivity and higher incomes, such kind of agriculture is operated under control conditions. Generally, completely soluble nutrients are mixed into the water and supplied to the plants (fertigation) using various types of injection technologies. The plants are held in place using various above-ground systems, including benches, beds, troughs, etc. (Fig.1). Mainly fruiting and leafy vegetables, strawberries and ornamental plants are grown by this technique (Van Os et al., 2019).

Fig.1. Soil less agriculture

Concept of Soil-Less Farming

The first term used for soil-less growing medium systems was 'hydroponics' by William Frederick Gericke in the 1930s. This term describes the method of providing mineral nutrient solutions (dissolved fertilizers in water) to support plant growth and development in the absence of soil. The term was later changed to soilless medium cultivation since the major constituent of the medium may be a solid or liquid, with organic or inorganic substrates. In principle the soilless medium is a substrate that is part of an artificial system of cultivation in which plants are grown without soil. The medium provides plants with physical support, regulates the water flow, serves as reservoir of nutrients and permits gas exchange to and from the roots.

Why Soil-Less Farming Works Better?

In soil-less farming, there is a complete monitoring on “what, when and in how much amount” materials plants need. The plants as grown in an inert medium, receive only what is given to them and nothing else. There is a complete control over the nutrient content, pH, nutrient strength, temperature, humidity, light intensification, the composition of the air etc.

Criteria of Good Growing Medium

A variety of materials which are used as the growing medium in soil-less farming along with their physico-chemical properties are summarized in Table 1.

An ideal soil-less medium should have the following physical and chemical properties:
1. A uniform texture that drains well but retains nutrients and water for the root system.
2. High porosity (between 50% and 85%) and low bulk density to facilitate installation and transportation (between 190 and 700 kg/m3).
3. Particle-size distribution to maintain good balance between air and water retention (between 0.25-0.5 mm).
4. A pH between 5.0 and 6.5, which can also be adjusted easily.
5. Low content of soluble salts.
6. Chemical inertia which means that the substrate does not affect the nutrient solution by releasing inorganic ions or immobilising nutrients.
7. Absence of pathogens and pests (but not necessarily sterile), and free of any compound’s toxic to plants.

Table 1. Physico-chemical properties of some commonly used growing medium

Substrate	Bulk density (g/cm3)	Water retention (%)	Porosity (%)	Cation exchange capacity (meq/100g)	Decomposition rate (C:N ratio)
Bagasse	Low	High	Low	Medium	High
Coconut / Coir Dust	Low	High	High	Medium	Low
Peat moss	Low	High	High	High	Medium
Rice hulls	Low	Low	High	Medium	Medium
Sand	High	Low	Medium	Low	Low
Vermiculite	Low	High	Medium	High	Low
Sawdust	Low	High	Medium	High	High
Bark	Low	Medium	Medium	Medium	Medium

Types of Soil-Less Farming

Soil-less culture systems are classified according to the type of substrate (soil-less medium) they use, how the nutrient solution is delivered to the plants (drip irrigation, flowing or stagnant nutrient solution) and what happens to the solution after it drains away such as open (free drain) or closed (recirculating water). Soilless media can be inorganic (e.g. sand, gravel, pebbles, perlite, rock wool, vermiculite), organic (e.g. rice hulls, peat, sawdust, straw, coconut coir) or synthetic (e.g. foam ship, sponges, moisture absorbent plastic fibre).The most popular soil-fewer farming methods are discussed below.

1. Hydroponics and Aquaponics: In hydroponic practice, the roots can be supported by a material like perlite or gravel or coco peat. The nutrient medium used here can be by-products of vegetable waste, fish waste or liquid chemicals. The first studies on hydroponics were started at the Bengal Government experimental farm at Kalimpong in the Darjeeling District. Hydroponic system thus involves plant growth without the use of soil medium and hence is also known as soil-less culture. It is one of the most favoured, hi-tech production systems having the scope to expand to agriculture development in India. This technique if used properly can overcome problems of space for plant growth, water availability, diseases, pests and soil problems (Sankhalkar et al., 2019). Plants grown hydroponically use only 10% of water compared to field-grown ones. Aquaponics is the practice of raising fish and plants in the same water source where fish actually provide the fertilizer for the plants and the plant roots filter the water for the fish. Naturally occurring nitrifying bacteria convert the fish waste (ammonia) into nitrites, and eventually nitrates, which is plant food.

2. Nutrient Film Technique: This practice is good for short-statured plants. Here the solution is held at the lowest point in a reservoir that contains a submersible pump and usually air stones for optimal dissolved oxygen levels and stagnation prevention. Once the water saturates the roots, it drains back into the reservoir.It has a constant flow of nutrient solution, thus no timer is required for the submersible pump.

3. Deep water culture: This is nothing but floating plants on recirculating water. Here the platform that holds the plants is made of Styrofoam insulation boards and floats directly on the nutrient solution. When the air pump supplies air to the air stone, it bubbles the nutrient solutions and supplies oxygen to the plant roots. This practice is good for short-statured leafy greens and herbs as they do not require much root support.

4. Wicking system: It is the simplest type of hydroponic system where the nutrient solution is drawn into the growing medium from reservoir through the wicks. Next this solution is delivered to the roots via the plant's capillary action. It is a passive growing technique having no moving parts.

5. Drip system: It is the widely used soil-less farming practice in the world. Here timer turns the pump on and the nutrient solution is dripped onto the base of each plant by a small drip line. It works well with growing mediums with high water retention (i.e. coco coir, peat moss, or rockwool). When the system is working correctly, it is very low maintenance and high output, but the drip lines can get clogged, which results in dried out plants. Synthetic nutrients are the logical choice for these systems because organic materials clog lines much faster.

6. Ebb and Flow (Flood and drain): This system works by temporarily flooding the grow tray with nutrient solution every few hours, submerging the roots and then draining the solution back into the reservoir. The action is performed by a submerged pump connected to a timer. Because of the root support and oxygen levels they can provide, ebb and flow systems are great for growing pretty much anything, but especially fruiting crops.

7. Aeroponics: This is the most hi-tech type of soil-less farming which involves misting of roots suspended in the air with hydroponic solutions. This is very precise with nutrient delivery and water usage. Though the clogging issues can be even worse than drip system as the emitters have very tiny holes, the roots have ample oxygen which promotes faster growth. Vine plants like Tomato, herbs like Chives, Mint, Oregano, Sage, Basil and Rosemary, leafy greens like Lettuce and Kale are commonly grown by aeroponics.

Pros and Cons of Soil-Less Farming

Just like the other things, there are also downsides of soil-less farming but considering the pros it can offer, it is worth doing. The pros and cons are as follows (Table 2).

Table 2. Advantages and disadvantages of soil-less farming

Advantages	Disadvanages
1. No soil is needed; therefore, crops can be grown in places where land is limited or, does not exist or, is heavily contaminated and unfit for agricultural practices. 2. Controlled environment agriculture, hence, crops can be grown year-round regardless the seasonal variability. 3. Better use of space and location. 4. Extreme decrease in water and nutrient use. Run-off wateris captured and return to the system. As	1. Need of Experience and technical knowledge. As this practice is highly technology oriented, it requires specific expertise for the devices used. 2. Ecological issues. There is a debate on whether plants grown in this way will get micro-biomes as they are in the soil. 3. Risk of water and electricity. 4. High initial expenses.

nutrients are conserved in the system, there are no losses like they are in the soil. 5. Faster growth as plants are placed in ideal conditions, nutrients are provided at the sufficient amounts and come into direct contacts with the root systems. 6. No weed, fewer pests and diseases incidence, therefore, lesser use of insecticide and herbicide. 7. Labour and time saver as agricultural operations like weeding, tilling, wateringis not needed.	5. Quick spread of diseases. Hence, the infected water, nutrient and the whole system should be sterilized. 6. Fertilizer costs, electricity consumption is high.

Conclusion

Soil-less farming is a part of modern agriculture and can be the farming of the future with proven competitive points over soils - space saver; effective use of plant nutrients; water-efficiency; no weeds, fewer pests, and plant diseases; stable and higher yields; control of the whole system; fewer fertilizers and insecticides used; easy to transplant; able to grow crops all year round, etc. However, we cannot expect perfection from anything in life. Even for soil growing, there are still more risks of pesticides, pests, etc. compared to soil-less farming. Despite the rise within the constituent cost of soilless culture, however the massive quantity of production offset this value in an exceedingly short time. As it has a good potential the selection of soil-less cultivation techniques that are simple, convenient, low in investment, low in cost and good in application will greatly promote soil-less cultivation techniques in practice.

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Health Benefits of Egg Plant

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Introduction - Brinjal

Scientific name: *Solanum melongena*

Brinjals, also referred to as eggplants, belong to the same family (Solanaceae). The plant flourishes in hot climates, but cannot tolerate drought. Brinjals are sensitive to cold weather and are damaged easily by frost. Because of the crop's high yield, only a few plants (6) are needed to feed a family. Brinjals are low in calories, contain mostly water with some protein, fibre and carbohydrates and no fats.

Vegetables are commonly known as "Protective food" as they supply essential amino acids, nutrients and vitamins to the human body and also fight against several diseases like diabetes, hypertension, cancer, which are associated with ageing by supplying antioxidants. Among these vegetables, brinjal or aubergine or eggplant [Solanum melongena L.] is an important vegetable crop growing mainly in Asian, European and African countries. Eggplant is mainly cultivated for its immature fruits consumed as a vegetable. Fruits are widely used in various culinary preparations viz., sliced baji, stuffed curry, bartha, chutney, pickles, etc. Eggplant fruit is reported to be a rich source of ascorbic acid and phenolics, both of which are powerful antioxidants. Presence of phenolic compounds like Caffeic, p-coumaric, ferulic, gallic, protocatechuic and p-hydroxybenzoic acids (Kowalski and Kowalski, 10) and anthocyanin compounds supply a good amount of antioxidants to the human body (Chanasut and Rattanapanone, 1) They help in binding of the free ion radicals, thereby, protects the body tissues from damage and ageing associated diseases like cancer, rheumatism and heart attack.

Nutrient Facts

1. For 100 gms of Brinjal.
2. Calories – 25.
3. Fat - 0.2 gms.
4. Sodium – 2 mg.
5. Potassium – 229m g.
6. Carbohydrate – 6gm.
7. Protein – 1 g.

8. Vitamin A- 0%.
9. Vitamin C – 3%.
10. Vitamin B-6 -5%.
11. Calcium – 0%.
12. Iron – 1%.
13. Magnesium – 3%.

Health Benefits of Egg Plant

Except for the nutritional and agricultural importance of eggplant, it has also numerous quantities of therapeutic benefits. Various research shows that the eggplant extracts have superb healing effects on different disorders like burns, warts, inflammatory infections, gastritis, stomatitis and arthritis (Im et al., 2016).

Eggplant is producing a widespread choice of various secondary metabolites along with some other compounds such as glycol-alkaloids, antioxidant compounds, and vitamins which carried a significant part in keeping good health. For example, a major phenolic compound chlorogenic acid (5-O-caffeoyl-quinic acid; CGA), found in fruit skin (Prohens et al., 2013) which work as an anti-obesity, anti-inflammatory, anti-diabetic agent and also have cardio-protective functions (Plazas et al., 2013).

A research conducted by Afshari et al., (2016) proved that extracts from brinjal have an extra toxic result on cancer cells than on normal cells. Chlorogenic acid also shows anticarcinogenic functions by making apoptosis in many human cancer cells, such as leukemia and lung cancer cells (Tajik et al., 2017). Eggplant also shown an effective action against various bacteria like Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Vibrio cholerae, Pseudomonas sp. and B. cereus (Ahmed et al., 2016). Eggplants are the rich source of anthocyanin compounds, besides their coloring functions.

It has been known that anthocyanin has significant role against diabetes, neuronal problems, cardiovascular disorders, and cancer as well. Purple eggplant has a high amount of nasunin compound in their flesh that consumption of such purple eggplant helps against lipid peroxidation and ROS accumulation which occur due to a high level of iron in cells (Casati et al., 2016).

Anthocyanins present in the skin of eggplant rise serum antioxidant volume and support against heart illness and hyperlipidemia by decreasing LDL (low-density lipoprotein) oxidation. Anthocyanin in peels of brinjal seems vital part in stopping overweightness by plummeting serum triglyceride and cholesterol and increasing high-density lipoprotein (HDL) cholesterol and decreasing serum triglyceride level (Seeram et al., 2001). Moreover, they are also helpful in ulcer treatment and vision (Yousuf et al., 2016, Ghosh and Konishi, 2007).

As carotenoids cannot be synthesized by our body, they should be taken in our diet. Carotenoid-rich foods consumptions strongly related through reducing the hazard of some types of cancer (Linnewiel-Hermoni et al., 2015). Vitamin A deficiency is one of the major problems for school-age children mostly in developing countries. Carotenoid-rich eggplant diet can reduce this problem in such countries (Kamga et al., 2013).

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Role of Micronutrients in Plant Nutrition

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Introduction

Micronutrients are essential elements that are used by plants in small quantities. Yield and quality of agricultural products increased with micronutrients application, therefore human and animal health is protected with feed of enrichment plant materials. Each essential element only when can perform its role in plant nutrition properly that other necessary elements are available in balanced ratios for plant. Divalent manganese ions (Mn^{2+}) is converted to Mn^{3+} or Mn^{4+} easily, therefore in the plant manganese plays an important role on oxidation and reduction processes, as electron transport in photosynthesis. Manganese deficiency has very serious effects on non-structural carbohydrates, and roots carbohydrates especially. Crops quality and quantity decreased due to manganese deficiency, and this is due to low fertility of pollen and low in carbohydrates during grain filling. Zinc uptake of soil solution in divalent cations form (Zn^{2+}); in calcareous soils with high pH zinc uptake may be a valence ion form. In the xylem routes zinc is transmitted to divalent form or with organic acids bond. In the phloem sap zinc makes up complex with organic acids with low molecular weight, and increases its concentration. Zinc deficiency can be seen in eroded, calcareous and weathering acidic soils. Zinc deficiency is often accompanied with iron deficiency in calcareous soils (Millaleo *et al*, 2010).

Role of Micronutrients

1. Zinc (Zn): Zinc is a divalent cation (Zn^{++}) that does not undergo valence changes and therefore has no redox activity in plants. High concentrations of other divalent cations such as Ca^{++} inhibit zinc uptake. Zinc acts either as a metal component of enzymes or as a functional, structural or regulatory cofactor of a large number of enzymes. Zinc is an essential component of a variety of dehydrogenases, proteinases and peptidases. More than 80 Zn-containing proteins have been reported. The rate of protein synthesis and the protein content of zinc-deficient plants are drastically reduced. The accumulation of amino acids and amides in these plants demonstrates the importance of zinc for protein synthesis. Zinc is an essential component of RNA polymerase and if the zinc is removed, the enzyme is inactivated. Zinc is also a constituent of ribosomes and is essential for their structural integrity. The decrease in protein content of zinc-deficient plants is also the result of enhanced rates of RNA degradation. Higher rates of RNAase activity are a typical feature of zinc deficiency in plants. The deficiency of Zn arises mainly due to alkaline soil pH, calcareousness, low organic matter, exposed sub soil, Zn free fertilizers and flooding induced electrochemical changes, light textured soils, higher soil phosphorous, low soil temperature and soils containing low amount of zinc (Epstein and Bloom, 2005).

2. Iron (Fe): Iron (Fe) is required for the formation of chlorophyll in plant cells. It serves as an activator for biochemical processes such as respiration, photosynthesis and symbiotic nitrogen fixation. Iron deficiency can be induced by high levels of manganese or high lime content in soils. Iron is taken up by plants as ferrous (Fe^{2+}) or ferric (Fe^{3+}) ions. The function of iron in plants depends on the ready transitions between its two oxidation states in solution. Plants store iron as ferritin, a protein that encapsulates ferric iron. Under aerobic soil conditions, iron is largely insoluble as a constituent of oxides and hydroxides. Ferric iron tends to be tied up in organic chelates. Hence, the concentration of free iron in the soil solution is exceedingly low in many soils. Plants have mechanisms to mobilize iron and make it available for absorption by their roots (Epstein and Bloom, 2005).

3. Manganese (Mn): Manganese serves as an activator for enzymes in growth processes. It assists iron in chlorophyll formation. It is part of the system where water is split and oxygen gas is liberated. The splitting of water is an oxidation, namely $2H_2O \rightarrow O_2 + 4H^+ + 4\ e^-$. The other protein in which manganese is an integral constituent is the manganese-containing superoxide dismutase. This enzyme is widespread in aerobic organisms. The function of this enzyme is to provide protection from free oxygen radicals formed when O_2 receives a single electron. Superoxide dismutases convert this highly toxic free radical into hydrogen peroxide (H_2O_2) which is subsequently broken down to water. High manganese concentration may induce iron deficiency. Manganese uptake is primarily in the form of Mn^{++} (Epstein and Bloom, 2005).

4. Copper (Cu): Copper (Cu) is a plant micronutrient and an important component of several enzymes and coenzymes involved in metablic pathways of plants. At high concentrations, Cu can become phytotoxic affecting plant development due to direct or indirect interference with numerous physiological processes. Cu may affect species differently and it can cause various effects depending on the plant growth stage at which the metal was applied, the concentration of Cu, and the duration of action. Copper accumulation in soils can be the result of natural soil properties, agricultural practices, like the use of Cu-containing fertilizers, organic residues, sewage sludge, fungicides and bactericides. Copper can catalyse the formation of harmful free radicals, such as the hydroxyl and superoxide radicals. Thus, the main effect of phytotoxic amounts of Cu is the induction of oxidative stress, which can cause changes in metabolic pathways as a defence mechanism that results in differential responses of enzymes in plant parts (Epstein and Bloom, 2005).

5. Boron (B): Boron is absorbed by the plants mainly as boric acid (H_3BO_3). However, it can also be absorbed in some of its anionic forms, viz. dihydrogen borate ($H_2BO_3^-$), mono hydrogen borate (HBO_3^{2-}) and borate (BO^{3-}). Boron is neither a constituent of enzymes nor it activates any of the enzymes. It is responsible for the cell wall formation and stabilization, lignification and xylem differentiation. It imparts drought tolerance to the crops, plays a role in pollen germination and pollen tube growth. It facilitates transport of K in guard cells as well as stomatal regulation (Epstein and Bloom, 2005).

6. Molybdenum (Mo): Molybdenum is involved in enzyme systems relating to nitrogen fixation by bacteria growing symbiotically with legumes. Nitrogen metabolism, protein synthesis and metabolism are also affected by molybdenum. Molybdenum has a significant effect on pollen formation, so fruit and grain formation are affected in molybdenum-deficient plants. Because molybdenum requirements are so low, most plant species do not exhibit molybdenum-deficiency symptoms. These deficiency symptoms in legumes are mainly exhibited as nitrogen-deficiency symptoms because of the primary role of molybdenum in nitrogen fixation. Unlike the other micronutrients, molybdenum-deficiency symptoms are not confined mainly to the youngest leaves because molybdenum is mobile in plants. The characteristic molybdenum deficiency symptom in some vegetable crops is irregular leaf blade formation known as whiptail, but interveinal mottling and marginal chlorosis of older leaves also have been observed. Molybdenum uptake by plants increases with increased soil pH, which is opposite that of the other micronutrients. Molybdenum deficiencies in legumes may be corrected by liming acid soils rather than by molybdenum applications. However, seed treatment with molybdenum sources may be more economical than liming in some areas.

Conclusion

Micronutrients required in smaller quantities, but essentials for increase in yield as well as quality of agricultural produce.

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Combinational Effect of am Fungi and PGPR for the Management Wilt Disease in Tomato

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Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most cultivated and popular vegetable crops across the world (Pastor *et. al.,* 2012). It belongs to the *Solanaceae* family and it is the most important vegetable after Potato. It is used as a fresh vegetable and can also be processed and canned as a paste, juice, sauce, powder or as a whole. Tomato grows well in a relatively cool and dry climate; it is well adapted to all climatic zones around the globe. Tomato is used for consumption due to its high nutritive values, antioxidant and curative properties and it contains Vitamin A, Vitamin C and Vitamin E with 95.3% of Water, 0.07% Calcium and Niacin which have great importance in metabolic activities of humans.

Tomato plants are susceptible to various diseases caused by different agents such as Bacteria, Viruses, Nematode, Fungi and Abiotic factors. Among the fungal diseases, *Fusarium* wilt is caused by *Fusarium oxysporum* f.sp. *lycopersici* and it causes economic loss of tomato production in worldwide. *F. oxysporum* f.sp. *lycopersici* is a soil borne pathogen, persists in soil for about 8-10 years in the form of chlamydospores as resting structure (Prachi singh *et. al.,* 2019).The fungus *F. oxysporum* f.sp. *lycopersici* is exerting pressure on production losses between 30 to 40% and may even raise up to 80% if so, climatic conditions favour the growth of the fungus (Nirmaladevi, 2016).

Arbuscular mycorrhizal fungi (AM fungi) are enormously present in the soil and roots. Their association to the plants is one of the well-known symbiosis in the Earth that link the roots and soil. AMF compete with plant pathogens for nutrients and space, by producing antibiotics, by parasitizing pathogens, or by inducing resistance in the host plants, these microbes have been used for biocontrol of pathogens.

Many of the PGPR strains produced active metabolites that are inhibitory to pathogen and suppress their growth. Isolates of *Pseudomonas* spp. and *Bacillus* spp. recovered from tomato rhizosphere were positive for HCN production which are able to control *Fusarium* wilt of tomato caused by *Fusarium* sp. AM fungi and PGPR are the encapsulated members of Rhizosphere and considered to be an effective symbionts by protecting the plants from root rot pathogens simultaneously increasing plant growth and imparting plant tolerance to various stress factors.

Yield Losses

Fusarium wilt is one of the most important constraint to tomato (*Solanum lycopersicum* L.*) production in major tomato growing areas in the world. That results were* reported 10-90% losses in yield of tomato in temperate. *Fusarium* wilt causes 90% of crop losses with repeated infections especially in the same growing season in greenhouses. Wilt of tomato is a serious and increasing threat disease, causing 25 - 47 per cent losses in Uttar Pradesh and 60-70 per cent yield loss in Bangladesh.

Pathogen

Fusarium oxysporum f.sp. *lycopersici* is a soil borne pathogen with high level of host specificity. There are more than 120 described formae speciales and races within the species. The pathogen produces three types of asexual spores *viz*., microconidia, macroconidia and chlamydospores. *Fusarium* wilt is a hyphomycetous fungus that inhabits various environments including the phytiosphere, which includes both plant tissues and rhizosphere.

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Epidemiology

F. oxysporum occurs, survives and grown in all the type of soil, but sandy soils are most favourable for growth and development. Infection and disease development in *Fusarium* wilt are favoured by warm soil temperature and low soil moisture. The disease tends to be most severe in sandy soil and generally less in heavier clay soil. This disease affects the tomato grown at warm temperature (28°C) in both greenhouse and field condition (Debbi *et. al.,* 2018). Disease development is favoured by warm temperatures (27–28°C), dry weather, and acidic soil (pH 5–5.6).

Symptoms

Fusarium oxysporum f.sp. *lycopersici* is a soil borne pathogen invade the plants mostly through the wounds in the cortical tissues of roots and also through the wounds on adventitious roots produced on stem. The symptoms of Fusariosis begin with a foliar chlorosis in a region of the plant and as the disease is established, the yellowing is observed in the majority of the plant, causing the wilt and later the death of the plant, without producing fruit or the fruit production is scarce (Baez-Valdez *et. al.,* 2010). The earliest symptoms appear with in 48 h after the entry of the pathogens. In the infected plants the leaves become yellow followed by dropping of leaves which occurs may be on one side of the plant or on both the sides of shoot. The main symptoms of the disease include yellowing of lower leaves, browning of vascular tissues, wilting of plant, stunting and eventually death.

Symptoms of Fusarium wilt

Vascular discoloration

Yellowing of leaves

Management

Arbuscular mycorrhizal fungi (AMF) are ubiquitous soil fungi, endophytic, biotrophic, form mutualistic symbiosis with a majority of terrestrial plant species (Sangeeta *et. al.,* 2015) and it have a widespread occurrence in the plant kingdom with many benefits to planting growth, where the host receives mineral nutrients while the fungus obtains photosynthates. Different mechanisms have been shown to play a role in plant protection by AM fungi namely: (I) enhancement of plant nutrition, (ii) competition with the pathogen for resources and space, (iii) plant morphological changes and barrier formation, (iv) changes in biochemical compounds related with plant response, (v) alleviation of physical stresses, and (vi) changes in antagonist and/ or deleterious microbe populations in the mycorrhizosphere. The PGPR are antagonistic against phytopathogenic microorganisms by producing siderophores, antibiotics, chitinase, β-1, 3 glucanase and Hydrogen cyanide (HCN). These bacteria are involved in solubilization of phosphate, inducing systematic resistance in host system to fight against a wide range of phytopathogens, and withstanding abiotic stresses. *B. subtilis* also produces a variety of biologically active compounds with a broad spectrum of activities towards phytopathogens and that are able to induce host systemic resistance.

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Conclusion

Combined application of *G. mosseae* (10kgs / ha)+ *P. fluorescens* + *B. subtilis* as seed treatment (10.0g / kg of seeds) + seedling root dip (20.0g/litre of water) + soil application (2.5kgs/ ha), gave the best disease control. The plant height was remarkably increased and yield per ha also reached higher level.

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Problem in Dryland Agriculture and Management

Article ID: 32029

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Introduction

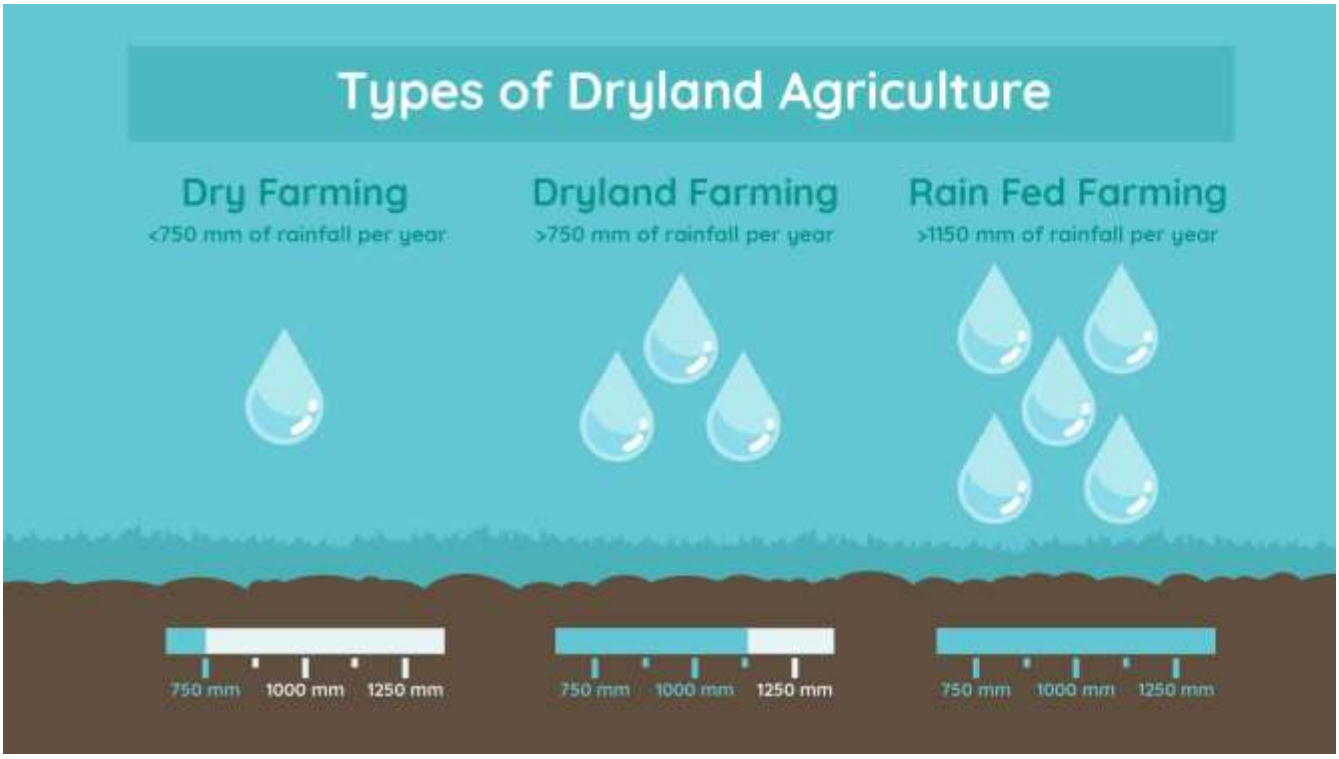
Dry land agriculture is the agriculture which restricts the crop growth to the most piece of the land of the year because of absence of adequate soil moisture (Peterson et al., 2006). In India 68 percent of the developed goes under dry land, which contributes around 44 percent of the all-out food production. Because of low chances and higher populace of landless and rural workers just as little territories land and work profitability, neediness is amassed in dry land agriculture. Dry lands regions which get precipitation running from 375 mm to 1125 mm and with constrained water system offices. Dry districts are helpless soil ripeness alongside various supplement lacks, low water holding limits and draining ground water table adds to low crop yields. So as to guarantee long haul manageability in dry land agriculture in India, different parts are needing a lot nearer consideration like water shed turn of events, improvement of downpour water use effectiveness, financial assets, crop animals farming framework and incorporated soil–supplement water-crop the executives.

Importance in Dryland Agriculture

In our country, irrigated area constitutes 33% and 67% is dry land and rainfed, out.8 million hectares of cultivated land. Total cropped area is 187.94 mha. Such dry land agriculture contributes about 44% of national food grain production. The maximum irrigated area will be achieved 50% after the full utilization of all sources of irrigation. In this way 50% cultivated area will remain unirrigated. After full exploitation of dry land, it may contribute up to 75% of total food grain production (Arun Katyayan.2009).

Types of Dryland Agriculture

Dry land agriculture might be arranged into three gatherings based on yearly precipitation.



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Dry Farming

Development of crops in area where yearly precipitation is under 750 mm and crop disappointments because of delayed droughts during crop period are generally normal. Dry farming is drilled in parched districts with the assistance of dampness conservation rehearses. Exchange land use framework is proposed in this locale.

Dry Land Farming

Development of crops in territories where yearly precipitation is in excess of 750 mm however under 1150 mm is called Dry land farming. Droughts may happen; however, crop disappointments are less continuous. Higher Evapotranspiration than the absolute precipitation is the principle purpose behind dampness shortfall in these territories .The dirt and dampness conservation measures is the key for dry land farming practices in semi-dry areas. Seepage office might be required particularly in dark soils.

Rainfed Farming

Means development of crops in areas where yearly precipitation is more than 1150mm. There is less odds of crop disappointments because of droughts. There is sufficient precipitation and seepage turns into the significant issue in downpour took care of farming. This farming is drilled in of 143humid locales.

Issue in Dry Land Agriculture

1. Dampness stress and unsure precipitation.
2. Helpless soil fruitfulness alongside different supplement insufficiencies.
3. Low water holding limits of soil.
4. Removal of dry farming produce.
5. Utilization of constrained crop assortment.
6. Second rate nature of homestead produce.

Dry Land Farming Procedures

1. Mulches: Up to 75% of the precipitation is lost through vanishing. Those misfortunes can be diminished by applying a few sorts of mulches. Mulching alludes to the different materials that are applied to the dirt surface to lessen vanishing and improve soil water. Applying mulches prompts extra advantages like soil conservation, balance of temperature, decrease in soil saltiness just as weed control and general improvement of soil structure.

There are a couple of kinds of mulches that can be utilized for an assortment of natural conditions. On the off chance that the dirt surface is released, it goes about as soil or residue mulch to lessen dissipation. For instance, soil mulch can be made through intercropping.

Figure- 1 Stubble mulch

Kinds of mulches:

a. Stubble mulch.
b. Soil mulch or dust mulch.
c. Stone mulch.
d. Plastic mulch.
e. Vertical mulching.

Figure- 2 Plastic mulch

2. Wind breaks and shelterbelts: Wind breaks are for the most part structures or structures that discourage the progression of wind and diminish wind speed. Asylum belts are lines of trees planted to shield plants from the breeze. Because of decrease in wind speed, dissipation misfortunes are diminished and more water is accessible for plants. Moreover, shelterbelts diminish wind disintegration.

3. Weed control: Since weeds contend with crops for restricted soil dampness, routinely weeding is the most valuable measure to diminish happening misfortunes. Consequently, it is suggested that weed control be done in a timely and normal way to dispose of this opposition and to give crops the greatest degree of accessible dampness.

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Need of Processing Guava

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Guava (Psidium guajava) is a fruit grown in tropical and sub-tropical regions. It belongs to the family Myrtaceae and originated from Mexico. It is called as "apple of the tropics" because it has nutritional composition almost similar to apple. Total area for guava cultivation in India is 268,000 ha while the production is 3,97,000MT while only 123000MT (worth Rupees 553.26lakh) is exported. It is a climacteric fruit, so it is extremely perishable. It is available during July- August and February-March. The shelf life at room temperature is 10 days and 20 days at refrigerated temperature. The contribution of food processing industries to the country's GDP has increased from 1.3 to 1.5 in 2012. So there arise a need to store it longer or processed into a stable product so that the utility of this beneficial fruit is available to the consumers before it is lost due to improper planning for storage and processing.

Nutritional composition of guava consists of 5.4g fibre, 11mg phosphorus, 417mg potassium, 0.73mg vitamin E, 2.2mg Magnesium,624IU vitamin A, 228.3mg vitamin C per 100g fruit. Since guava fruit is cheap compared to apple, it is also known as common man's fruit. Therefore, the fruit can be considered as a highly valuable. Since India is having good production of guava fresh fruit with short shelf life in room condition, there is huge loss after harvest before reaching the consumer or due to glut production with lack of storage facility for the farmers. If the fresh produce which is not marketed could be processed into other forms, the shelf life will be extended and the return will be more preventing the post-harvest loss.

There are many values added products which can be processed from guava viz: Guava jam, jelly, juice, squash, toffee.

Guava squash

Guava Squash is prepared after selecting ripe fruits, wash with chlorinated water. Juice is extracted in screw type juice extractor, basket press or fruit pulper. The juice is clarified using different methods. Fortification may be done by addition of ascorbic acid or beta carotene with addition of some acid. Sweetening is done by addition of sugar syrup or direct addition of sugar which is then homogenised with pasteurisation and bottled.

Guava Leather

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Guava leather is a product not widely common to the consumers though it is very nutritious. It is prepared from guava pulp mixed with 5% salt smeared on aluminium or stainless-steel trays and spread it in thin layer which is to be dried in hot air oven at 50 degree Celsius for 8-10 hours after which the 2-3 layers are pressed together and dried again. They are cut into desirable shapes and sizes which is wrapped in a metalized polyester wrapper.

Guava jam, one of the famous fruit jams, is also prepared from guava pulp with a high concentration of sugar (750gm/kg fruit pulp) and boiled to a thick consistency. Citric acid is added at concentration of 3g/kg pulp which is to be boiled till it reaches temperature of 105-degree Celsius which is then filled hot in sterilised jar. Guava is also prepared with the same procedure but instead of guava pulp, clear strained guava juice is used for the preparation of jelly.

Guava RTS (Ready-to-serve) beverages with 10% guava pulp mixed with syrup containing 11%TSS, 0.25% acidity and 70ppm SO_2 and bottled followed by pasteurisation.

Guava cheese is prepared from ripe fruit after washing and cutting which is later boiled in water with addition of citric acid (3g) followed by removal of skin and skin. Sugar @1.25kg/litre pulp is added and boiled to a desired thick consistency which is then transfer to a tray smeared with butter and allowed to cool overnight which is then cut into suitable sizes and wrapped in cellophane paper.

Frozen guava is made from ripe fruit after washing and boiling in 2%lye solution till skin becomes black which is then removed and washed with water and again dipped in 0.5% citric acid solution and cut into four pieces and scooped the seeds which are then packed in polybags with25% sugar syrup as covering liquid and sealed to freeze at -40degree Celsius and stored at -20 degree Celsius.

Guava jam

Guava jelly

Guava RTS

Guava cheese

Frozen Guava pulp

Frozen Guava slice

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Conclusion

Since guava is a crop which is available in cheap price but nutritionally similar to apple, it would be a substitute for apple for those section of population which cannot afford apples. Since it is very perishable, it could be processed into different processed products to add variety to the fruit products as well as provide a profitable return for processors providing a good scope for young unemployed youths which will ultimately contribute to the economic growth.

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Biofertilizers Towards Sustainable Agriculture and Environment Development

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Introduction

Biofertilizers used in integrated nutrient management are considered eco-friendly, cost effective and renewable source of non-bulky, low cost plant supplementing organic fertiliser. Biofertilizers are prepared by inoculating living or latent cells of efficient strains of microorganisms, with the purpose of enhancing crop nutrient uptake and crop production by their interactions in rhizosphere when applied through seed treatment or soil application. They increase plant nutrient supply in a sustainable or eco-friendly manner. They accelerate certain microbial processes going on in the soil which in turn augment the extent of availability of nutrients in a form easily assimilated by plants. Technically, biofertilizers are considered as any plant extract, composted rural or urban wastes, and several microbial mixtures which act as inexpensive source of plant nutrients. In terms of agricultural significance biofertilizers can be composed of efficient microbial strains that by their interactions in rhizosphere, benefit plants by nutrients uptake. Biofertilizers basically refers to combination of selected strains of beneficial soil microorganisms cultured in the laboratory in association with a suitable carrier. They can be used either in the form of seed treatment or soil application. Therefore, biofertilizer can be considered as a natural input that that can be applied as a complement to, or as a substituent of chemical fertiliser in sustainable agriculture (Ebrahimpour et al., 2011).

Types of Biofertilizers

1. Nitrogen-fixing Biofertilizers: Certain microorganisms present in the soil have a unique capacity of fixing atmospheric nitrogen considerable. This property allows for the efficient plant uptake of the fixed nitrogen and reduces losses due to denitrification, leaching and volatilization from the soil. These microbes can be further classified into:

a. Free living nitrogen fixers: Example- *Anabaena, Azotobacter, Klebsiella, Nostoc, Rhodospirillum, Clostridium, Chromatium*, etc.

b. Symbiotic nitrogen fixers: Having symbiotic and other endophytic associations with plants. Example- *Rhizobium, Bradyrhizobium, Sinorhizobium, Frankia, Anabaena azollae,* etc.

c. Associative nitrogen fixers: These nitrogen fixing microbes have less intimate association with roots in comparison with symbiotic microbes. Example- *Azospirillum sp., Acetobacter diazotrophicus, Alcaligenes, Bacillus, Enterobacter, Pseudomonas*.

2. Phosphate Solubilizing Biofertilizers (PSB): Many microbes have the capacity to solubilize insoluble forms of phosphates into plant available forms. Example-Phosphorus solubilizing bacteria (PSB) like *Bacillus* and *Pseudomonas* and certain soil fungus like *Aspergillus, Penicillium*.

3. Mycorrhizal Biofertilizers: They facilitate solubilization and mobilization of phosphorus. Example- Arbuscular mycorrhiza, ectomycorrhiza, ericoid mycorrhiza, orchid mycorrhiza.

4. Plant growth promoting Biofertilizers: Example- *Pseudomonas fluorescens, P. aeruginosa.*

5. Other Mineral-Solubilizing Biofertilizers: Used to provide various nutrients other than Nitrogen and Phosphorus such as Potassium, Zinc, Iron and Copper. Example- *Bacillus edaphicus, Paenibacillus glucanolyticus*, etc.

Benefits of Biofertilizers in Agriculture

1. Low cost and easy application technique: Biofertilizers are cost effective source of nutrients in comparison of chemical fertilizers. They differ from chemical and organic fertilizers because they don't directly supply any nutrients to crops and constitute cultures of special bacteria and fungi with relatively low installation cost. They have lower manufacturing and reduced use costs, especially regarding Nitrogen and Phosphorus use. The way of its application is easy and consumes smaller amounts of energy.

2. Provision of Nitrogen and several growth hormones: Nitrogen fixing microorganisms play an important role in nitrogen supply by converting atmosphere nitrogen into plant usable forms which can contribute to a decrease in the nitrogen fertilizer application and reduction of environmental risks. In addition to this, they have the ability to synthesize and secrete considerable amounts of biologically active substances such as vitamins like thiamine, riboflavin, biotin, etc. which can help in modification of the nutrient uptake by the plants. Some microbes also produce plant growth hormones heteroxins, gibberellins.

3. Reduce atmospheric pollution but increase soil fertility: The use of biofertilizer alleviates the problem of environmental pollution by reduction of excessive use of chemical fertilization. Thus, their use in organic farming contribute to implementation of healthy environmental policies at regional, national and global level. Continuous use of biofertilizers enables build-up of the microbial population in the soil on a long-term basis and helps in maintaining soil fertility in a sustainable manner.

4. Excretion of antibiotics and acting as pesticides: Biofertilizers enhance antagonistic property in soil through siderophores and antibiotics production by them, and facilitate biological control of phytopathogenic organisms like foliar or rhizosphere pathogenic bacteria, fungi and insects thereby exerting positive effect on soil microbiology.

5. Improvement of soil physical and chemical properties: Biofertilizers especially mychorhiza improve soil structure and soil particles aggregation, reduces soil compaction and increases the pore spaces and water infiltration contributing to better physical conditions of the soil. They contribute towards better tilth ,ensure better soil aeration and water percolation, and reduces soil erosion.

6. Enhance crop yield even under rainfed conditions: Biofertilizers enhances water and nutrient holding capacity of the soil and also increase the drainage and absorption of moisture in poor structured soils. They increase drought and moisture stress tolerance in plants. In this way, they increase the crop yield even in conditions having lack of sufficient irrigation water supply.

7. Eco-friendly: Biofertilizers are eco-friendly organic agro-input compared to chemical fertilizers and contribute towards ecological soundness.

Limitations for the Use of Biofertilizers

1. Lack of regulatory acts and facilities for testing the samples: There is lack of technical testing to verify safety of biofertilizers at global scale. There is a need of future research on biofertilization focusing on identifying the options available to overcome the issues and create frameworks for development of eco-friendly practices for improvement of efficiency and consequent supply of product for the global industry.

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2. Insufficient popularization of Biofertilizers and low level of farmer acceptance: biofertilizers have several potential activities still they have not gained sufficient popularity among farmers for adequate acceptance. The lack of awareness of the farmers about the concentration, time, method and efficiency of biofertilizer application compared to the use of conventional inorganic fertilizers is serious limitation of their wide-scale application. In addition to these problems there are several other problems in adoption of bio fertilisers like lack of timely availability of financing, lack of guidance from experts and non-availability of biofertilizers.

3. Possible risks for the safety of consumers and the physicochemical and biological stability of soils: biofertilizers are used in association with manure which could increase the amount of weed flora. The presence of heavy metals (e.g., Mercury, Chromium and Lead) in manures poses a threat due to their carcinogenic potential and their capability of bio-accumulation and bio-magnification in the food chain limiting their usage.

Constraints in Biofertilizer Production Technology

1. Technological constraints:

a. Use of inappropriate and inefficient strains of microorganisms for production
b. Inadequate and inexperienced staff and technically non-qualified personnel
c. Quality of carrier material.
d. Shelf-life of inoculants.

2. Infrastructural constraints:

a. Facilities for production
b. Equipment
c. Laboratory, production, and storage space

3. Financial constraints:

a. Funding
b. Sale returns

4. Physical and environmental constraints:

a. Seasonal demand for biofertilizers.
b. Soil characteristics.
c. Cropping operations.

Future Perspectives of Biofertilizer

Over-application of chemical fertilizers during intensive agricultural practices by farmers has led to excess nutrients accumulation in soils making the soils dead. Therefore nowadays, the production of efficient and sustainable biofertilizer with the purpose of reducing usage of inorganic fertilizer application to avoid further pollution problems, represents major area of research interest.

Therefore, most important attention for research perspective shoaled be given to following points:
1. Selection of effective and competitive multi-functional beneficiary biofertilizers.
2. Quality control systems for production of inoculants and their field application.
3. Study of microbial persistence of biofertilizer in soil environments under stressful conditions.
4. Transferring technological know-how on biofertilizer production to the industrial level.

Conclusion

In recent methods of agricultural practices adopted, biofertilizers form an important component of sustainable organic farming as a viable alternative of chemical fertilizers associated with various environmental hazards. However, an increased awareness and demand of biofertilizers among farmers and planters needs to be created to popularize its usage. Use of biofertilizer in combination with organics is an integral part of sustainable agriculture, therefore it must be suitable according to social and infrastructural situations of the farmers. Use of bio fertilisers technology must be economically feasible and viable, renewable, equally applicable, adaptable to existing local conditions and acceptable by various cultural patterns of society, practically implementable and productive.

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Hydroponics: A New Approach for Agriculture Development

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Introduction

In present era the hydroponic cultivation is gaining popularity all over the world because of efficient resources management and quality production of food grains and plant material. Soil based agriculture is now facing various challenges such as shrinking of land, urbanization, natural disaster, climate change, indiscriminate use of chemicals and pesticides which is depleting the land fertility. Important countries in hydroponic are Netherland, Australia and France. Julius von Sachs in1860 was confirmed for the first time that plants could be grow in a distinct nutrient solution in complete absence of soil and he was a prominent German botanist. The term Hydroponics was derived from the Greek words' hydro' means water and ponos' means labour and accurately means water work. This technique or method of growing crop in a nutrient solution with or without the use of an inert medium such as gravel, vermiculite, rock wool, peat moss, saw dust, coir dust, coconut fibre, etc. to provide mechanical support is known as hydroponics. Hydroponics has been successfully working as a technique for the commercial production of vegetables and fruit such as tomato, seedless cucumber, Strawberry, capsicum, cannabis, herbs and lettuce. Maximum hydroponic systems work automatically to control the amount of water and nutrients based on the necessities of different crops. The nutrients used in hydroponic cultivation can come from various sources viz including fish excrement, duck manure, purchased chemical fertilizers or artificial nutrient solutions of major and minor nutrients. Hydroponics can be retrieved on several kinds of spaces such as balconies, roofs and greenhouses suitable for cultivation. Such kinds of agriculture operate under control conditions in order to obtain higher production of fresh and healthy crop in urban areas and also good amount of income.

Basic Type of Hydroponic Systems and How they Work

There are six basic types of hydroponic systems; Wick, Water Culture, Ebb and Flow (Flood & Drain), Drip (recovery or non-recovery), N.F.T. (Nutrient Film Technique) and Aeroponic.

1. Wick system: The wick system six types of hydroponic. That's because traditionally it doesn't have any moving parts, thus it doesn't use any pumps, aerators and electricity. Plants are engaged in an absorbent medium like coco coir, vermiculite, perlite with a nylon wick running from plant roots into a reservoir of nutrient solution. Nutrient solution delivered to plants through capillary action. This system works well for small plants, herbs and spice.

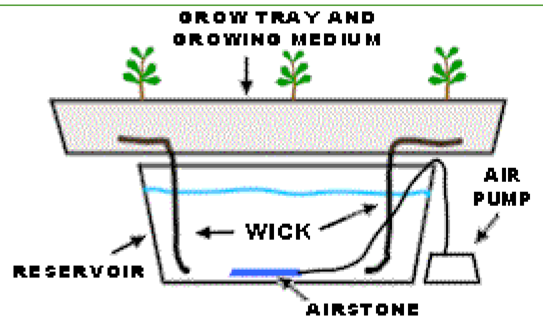

Fig- Wick system

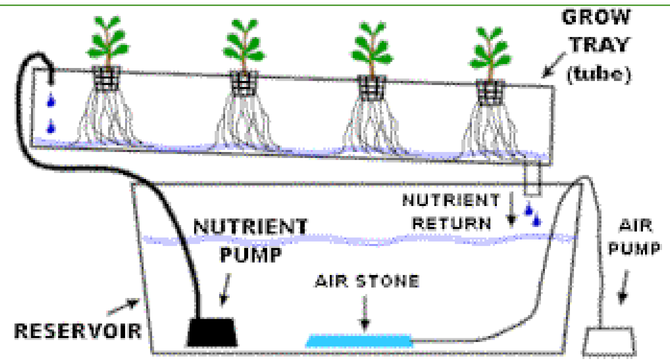

Fig- Nutrient Film Technique

2. Drip system: Drip systems are the extensively used hydroponic systems in the world. This method widely used by home and commercial growers. Drip systems provide adequate aeration to the plant because plants

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root is never totally submerged in nutrient solution but are never permissible to dry out of plant roots. Nutrient solution from the reservoir is provided to individual plant roots in appropriate proportion with the help of pump.

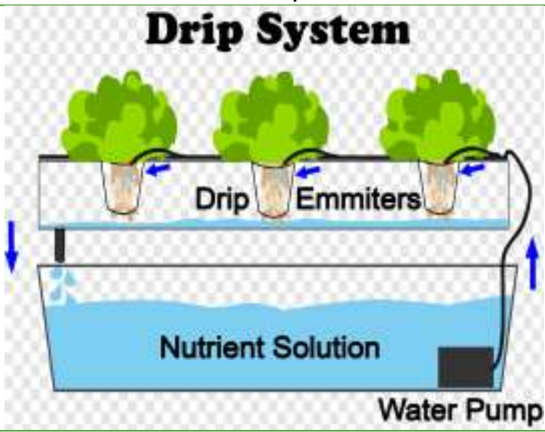

Fig- Drip systems

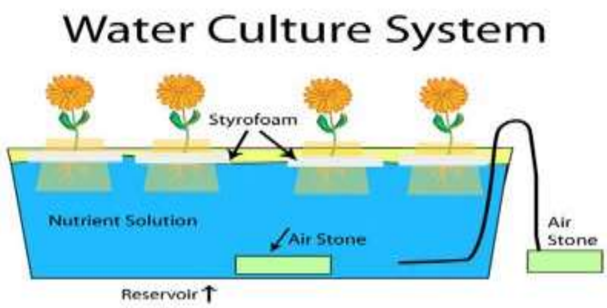

Fig- Water Culture

3. Nutrient Film Technique (N.F.T.): Nutrient film technique hydroponic systems are most productive compare to other systems. They are most selected method for commercial production. Plant roots are grown in a light-tight and shallow passage. The nutrient solution is pumped into the growing tray and flows over the roots of the plants and then drains back into the tank. A wide range of vegetables and ornamental crops can be grown in an NFT system.

4. Aeroponic: This is the most high-tech type of hydroponic system. The growing medium is primarily present in the air and the roots hang in the air and misted with nutrient solution. The misting is frequently done every few minutes. Because the roots are exposed to the air, the roots will dry out rapidly if the misting cycles are intermittent. Due the water's constant spread and the action of a high-pressure pump, the levels of oxygen in the water are kept high.

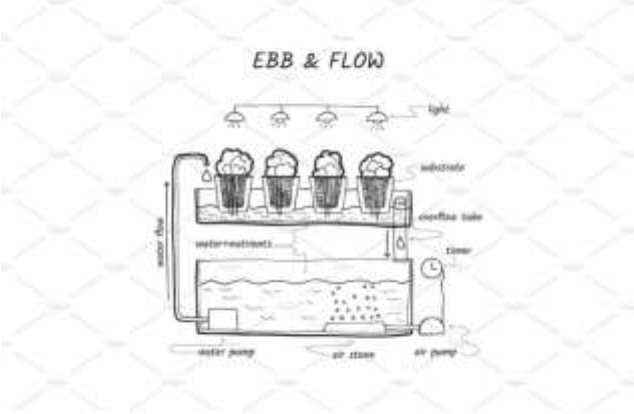

Fig- EBB & Flow

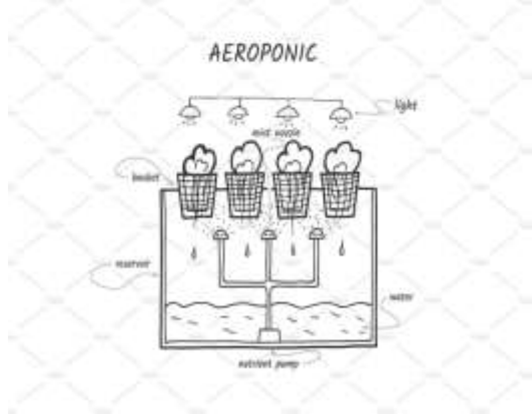

Fig- Aeroponic

5. EBB & FLOW: This is first commercial system of hydroponic, which works on the principle of flood and drain and this is also called flood and drain type. The plants are typically grown-up in pots with their roots maintained by a growing medium.

6. Water Culture: The system holds the plants is floats directly on the nutrient solution. Water culture growing leaf lettuce.

Advantages of Hydroponic Gardening

1. In hydroponics, soil is not necessary for any crop cultivation.
2. Plants grow very faster than other method of cultivation. Specialists advise that plants grow at least 20 per cent faster in hydroponic systems than they do in soil.
3. Hydroponics system of cultivation saves more water other type of farming of crop. Hydroponics system permits plants to take up only the water they need crop for metabolism activity and growth.

4. Better space utilization in this system.
5. Plants grow faster and high yielding.
6. In hydroponic system of cultivation 20 to 25 per cent superior yields are found compared to soil cultivation of crop.
7. This technique is very beneficial for the area where environmental stress (cold, heat, dessert etc.) is a major problem.
8. In hydroponic system crop are not influenced by climate change thus, can be cultivated year-round and considered as off season.
9. Commercial hydroponic systems are mechanically operated and probable to reduce labour and several traditional agricultural practices can be removed, such as weeding, spraying, watering, pests, disease and tilling.
10. The nutrition elements are used as solution forms in truthful quantities as the plant requirements and not in Hugh quantities as in the standard plantation.
11. E.C. and pH of the nutrient solution can be controlled allowing to the requirement of the crop and environmental situations and that is strongly problematic and expensive in the case of normal soil cultures.

Disadvantages of Hydroponic Gardening

1. The initial stage higher capital investment and technical knowledge is basic requirement for commercial scale cultivation.
2. Unavailability of skilled labour.
3. Hydroponics system is distribution the exact same nutrient and water borne diseases can easily and quickly spread from one plant to another plant.
4. Highly water and electricity risks and diseases and pests may spread rapidly.
5. System (Electricity Machine) failures fears and hydroponic are organic debates.

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Detection Techniques for Seed Vigour: An Overview

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Introduction

Seed vigour is defined as 'the sum total of those properties of seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence" (ISTA, 2010). Therefore, estimates of high vigour assures the reliability of good emergence even in less ideal sowing conditions and consequently better field performance of the crop due to successful field establishment of the vigorous seedlings.

Characteristics of a Seed Vigour Test

A vigour test should possess certain characteristics as reported below that can make it useful to the seed producer and consumer.

1. Inexpensive.
2. Rapid.
3. Uncomplicated.
4. Reproducible.
5. Correlated with field performance.

Types of Seed Vigour Tests

Physical tests	Performance tests	Biochemical tests	Stress resistant tests
Seed size	First count	Tetrazolium Test	Accelerated ageing test
1000 Seed weight	Speed of germination	Electrical Conductivity	Temperature stress test (cold and cool test)
Physical soundness	Seedling growth rate	Enzyme test	Osmotic stress test
	Seedling dry weight	Respiration test	Exhaustion test
			Brick gravel test
			Paper piercing test
			Mobilization efficiency

Physical Tests

1. Seed Size: The length, breadth and diameter of seeds can be a factor for deciding vigour of the seed lot. Seeds which are larger than the average seed size of the seed lot have high vigour.
2. Thousand seed weight: Seed lot with higher value computed for thousand seed weight has more vigour.
3. Physical soundness: Fully matured, bold seeds without any crack or damage.

Performance Tests

1. First count: Number of normal seedlings which can be removed on first count of germination test indicates the seed lots vigour. Higher the percentage of normal seedlings in first count day, the better is seed vigour and quality.

2. Speed of germination: Normal seedlings are removed and counted daily, until all seeds capable of producing normal seedlings. An index is computed for each seed lot by dividing the number of normal seedlings removed each day by the day on which they are removed from a minimum of four replications of 100 seeds and by adding the quotients of daily counts divided by the number of days of germination.

3. Seedling growth rate: Seedling lengths are measured after a number of days after planting (DAP) as specified for different crops (e.g. 5 days for rice and maize, 6 days for wheat, 7 days for tobacco and 8 days for cowpea). Seed lot with better seedling length than the average is considered to have higher vigour.

4. Seedling dry weight: Seedlings which are having higher dry weight are considered to have higher vigour.

Biochemical Tests

The biochemical tests which measure some events in seeds associated with germination can be applied to measure seed vigour. These tests require less testing time than the other methods and necessitate more specialized equipment and trained personnel.

1. Tetrazolium test (lakon,1942): The tetrazolium test is based on the measurement of dehydrogenase enzyme activity. The enzyme reduces the colourless tetrazolium chloride salt to form a water soluble red compound farmazon which stains the living cells red, while the dead cells remain colourless.

2. Electrical Conductivity test (Perry,1984): The resistance of seed to electrical conductance is measured and correlated with vigour. Poor membrane structure and leaky cells are usually associated with low vigour seeds. These would results in a greater loss of electrolytes such as amino acids and organic acids from imbibing seed and increase the conductivity of the leachates. The conductivity test is based on the concept that when seeds are soaked in water, low vigour seeds release more electrolytes into the solution than do high vigour seeds. When the same seeds are planted in soil, electrolytes probably provided food material for the soil fungi, which in turn leads to seed decay and poor stand establishment.

To perform the test, seeds are soaked in container of distilled or deionized water for a standardized time period. The conductivity of seed leachate is measured by a meter. High conductivity values indicate low vigour. In the methods prescribed by ISTA (2010) conductivity readings are made on quantities of 50 or more seeds. Such readings indicate the average conductivity value of the lots but do not indicate the percentage of low and high vigour seeds.

Closely related to conductivity tests are calorimetric tests for proteins and sugars. One important limitation of this test is, it expresses the result as an average for a number of seeds, which presumes that all seeds are equally deteriorated. A seed lot is however, composed of population of individuals each with its own unique potential to perform in the field. Conductivity test results therefore would better reflect vigour capability of seed lots, if they are presented on individual basis.

3. Enzyme test (Grabe,1964): During germination, the proteins are hydrolysed into amino acids by proteolytic enzyme. Amino acid decarboxylases are widely distributed in seeds. Glutamic acid decarboxylase (GADA) activity is particularly important in seed germination as glutamic acid comprises a high percentage of total amino acids in seeds. GADA is normally measured by the amount of CO_2 produced in the presence of glutamic acid. The greater the enzyme acitivity, the greater is the vigour.

4. Respiration test (Agrawal and Dadlani,1987): Seed germination and seedling growth require use of metabolic energy acquired from respiration of germinating seeds has been showed to precede a decrease in the rate of seedling growth. Respiration rate measured during the first few hours of imbibitions has been shown to be correlated with subsequent growth of seedlings of many crops. Respiration rates, therefore, may provide useful information regarding physiological condition of seeds. Respiration tests are quantitative but require a respirometer and trained personnel. The mechanical injury lowers the seed vigour, may increase rather than decrease respiration rates.

Stress Tests

1. Accelerated ageing test: Seeds are exposed at 40° to $50^{\circ}C$ at 100% Relative Humidity for 2 to 8 days and sown for regular germination test in laboratory. Seed lot showing good germination even after such rigorous ageing test has high vigour and capacity to perform well under field conditions.

2. Temperature stress test (cold and cool test): Cold and cool germination tests are commonly used for vigour assessment.

a. Cold Test (Fiala,1981): It is stimulating early spring in field conditions. The cold test is one of the oldest method of stressing seeds and most often employed for evaluating seed vigour. In corn and soybean seeds are placed in soil or paper towel and exposed to cold for a specific period during which stress from imbibitions, temperature and micro organisms occur. Following the cold treatment the seeds are placed under favourable growth conditions and allowed to germinate.

b. Cool test: This test was developed for the vigour evaluation of cotton. Seeds are germinated in darkness at a constant temperature of 180C for 7 days. The influence of low temperature on germinating cotton seed might also induce radicle injury, a lower rate of hypocotyls elongation. Cotton seedlings having a total length of 4 cm or longer after seven days of germination are considered as high vigour seedlings.

3. Osmotic stress test (Parmar and Moore,1968): Seeds are germinated in high molecular weight PEG solution with specific osmotic potential. The rate of germination under osmatic conditions is markedly reduced and the emergence of the plumule is generally more affected than that of the radicle since vigourous seeds can tolerate greater osmotic stress.

4. Exhaustion test: The test involves germination and seedling development in complete darkness with carefully regulated amounts of water supply. This test is used for cereal seeds, involves the placement of seeds on a printed line on moist paper towel. The towel is three folded into a roll and placed within a glass container that is covered to prevent evaporation. The tests are kept at 100C for 10 days. Seedlings which have shoots that extends beyond a line space 3.75 cm above the seed placement line and also have roots that extend beyond a line 5 cm below seed placement line and considered to be strong. For cereals, the double layer of towel is moistening initially with 30 cc of water. 50 cc of water is used for corn, bean and peas. No specialized information is added. The additional information gained from this test emphasizes many weaknesses that are not reflected by total germination percentage of the same tests also prevails. The use of specific amounts of water and the printed boundary lines for separating strong from weak seedlings facilates the reading of test.

5. Brick-gravel test (Hiltner and Ihseen,1911): This test was developed for identify vigour potential in seeds. A 2 to 3 cm thick layer of porous type of brick gravel is placed over the seeds sown for germination. In case of small grains, about 30 to 40 mm thick layer of moist gravel is placed above the seeds. Weak, partially diseased, corkscrew type seedling and other defective seedlings or those with injured coleoptiles tips cannot emerge through this layer. The seedlings that emerge through the brick gravels are considered to possess high vigour and are expressed in percentage for comparison of seed lots.

6. Paper piercing test: This test is used in place of brick-gravel test to provide a standard impeding cover above the seeds. It utilizes the regular germination testing method with a special type of paper disc placed over the seeds in such a way that only vigorous seedlings will be able to penetrate. This test is especially suitable for small grains. Seeds of cereals are placed on top of about 1 to 2 cm moist sand, covered with the paper and about 3 cm of moist sand above it and kept at 20°C for 8 days.

7. Mobilization efficiency: Mobilization efficiency test must be performed under complete darkness. It is direct interpretation of overall biochemical and physiological process and seems to be the most accurate index for detecting deterioration thus the loss of viability and vigour in seeds.

$$ME = \frac{\text{Increase in dry weight of embryonic axis (Dry weight of seedlings).}}{\text{Decrease in dry weight of tow cotyledons.}}$$

Conclusion

Seed vigour is one of the significant component of seed quality and acceptable levels are necessary in addition of other seed quality parameters (moisture content, physical and genetic purity, germination and seed health) to obtain optimum plant stand and high production of crops. In future research is needed to further refine the present seed vigour testing methods and to develop new methods which are more rapid and more related to field/storage conditions.

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"Liquorice" - A Potential Plants to Combat Corona Virus

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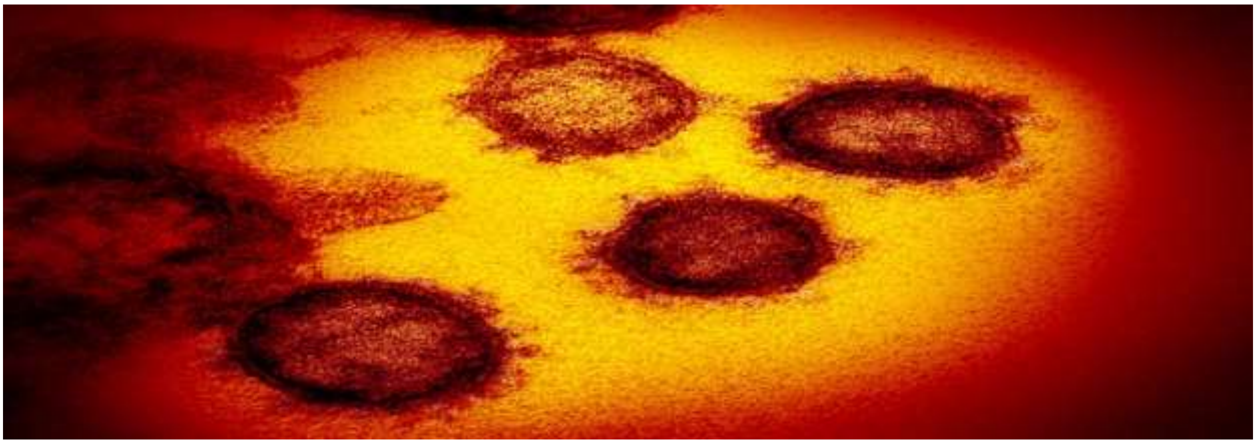
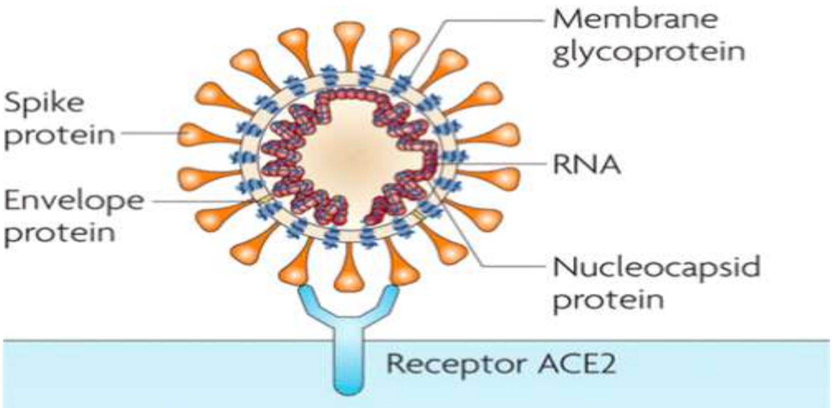
The Covid-19, also known as 2019-nCoV or SARS-CoV-2 virus, belonging to the family of Coronavirus. SARS-CoV-2 belongs to genus β. It is a positive-sense single-stranded RNA (ss-RNA) virus. The main proteins in this virus and those previously identified in SARS-CoV or MERS-CoV exhibit high similarity between them. The novelty of this strain of virus means that there are so many uncertainties surrounding its behaviour, therefore it is too early to determine whether herbal plants or compounds could in fact contribute to society as prophylactic agents or as suitable substances in anti-coronavirus drugs against Covid-19. However, due to Covid-19's high similarity with the previously reported SARS-CoV and MERS-CoV viruses, previous published research on herbal compounds, which have been proven to exert anti-coronavirus effects, may be a valuable guide to finding anti-coronavirus herbal plants, which may be active against the SARS-CoV-2 virus.



Electron microscope images of the corona virus revealed by "The National Institute of Allergy and Infectious Diseases" (NIAID) and "Rocky Mountains Laboratories (RML)".



Structure of SARS-COVID-19

In 2003 after the breakdown of SARS-CoV, scientists have working vigorously to exploit several antiviral compounds against SARS-VoV. The group of experts from china have exploited and screened more than 200 plants and their extracts againt this coronavirus strain. Among these 4 extracts exhibited effect against SARS-CoV. *Lycoris radiata* (Licorice), *Artemisia annua* (Sweet wormwood), *Pyrrosia lingua* (a fern), *Toona sinensis Roem* and *Lindera aggregate* (an aromatic evergreen shrub member of the laurel family). In particular *Lycoris radiata* exhibited the most potent anti-viral activity against the virus strain. Traditional herbs from different geographical areas and environments are considered as a potential new drug for the treatment of viral infections, including those caused by SARS-CoV.

The Glycyrrhizin is an active constituent present in Licorice roots which have been proven to have anti- SARS-Cov activity by inhibiting its multiplication ability. Glycyrrhizin also exhibited antiviral activity when tested for its *in vitro* antiviral effects on 10 different clinical isolates of SARS coronavirus. Lycorine, another constituent of Licorice, demonstrated potent antiviral action against SARS-CoV.3 Several studies suggest that Lycorine have proved to have broad antiviral activities and has been reported to have demonstrated an inhibitory action on the Herpes Simplex virus (type I) and the Poliomyelitis virus.

The saikosaponins is the naturally occurring triterpene glycosides isolated from plant species such as *Bupleurum spp*, *Heteromorpha spp* and *Scrophularia scorodonia*, have proven antiviral activity against HCoV-22E9. These natural compounds prevent effectively in the early stage of HCoV-22E9 infection, including viral attachment and penetration. Natural inhibitors against the SARS-CoV enzymes, include myricetin, scutellarein, and phenolic compounds from *Isatis indigotica* and *Torreya nucifera.* Other anti-corona virus natural medicines include the extract from *Houttuynia cordata* , which has been observed to exhibit several antiviral mechanisms against SARS-CoV.

PEDV (Porocine epidemic diarrhea virus) is an enveloped single stranded RNA virus belonging to coronaviridae after screening of many numbers of plants species it was found that *Camellia japonica*, *Saposhnikovia divaricate* and *Dryoteris crassirhizoma* showed potential action to prevent replication of this virus.

Diterpenoids, sesquiterpenoids, triterpenoids, lignoids and curcumin were shown to inhibit SARS-CoV in the range of 3–10 µM. Betulinic acid and savinin are the natural component which competitively inhibit the SARS-CoV and these components are found in some plant species *Psophocarpus tetragonolobus, Diospyros perigrina, Solanum aviculare, Wormia burbidgei, Lemaireocereus griseus, Dillenia indica and Zizyphus jijiba.*

Since ages Licorice roots has been used in ancient Egyptian medicine, Indian ayurvedic system of medicine and also in traditional Chinese medicine. Liqorice contain a very potent antiviral phytochemicals which has been found by researchers to control SARS CoV. There are about 83 published research papers findings regarding effectiveness of phytochemicals in Licorice roots and SARS virus. Since SARS virus and new corona virus strain a2019-nCov also called as Wuhan Virus show about 84 per cent similarities Licorice can be potentially used as an anti-COVID-19 drug. The **roots of licorice** contain phytochemicals favonoids like Glycyrrhizin, Liquiritigenin, and Glabridin that had antiviral activity against the SARS coronavirus. **Licorice roots contains** especially glycyrrhizic acid and glycyrrhetinic acid that was found to be extremely potent against the **SARS Corona virus.**

Botany

Scientific name: *Glycerrhiza glabra*
Family: Leguminaceae
Origin: Europe and Asia minor
Growth: Perennial
Economic part: Roots, leaves, and rhizomes.

Liquorce plant, stem, and flower

Some of the other effects of licorice root supplementation includes:
1. Absence of a menstrual period.
2. Congestive heart failure.
3. Decreased sexual interest.
4. Erectile dysfunction.
5. Pulmonary edema.
6. Fluid and sodium retention.
7. Headache.
8. High blood pressure.
9. Hypokalemic myopathy.
10. Lethargy.
11. Hypokalemia.
12. Mineralocorticoid effects.
13. Muscle wasting.
14. Myoglobinuria.
15. Paralysis.
16. Edema.
17. Tiredness.
18. Weakness.

Conclusion

There are many research which are still in pipeline and requirement of vaccine for this dangerous SARS-COVID19 is the need for the hour in order to prevent the alarm increase in the spread. Hence through many proven scientific research the plants which are rich source of many phytochemicals which combat this viral strain from multiplication. Among all the above medicinal plants liqorice is available and most commonly found in India and can be potentially used as an source to prevent the SARS-COVID19 in a most effective way.

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Newer Insecticide Molecules

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Mankind has a history of using crop protection products from non-selective, naturally occurring compounds to highly specific synthetic and biological materials for assured food production and protection of environment since long time. Accordingly, many conventional pesticides have been replaced by newer insecticides which are more selective. The prime motto for these developments is to give protection to the crops along with safety to the natural enemies of different pests as a whole safety to environment.

Pesticides

Pesticides are substances or a mixture of substances, of chemical or biological origin, used by human society to mitigate or repel pests such as bacteria, nematodes, insects, mites, mollusks, birds, rodents, and other organisms. While, insecticides are pesticides that are formulated to kill, harm, repel or mitigate one or more species of insect.

Newer Insecticides

Newer insecticides include juvenile hormone mimics, synthetic versions of insect juvenile hormones that act by preventing immature stages of the insects from molting into an adult, and ivermectin, natural products produced by soil microorganisms, insecticidal at very low concentrations. Thus, the newer molecules are attractive replacement for synthetic organic pesticides.

Classification of Newer Insecticide

Neo- Nicotinoids	Thiazolidine group	Tetronic acid derivatives
Phenyl pyrozoles	Thiourea derivatives	Pyridalyl
Pyridine azomethines	Sulfite ester group	Insect growth regulator
Oxadiazine group	Diamide group	New insecticide from Microorganism
Halognated Pyrroles	Quinazoline group	

List of Newer molecules, their mode of action and trade names

Insecticide	Trade names	Insecticide	Trade names
Chloronicotinyl compounds		**Chloronicotinyl compounds**	
Imidacloprid	Merit®, Admire®, Advantage™, Gaucho™, Provado®, Premise®	Flubendiamide	Fame, Belt
Acetamiprid	Pride®	Formamidines Chlordimeform	Galecron, Fundal, Fundal, Spike
Thiacloprid	Calypso	Amitraz	Acarac, Amitraze, Baam
Thionicotinyl group compounds	Actara®, Cruiser®	Quinazoline Group	Fenazaquin 10% EC
Furanicotinyl group compounds	Osheen and Token	Tetronic Acid Derivatives	
Pyridincarboxamides	Ulala	Spiromesifen	Oberon

Phenyl Pyrazoles	Regent®	Spirodiclofen	Envidor
Pyridine azomethines	Chess®, Fulfill®	Spirotetramat	Movento
Oxadiazine Group Indoxacarb	Avaunt® and Avanut EC	Insect Growth Regulators	
Halogenated Pyrroles Chlorfenapyr	Intrepid®	Antijuvenile hormone agents Benzoyl Urea Novaluron and Lufenuron	Rimon and Signa
Thiazolidine Group Hexythiazox	Maiden	Thiadiazines	Applaud
Thiourea Derivatives	Pegasus or Polo	Carbazate Acaricide	Floramite
Sulfite Ester Group Propargite	Omite	Pyridazinones Acaricide	Fenpyroximate Mitigate
Diamide Group Chlorantraniliprole	Coragen 200SC and Altacor 35 WG	New Insecticides from microorganisms Avermectins	Vertimec®, Avid®, Agrimec®
Cyantraniliprole	Cyazypyr	Spinosyns	Tracer

Conclusion

New insecticide introduced in crop protection are quite different in chemical structure over the existing groups and target alternate physiological and biochemical effect with diverse mode of action. The ability of these new groups of insecticides to be effective at low rates (or) doses, easily biodegradable high level of selectivity, greater specificity to target pests along with low toxicity to non-target organisms and the environment. For a newer insecticide to be effective, it is important to maintain the diversity in chemistry of insecticides for maximizing flexibility, precision and stability in pest management.

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Modern Organic Practices: A Hope for Sustainable Agriculture

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Why there is Need to Go for Organic Agriculture?

Since the publication of "silent spring" we realised about the hazardious effect of chemical pesticides how they are responsible for serious ill effects in mankind. Several numbers of pesticides sprays in the ecosystem may cause elimination of natural enemies fauna and disturbance in biotic factors. Due to frequent and injudicious uses Insect-pests have developed resistance to almost all of the conventional synthetic insecticides and are also developing resistance to multiple classes of insecticides. Additionally, the conventional insecticides provide poor control of insect-pests and generally lead to pest resurgence. They also cause the problem of secondary pest outbreak and affect the food chain by leaving residues on crop. Hence, to overcome these ecological as well as health problems the basic and important solution is to return back to organic farming. It allows the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances. In country like India we need to alarm ourself where the live example like "cancer train" is present.

Modern Organic Practices A Tool for Sustainable Agriculture

Sustainable agriculture have 3 objectives:

1. Healty environment (organic agriculture avoid harmful chemicals which pollute our environment viz., land , air, water).

2. Economic profitability (when we compare the cost of cultivation of organic with chemical cultivation maximum time we found that there is much expenditure in organic farming until it is Itks(indegenious technical knowledges) but how could it fitted in this criteria of economic profitability? The reason is increasing awareness of organic produce among peoples due to which the produce even get double prices. So that in present era there are less chances of loss in organic farming/practices).

3. Social and economic equity (As organic agriculture had low adoption levels in past years also there were not visible complete acceptance of in society but due to awareness among people towards the harmful effects of chemical pesticides leads them to move towards organic agriculture direction. Also there are chances of getting good money gradually people are understanding that).

Comparison Between Chemical and Organic Agriculture

There are several practices like cultural, mechanical, physical, biological and chemical which are applied from time to time to manage the pests as well as for increasing fertility of soil. In order to prevent the losses caused by insects and to produce quality crop, it is essential to manage the pest population at appropriate time with suitable measures.

Of the above mentioned methods, chemical method is the most favored method used by farmers as it gives quick results and checks the 'insect-pests' population effectively while a single component of organic method is not sufficient to compete with chemical pesticides so for organic agriculture in field needed proper organic modules which includes different component of organic practices . A variety of chemicals have been used for the control of pest population in crop. Insect-pests have developed resistance to almost all of the conventional synthetic insecticides and are also developing resistance to multiple classes of insecticides and by use of chemical fertilizers the health of soil degrading day by day. Additionally, the conventional insecticides provide poor control of insect-pests and generally lead to pest resurgence. They also cause the problem of secondary pest outbreak and affect the food chain by leaving residues on crop. Hence, to overcome these ecological as well as health problems the basic and important solution is to return back to organic farming. It allows the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances.

Due to heavy insect pests invasion in crop, famers are using insecticides injudiciously and indiscriminately resulted heavy deposition of lethal chemicals on fruits which would be responsible for serious ill effects in mankind. Several numbers of sprays in the ecosystem may cause elimination of natural enemies fauna and disturbance in biotic factors.

Hence Uttarakhand has been declared as organic state in recent year and there is great challenge to overcome insect pests problem and production of crops organically without degradation of soil fertility.

There are Some Examples, How to Make Organic Module in Prospective to Okra Crop

Modules	Treatment
Organic module 1	Vermi-compost at the time of sowing + Application of Sticky trap after 15 days of sowing up to flowering stage. Application of NSKE solution after flowering + Use Marigold as trap crop.
Organic module 2	FYM (farm yard manure) at the time of sowing +Application of cow urine after 15 days of sowing + Application of Bt (Bacillus thuringiensis) after flowering.
Organic module 3	Neem cake at the time of sowing + Application of neem-oil spray (Azadiractin) after 15 days of sowing at weekly interval upto 2 times + Caging with insect proof net. Deployment of pheromone trap after flowering for mass trapping of Earias vittella + Application of insect pathogen i.e, Beauveria bassiana after flowering.
Organic module 4	Vermi-compost + FYM at the time of sowing + Utilisation of NSKE5% solution after 15 days of sowing + Use of Sticky Trap after 15 days of sowing up to flowering stage. Use of Pheromone Trap after flowering.

Conclusion

Although, yield may be higher in chemical and pest population might be minimum but this may lead to problem of pest resurgence, secondary pest outbreak of pest and affect the food chain by leaving residues on crop. Hence, to overcome these ecological as well as health problems the basic and important solution is to return back to organic farming. We can suggest these modules to farmer for safe and sustainable farming also because of awareness among people they prefer organic produce and there may be higher profitability.

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Greenhouse Technology: An Alternative for Off Season Farming in Controlled Environment

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Introduction

Todays the world scenario has been changing from plentiful to limited resources owing to exponential growth of population. This exerts a continuous pressure land & fresh water and it demands a radical change in agricultural practices in years to come. Greenhouse technology is the science of providing favourable environment condition to the plants.

Greenhouses are framed or inflated structures covered with the transparent or translucent material large enough to grow crops under partial or full controlled environmental conditions to get optimum growth and productivity. Off season farming refers to the production after or before the normal season of production by availing and using different agro climatic conditions.

Now a day's demand for fresh agriculture commodity is increasing day by day that too throughout the year in order to meet these demands some innovative way of agricultural practices is required and greenhouse technology is such types of practices in which we can control the all the environmental condition inside it and which will ultimately help us for off season farming.

The greenhouse technology for a controlled environment is widely used for production of Fruits, Vegetables, Floriculture, Nurseries and medicinal plants especially in those areas where terrain and extreme environmental condition does not allow the regular farming.

The concept of greenhouse technology has been globally accepted by researchers, crop growers and professional entrepreneurs. This type of technology will be more fruitful in developing country like India where huge population is dependent on agriculture directly or indirectly, large portion of our agricultural land is dependent on monsoon season for the cultivation.

Why Greenhouse Technology?

1. The yield may be 10-12 times higher than that of outdoor cultivation depending upon the types of greenhouse, types of crops and environmental control facilities.
2. Reliability of the crops increases under greenhouse cultivation.
3. Efficient utilization of the chemicals, pesticides to control pest and diseases.
4. Water requirements of crops very limited and easy to control.
5. Production of quality produces free from blemishes.
6. Monitoring of the crops become very easy.
7. Conservation of water and soil.
8. Efficient utilization of the natural resources presents nearby.

Why Off-Season Farming?

1. To increase total production.
2. To ensure year round supply of agricultural produce.
3. To ensure better quality produced by using protected structure.
4. To get more prices by selling off season produce.
5. Manifold increase in production from same unit areas.

Commonly Grown Greenhouse Crops

The various crops which are grown inside greenhouse includes different types of vegetables such as Tomatoes, Cucumber, Lettuce, Onions, Cabbage, Beans, Peas, Chilies and Okara. The fruits which are grown inside the greenhouse include Strawberries, Grapes, Citrus and Melons. An ornamental plant includes Roses, Poinsettias and others plants such as Tobacco and nurseries can also be successfully grown inside the greenhouse.

Constituents of Environment in a Greenhouse

The micro-climate of a plant is specified in terms of light, air composition, temperature, and the root media. Air and soil temperatures are generally parameters considered studying the plant- environment interaction. The light which influences plant growth, consist of sources energy content, spectral quality, photosysnthetically active radiation (PAR) and the albedo of the surrounding.

Gaseous composition of the air surrounding the plant is CO_2, O_2, N_2, and other trace gasses. These influence the plant metabolism significantly. Physical, Chemical and microbial composition of soil define the root media. Greenhouses are supposed to control inside climatic parameters and overcome climate adversity but it does not mean that external factors are not important. Various external factors Light, temperatures, altitude and proximity to large water bodies also affects the production of crops presents inside the greenhouse.

1. Light: Greenhouses are convertors of solar radiation. Their ability to do this efficiently depends upon location, structure and arrangement. The solar energy used by plants comprises a small part of total spectrum. Sunlight is only sources as far as open field cultivation is concerned.

Whereas electrical lights in addition to sunlight could be used in greenhouse cultivation whenever required. Generally three categories of lamps used as light sources in greenhouse i.e. Incandescent lamps, Fluorescent lamps, high intensity discharge lamps, high and low pressure sodium lamps and high pressure mercury lamps are used for light source in the greenhouse.

2. Carbon dioxide: Manufacturing of food for plant growth requires carbon dioxide. Carbon dioxide uptake by green leaf in sunlight or supplemental artificial illumination is common measure of photosynthetic rate. It can ultimately be translated in terms of growth, yield and quality.

Many plants continue to photosynthesis even at zero CO_2 levels as liberation of respiration gas utilized by plants. The importance of CO_2 in relation to plant growth is obvious as in photosynthetic process a plant leaf seeks to combine molecules of carbon dioxide and water to in presence of sunlight to form carbohydrates and oxygen. In greenhouse the enclosed air may have a CO_2 concentration of 1000 ppm because of respired CO_2 remained trapped overnight.

As sunlight becomes available photosynthesis process begins and CO_2 from greenhouse air gets depleted due to this the level of CO_2 goes below 300 ppm much before noon and in this case plant do not received additional CO_2 from some other sources the plant would become CO_2 deficient.

3. Temperature: The plant temperature ultimately provides a platform to basic physiological processes common to all plants. These include photosynthesis, respiration, translocation, ion uptake, transpiration, pigment formation, reproduction and elongation.

Temperature influences all these processes in various ways and to different degree. A rise in leaf temperature will lead to increase vapour pressure inside the leaf due to this, transpiration takes place at faster rate, assuming outside vapour pressure remains constant. If the soil is cold, water and ion uptake, and root growth will be reduced, perhaps to a point where all top growth ceases regardless of the air temperature.

4. Humidity: Along the light and temperature, humidity is one of the most important elements in the greenhouse climate. Humidity inside the greenhouse is influenced by outside climatic parameters like air temperature and solar intensity.

Dry air (low relative humidity) can be attained on the one hand in greenhouse practices by increasing the air temperature and, on the other hand by ventilation. Moist air can be attained by increasing evaporation from the soil in the closed greenhouse with relatively low air temperature. Transport of nutrients from the soil to plant organ is governed by water uptake and transpiration which is essential for the proper growth and development of crops. Relative humidity affects the leaf area development and stomatal conductance thereby interfering with the photosynthesis and dry matter produced.

Conclusion

From the above discussion we can conclude that in the present scenario, greenhouse cultivation could serve as viable solution, facilitating off- season cultivation and protecting crops from unfavorable outdoor conditions to meet the worldwide demand of enhanced production. Apart from these, greenhouse could be a better option for the nursery raising, hardening of the tissues culture plants, cultivation in the region which are prone to the soil problems and extreme climate. It will be also helpful in increasing the farmer income and reliability of the crop is also more in greenhouse cultivation as compared to the normal outdoor farming.

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Diseases of Chilli

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Damping Off

Causal organism: *Pythium aphanidermatum* (Edson) Fitzp

Damage symptoms: Disease of nursery beds and young seedlings resulting in reduced seed germination and poor stand of seedlings. Very high seedling mortality 25-75%. Pre-emergence damping off: Seedlings disintegrate before they come out of soil surface leading to poor seed germination. Post-emergence damping off is characterised by development of disease after seedlings have emerged out of soil but before the stems are lignified.

Water soaked lesion formation at collar region. Infected areas turn brown and rot. Plants shrivel and collapse as a result of softening of tissues. In *Rhizoctonia solani* attack infected stems become hard, thin (wire stem symptoms) and infected seedlings topple Disease appear in patches both in nursery and field beds.

Favourable conditions: Heavy rainfall, excessive and frequent irrigation, poorly drained soil and close spacing, high soil moisture with temp around 25-30 °C. For Rhizoctonia: High soil moisture with temp around 30 – 35 °C.

Die-Back and Anthracnose (Fruit Rot)

Causal organism: *Colletotrichum* spp

Damage symptoms: Dieback Symptoms: Disease is more in December - October in transplanted crop. Small, circular to irregular, brownish black scattered spots appear on leaves. Severely infected leaves defoliate. Infection of growing tips leads to necrosis of branches from tip backwards. Necrotic tissues appear grayish white with black dot like acervuli in the center. Shedding of flowers due to the infection at pedicel and tips of branches

Fruit symptoms: Ripe fruits are more vulnerable to attack than green ones. Small, circular, yellowish to pinkish sunken spots appear on fruits. Spots increase along fruit length attaining elliptical shape. Severe infection result in the shrivelling and drying of fruits.

Tissues around lesions will be bleached and turn white or greyish in colour and lose their pungency. On the surface of the lesions minute black dot like fruiting bodies called 'acervuli' develop in concentric rings and fruits appear straw coloured. The affected fruits may fall off subsequently. The seeds produced in severely infected fruits are discoloured and covered with mycelial mat.

Favourable conditions: Temp, 28 °C with RH more than 97%, humid weather with rainfall at frequent intervals, intercropping with turmeric which is another host of the fungus.

Choeanephora Blight / Wet Rot

Causal organism: *Coeanephora cucurbitarum* (Berk. & Ravenel) Thaxt

Damage symptoms: Plants from seedling to early flowering stage are susceptible. Being a weak parasite the fungus colonises dead or dying tissues before it actively invades living tissues. Fruit infection is observed predominantly around calyx. The pathogen attacks flowers through the senescing petals and overgrows on flowers resulting in brown or black mass of rotten tissue.

Flower stalks, buds and leaves will be attacked subsequently. On infected tissues stiff silvery mass of whisker-like or hairy strands of the fungal growth develops on which black mass of spores is produced which is the chief diagnostic feature. Infected young fruits may abort. Individual branches of plants may be attacked which show dieback. Stems of infected plants appear wet and green and the bark peels off in to shreds

Favourable conditions: Warm, Rainy and wet weather Temp, 28°C with RH more than 97%. Extended periods of high rainfall followed by warm weather.

Mosaic Complex

Damage symptoms: Symptoms vary with the virus TMV. Raised blisters and mottled areas of light and dark green areas on the foliage. Leaves point towards ground. Necrotic spots on stem. Fruit ripens unevenly and is reduced in size CMV. Reduction in leaf size and narrowing of lamina Chlorosis leading to mosaic symptoms. Downward curling along with midrib. Fruit may be small and distorted, on volunteer Chilli plants and on infected plant debris.

Favourable conditions: Moist weather and splattering rains. High humidity or persistent dew.

Powdery Mildew

Causal organism: *Leveillula taurica* (Lév.) G. Arnaud.

Damage symptoms: White powdery coating appears mostly on the lower surface and occasionally on upper surface. Correspondingly on the upper surface yellow patches are seen. Severe infection results in the drying and shedding of affected leaves. Powdery growth can also be seen on branches and young fruits. Diseased fruits do not grow further and may drop down prematurely.

Favourable conditions: Cool dry weather favours conidial germination. High RH favours disease development.

Cercospora Leaf Spot

Causal organism: *Cercospora capsici*.

Damage symptoms: Circular spots with brown margins and grey centre appear on leaves. The spots enlarge and coalesce with others. The central portion of the spot becomes white and the leaves turn yellow and defoliate. Sometimes central portion of spot drops off. Spots also appear on stems and twigs as dark brown, irregular lesions with whitish centers. In severe cases die-back of twigs occur.

Bacterial Leaf Spot

Causal organism: *Xanthomonas campestris* pv. *vesicatoria* (Pammel) Dowson.

Damage symptoms: Leaves, fruits and stems are affected. Lesions on leaf begin as circular, water soaked spots. Spots become necrotic with brown center with chlorotic borders. Enlarged spots may develop straw coloured centres. Lesions are slightly raised on lower leaf surface. Severely spotted leaves turn yellow and drop. Raised brown lesions appear on fruits. Narrow elongated lesions or streaks may develop on stems.

Favourable conditions: Moderate temperature, High relative humidityand Intermittent rains.

Alternaria Leaf Spot

Causal organism: *Alternaria solani* Ell. Mart

Damage symptoms: This is a common disease of chilli occurring on the foliage at any stage of the growth. The fungus attacks the foliage causing characteristic leaf spots and blight. Early blight is first observed on the plants as small, black lesions mostly on the older foliage.

Spots enlarge, and by the time they are one-fourth inch in diameter or larger, concentric rings in a bull's eye pattern can be seen in the center of the diseased area. Tissue surrounding the spots may turn yellow. If high temperature and humidity occur at this time, much of the foliage is killed. Lesions on the stems are similar to those on leaves, sometimes girdling the plant if they occur near the soil line.

Transplants showing infection by the late blight fungus often die when set in the field. The fungus also infects the fruit, generally through the calyx or stem attachment. Lesions attain considerable size, usually involving nearly the entire fruit; concentric rings are also present on the fruit.

Favourable conditions: Warm, rainy and wet weather.

Fusarium Wilt

Causal organism: *Fusarium solani* (Mart.) Sacc.

Damage symptoms: The first symptom of the disease is clearing of the veinlets and chlorosis of the leaves. The younger leaves may die in succession and the entire may wilt and die in a course of few days. Soon the petiole and the leaves droop and wilt. In young plants, symptom consists of clearing of veinlet and dropping of petioles. In field, yellowing of the lower leaves first and affected leaflets wilt and die. The symptoms continue in subsequent leaves. At later stage, browning of vascular system occurs. Plants become stunted and die.

Favourable conditions: Relatively high soil moisture and soil temperature.

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Diseases of Citrus

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Citrus Scab

Damage symptoms: Initially small, semi-translucent dots like lesion develops on leaves which become sharply defined pustular elevations. The opposite surface corresponding to the warty growth shows a circular depression with a pink to red centre. On the fruit, lesions consist of corky projections which often break into scab affecting larger areas on the fruits

Citrus Canker

Damage symptoms: Initially, disease appears as minute water soaked round, yellow spots which enlarge slightly and turn brown, eruptive and corky. These pustules are surrounded by a characteristic yellow halo. Canker lesions on the fruit do not possess the yellow halo as on leaves. Several lesions on fruit may coalesce to form larger canker. Due to severe infections the there may be defoliation, and twig and stem may show die-back symptoms.

Citrus Tristeza Disease

Damage symptoms: Disease affected tree leaves becomes chlorotic in the early stages. Gradually the leaves drop and the defoliated twigs show die-back. Diseased trees usually blossom heavily. Under the tree bark stem pitting can be observed. Trees with stem pitting are stunted and set less fruits. The fruits are of smaller size and of poor quality (insipid fruits).

Transmission and favourable conditions: The disease is transmitted in semi persistent manner by aphid *Aphis gossypii*. Aphids are more active in warm summer conditions and increase their population as well as spread of the disease.

Gummosis

Damage symptoms: Disease starts as water soaked large patches on the basal portions of the stem near the ground level. Bark in such parts dries, shrinks and cracks and shreds in lengthwise vertical strips. Later profuse exudation of gum from the bark of the trunk occurs. Considerable amount of gum formation in sweet oranges may be observed, but relatively little in grapefruit.

Favourable conditions: The Phytophthora species causing gummosis develop rapidly under moist and cool conditions.

Greening or Huanglongbing

Damage symptoms: Affected leaves show small circular green islands within the chlorotic areas. Heavy leaf fall occurs with the onset of summer. Twig die-back may also occurs. Affected areas of the fruits remain green and gives bitter taste. Affected fruits show reduction in size, loopsided growth and oblique columella. Seeds are poorly developed, dark coloured and aborted.

Transmission and favourable conditions: The bacterium is transmitted by the psyllids. The bacteria can be acquired by the insects in the nymphal stages and the bacteria may be transmitted throughout the life span of the psyllid.

Anthracnose

Damage symptoms: Leaf - common symptoms are a more or less circular, flat area, light tan in color with a prominent purple margin that at a later phase of infection will show the fruiting bodies of the fungus (tiny dispersed black flecks). Tissues injured by various environmental factors (such as mesophyll collapse or heavy infestations of spider mites) are more susceptible to anthracnose colonization. Fruit - anthracnose usually only occurs on fruit that have been injured by other agents, such as sunburn, chemical burn, pest damage, bruising, or extended storage periods. The lesions are brown to black spots of 1.5 mm or greater diameter. The decay is usually firm and dry but if deep enough can soften the fruit. If kept under humid conditions, the spore masses are pink to salmon, but if kept dry, the spores appear brown to black. On ethylene degreened fruit, lesions are flat and silver in color with a leathery texture. On degreened fruit, much of the rind is affected. The lesions will eventually become brown to grey black leading to soft rot.

Favourable conditions: Cool weather (temp 20°C) responsible for development of disease in plants. Long period of high relative humidity >80% with mists.

Sooty Mould

Damage symptoms: The dark, felty growth from sooty mold can be scraped off of plant surfaces, unlike fruit rots that extend into the rind and flesh. Where sooty mold occurs, look for aphids, citricola scale, cottony cushion scale, mealy bugs, whiteflies, and other phloem-sucking insects that excrete honeydew on which sooty mold fungi grow.

Powdery Mildew

Disease symptoms on Leaves: White 'powdery' spores develop mostly on the upper leaf surface. Young leaves turn a pale whitish-grey-green. The ends of mildewed leaves can twist and curl upward. Young shoots can wither and die back. Severe infections cause defoliation.

Disease symptoms on Fruit: White 'powdery' spores develop on the young fruits. Infected fruit fall prematurely.

Favourable conditions: Cool and damp weather (temp 20°C) responsible for development of disease in plants. Long period of high relative humidity >80% with mists and fog are especially conducive for the development of disease.

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Diseases of Turmeric

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Rhizome Rot

The disease is soil-borne and rhizomes borne and occurs with the onset of monsoon. This disease mostly occurs during the months of June to September.

Causal organism: *Pythium graminicolum.*

Damage symptoms: The infection starts at the collar region of the pseudostem and progresses upwards as well as downwards. The collar region of the affected pseudostem becomes water soaked and the rotting spreads to the rhizome resulting in soft rot. At a later stage root infection is also noticed. Foliar symptoms appear as light yellowing of the tips of lower leaves which gradually spreads to the leaf blades. In early stages of the disease, the middle portion of the leaves remain green while the margins become yellow. Later, the yellowing spreads to all leaves of the plant from the lower region upwards and is followed by drooping, withering and drying of pseudostems.

Favourable conditions: Younger sprouts are the most susceptible to the pathogen. Nematode infestation aggravates rhizome rot disease. Temperature above 30° C and high soil moisture are the important predisposing factors favouring the disease. Water logging in the field due to poor drainage increases the intensity of the disease.

Leaf Spot

Causal organism: *Colletotrichum capsici.* Disease is soil-borne noticed on the leaves from July to October.

Disease symptoms: Symptom appears as brown spots of various sizes on the upper surface of the young leaves. The spots are irregular in shape and white or grey in the centre. Later, spots may coalesce and form an irregular patch covering almost the whole leaf. The centre of spots contains fruit head shaped fruiting structures.

Favourable conditions: High soil moisture, temperature 25° C and leaf wetness.

Leaf Blotch

Causal organism: *Taphrina maculans.*

Disease symptoms: Disease symptom appears as small, oval, rectangular or irregular brown spots on either side of the leaves which soon become dirty yellow or dark brown. The leaves also turn yellow. In severe cases the plants present a scorched appearance and the rhizome yield is reduced.

Favourable conditions: High soil moisture, temperature 25O C and leaf wetness.

Dry Rot

Causal organism: *Rhizoctonia bataticola.*

Disease symptoms: The disease causes root rot and rhizome rot resulting in typical dry rot of rhizomes from October onwards. The affected rhizomes appear soft and shrunken to start with, later dry up and become hard. Foliar yellowing and drying up of foliage which are the normal symptoms of maturity of the crop during October - November would be indistinguishable from the symptoms of the disease affected clumps. When infected rhizomes are cut open, the infected zones typically appear as dull brown and dark.

Favourable conditions: The disease is favoured by 35° C soil temperature, 15-20 per cent soil moisture and alluvial or sandy soils.

Bacterial Wilt

Causal organism: *Ralstonia solanacearum.*

Damage symptoms: Rapid wilting and death of the entire plant without any yellowing or spotting of leaves are the characteristic symptom. All branches wilt at about the same time. When the stem of a wilted plant is cut across, the pith has a darkened, water-soaked appearance. Grayish slimy ooze comes out on pressing the stem. In later stages of the disease, decay of the pith may cause extensive hollowing of the stem.

Favourable conditions: The bacterium is especially destructive in moist soils at temperatures above 24° C. High soil temperature and moisture is favourable for disease.

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Post-Harvest Management of Cardamom, Turmeric and Ginger

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Cardamom

Its ripe fruits (physiologically ripe) are generally harvested. Splitting of capsules is done in mature capsules. Percentage of dry recovery is highest (20%) in fully ripe capsules followed by those harvested at physiological maturity (24%) and in immature stage (14%). Capsules may be washed in water to remove the adhering soil and treatment with 2% washing soda (alkali) for 10 minutes enables to retain green colour and prevent mould growth.

Curing

Curing of cardamom is nothing but drying at low temperature. In this process, moisture of green cardamom is reduced from 80 to 12% at 50°C so as to retain their green colour to the maximum extent. The sun-drying is followed for less quantity (50kg). It requires about 5 - 6 days for complete drying. Cardamom is spread over the low -density and high-density polyethylene sheets or bamboo mat or cement floor. Solar-driers can also be used for drying cardamom. In electrical drier, cardamom can be dried in tray type electrical dryer fitted with exhaust fan in 10-l2 hr at 45° - 50°C. Drying at low temperature helps retain green colour as well as avoid splitting of capsules. Pipe curing/drying in curing house is the best method of curing at a large scale to get high quality green cardamoms. It consists of walls made of bricks or stones and tiled roof with ceiling. A pipe made of iron or zinc sheet starting from the furnace passes through the chamber and opens outside the roof. The flue gas generated in the furnace passes through the pipe and heats the pipe. Conduction as well as radiation heat up the air surrounding the pipe. Then by natural heat convection, the entire room is heated. In modern curing houses, exhaust fan is also fitted. The exhaust fans located on either sides of the wall uniformly spread the temperature as well as it draws out high humid air, particularly at the beginning of drying, from the drying chamber. Inside the room, cardamom is kept in wooden aluminium trays arranged in racks. Fire in the furnace is adjusted to maintain the temperature of 45°- 50°C. It may take about 18-22hr. for drying. Though many other types of mechanical driers are available, curing house is still used by most of the planters.

Value-Added Products

Bleached cardamom is creamy-white or golden-yellow. It can be done with either dried or freshly-harvested capsules. It is prepared using sulphur dioxide, potassium metabisulphite (25g containing 1% HCL for 30 minutes) and hydrogen peroxide (4 - 6% and pH 4.0). However, bleached cardamom loses more volatile oil.

Cardamom oil is a major value added product. Most varieties contain 5-9% oil. Immature cardamom has more oil. Unlike pepper and ginger, cardamom oil imparts full taste of the spice. Major chemical constituents of the oil are 1, 8- cineole and x-terpinyl acetate. A high terpinyl acetate and low cineolic content in the oil impart sweet flavour, while a high cineolic content impart more of an undesirable camphoraceous note to the oil.

Turmeric

Curcumin is the principal colouring pigment in turmeric. Indian turmeric is popular for its intrinsic quality. Some precautions are necessary to preserve its quality. Seed turmeric should be immersed in suitable fungicide and pesticide for half an hour. Thereafter, it may be dried in shade and kept safely. Robust rhizomes are suitable for seed material. Larger rhizomes can be split and used. Harvesting should be done at maturity without damage and the rhizomes may be washed. Turmeric should be boiled and dried. For boiling, use clean water. The bulbs and the fingers should be boiled separately. While boiling, water should be filled in to cover the turmeric. Cover the turmeric using gunny bag or jute bag to restrain the steam within.

Heating should be uniform. After the commencement of boiling, it takes 45-50 minutes to complete the cooking process. It can be tested by passing between fingers or by piercing a small stick through the rhizome, which easily passes through if properly boiled. The odour of the smoke too indicates that it is fully cooked.

Clean terraces or cemented yards or clean bamboo mats should be used for drying. It should be heaped and covered during night to protect it from rains. It may take about 10—15 days and if the drying is complete, turmeric breaks with a metallic twang. Dried turmeric can be marketed as such or after polishing is done by sprinkling turmeric powder using a mechanical drum. It should be kept in clean sacks and stored over wooden platforms in store rooms. The room should be kept clean, free from pests, spiders and rodents. Cow-dung smeared floor or mats should not be used for drying. Dried turmeric should be stored safely.

Alleppy finger turmeric is very famous for its colour in trade. In turmeric, curcumin content varies from 4 - 7%. There are quite a few varieties available which have more than 6% curcumin content.

Ginger

The quality of ginger products depends on variety and its cultivation practices. Appropriate variety is selected for various end products is dry ginger, raw ginger, ginger oil, oleoresin etc.

Himachal, Maran, Mananthody and Kuruppampady are good varieties to prepare dry ginger, whereas Rio-de Janeiro, China, Wynad and Varada are good for raw ginger. Only recommended doses of pesticides and other chemicals should be applied to avoid their residues. Ginger rhizomes should be thoroughly cleaned before peeling. Extreme care is necessary while peeling to prevent loss of volatile oil. Wooden scrapers of bamboo stick are ideal for peeling. Knives or sickles may leave dark spots. Ginger can be dried on clean bamboo mats or cement floor. Depending on availability of sunlight full drying period may vary from 7 - 14 days. Desirable moisture level is 10%, above which it may cause development of aflatoxin. The dried ginger should be packed in air-proof polyethylene bags and then stacked on wooden platform.

Rhizomes affected with rot should not be used for preparing dry ginger. Fumigation of stored dry ginger should not be done without consulting experts as many importing countries have imposed a ban on fumigated materials. Mixing of fully dried ginger with half-dried one may be avoided. Rodents, birds, pests and animals should not be allowed in the area where ginger is stored. The major Indian trade types are Cochin and Calicut ginger. Cochin ginger is superior in quality. Appearance, contents of volatile oil and fibre, pungency level and a subjective assessment of aroma and flavour are important in the quality evaluation of dried ginger. This depends on cultivars and stage of maturity at harvest. Oil and oleoresin decrease as maturity progresses.

Value-Added Products

Ginger oil (0.5 - 3.0%) possesses only aroma and not the flavour of the spice. Ginger oleoresin is a blend of oil and resinoides. It is extracted from ginger powder using organic solvents like acetone, ethylene dichloride etc. Its content is 3.5-9.5%. Major pungent principle is gingerol (a phenyl ketone).

Ginger preserve or muraba, ginger candy, soft drinks like ginger cocktail (which aids in digestion), ginger pickles, salted ginger, salted in vinegar or vinegar or vinegar mixed with lime and green chilli are important value-added products prepared form fresh ginger.

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Cassava: Bio Energy Crop

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Summary

1. The "food of the poor" has become a multipurpose crop that responds to the priorities of developing countries, to trends in the global economy and to the challenge of climate change.

2. Energy is an important factor in our daily lives, helping to improve the quality of life and playing a significant role in the country's economic development. In particular, energy demand in India, where this study is conducted, has been increasing continuously together with the energy prices.

3. The nutritive reserves of cassava is made up of starch, which is one of the most important products synthesized by plants that is consumed as food and used in industrial processes.

4. Furthermore, India has to face the environmental impacts caused by energy usage, particularly the impact on climate change resulting from, for example, global warming.

Introduction

1. USA covers the oil wells of Kuwait and other Gulf countries in few 3-ears also indicate that the mineral oils are limited. Self sufficiency in energy requirement is critical to the success of any growing economy.

2. With increasing energy consumption, dependence on fossil fuels will necessarily have to be reduced. Now it is necessary to discover an alternative source of petroleum products. Biofuel is a type of alternative energy that is obtained from living or biological materials.

3. Biofuel is a type of fuel whose energy is derived from biological carbon fixation. Biofuel include flues derived from biomass conservation, as well as solid biomass, liquid fuels and various biogases.

History of Biofuels

1. Biofuels are gaining increased public and scientific attention, driven by factors such as oil price hikes and the need for increased energy security.

2. Due to revolution and the white revolution, we are now self dependent in the production of food grains and milk.

3. Now it is time to think about black revolution to attain the self dependence in the production of ethanol (biofuel) and mixed it at the level of 10% in petrol and secondly, production of biodiesel. In this context, year

2004 was celebrated as the year of Bio-trade. India has rich biomass resources which can be converted into renewable energy.

About Cassava Biofuel

1. Cassava rhizome is an attractive lignocellulosic material for bioethanol production, which mostly comes from agricultural residuals.

2. An energy crop is a plant grown at a low cost and low maintenance harvest used to make biofuels, or directly exploited for its energy content. Conventional energy crops include Barbados nut *(Jatropha curcas),* sunflower *(Helianthus annus),* sugarcane *(Saccharum officinarum),* soyabean *(Glycine max),* and maize *(Zea mays).* Cassava is yet to gain global recognition as an energy crop, although its importance in this regard is known in several places.

About Cassava

1. The center of origin of cassava is in Central Brazil, where it has been a staple food for the native Indian population for at least 4000 years, and continues to be so until this day.

2. Brazil is still the second largest producer of cassava in the world, after Nigeria and followed by Thailand. In semi-arid north eastern Brazil, farina, made from grated and roasted cassava roots, remains a very popular food. In Nigeria and much of West Africa, cassava is the most important food staple, eaten mostly as "gari", another toasted product made by household processors from grated cassava roots.

3. Currently, Thailand is the largest exporter of cassava products in the world which represents more than 80% of its global trade. Among the important cassava root products are tapioca starch and flour. Tapioca starch (95% starch) could be used in many industries such as food, textile, chemical and pharmaceutical.

4. Ethanol fuel is ethanol (ethyl alcohol, 2C2H5OH), the same type of alcohol found in alcoholic beverages. It can be used as fuel, mainly as a biofuel alternative to gasoline, and is widely used by flex-fuel light vehicles in Brazil, and as an oxygenate to gasoline in the United States.

Cassava Other Products

1. Cassava is the basis of a multitude of products, including food, flour, animal feed, alcohol, starches for sizing paper and textiles, sweeteners, prepared foods and bio-degradable products.

2. The products are derived from a number of forms of cassava, ranging from fresh leaves and roots to modified cassava starch. The degree of processing and the technical requirements tend to increase from the fresh form to the modified starch form.

3. While some cassava is sold as fresh roots or leaves, even these products usually receive some special post-harvest handling or treatment before they are consumed. As cassava normally requires some form of processing before it can be consumed or sold, processing is of central importance in the future of the crop.

4. While the market potentials are great, it must be remembered that these opportunities are location and time specific. Because of the specificity of market opportunities it is impossible to compile a list of priority market opportunities.

Products from Leaves and Roots

1. Fresh roots and leaves are used primarily as human food. Because of their perishability, most roots are usually consumed or marketed close to the centres of production.

2. Traditional methods for preserving fresh roots include packing roots in moist mulch or removing leaves two weeks prior to harvest to increase root shelf life to two weeks. In Colombia, CIAT researchers found that preservative treatments such as dipping fresh roots in wax or paraffin and storing them in plastic bags reduced vascular streak and prolonged storage for 3 to 4 weeks. Roots can be peeled, chopped into chunks and frozen for specialized markets.

3. Cassava leaves can be eaten as a fresh vegetable, ground fresh and frozen in plastic bags, or dried and ground for sale in plastic bags.

4. The leaves are more nutritionally balanced than the roots and can help to prevent certain deficiency diseases. Leaves, however, may be high in hydrocyanic acid (HCN), but the HCN can be reduced to safe levels in most cases when the liquid is squeezed out after grinding and through evaporation during cooking.

Potential for Fresh Cassava

1. Higher incomes and urbanization are associated with greater consumption of convenience foods and foods that are perceived as more desirable foods. In cassava-producing countries, urbanization represents an opportunity for producers to produce cassava for a larger consuming population.

2. The implication is that cassava markets for fresh cassava can grow if the cassava products are convenient and in a more desirable form. Costa Rica has demonstrated that there is a growing export market for fresh cassava - if it is packaged in an attractive and useful manner.

Products from Cassava Starch

Cassava starch is used directly in different ways or as a raw material for further processing. Special features of cassava starch are its viscosity, resistance to shear stress and resistance to freezing. The main classes of starch-based products are:

1. Unmodified or native starch.
2. Modified (physical, chemical, biological) starches for industrial purposes.
3. Sweeteners, including high-fructose syrup and glucose (dextrin, monosodium glutamate, pharmaceuticals, etc.).

Conclusion

Considering the fact that cassava is a very cheap and important food crop that requires little skill to cultivate, with moderate requirement for soil nutrient, climatic condition and water, its cultivation should be highly encouraged mostly in rural areas, so as to bring sustainable growth and development to such areas. Furthermore, also cassava is a hardy and grown of small holding farmers of south India. Thus, by processing of cassava it is highly beneficial to the marginal farmers.

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Application of Cold Plasma Technology in Food and Agriculture Industries

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Introduction

Cold plasma is a novel non-thermal and sanitization technology for food industry applications. It is produced by applying the electric discharge to single element gas or combination of gases (Oxygen, Nitrogen, Argon, Helium, and atmospheric gas). The ionization process of gases generates various chemical species. These chemical species have various active properties that enforce the plasma technology for several applications in food and agriculture industries i.e. germination enhancement, insecticidal activity, pesticide dissipation, microbial inactivation, modification, or changes of food properties and packaging material. The most important advantage of cold plasma processing is minimum and very less nutritive changes in food and agricultural products in short processing time (a few seconds to minutes).

Plasma is generated by expressing the higher energy to gases (Air, oxygen, nitrogen, helium, etc.), and energy should be used which has the potential to ionized the gases. It can be get converted to another state which contains partially or wholly ionized forms of particles. Plasma is comprised of visible light, UV photons, neutral positive and negative charged ions, reactive oxygen and nitrogen species, etc.(Bauer et al., 2017). Most of the chemical species of plasma are characterized by efficient antimicrobial action. Based on generating mechanism and electrons temperature of plasma, it is categorized into thermal (T>20000K) and non-thermal plasma (T<100K)(Misra & Jo, 2017). Non-thermal plasma generates at atmospheric temperature or inside the vacuum and shows the non-equilibrium behavior with electron and gas species. In this article, the basic introduction of cold plasma, method of generation and some application in food and agriculture are discussed.

Fig. An overview: Application of cold Plasma processing in food and Agriculture field

Mechanism and Method for Generation of Cold Plasma

Plasma is generated by supplying higher energy to gases. There are various methods (corona, microwave, ultraviolet) for ionization of gases but the electrical discharge method is commonly used in the disinfection of food material. Based on the mechanism of generation, plasma is categorized into microwave discharge, jet discharge, radiofrequency, pulse discharge dielectric barrier discharge (DBD), corona discharge. Among all of these methods, jet plasma and dielectric barriers discharge plasma is most commonly used in the food and agriculture research sector. These methods have various advantages i.e simple and versatile design, adaptive for processes (Hertwig et al., 2018). The type and formation of plasma discharge depend upon the frequency of applied energy, type of current such as direct current (DC), and alternating current (AC), as well as pressure at which plasma generate i.e. such as atmospheric pressure and vacuum pressure, and the shapes of the electrodes (Fridman, 2012).

Application

1. Food decontamination: Cold plasma processing has demonstrated as a powerful and effective technology for deactivation of different pathogenic and spoilage microorganisms of food and it's also helpful for the inactivation of various endogenous enzymes. As a non-thermal process for microbial and enzymes inactivation, it has certain advantages i.e. lower processing and product temperature, minimal sensory and nutritive destruction of products along with no toxic by-product development in food. Cold plasma treatment can inactivate the microorganism in chicken meat and it reduces the 1.6 ± 0.5 log cfu/g viable count of Listeria innocuain in meat. Destruction and viability of microorganisms depend on the composition of active species in plasma (Rød et al., 2012). The superficial cell wall of microbes altered or damaged because of the direct oxidative effect of reactive species on microbes. In general, cold plasma treatment for decontamination of food products works by mostly three basic mechanisms such as DNA cleavage by UV photons, charged particles (e−, O−, OH−, and H+) damage the cell membrane, breakdown of covalent bonds by reactive chemical species (O, NOx, O3, and H2O2). CP has the potential and alternative method to decontaminate the food surface from vegetables and spores cells. Cold plasma processing can reduce trypsin enzymatic activity (zero at 4Jcm-2). It breakdown the peptide bonds and results in changes in the 3D structure of the protein (Dobrynin et al., 2009).

2. Food Packaging: Cold plasma can inactivate the various types of micro-organisms (spore, bacteria, yeast, and mold) from food packaging material. This is a chemical-free and fast approach for sterilization of different packaging material (PET foils, PET/PVDC/PE-LD, Polystyrene). It also changes the surface roughness and topography of packaging material. The surface roughness of PLA films was increased with the treatment of DBD air plasma. The bombardments of active particles on material create sputtering and etching effect which leads to modification in surface roughness of the film. Along with surface roughness increased, hydrophobicity of, and oxygenated compounds on cornstarch films also increased (Pankaj et al., 2015). Besides these, the water contact angle on corn starch film was decreased from 54 to 21º after DBD plasma treatment for 5 minutes. In the majority of research on cold plasma treatment on various polymers, significantly an increase in surface free energy observed. Plasma components and polymer interaction increase the polar group of free surface free.

3. Toxic degradation: Food processing industries are handling and degrading the various natural (lectins, trypsin inhibitors, mycotoxins, saponins, and goitrogens) and synthetic toxic (pesticides, endocrine disruptors) compounds present in food material. These compounds are raising problems regarding the health and safety of the consumer. At present, there is a limited non-thermal process for degradation and control of toxic compounds like pesticides and mycotoxins, etc. In the past few years, cold plasma technology showing potential and gaining the attention of researchers for eliminating the toxic compound from agricultural and food products. The application of cold plasma has proven economically and efficiently for the degradation of pesticides and mycotoxins from various products (Zhou et al., 2018; Species et al., 2017). Ions, species, and free radicals present in cold plasma leads to the degradation of pesticides.

4. Soil Remediation: Soil remediation capacity by cold plasma process depends on gas used for plasma generation, applied voltage, and soil moisture content. Soil remediation (decolorization rate for dye) efficiency of contaminated soil is increased by an increase in cold plasma processing parameters i.e. applied voltage with discharge frequency. The degradation rate of dye was 93% and it also eliminates the effect of the chemical oxygen demand by 74% at a treatment time of 25 min(Lu et al., 2014). The degradation efficiency of chloramphenicol (CAP) after 20 min plasma processing time was 81%. Optimum moisture content for this treatment was 10%. The degradation process was mostly affected and contributed by O3 in comparison to air, nitrogen, oxygen, argon (Lou et al., 2012).

5. Seed Germination: Cold plasma treatment is gaining attention for increasing the germination rate and yield of germination in the seed. It also leads to an increase in the water intake capacity of seed (due to formation and introduction of coating and functional group with active species, etching effect on the seed), decontamination, and some improvement and changes in other growth parameters. Some scientists proposed that early seed germination is due to active chemical species in plasma penetrate seed coat and influencing the cell seed inside. Improvement in the germination rate is due to the interface of plasma species with seed cells. And this interaction might result in changes in protein structure, rupture of the cell wall, DNA damage, influencing the various enzymatic activities. Cold plasma treatment enhanced the germination of wild asparagus by 15% and it also reduced the value of T50 (Lo Porto et al., 2019). They suggest that plasma treatment can improve the water imbibitions capacity and decontamination efficiency for seed material. In a similar study on the black gram by DBD air plasma treatment increases the germination and seedling growth rate by 13.67 and 37.13% (Billah et al., 2020).

Conclusion

With continuously increasing the world population, global agriculture and food industries are facing challenges to produce more fresh and healthy products. Non-thermal plasma shows great potential for the decontamination of fresh and minimally processed agricultural and food materials. CP effective technology for microbial and enzymatic decontamination of fresh fruit, cut, and seed material. It can also be used in the food packaging industry for package surface modification, increase the physical and chemical properties of packaging material surface. Cold plasma processing is also effective for soil remediation and toxic compounds degradation.

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Molecular Docking

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Introduction

The three-dimensional structures known may be represented to show different views of the structures. With complex molecular mechanics programs, it is possible to superimpose one structure on another. The same approach is used to superimpose the three-dimensional structure of a potential drug on its possible target site. This process, which is often automated, is known as docking. Molecular docking is used to predict the structure of the intermolecular complex formed between two molecules. The small molecule called Ligand usually interacts with protein's binding sites. Binding sites are areas of protein known to be active in forming of compounds. There are several possible mutual conformations in which binding may occur. These are commonly called binding modes. It also predicts the strength of the binding, the energy of the complex; the types of signal produced and calculate the binding affinity between two molecules using scoring functions. The most interesting case is the type protein-ligand interaction, which has its applications in medicine.

General Concept of the Docking Algorithm

1. A 'negative' image of the binding site is made - a collection of spheres of varying radii, each of which touches the molecular surface at just 2 points (Figure 1a).
2. Ligand atoms are then matched to sphere centers where at least four distances between ligand atoms are matched to sphere center-sphere center distances (Figure 1b).
3. Proper orientation is achieved by a least square fit of ligand atoms to the sphere centers.
4. Orientation is checked for any steric clashes between ligand and receptor.
5. If acceptable, then interaction energy is computed as a 'score' for that binding mode.
6. New orientations are obtained by matching different sets of atoms and sphere centers.
7. Top-scoring orientations are retained for subsequent analysis.

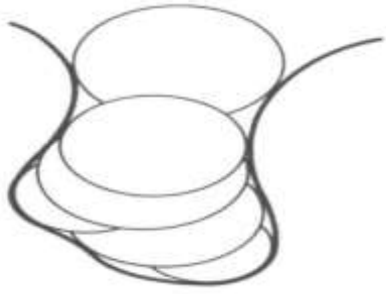

Figure 1a. Making of a negative image of the binding site

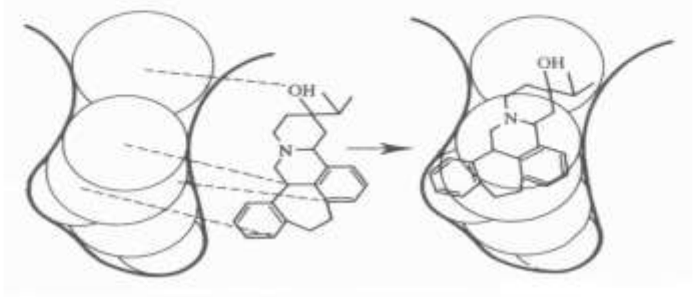

Figure 1b. Ligand atoms are matched to sphere centers

Different Types of Interactions

Electrostatic forces	Forces with electrostatic origin are due to the charges residing in the matter. The most common interactions are charge-charge, charge-dipole and dipole-dipole.
Electrodynamics forces	The most widely known is probably the van der Waals interaction.
Steric forces	Steric forces are caused by entropy. For example, in cases where entropy is limited, there may be forces to minimize the free energy of the system, which are due to entropy.

Solvent-related forces	Solvent-related forces are due to the structural changes of the solvent. These structural changes are generated, when ions, colloids, proteins etc, are added into the structure of solvent. The most commonly are Hydrogen bond and hydrophobic interactions.
Other physical factors	conformational changes in the protein and the ligand are often necessary for a successful docking process.

Types of Docking

Lock and Key\Rigid Docking	Induced fit\Flexible Docking
In rigid docking, both the internal geometry of the receptor and ligand is kept fixed and docking is performed.	An enumeration on the rotations of one of the molecules (usually smaller one) is performed. Every rotation the surface cell occupancy and energy are calculated; later the most optimum pose is selected.

Molecular Docking

Molecular docking can be divided into two separate sections and the major steps in molecular docking are indexed in Table 1.

Search algorithm	Scoring Function
The algorithm should create an optimum number of configurations that include the experimentally determined binding modes.	These are mathematical methods used to predict the strength of the non-covalent interaction called as binding affinity, between two molecules after they have been docked.
Various algorithms used for docking analysis such as Molecular dynamics, Monte Carlo methods, Genetic algorithms, Fragment-based methods, Point complementary methods, Distance geometry methods and Systematic searches	Scoring functions have also been developed to predict the strength of other types of intermolecular interactions.
	These configurations are evaluated using scoring functions to distinguish the experimental binding modes from all other modes explored through the searching algorithm.

Conclusion

The potential docking technique is done after thoroughly screening the target, ligands and docking method performance. The ligand flexibility however is almost resolved and does not create much problem however protein flexibility needs to be improved. Water molecules should be included to consider the hydrogen bonding with non-aqueous residues. It is evident from docking literature that it has attained a good amount of maturity and in this short review, we have focused on types, approaches, applications and challenges of molecular docking in brief but accounting for flexibility and successful scoring remain significant challenges.

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Table 1. Major steps in molecular docking

Step I	Building the Receptor	• This step the 3D structure of the receptor should be considered which can be downloaded from PDB; later the available structure should be processed.

		• This should include removal of the water molecules from the cavity, stabilizing the charges, filling the missing residues, generation the side chains etc. The receptor should be biological active and stable state.
Step II	Identification of the Active Site	• After the receptor is built, the active site within the receptor should be identified. • The receptor may have many active sites but the one of the interests should be selected. • Most of the water molecules and heteroatom if present should be removed.
Step III	Ligand Preparation	• Ligands can be obtained from various databases like ZINC, PubChem or can be sketched using tools Chemsketch. While selecting the ligand, the LIPINSKY'S RULE OF 5 should be applied. • For selection of a ligand according to the LIPINSKY'S RULE i.e. Not more than 5 –H bond donors, Molecular Weight NOT more than 500 Da, Log P not over 5 and NOT more than 10 H bond acceptors.
Step IV	Docking	• This is the last step, where the ligand is docked onto the receptor and the interactions are checked. • The scoring function generates score depending on which the best fit ligand is selected. Softwares available for Molecular Docking are SANJEEVINI, SCHRODINGER, DOCK AUTOLOCK TOOLS, DISCOVERY STUDIO and iGemDock

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Production Technology of Cinchona

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Cinchona Linn. belongs to the Rubiaceae family comprising of 65 species. Among the species *C. succirubra, C. officinalis, C. ledgeriana, C. robusta* and *C. hybrida* are grown commercially for Peruvian bark which is that the source of quinine and other antimalarial drugs. Additionally, quite twenty other alkaloids are isolated from cinchona of which cinchonidine, quinidine and cinchonine are important. Other than this, quinamine, quinicine (quinotoxin), cinchonicine (cinchotoxin), hydroquinine, hydroquinidine, hydrocinchonine (Cinchotine), hydrocinchonidine (cinchonidine), cinchonamine, quinamine, conquinamine, poricine *etc.* are also present in this crop. The leaves contain 1 per cent total alkaloids. In *C. ledgerina* almost 90 per cent of the entire alkaloids of the stem bark is quinine, while of the entire alkaloids of the basis bark, only 60 per cent is quinine.

Quinine as a curative to malaria has been known since time immemorial and even today expert medical opinion regards quinine, as a secure and sure remedy for malaria. It's been used as a sclerosing agent within the treatment of internal haemorrhoids and varicose veins. Quinine protects the skin against sunburn. It's a bitter tonic and stomachic appetizer. In small doses in solution it's a light irritant and a stimulant of the gastric mucosa and other mucous membranes. It's a weak uterine stimulant. Quinine and other alkaloids have variety of nonmedical uses also. Salts of quinine are employed in beverages, as an addition to hair-oil, vulcanization accelerators in rubber industry, polarised lenses and other uses in photography and optics.

Origin and Distribution

Cinchona is indigenous to South America. Some species are cultivated in Java, Sri Lanka, India, Burma, Zaire and Costa Rica. In India it's confined to some parts of West Bengal, Tamil Nadu (Annamalais, Naduvattam, Shevory, Palanis and parts of Tirunelveli) and Karnataka (South Canara and Coorg).

Botany

Cinchona spp. (x=17) are evergreen shrubs or trees. Leaves are opposite, simple, entire; stipules interpetiolar, deciduous. Inflorescence may be a terminal panicle. Fruit may be a capsule, dehiscing from base upwards with 40-50, small, flat, winged seeds.

Varieties

Cinchona is a naturally cross-pollinated plant and therefore the present stands of cinchona are only crosses between the various species. Tamil Nadu cinchona department developed one clone No. 701 containing over 12 per cent of quinine sulphate in the bark and is propagated on extensive scale in Nilgiris and Anamalais.

Soil

Cinchona prefers a well-drained forest soil rich in humus with no possibility of sub-soil water logging and high moisture holding capacity. It prefers acidic soil (pH 4.6 to 6.5).

Climate

C. ledgeriana grows best during a tropical climate at attitudes of 1800 m (6000 feet). However, the other species grow well in areas with a mean minimum temperature of 13.50C and maximum of 210C with a mean RH of 83 per cent. The expansion is extremely poor at temperatures below 70C or above 260C. They grow well in places where the annual rainfall is small but 2000 mm and is well distributed over atleast eight months within the year.

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Cinchona is susceptible to frost hence, it's not grown on high hill ranges. The optimum elevation at which the crop grows well is 1800 m (6000 feet).

Cultivation

Propagation: Cinchona is propagated both by seeds and also as vegetatively through cutting, stooling, layering, cleft grafting, veneer or side grafting and patch budding. As most of the species of Cinchona are highly heterozygous, vegetative propagation is preferred. But in India, cinchona is propagated by seeds because it is relatively less costly.

Propagation by Seeds

Cinchona seeds are small and light weight and loose viability on storage. Seeds are generally sown during April in sloping beds, 12 feet x 4 feet and covered by a thatch roof. The nursery area is ready in such how that the highest layer up to a depth of 2-3 inches consists of a mix of leaf mould and sand in equal proportions, and is carefully pressed by hand in order that it's uniformly firm everywhere. Cattle manure is typically not applied to the nursery beds. The seed germination will take 20-40 days after sowing. About 50 per cent germination is noticed out of which only about 10 per cent of the seedlings are going to be suitable for transplanting after eliminating all the weak, lean and lanky seedlings. The seedlings grown within the ground nursery are often transplanted in baskets or polythene bags once they are about four months old with 2 pairs of leaves. The seedlings are going to be ready for planting within the main field during mid-May of succeeding year once they are about 14-18 months old and 3060 cm tall.

Vegetative Propagation

Vegetative propagation like patch budding, soft terminal cuttings and layering have recorded best results in cinchona. A high percentage (85%) of success is obtained in patch budding during March to middle of June. Patch budding is typically wiped out the nurseries or plantations in place on plants one to 2 years old. Even the budding on coppice has given good success and better growth of budded plants. The cuttings are made to root by cincturing and etiolation. During May-June the shoots are treated from which cuttings are taken after 50-65 days and planted in nursery. In layering, the East Malling method with some modifications has given good results, each stool will give annually about 100-200 shoots in 2 or 3 coppicing. *C. succirubra* is employed as stock wherever grafting is completed.

Land Preparation

For raising cinchona plantation humus rich forest soils are best suited. The forest is cleared and therefore the ground is levelled and dug to a depth of 1 1/2 feet to enhance the soil structure. The pits should be dug at 60x60x60 cm and filled up with top soil and well decomposed organic matter.

Planting

Planting is completed before the setting of heavy rains. The planting is completed in pits opened at a spacing of 120 x 120 cm or 150 x 150 cm or dense planting of about 8000 plants per hectare is completed and therefore the plants are gradually harvested from 3-5 years until about 800 plants remain in one hectare after 25 years. Young cinchona plants need shade which is provided by planting shade plants like *Alnus nepalensis*, Indian coral tree, *Albizzia stipulata* and *Grivellea robusta* 20 feet apart.

Application of Fertilizers

Application of a fertilizer mixture containing nitrogen, phosphorus and potash give marked results. Liming (dolomite or lime stone) is applied for soil if the pH is 5 or lower. Nutrients are supplied at 115 kg N, 105 kg P_2O_5 and 115 kg K_2O per hectare. The quinine content in cinchona is higher with the age of the tree under favourable nutritional conditions.

Weeding

Weeds need to be removed at regular intervals, particularly in young plantations.

Cover Cropping

Besides the native cover *Crotalaria usaramoenis* are grown as cover crop in cinchona plantations.

Cultural Operations

The plants should be staked properly within the first three years to stop their lodging.

Harvesting

By considering the quantity of vegetative growth, the trees are coppiced once they are six to eight years old. Coppicing involves pruning the tree at a height of 5 cm (2 inches) from the bottom level. The overlooked stump regenerates to supply more number of shoots but only two or three of those are retained and allowed to grow further. A second coppicing is completed 8-10 years after the primary coppice. Only about two to three shoots are left to grow further. Uprooting of the plants is completed within the 30th year when the vigour of the plant declines. Major harvests are obtained at the time of first two coppicing and only little yield of bark is obtained from the dead and drying trees and pruned branches. The primary set of yields are obtained from the third year after planting. The bark is separated from the coppices by beating with a mallet then peeled by hand or knife. The peeled bark should be dried immediately to stop the loss of alkaloids. The bark is dried preferably in shade. In rainy weather, drying is completed in special sheds or by use of artificial heat. In well-established plantations drying is completed by well regulated ovens. For this purpose hot air oven is regulated at 700C. The long strips of bark are cut into small pieces and fed into the upper end of an extended slightly inclined, rotating cylindrical oven. The dried product contains 10 per cent moisture. Dried bark is then packed in gunny bags. The dried bark is named `Druggists' bark (quinine content 1.8-2%) in trade.

Yield of Bark

During the primary two coppicing, a yield of 4000 kg of dry stem bark per hectare is obtained. At the ultimate stage of uprooting the tree the yield of the bark could also be about 6000 kg per hectare.

Isolation of Quinine

The alkaloids are extracted from the powdered bark. Quinine is isolated from the entire alkaloids of the bark as quinine sulphate. The commercial preparations contain cinchonidine and dihydroquinine and quinine could also be purified by recrystallization to constant specific rotation. The crystalline, efflorescent trihydrate, is a white, odourless, intensely bitter, micro-crystalline powder.

Substitutes for Peruvian Bark

The barks of *C. lancifolia, C. ovata, Remijia pedunculata* and *R. purdieana* are often used as substitutes for Peruvian bark.

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Economic and Eco-Friendly Means for Disease Management: Bio Control Agents

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Introduction

Biocontrol of plant diseases provides practices compatible with the goal of a sustainable agricultural system. It means controlling the disease by the use of living organism that is inhibitory to another microorganism. They are the need of hour and getting economic and commercial importance over conventional means of management such as use of fungicides, insecticides. Firstly, they are cheaper and don't have residual effect. Secondly, they are ecofriendly. and have long lasting effect. Thirdly they are effective as compare to conventional means. Last but not least they also nourish the soil by providing nutrients, increasing biomass in soil, hence improve structural, physical, chemical properties of soil. They have different mode of action in managing pathogen. But main gist of their action is competition. They inhibit their growth, fecundity, reproduction and compete with nutrients, light space and by secreting some harmful metabolites called antibiotics. Hence called as because they suppress the survival of another organism in disease management biocontrol technologies have gained momentum of crop plants in recent times as these technologies not only minimize or replace the usage of harmful chemical pesticides but also found to be cheaper and efficient in certain disease control programmers.

Successful use of fungal biocontrol agents like *Trichoderma* spp. for the management for soil borne pathogens e.g. *Fusarium, Rhizoctonia, Sclerotium, Colletotrichum* etc *Trichoderma* has gained maximum attention as biocontrol agent due to the fact that it is effective against a large number of soil-borne plant pathogenic fungi, suppressive effects on some root nematodes without adversely affecting beneficial microbes like *Rhizobium* and capable of promoting growth of certain crops.

Mode of Action

The mechanisms of biocontrol mainly include:

Antibiosis: Antibiotics are microbial toxins that can, at low concentrations, poison or kill other microorganisms. Antibiotics produced bybacteria include volatile antibiotics (hydrogen cyanide, aldehydes, alcohols, ketones, and sulfides) and nonvolatile antibiotics: polyketides (diacetylphloroglucinol; DAPGand mupirocin), heterocyclic nitrogenous compounds (phenazine derivatives: pyocyanin, phenazine-1-carboxylic acid; PCA, PCN, and hydroxyphenazines) (de Souza et al. 2003),andphenylpyrrole antibiotic (pyrrolnitrin) (Ahmad et al. 2008). Bacillus strains produce a variety of lipopeptide antibiotics (iturins, bacillomycin, surfactin, and Zwittermicin A).

Eg. Phenazine antibiotic (Phz) produced by Pseudomonas fluorescens strain 2-79 has been implicated in control of take all disease of wheat caused by *Gaeumannomyces graminis* var. *tritici.* Among other bacteria, antibiotic Agrocin 84 produced by *Agrobacterium radiobacter* strain K84 is one of best described examples of biocontrol to control crown gall caused by virulent *A. tumefaciens* strains.

Competition: Biocontrol by nutrient competition can occur when the biocontrol agent decreases the availability of a particular substance thereby limiting the growth of the pathogen. Particularly, the biocontrol agents have a more efficient uptake or utilizing system for the substance than do the pathogens.

Eg. Pseudomonas produce siderophores (iron chelating compounds) that have very high affinities for iron and can sequester this limited resource from other microflora thereby preventing their growth.

Mycoparasitism: This process involves the direct utilization of one organism as food by another. *Trichoderma lignorum (T. viride*) parasitizing hyphae of *Rhizoctonia solani.*

Cell wall degrading enzymes: various enzymes like chitinase, cellulase, pectinase, hemicellulase are secreted by bioagents that hinders the growth of pathogen. It mainly occurs in pathogen affecting cell wall and epidermis.

Induced resistance: It refers defence responses may include the physical thickening of cell walls by lignification, deposition of callose, accumulation of antimicrobial low-molecular-weight substances (e.g., phytoalexins), and synthesis of various proteins (e.g., chitinases, glucanases, peroxidases, and other pathogenesis related (PR) proteins) that hence induce defence response in plants.

Commercial Formulation Available in Market

They are available as solid based formulation (talc based, vermiculite wheat bran, Pesta granules, Wheat flour based kaolin based, and alginate prills), liquid based includes (oil based, pressmud formulation).

Method of Application

Their application is based on mode of primary and secondary infection of pathogen that may be seed, soil, air borne. They can be applied as seed treatment (ST), soil application(SA), foliar spray (FS), seed biopriming and as wound dresser.

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Biopesticides: A Novel Approach for Pest Management

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Biopesticides are derived from naturally occurring living macro and microorganisms. Biopesticides have been termed as "a form of pesticide based on micro-organisms or natural products. Many biopesticides have been developed from microorganisms (bacteria, fungi, viruses, etc.), plant, animal derived products and genetically modified organisms and used worldwide for insect pest management (Islam, 2012).

In the recent years biopesticides are replacing the chemical pesticides to overcome the harmful effect of the chemicals on non-target organism. These bioagents, which have specific modes of action, are generally considered safer as compared to conventional chemical insecticides. They are usually important components of IPM programmes and have received much practical attention as substitutes to synthetic chemical plant protection products.

Types of Bio-Pesticides

Biopesticides divided into three parts:

1. Microbial Pesticides: This group includes microorganisms such as bacteria, fungi, viruses or protozoan communities as an active ingredient against target pests. The effect by microbial entomopathogens occurs by invasion through the integument or gut of the insect, followed by multiplication of the pathogen resulting in the death of the host.

For example, there are fungi that control certain weeds, and other fungi that kill specific insects (Bhatti *et al.*, 2017). One bacterial species like *Bacillus thuringiensis* may be more effective on *Aedes aegypti* while one another *B. sphaericus* strain can be effective on mosquito, *Culex quinquefasciatus*.

2. Genetically modified plants / Plant Incorporated Protectants (PIP's): PIPs can help plants resist viruses, bacteria and insects. When PIP crops target insects, they can be called "insect-resistant. These are the pesticidal substances that plants are able to produce from genetic material that has been incorporated in it by using genetic engineering tools.

E.g., *Bacillus thuringiensis* (Bt.) gene is incorporated in plant genetic material which gives it strength to crop with the specific pest. Baculoviruses are the only viruses being used as the safest biological control agents. They infect insects and have narrow host ranges. *Bacillus thuringiensis* is the most widely and successfully used bio-insecticide in the integrated pest management programs.

3. Biochemical Pesticides: Biochemical pesticides are produced naturally and provide defense against pests by non-toxic mechanisms. This category includes insect pheromones, which inhibit mating, and also comprise various scented plant extracts to trap insect pests.

Pheromones produced by insects are highly species specific. Present scenario pheromones and other semiochemicals are applied for insect pest monitoring and control in millions of hectares. E.g., Methoxy benzene (anisole) is the aggregation pheromone for scarabidae beetles.

Role of Biopesticides

1. Reduce environmental pollution.
2. Limited field persistence.
3. Conservation of natural resources.
4. Maintain ecological balances.
5. Reduce pesticides residual effect.

6. Preservation of biodiversity, pollinators and Non-target species.
7. Generation of rural employment.
8. Reduce human and animal health hazards.

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Overview of Mulching & How it Works in Agriculture Field

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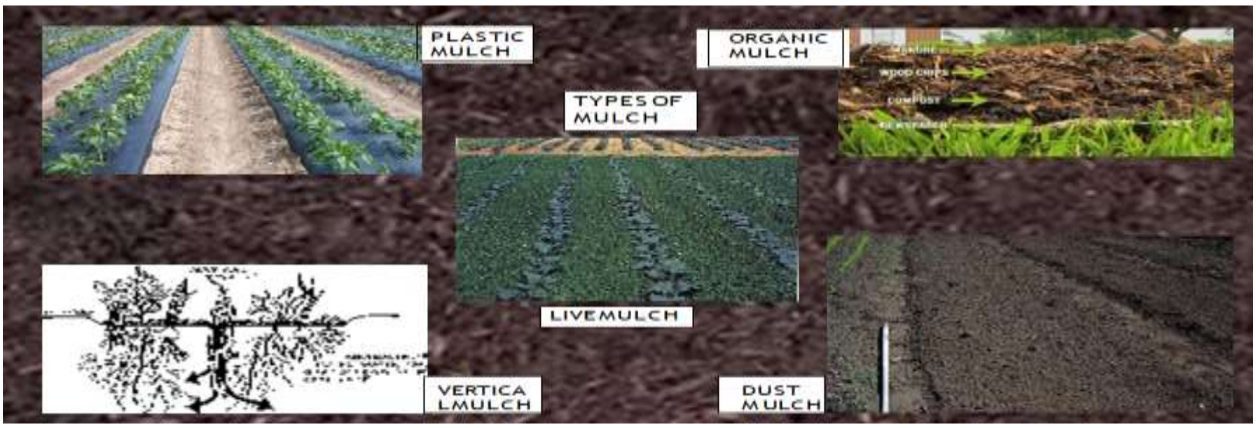
Introduction

Mulching is the intermediate boundary of organic and inorganic material between soil and atmospheres. Mulches are material placed over the soil surface to maintain moisture, prevent weed growth and improve soil conditions. According to Mekonnen et al (2015) revealed that in 20th century soil and water conservation has a serious concern. At present condition farmers use various types of mulch because it is the simplest and cheapest method for augmenting the yield up to 25 to 60%. In India most of the area faces a soil erosion problem where mulching plays a crucial role for the soil conservation and also provide the additional benefit i.e. it reduces the evaporation 75% by increasing the soil moisture conservation viz., 25% in organic mulch and 75% in inorganic mulch. Organic mulch ensures the continuous release of nutrients into the soil as well as it acts as a food for microbial proliferation. Mulch application rate greatly impacted soil and water loss; generally, with the increase of mulch application rate, the rates of soil loss and runoff reduction increased and when mulch application rate reached 6–10 Mg ha−1, soil and water loss decreased significantly. Mulching has become a significant practice in modern crop production. Various Mulches like organic mulch, live mulch, paper etc. reduces the application of synthetic fertilizer and herbicide, weed control and maintain the land temperature. However inorganic mulch (plastic mulch) has enhanced the temperature in the range of 4-10 ºC at a 5 cm of the soil and this rise temperature plays a vital role for the control of weed population below the critical limit.

Types of Mulches

There are different type of mulch which pictorially presented in below and its mulching nature depends upon the composition of mulch material i.e. Organic mulch is made up of natural substance such as bark, wood chips, pine needles, dry grasses, paddy straw, dry leaves, saw dust, grass clipping, etc. Organic mulch attracts insects, slugs and the cutworms that eat them. They get decomposed easily and need frequent replacements. However there are various type of plastic used in the mulch like black and transparent films are generally used for mulching. Advancement in plastic chemistry has resulted in development of films with optical properties that are ideal for a specific crop in a given location. Douglas and Sanders (2001) stated that the advantages of using plastic mulches are: increasing soil temperature from 4 to 5 ºC under black mulch, 5 to 8 ºC with infrared transmitting mulch (clear green), or 8 to 10 ºC at a 5 cm depth under clear mulch, reducing soil compaction, reducing evaporation, reducing weed problems, earlier crops and increasing growth.



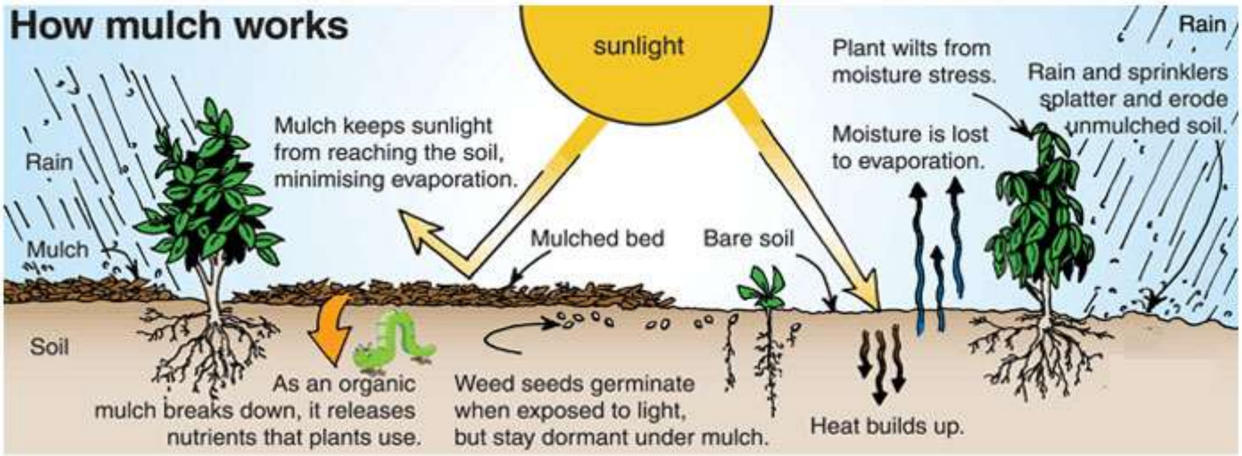
These are two types.

1. Photo-degradable plastic mulch: This type of plastic mulch film gets destroyed by sun light in a shorter period.

2. Bio-degradable plastic mulch: This type of plastic mulch film is easily degraded in the soil over a period of time.

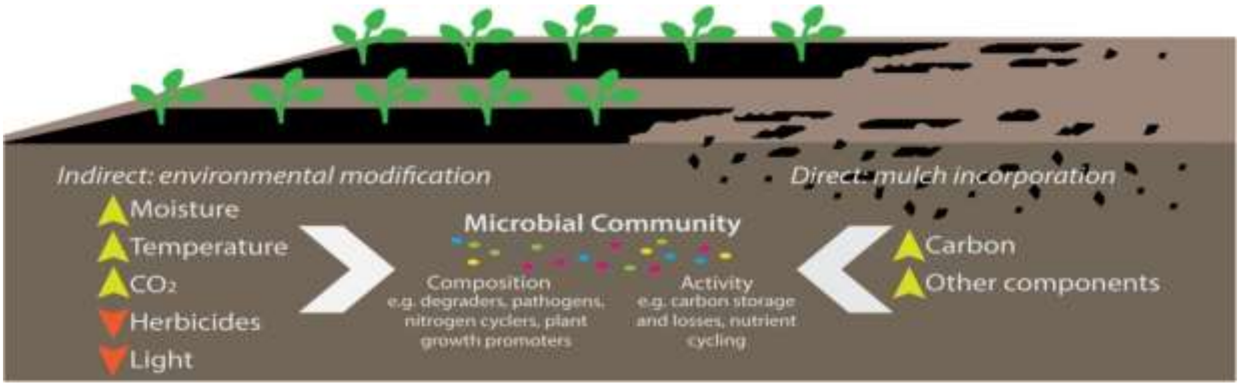
How Mulch Works?

In given figure, it is clearly depicted the two condition [1] organic mulch spread in the field and [2] bare soil where no mulch is used. The impact of organic mulch and its role are easily pictorially presented. The mulch material like Organic residues, grass clippings, leaves, hay, straw, shredded bark, whole bark, animal manure etc. are spread over the soil surface and it prevents the beating action of rain directly on the soil so it reduces the impact forces and soil erosion, however the mulch keeps sunlight from reaching the soil and minimizing evaporation. In spite of this organic mulch undergo the decomposition process and it releases nutrients in the soil solution pool for ease uptake by plant. Solar radiation is crucial for weed germination but mulch cut down the light supply so weed stay dormant under mulch.



Direct and Indirect Environmental Modification by Mulch

This pictorial representation that shows that how mulch directly and indirectly modified the environment of the soil because organic mulch regulates the different components i.e. moisture, temperature, carbon dioxide, herbicide, light, microbial density, carbon content and so on. Organic mulch is easily decomposed by various microbes and it releases different macro, micro nutrients as well as secretes the organic acid that plays a vital role in soil aggregation process and also conditioning the soil health.



Conclusion

In general, the average soil temperature was greater than bare soil in case of using plastic mulch. Therefore, plastic mulches are recommended to obtain high soil temperatures in the cold conditions; meanwhile, the organic mulches are better than plastic mulching in a hot climate due to its ability for moderating soil temperature and create a favourable condition for the better plant seedling growth and also conserve the natural resources. Organic mulch has an additional benefit that provides the food for the microbial proliferation and also supplies the macro and micro nutrient in the soil as well as also improves the soil physio-chemical and microbial property. Organic and inorganic mulch conserve the soil moisture with different percentage are 25%

and 75% respectively. Mulching has increased the yield of 25-75% by reducing the evaporation i.e. 70% and also curtail the soil erosion is 41-75%.

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System of Rice Intensification (SRI): A Resource Conserving Method of Rice Crop Establishment

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Introduction

Rice is commonly grown by transplanting one-month-old seedlings into puddled and continuously flooded soil which leads to higher losses of water through puddling, surface evaporation and percolation. Excessive pumping of water for puddling causes problems of declining water table and poor-quality water for irrigation. High water need, seed amount, labour costs and labour requirements for transplanting have reduced profit margins. During the past year's efforts have been tried to find out alternatives to the traditional method of rice cultivation. System of rice intensification a resource conservation method is found to be an efficient alternative to increase the rice production as it requires less water, less seed, reducing cost of cultivation and saving labour over time.

The system of rice intensification methodology was developed in Madagascar in early 80's (Laulanie, 1993) as a system approach to increase rice productivity with less external and use of low-cost inputs. SRI cultivation is slowly gaining importance all over the globe including India. SRI as a holistic agro ecological crop management technique seeking alternatives to the traditional high-input agriculture through effective integration of crop, soil, water and nutrient management.

SRI is Based on the Following Principles

1. Early Transplanting: Transplant 8-12 day old seedlings, with only two small leaves, (More tillering potential and root growth potential).

2. Careful Transplanting: Minimise trauma in transplanting. Remove plant from nursery with the seed, soil and roots carefully and place it in the field without plunging too deep into soil (More tillering potential).

3. Wide Spacing: plant single seedlings, not in clumps, and in a square pattern 25cm x 25cm apart or wider. Do not plant in rows. (More root growth potential)

4. Weeding and Aeration: use simple mechanical "Cono weeder" that churns up soil; 2 weedings required, (More root growth, due to reduced weed competition, and aeration of soil, giving roots more Oxygen and Nitrogen due to increased microbial activity) Each additional weeding after two rounds results in increased productivity up to 2 tons ha-1 per weeding.

5. Water Management: regular water application to keep soil moist but not saturated, with intermittent dryings, alternating aerobic and anaerobic soil conditions (More root growth because it avoids root degeneration, enables better abosrption of nutrients from the soil).

6. Compost / FYM: applied instead of or in addition to chemical fertilizer; 10 tons ha-1 (More plant growth because of better soil health and structure, and more balanced nutrient supply).

Impact of Drum Seeding Technique in Paddy

An investigation on "Productivity and water use efficiency of rice (Oryza sativa L.) cultivars under different irrigation regimes and systems of cultivation" was conducted at Indian Institute of Rice Research (IIRR) formerly Directorate of Rice Research (DRR), Rajendranagar, Hyderabad, Telanagana during kharif seasons of 2017 and 2018. System of rice intensification was better in terms of growth parameters, yield attributes, grain and straw yields, nutrient uptake, NUE, water productivity and WUE over normal transplanting method but it was comparable with drum seeding method. The experimental plot was dry ploughed twice followed by puddling with tractor mounted cage wheels and later levelled uniformly. The plots were laid out as per the treatment schedule and buffer channels were provided to avoid movement of water from one plot to another. The treatments were randomly assigned to the plots as per the experimental design. The treated seeds were soaked in water for 24 hours. After soaking, the seeds were incubated in moist gunny bags under paddy straw for about 24 hours to induce sprouting. The sprouted seeds were sown in the nursery for SRI and normal transplanting methods.

For nursery raised bed (about 10 cm) of 10.0 m length and 1.0 m width was primed. 40 cm drainage cum irrigation channel was prepared around the bed. Soil and vermicompost (1:1) mixture was spread up to 4-5 cm thickness on the nursery bed. One day before sowing the nursery bed was prepared. Seeds were soaked and incubated in moist gunny bag for 24 hours. The sprouted seeds were broadcasted uniformly on the nursery bed. A seed rate of 5 kg was sown in 100 m-2 of nursery bed and it was enough to transplant in the one-hectare main field. After broadcasting the sprouted seed, soil and vermicompost mixture was spread again in a thin layer of 0.5 to 1 cm over the seeds and carefully mulched with rice straw for 2-3 days to avoid the seed from direct exposure to the sun, birds, rain, etc., (Kumar and Shivay, 2004). 12 days old aged seedlings were transplanted manually (single seedling hill-1) with 25 cm x 25 cm spacing. The seedlings were removed together with roots from the nursery bed carefully and transplanted in the main field at very shallow depth within 30 minutes after removing from the nursery. Separate raised bed nursery was prepared for normal transplanting and twenty-five days old rice seedlings were transplanted, with 2 to 3 seedlings per hill-1. The crop geometry of 20 cm x 15 cm was adopted.

Benefits of SRI

1. Higher yields - Both grain and straw.
2. Reduced duration (by 10 days).
3. Lesser chemical inputs.
4. Less water requirement.
5. Less chaffy grain %.
6. Grain weight increased without change in grain size.
7. Higher head rice recovery.
8. Withstand cyclonic gales.
9. Cold tolerance.
10. Soil health improves through biological activity.

Disadvantages

1. Higher labour costs in the initial years.
2. Difficulties in acquiring the necessary skills.
3. Not suitable when no irrigation source available.


Plate.1. Cono weeding in SRI method

Plate.2. 30 DAT	Plate.3. 60 DAT

Plate.4. Tillering stage

Table 1. Differences between normal transplanting and SRI methods rice cultivation (per ha):

Particulars	Normal Transplanting	SRI
Seed rate	75 - 100 kg	5 kg
Days to transplant	25 - 30 days nursery	8-12 days
Spacing	20 x 15 cm	25 x 25 cm
No. of seedlings per hill	3	1
Water management	5 cm or more standing water from the day of transplantation to 15 days before harvesting	Alternative wetting and drying of soil outcome in augmented microbial activity in the soil and easy accessibility of nutrients to the plants.
Weed management	Manual weeding twice (or) some apply of weedicides 1st time and manual weeding 2nd time.	Cono-weeding was done twice at 20 and 40 DAT in one direction and one hand weeding was required at 30 DAT if weed growth is more.
Number of hills m-2	33	16
Number of tillers m-2	257	320
Number of filled grains panicle-1	121	143
Total number of grains panicle-1	148	160

Chaffy grain per centage	17.96	10.19
Grain yield kg ha-1	5202	6041
Total cost of cultivation	Rs. 31401 ha-1	Rs. 36531 ha-1
Gross returns	Rs. 89248 ha-1	Rs. 103230 ha-1
Net returns per acre	Rs. 51317 ha-1	Rs. 66449 ha-1
Benefit-cost ratio	2.35	2.81

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Biotechnology - Combined Approach of Morphological and Molecular Diagnosis of Diseases in Plants

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Introduction

Food security has become an important international issue in recent years. The demand for food will continue to increase due to rapid increase in human population. One of the most prominent reasons behind the food crisis is decrease in agricultural productivity. Spoil caused by pathogens and pests in plants plays a considerable role in crop losses. In order to minimize the damage caused by pathogens and pests in crops during growth, harvest, postharvest stages and to increase the productivity rapid and advanced disease detection methods are highly significant. The morphological diagnosis of disease in plants quickly identifies limited number of species associated with particular host or disease. Identification and detection of diseases in crops can be done with conventional and molecular methods. Conventional methods include histopathological (on the basis of infected tissues) mostly done in cases of fungi, bacteria and nematodes, Culture growth/colony characters, microscopy, staining and differentiation on basis of bio-chemical properties. In current years, molecular techniques of plant disease detection have been well recognized and are more reliable. The molecular techniques are very sensitive as requires minimum amount of microorganism that can be detected. The frequently used molecular techniques for disease detection are ELISA and PCR. Other molecular techniques include immunofluorescence (IF), flow cytometry, fluorescence in situ hybridization (FISH) and DNA microarrays.

Conventional Methods

Conventional methods are done by observing the symptoms appeared on the host tissue either by naked eye and hand lens. All plant pathogens produce distinctiveness symptoms in different parts of the plants.

Histopathological Methods

Culture growth/ colony characters and Microscopy differentiation on basis of bio-chemical properties.

Advance Methods of Disease Detection

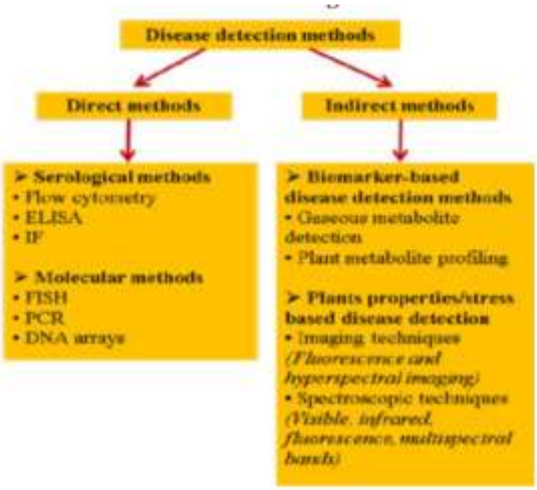

Fig.1. Different disease detection methods

There are two types of advanced methods of disease detection in plants. Direct methods and indirect methods.

Direct methods include laboratory-based techniques such as polymerase chain reaction (PCR), immune fluorescence (IF), fluorescence insitu hybridization (FISH), enzyme-linked immune sorbent assay (ELISA), flow cytometry (FCM) and gas chromatography-mass spectrometry (GC-MS), whereas thermography, fluorescence imaging and hyper spectral techniques are used under indirect methods. Biosensors based on enzyme, antibody, DNA/ RNA and bacteriophage as a new tool for the early identification of crop diseases. The flow chart of disease detection methods is showed in fig.1.

Direct Methods

1. Serological methods: Serological methods are used for high-throughput analysis for large numbers of samples. In these methods the disease-causing pathogens such as bacteria, fungi and viruses are directly detected to provide accurate identification of the disease/pathogen. Some serological methods are listed below. Flow Cytometry Enzyme-Linked Immunosorbent Assay (ELISA) Immunofluorescences (IF) Fluorescence in-situ hybridization (FISH).

2. Molecular methods: Direct detection of diseases includes various molecular methods that could be used for high-throughput analysis. Based on DNA hybridization and replication, PCR was initially used for highly specific detection of diseases. Now it has been extensively used for the detection of plant pathogens. In addition to the basic PCR technology, advanced PCR methods such as reverse-transcription PCR (RT-PCR), Multiplex PCR and Real-time PCR has also been used for plant pathogen identification due to its high sensitivity. Some broadly used molecular methods are given below. Polymerase Chain Reaction, Multiplex RT-PCR, LAMP technique, Real-time RT-PCR and DNA-arrays.

Indirect Methods

Thermography fluorescence Imaging Hyper spectral Techniques and Gas Chromatography.

Detection of Plant Diseases Using Portable Sensors

Bacteriophage-Based Biosensors, Affinity biosensors, Antibody-Based Biosensors and DNA/RNA-Based Affinity Biosensor.

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Bionomics and Management of Whitefly *(Bemisia tabaci)*

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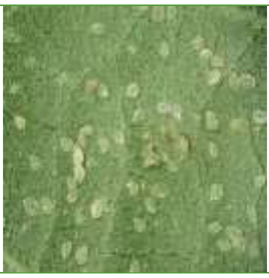
Whiteflies are very small insects that resemble tiny white moths. Whiteflies usually feed on the lower surface of their host plant leaves, hosts (more than 600 host plants) and vectors over 111 plant virus species and is considered to be a major invasive species worldwide, which was agriculturally unimportant pest before 3 decades occupied its devastate form in early 1980s causing damaging in melons vegetables and cotton crops in different countries. Losses in agricultural production have increased owing to *B. tabaci* as new, more virulent and less pesticide-sensitive cryptic species have spread to all continents. The taxonomic status of *B. tabaci* remains debated between 36 previously identified biotypes and the newly proposed 26 discrete species and they can only be identified by performing genetic analysis. Because many species of adult whiteflies are similar in appearance, entomologists use the last nymph stage for specific identification purpose as in general. The actual biotypes unknown but at least 16 numbers identified. The two most invasive members of the cryptic species complex posing the greatest threat to growers are Middle East –Asia Minor 1 (MEAM1) and Mediterranean (MED) (commonly known as biotypes B and Q respectively).

Life History & Anatomy

Egg stage: Whitefly eggs have a pedicel that is an extension of the egg chorion. A large bacteriome (formally mycetome) in each whitefly egg contains symbiotic bacteria received through transovariole transmission from the mother.

Nymphal stage: The early first instar or "crawler" has well-developed legs and, after hatching, it wanders over the leaf surface in search of a suitable settling site. Cohen et al. (1996a) stated that crawlers must locate a settling site in 3–5 h or die (presumably at 25◦C).The "eyes" of the nymphal stage consist of two small spots that lack a cuticular cornea and have an underdeveloped retina (Gelman et al. 2002). They later develop into the compound eyes of the adult, but in the nymph they presumably function as simple light detectors.

Pupal stage: "Pupal stage" which is the latter part of the fourth nymphal instar Unlike the Holometabola, the pupal stage is not a separate instar. The metamorphosis is the enlargement of the eyes from small red pinpoints to larger diffuse red oval spots, and finally to conspicuous red eye spots giving rise to the term "red-eyed nymph". Close to the time of adult eclosion, the fourth instar. cuticle is mostly transparent, and the pharate adult becomes visible underneath.

			
Egg stage	**Nymph**	**Red Eyed Stage**	**Adult**

Adult stage: Whiteflies cover their body with tiny wax particles produced by large wax plates located on the ventral side of the abdomen; Bemisia and all other members of their subfamily (Aleyrodinae) have two pair of wax plates on females and four pair on males. As in most whiteflies, the antennae of adult Bemisia are 7-segmented and possess several different kinds of sensillae. The apical 5 segments, the flagellum. The abdomen consists of nine conspicuous segments, and a highly reduced tenth segment that surrounds the vasiform orifice. The male genitalia extend posteriorly from the ninth abdominal segment and consist of a pair of tong-like parameres, or "claspers," and a single penis. The claspers are used to grasp the female ovipositor during copulation.

Feeding Behaviour

Bemisia sp feeds primarily on phloem in minor veins and ingest sap specifically from sieve elements that have a very high turgor pressure (0.2–1 MPa – Kingsolver and Daniel 1995) due to their high sugar concentration. Stylet penetration usually is initiate in the anticlinal grooves between adjacent epidermal cells. In contrast to aphids, intracellular punctures by whiteflies are much less frequent, and generally occur only after the stylets have penetrated deep into the leaf tissue.

Mating Behaviour

Whiteflies participate in a series of complex and elaborate behaviours in selecting, courting, and copulating with the opposite sex of their own species or biotype. Upon emergence, both sexes were clear winged and sexually immature. They matured during the next 24 h and their wings were coated with wax. The precopulatory, copulatory, and postcopulatory behaviours, including the time spent at each step, are described for mature adults. A comparison of the sexual behaviour of emerged males were attracted to I-d-old females and sometimes initiated courtship that rarely persisted.

Relationship with Other Organism

Bemisia tabaci (Gennadius) in particular – are involved in complex interactions with the host plant, various microorganisms and arthropods (herbivores and natural enemies). These relationships are not only important to the ecology and evolution of *B. tabaci* but are also essential to understanding and developing innovative control strategies.

The Role of Secondary Symbionts in Whitefly Biology

The diversity of S-symbionts in whiteflies is most probably as important in shaping the ecology and evolution of whiteflies. Some of them apparently participate in supplying the host with nutrients under certain conditions, assist the insect in exploiting novel host plants, thus potentially leading to new biotypes or host races. There is some indication that these secondary symbionts may biosynthesize and supply enzymes for host-plant adaptation. Directly or indirectly be associated with the induction of toxic disorders such as squash silverleaf.

Interaction with Herbivores

Aggregations of phloem feeders can strengthen their ability to draw assimilates and improve their nutrition amino acids in the sap. Whiteflies may benefit from such aggregation as long as the density does not lead to competition. The plant viruses may modify the suitability of plants, whiteflies may influence each other via their transmission. Studies that examined speciation and spread of several biotypes of B. tabaci revealed that intra-specific competition plays a major role in whitefly biology and evolution. The symbiotic relationships between whiteflies and bacterial species have taken on preeminent importance in this time of increased whitefly resistance to insecticides.

Plant-Virus-Vector Interaction

Begomo viruses are vectored in a circulative persistent manner by the whitefly Bemisia tabaci. The insect ingests viral particles with its stylets while virions pass along the food canal and reach the esophagus and the midgut. They cross the filter chamber and the midgut into the haemolymph and translocate into the primary salivary glands and are egested with the saliva into the plant phloem. Virions pass along the food canal and reach the esophagus and the midgut. They cross the filter chamber and the midgut into the haemolymph, translocate into the primary salivary glands and are ingested with the saliva into the plant phloem mainly from the tomato yellow leaf curl virus (TYLCV) family, may be transcribed and may replicate. However, at the same time, virus amounts peak, and the insect autophagic response is activated, which in turn inhibits replication and induces the destruction of the virus.

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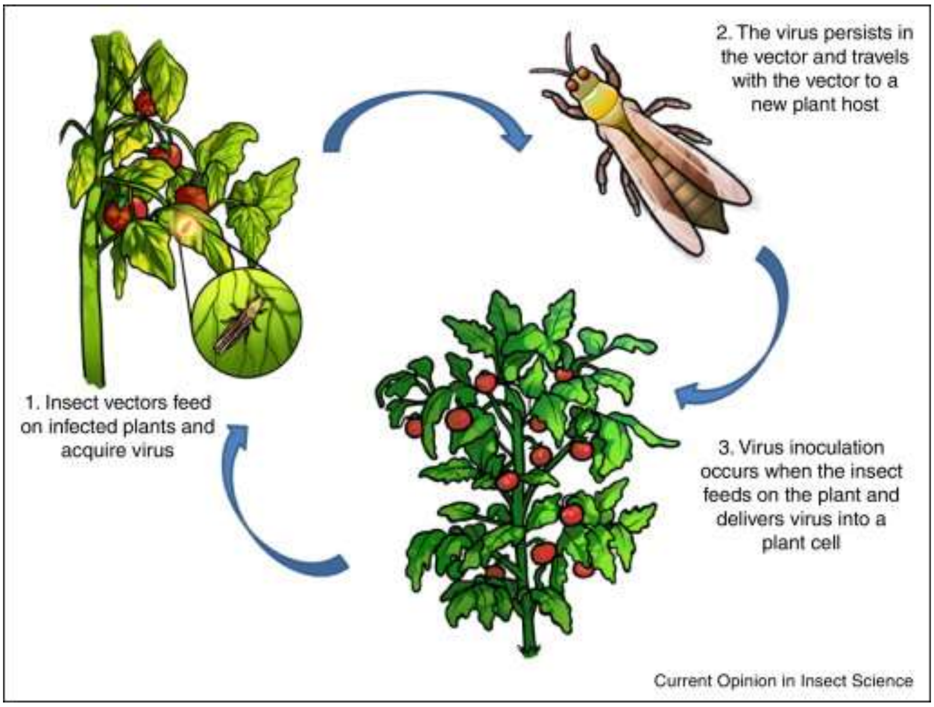

IPM Practices in White Fly Management

1. Cultural methods: Various cultural practices such as maintain crop-free periods, residual crop deposits in the fields, shifting the planting dates, timely removal of weed species from the field and from border area, application of barrier crops viz. maize border , maintain high density planting besides check weed growth and alternate micro climate i.e unfavourable to the whitefly species, intercropping with antagonistic crop and application of reflective plastic mulches in the field are some cultural practices that can be effectively used to maintain pest population reduction in the field.

2. Host plant resistance: The leaf-trichome densities and presence of acyl sugars in the exudate of glandular trichomes as well as type of trichomes were reported to be important factors affecting whitefly-tomato relationships. Two commercial cultivars of tomato, 'Alta' and 'Peto 95', the accession LA716 of *S. pennellii* and lines 94GH-006 and 94GH-033 (backcrosses between 'Peto 95' and LA716), with different leaf acyl sugar contents were screened for resistance to the Spanish B-biotype of *B. tabaci* in greenhouse .

3. Biological control: Field release of natural predators viz, chrysoperla carnea ,encarcia sp, can be an effective management tool in biological control programme and also incorporate in pest management strategies.

Application of *Verticillium lecani*, *Beauveria bassiana* based entomopathogenic fungi

4. Chemical control: New generation chemical such as spinetoram, cyazypry, emamectin benzoate can be effectively incorporate in integrated whitefly management programme.

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Importance of Arid and Semi-Arid Fruit Crops in Future Due to Climate Change

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Introduction

Arid and semi-arid regions are characterized by extreme temperature, low humidity and low rainfall will limit the commercial cultivation of traditional crops, but growing of perennial arid fruit crops like ber, date palm, custard apple, tamarind, dragon fruit, etc., in this conditions can produce the quality fruits. The cultivation of these fruit crops in arid regions will helps in proper utilization of marginal lands, maintains ecological balance, provides food and nutritional security (date palm, ber, aonla), and have the much scope in processing industry also.

Why Arid and Semi-Arid Fruit Crops are Important in Future

The global warming due to direct and indirect human activities is likely to reach 1.5°C temperature between 2030 and 2052 at the current rate.The increase in mean temperature, hot extremes in most inhabited regions, sea level rise, heavy rainfall, occurrence of drought and precipitation deficits are the impacts of climate change and global warming (IPCC, 2018). The Land degradation is a negative trend in land condition, caused by direct and indirect human activities leads to climate change, expressed as long-term loss of biological productivity and ecological integrity. Arid, semi-arid and dry sub-humid areas together constitute drylands. The recent estimates based on aridity index reveals that global drylands cover about 46.2% (±0.8%) of total area (Mirzabaev et al., 2019). In India, 38.7 million hectares of arid region is there mainly in the states of Rajasthan, Gujarat, Haryana, Punjab, Karnataka and Andhra Pradesh. In this arid region, cultivation of traditional crops is not economical mainly due to extreme environmental conditions (Sharma et al., 2013). The growing of perennial draught hardy fruit crops like pomegranate, date palm, aonla, custard apple, etc., are feasible to improve the socio-economic status.

Suitability of Fruit Crops to Arid Region

Arid fruit crops are able to withstand high temperature, erratic rainfall, hot winds and occurrence of draught during summer compared to food grains and other fruit crops. These crops having the draught tolerant mechanisms like draught escape, draught avoidance and draught tolerance, and other morphological and physiological modifications to adapt arid and semi- arid regions as discussed below. The suitable fruit crops for arid and semi-arid regions are listed in Table 1 and 2.

Morphological Modifications

1. Reduced leaf size to avoid the water loss eg. Tamarind
2. Reduced leaf area
3. Leaf rolling, greenish stem and presence of spines eg. ber, cactus pear
4. Deep tap root system and expansion of root hairs for accumulation of moisture and nutrients eg. ber, bael, cactus pear
5. Increased root: shoot ratio eg. Cactus pear
6. Formation of cuticular wax to reflect the radiations and to avoid water loss eg. Date palm, ber, cactus pear

Physiological Changes to Adapt Draught

1. High chlorophyll stability index.

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2. Higher membrane stability index.
3. Maintenance of high relative water content.
4. Osmotic adjustment - synthesis of osmolytes like proline, glycine betaine, mannitol, sucrose, etc., to adapt draught.
5. Closing of stomata by synthesizing ABA.
6. Reduced stomatal conductance and transpiration rate.

Table 1. Fruit crops and their varieties for cultivation in semi-arid and arid regions (Sharma et al., 2013).

Sl. No.	Crop	Scientific name	Varieties
1	Ber	*Ziziphus mauritiana*	Gola, Seb, Umran, Mundia, Kaithali, Banarasi Kadaka, Thar Bhubharaj, Thar Sevika, Goma Kirti
2	Bael	*Aegle marmelos*	NB-5, NB-9, Pant Aparna, Pant Sujata, Pant Shivani, CISH Bael-1, CISH Bael-2, Goma Yashi, NB-16, NB-17
3	Pomegranate	*Punica granatum*	Ganesh, Jalor seedless, G-137, Mridula, Bhagawa, Phule Arakta, Super Bhagava (Sel-4)
4	Aonla	*Emblica officinalis*	NA-7, NA-6, NA-10, Kanchana, Krishna, Balwant, Laxmi-52
5	Custard apple	*Annona squamosa*	Arka Sahan, Balanagar, Mammoth, Island Gem, Red Sitaphal, APK (Ca)-1
6	Date palm	*Phoenix dactylifera*	Halawy, Barhee, Medjool, Khadrawy, Zahidi
7	Fig	*Ficus carica*	Poona Fig, Dinkar, Conadria, Excel, Chalisgaon
8	Tamarind	*Tamarindus indica*	PKM 1, Pratisthan, Yogeshwari, Goma Prateek

Table 2. New fruit crops growing in arid and semi-arid regions (Mizrahi et. al., 2002).

Common name		Scientific name	Majorly growing countries
Cactus pear or prickly pear		*Opuntia ficus- indica*	World wide
Climbing cactus	Yellow pitaya	*Selenicereus megalanthus*	Israel and Colombia
	Red pitaya or dragon fruit	*Hylocereus undatus*	Latin America and Asian countries
Columnar cactus		*Cereus peruvianus*	Israel

Conclusion

Arid regions are characterised by extreme temperature, low humidity, erratic rainfall and high evapotranspiration. The cultivation of traditional crops is not economical in arid regions, hence, low water requiring, draught hardy perennial fruit crops like custard apple, pomegranate, ber, dragon fruit and date palm are suitable for arid and semi-arid regions to improve socio-economic status, nutritional and food security.

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Environmental Impact Assessment

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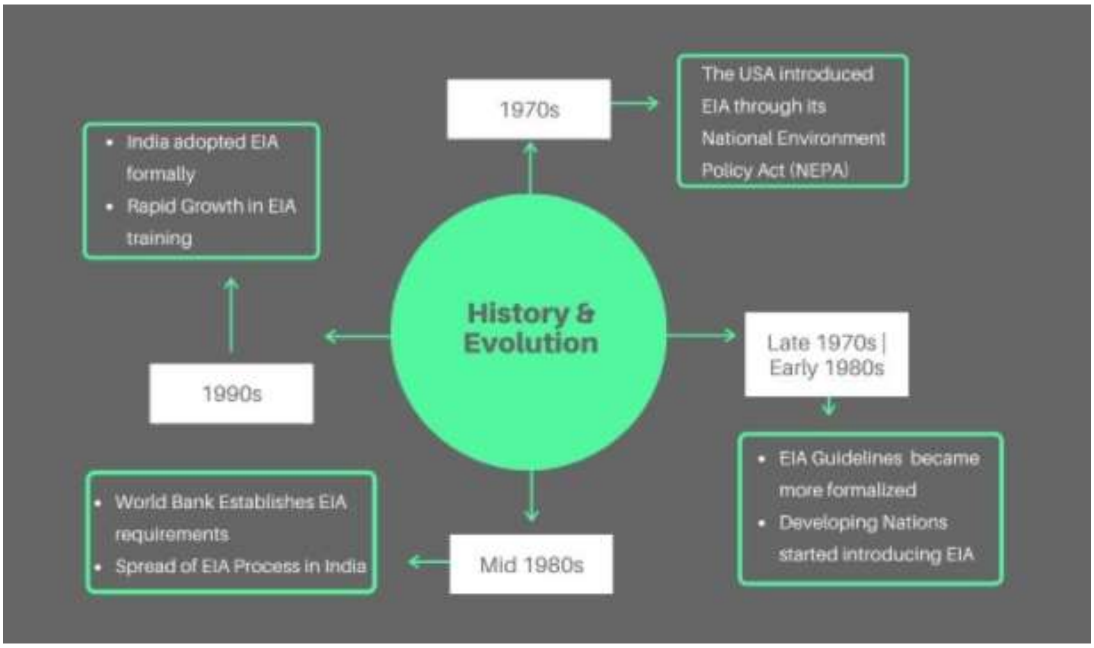
Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process of evaluating the impacts of a proposed or development projects on the environment, taking into consideration various inter-related socio-economic, cultural and, human-health impacts, both positive and negative. EIA is a significant tool utilized by the Ministry of Environment, Forests, and Climate Change (MoEFCC) to reduce the adverse impact of industrialization on the environment. It lays down the environmental clearance processes that a project must bear before it is given the green light. This comprises in-depth screening process by authorities and experts. An EIA is extremely important to reduce the chance of oil spills, gas leaks, and release of other toxins from industries into the environment.

EIA activities in India comes under the Ministry of Environment, Forest and Climate Change, Govt of India. EIA has been made mandatory in 1994 under the Environmental (Protection) Act, 1986 for 29 categories of developmental activities involving investments of Rs.50 crores and above.

History of EIA



Although legislation and practice differ around the world, the fundamental components of an EIA remain the same.

Forms of Impact Assessment

There are mainly two methods for assessing or evaluating the impacts raised due to the development projects. They are:

1. Environmental Impact Assessment (EIA).
2. Strategic Environment Assessment (SEA).

EIA	SEA
Reactive approach	Proactive approach

Takes place at the end of the decision-making process	Takes place at earlier stages of the decision-making process
It identifies only specific impacts on the environment	It also identifies environmental implications, issues of sustainable development
Mainly emphasis on mitigating and reducing the impacts	Early warning of cumulative effects
Well defined process	Multistage process
Narrow perspective	Broad perspective
Limited reviewing of cumulative effects	Broad reviewing of cumulative effects

EIA Cycles & Procedures

1. Screening.
2. Scoping & consideration of alternatives (Time limit).
3. Baseline data collection (Air, Water, Land, Socio-economic and Biological Impacts).
4. Impact Analysis.
5. Mitigation and EIA statement (EMP).
6. Public hearing (Proponents and Decision-makers).
7. Decision Making.
8. Monitoring the Clearance Condition (Construction and Operation phase).

Current EIA Reports – India

EIA Notification 2020 draft has been made public. Once the EIA Notification 2020 is published in the Official Gazette, it will replace EIA notification of 2006. EIA notification 2020 was opposed by public because one of the amendments will be the removal of public consultation from several activities (Put under Category B2) in the draft.

Category B2 Projects	
EIA 2006	EIA 2020
Nil	Petroleum products (medium enterprises)
	Dyes & Dye-intermediates proposed with ZLD in Industrial Estates & MSMEs
	Bulk drugs & intermediates proposed with ZLD in Industrial Estates & MSMEs
	MSM [-synthetic rubber]
	Synthetic resins/adhesive up to 1000 TPA and small & medium

Benefits of EIA

1. Protection of environment.
2. Promotes community participation.
3. Environment-friendly projects.
4. Lowers project costs.
5. Improved project design and increased acceptance of projects.
6. Optimum utilization of natural resources.

Disadvantages of EIA

1. Time-consuming and expensive.
2. Unavailability of reliable data especially in developing countries.
3. Post monitoring is seldom dispensed.

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Indian Financial System

Article ID: 32054

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Introduction

The economic development of a nation is reflected by the progress of the various economic units, broadly classified into corporate sector, government and household sector. While performing their activities these units will be placed in a surplus/deficit/balanced budgetary situations. There are areas or people with surplus funds and there are those with a deficit. A financial system or financial sector functions as an intermediary and facilitates the flow of funds from the areas of surplus to the areas of deficit. It is a composition of various institutions, markets, regulations and laws, practices, money manager analysts, transactions and claims and liabilities. A financial system may be defined as a set of institutions, instruments and markets which fosters savings and channels them to their most efficient use.

Structure of Indian Financial System

The Indian financial system can be broadly classified into formal (organized) financial system and the informal (un-organized) financial system. The informal financial system consists of individual money lenders, groups of people operating as funds or associations, partnership firms consisting of local brokers, pawn brokers.

Financial Institutions

1. Financial institutions are the participants in a financial market
2. They are business organizations dealing in financial resources
3. They collect resources by accepting deposits from individuals and institutions and lend them to trade, industry and others
4. They buy and sell financial instruments.

FI are classified as:
1. Regulatory and Promotional institutions.
2. Banking institutions.
3. Non-banking financial institutions.

Regulatory and Promotional Institutions

1. The two major Regulatory and Promotional Institutions in India are Reserve Bank of India (RBI) and Securities Exchange Board of India (SEBI).
2. Both RBI and SEBI administer, legislate, supervise, monitor, control and discipline the entire financial system.
3. RBI is the apex of all financial institutions in India and all financial institutions are under the control of RBI.
4. The financial markets are under the control of SEBI.

Reserve Bank of India (RBI)

Established: The Reserve Bank of India was established following the Reserve Bank of India Act of 1934. Though privately owned initially, it was nationalised in 1949 and since then fully owned by Government of India (GoI).
Headquarter: Mumbai, Maharashtra, India.
Governor: Dr. Urjith Patel.
First RBI governor: Osborne Smith.
First Indian RBI governor: C .D. Deshmukh.

NABARD (National Bank for Agriculture and Rural Development)

Established: NABARD was established on 12th July 1982 on the recommendation of CRAFICARD committee which is also known as the SivaRaman Committee.
Headquarter: Mumbai, Maharashtra.
Chairman: Harsh Kumar Bhanwala.
Biggest Rural Development Bank.
AIM To uplift Rural India & rural non-farm sector.
NABARD acts as regulator for co-operative banks &RRB's (Regional Rural Banks).

Primary Function

1. NABARD is the apex organisation related to financing in the agricultural sector.
2. It looks after matters concerned with policy, planning and operations in rural areas in India.
3. Rural Infrastructure Development Fund (RIDF) is operated by NABARD.
4. Provides refinance to lending institutions in rural areas.
5. Helps SHG (Self Help Group) & poor people in rural areas.
6. Runs programme for agricultural & rural development. Recommends about licensing for RRBs, Co-operative banks to RBI.

SEBI (Securities and Exchange Board of India)

Established: SEBI was first set up as a non-statutory body in April 1988, to regulate the working of the stock exchange. Later it was made an autonomous body on 12 April 1992 via SEBI Act 1992. 1st chairman of SEBI is Dr S.A. Dave [12 April 1988-23 Aug 1990]
Headquarter: Mumbai, Maharashtra.
Chairman: Ajay Tyagi.
Objective: Protects the interest of investors and to promote the development of stock exchange & regulate the activities of stock market.

Banking Institutions

Banking institutions mobilize the savings of the people.
1. They provide a mechanism for the smooth exchange of goods and services.
2. Basic categories of banking institutions are commercial banks, cooperative banks, developmental banks.

Non-Banking Financial Institutions

Nonbanking financial institutions also mobilize financial resources directly or indirectly from the people. They lend funds but not create credit Companies like LIC, GIC, UTI, Development Financial Institutions, Organizational Funds etc. fall in this category. Non-banking financial institutions can be categorized as investment companies, housing companies, leasing companies, hire purchase companies, specialized financial institutions (EXIM Bank) etc.

Financial Markets

Financial market deals in financial securities (or financial instruments) and financial services. Financial markets are the centers or arrangements that provide facilities for buying and selling of financial claims and services. These are the markets in which money as well as monetary claims is traded in. Financial markets exist wherever financial transactions take place. Financial transactions include issue of equity stock by a company, purchase of bonds in the secondary market, deposit of money in a bank account, transfer of funds from a current account to a savings account etc.

Classification of financial market:
1. Basis of maturity of claim: Money market and Capital market.
2. Basis of timing of delivery: Cash/Spot market and Future Market.
3. Other classification: Foreign Exchange Market and Derivatives Market.

Financial Services

1. Fund based services: The firm raises funds through debt, equity, deposits and the bank invests the funds in securities or lends to those who are in need of capital.

The following are some of the fund-based services:

a. Leasing and Hire Purchase.
b. Housing Finance.
c. Credit Cards.
d. Venture Capital.

2. Fee based services: The services wherein financial institutions operate in specialized fields to earn a substantial income in the form of fees or dividends or brokerage on operations.

The major fee based financial services are as follows:

a. Issue Management.
b. Corporate Advisory Services.
c. Credit Rating.
d. Mutual Funds.
e. Asset Securitization.
f. Stock Broking Services.

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Pest of Drumstick and their Management

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Introduction

Moringa oleifera L. belongs to the family Moringaceae, which is the family consisting of only one genus with about 13 species of deciduous trees (Keay, 1989). Leaves, tender pods, fruits, flowers, etc. are the edible parts of this plant as vegetable which have tremendous nutritional and medicinal values. It has multifarious uses of Moringa trees that include alley cropping (biomass production), animal forage (leaves and treated seedcake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed cakes), foliar nutrient (juice extracted from the leaves), green manure (from leaves), gum (from tree trunks), honey and sugar cane juice clarifier (powdered seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, biopesticide (soil incorporation of leaves to prevent seedling damping off, etc.), pulp (wood), rope (bark), tannin for tanning hides (bark and gum), water purification (powdered seeds) etc. (Fugile, 2000). There are a number of biotic stresses of *M. oleifera* in its native Indian range, which affects its production from both qualitative and quantitative aspects. Infestations by insect pests and mites have been placed among the main limiting factors.

Butani and Verma (1981) reported twenty eight different insect species and two species of mites from India on various parts of drumstick trees. Among them major insect pests are given below:

Sr. No.	Common Name	Scientific Name	Family	Order
1.	Bark-eating caterpillar	*Indarbela quadrinotata* Wlk., *Indarbela tetraonis* Moore.	Cossidae	Lepidoptera
2.	Green leaf caterpillar	*Noorda blitealis* Wlk	Crambidae	Lepidoptera
3.	Budworm	*N. moringae* Tams.	Pyraustidae	Lepidoptera
4.	Hairy caterpillar	*Eupterote molifera* Wlk.	Eupterotidae	Lepidoptera
5.	Black hairy caterpillar	*Pericallia ricini* Fab.	Arctidae	Lepidoptera
6.	Pod fly	*Gitonia distigmata* Meigon.	Drosophilidae	Diptera
7.	Long horn beetles	*Batocera rubus* Linn.	Cerambycidae	Coleoptera

Bark-Eating Caterpillar

Indarbela quadrinotata Wlk. (Metarbelidae: Lepidoptera).

It is a primitive lepidopteran pest and only about 14 species of these moths under 3 genera have been reported from India. Among these, the genus *Indarbela* is the largest containing 12 species of which, at least 5 species occur in southern India.

Hosts of economic importance: *I. quadrinotata* is highly polyphagous pest. In addition to *Moringa*, recorded hosts of the pest include *Acacia catechu, Mangifera indica, Morusalba, Mytrogyna* sp., *Phyllanthus emblica*, *Psidium guajava*.

Identification and Biology: The full-grown larva is smooth, with sparse hairs and measures 3.5 to 4 cm in length. The thoracic legs are simple with the last segment ending in a curved claw. The caudal end (cremaster) bears several small spines - like 10 processes. These spines and teeth - like processes help the pupa to orient itself towards the tunnel mouth prior to eclosion. Eggs hatch in about 15-25 days. The larval period lasts for 9- 10 months. Pupation occurs within the larval tunnel, with the cephalic end of the pupa slightly protruding outside. The pupal period lasts about 15-25 days.

Mode of feeding and nature of damage: Newly hatched larvae initially feed on the bark and subsequently bore into the trunk. The tunnel entry remains closed with a frass covering which is drawn out into a sleeve through which the larva moves. The tunnel is used as shelter by the larva and is kept clean of the faecal pellets and frass which are added on to the distal end of the sleeve. Zig-zag galleries and silken webbed masses comprising of chewed material and excreta of larva are seen on the trunk of infested tree.

Management:

a. Mechanical method: This involved killing the larvae within the tunnels by inserting a sharp metallic probe and sealing the tunnel entrance using tar or wax.

b. Chemical method: Application of a toxic substance either by injection or by inserting a cotton swab soaked in the chemical is the most widely used method. Spot application either by brushing or spraying may also be tried in certain cases. Application of 5-10 ml of a diluted solution of quinalphos 25 EC at 1:200 into the borer holes resulted in good control of this insect on shade trees in north-east India.

Moringa Budworm

Noorda moringae (Family: Crambidae)

It is one of the important pests of *Moringa* in India.

Identification and biology: The adults are small and dark brown. It lays oval, creamy white, slightly sculptured eggs in clusters and occasionally singly on the buds. A female may lay up to 250 eggs. Egg stages lasts for three to four days. The larva bores in to the bud and first feeds on the anthers and then on the other internal parts leaving the outer most petals intact. Full grown larvae measures 11 to 14 mm long, is dirty brown with a prominent mid- dorsal stripe, head and pro- thoracic shield being black. Infested buds drop down and the larva pupate in the soil in a cocoon of silk covered with soil particles. Adult emerge sin 6-10 days. Total life cycle is 10-28 days.

Mode of feeding and nature of damage: The larvae feed on young flower buds, which results in shedding. Infestation goes up to 78% in the affected plants. The infestation is generally lower during October- December and reaches the peak in June.

Management:

a. Cultural control: Plough around trees to expose and kill pupae. Collect and destroy damaged buds along with caterpillars.

b. Biological control: Its natural enemies include the following larval parasites: *Pristomeres* sp. (Ichneumonidae), *Bracon brevicornis, Chelonus* sp. (Braconiae), *Elasmus hyblaeae, Perrilampus* sp. and *Stytasis* sp.(Chalcidoideea).

c. Physical control: Use light traps to attract and kill adults @ 1-2 /ha.

d. Chemical control: Spray carbaryl 50 WP 1.0 kg or malathion or endosulfan 1.0 L in 500 - 750 ml of water per ha.

Moringa Leaf Caterpillar

Noorda blitealis Wlk. (Pyraustidae: Lepidoptera)

The leaf eating caterpillar (*N. blitealis* Wlk.) is the sporadically serious pest of drumstick throughout the year especially in South India.

Hosts of economic importance: Besides moringa trees, it is also an important pest of niger.

Identification and biology: Adult are similar to *N. moringae* but bigger in size. The moth is dark brown and the black pattern on forewings broader and wavy. Eggs are laid in clusters of 34 to 96 usually on ventral surface of tender leaves. A female lays up to 232 eggs in her life time. Incubation period is about 3 days. Larval period is about 7- 15 days depending upon environmental conditions. It pupates in the soil and the adult emerges in six to nine days. Total life cycle is completed in about 16- 26 days.

Mode of feeding and nature of damage: *N. blitealis* larvae feed on the leaves of moringa while hanging from the under surface of leaflets in a thin silken web. The leaves appear papery and get dried. If left untreated, the whole tree is defoliated. Severe infestation occurs on new flush of the crop during June-August which later recedes.

Management:

a. Cultural control: Plough around trees to expose and kill pupae. Collect and destroy damaged buds along with caterpillar.

b. Physical control: Set up light trap @ 1/ha.

c. Mechanical control: Provision for sitting arrangement for birds above the height of the moringa crop in field enabling the birds to visit and prey them.

d. Biological control: Spiders are found inhabiting in large numbers on new flush which exert natural control on the increasing population.

e. Chemical control: Spray insecticides like Carbaryl 50 WP@ 1gm/ lit or malathion 50 EC 2 ml/ lit of water. Also 1-2 sprays of malathion (2 ml/l) can be applied to reduce infestation.

D. Hairy Caterpillar

Eupterote mollifera (Eupterotidae: Lepidoptera)

Host of commercial importance: In addition to moringa, it recorded as a host of pest includes, Castor (*Ricinus communis*), *Brassica oleracea* and mulberry.

Identification and Life history: Eggs laid in clusters on leaves and tender stem. Larvae brownish in colour with densely hairy. Full grown caterpillar is about 4.4cm in length. Adult is large sized moth with uniform light yellowish brown in colour with faint lines. Lay eggs in groups on tender portions of trees like shoots and leaves. They pupate in soil.

Mode of feeding and nature of damage: Larva seen in groups in tree trunks and they feed gregariously by scraping the bark and gnawing foliage. Severe infestation leads to defoliation of the tree.

Management:

a. Cultural control: Collection and destruction of egg masses and caterpillars by burning or using strong contact insecticide.

b. Physical control: Setting up of light trap @ 1 / ha to attract and kill adults immediately after rain.

c. Mechanical control: Use burning torch to kill congregating larvae on the trunk.

d. Chemical control: Spraying of Fish Oil Rosin Soap @ 25g/lit or carbaryl 50 WP @ 2g/lit. Spray chlorpyriphos 20 EC or quinalphos 25 EC in 500 -750 L of water per ha on the trunks and foliage, immediately after rain and 15 days later.

Black Hairy Caterpillar

Pericallia ricini (Fab.) (Arctidae: Lepidoptera)

This is a foliage feeding pest that occasionally appears in large numbers.

Hosts of commercial importance: Besides drumstick trees, it has been reported to infest banana, blck gram, cotton, cucurbits, castor, cowpea, soybean, tea, yam etc.

Identification and biology: Full grown caterpillars are 40-50 mm. long, dark brown in colour, specked with white and have dorsal and lateral tufts of long dark hair. Eggs are laid in clusters on ventral surface of leaves. Egg, caterpillar and pupal periods occupy 4 to 8, 26 to 32 and 10 to 12 days respectively. Total life cycle is completed in about 40 days during April-May.

Mode of feeding and nature of damage: On hatching the caterpillar feed on the leaf lamina initially by scrapping epidermal layers and later by cutting the lamina. Management Same as hairy caterpillar.

Pod Fly

Gitona distigmata (Drosophilidae: Diptera)

Hosts of commercial importance: Moringa.

Identification and biology: Adult are a small yellowish fly with red eyes. Wings extend beyond body and have a dark spot near the coastal margin. Maggot is cream coloured. Activity is maximum from April to October and declines thereafter. Egg is Cigar shaped, sculptured and white coloured eggs are laid on the grooves of tender pod either singly or in groups of 3-4. Egg period 3-4 days, maggot period 18-25 days. Full-grown cream coloured maggots pupate in soil for 5-9 days.

Nature of damage: Drying and splitting of fruits from tip. Oozing of gummy exudate from fruit comes out.

Management:

a. **Cultural control:** Weekly removal of affected fruits.

b. **Mechanical control:** Rake up the soil under the trees or plough the infested field to destroy puparia.

c. **Botanical control:** Use attractants like citronella oil, eucalyptus oil, vinegar, dextrose or lactic acid.

d. **Chemical control:** Spray insecticides like nimbecidine 3 ml/lit during 50 % fruit set and 35 days later. Application of fenthion 80 EC 0.04 per cent during the vegetative and flowering stage. Emamectin benzoate 5 SG at 0.25 g/l and spinosad 45 SC at 0.20 ml/l were significantly superior throughout the period of investigation against *G. distigmata.*

Long Horn Beetles

Batocera rubus (Cerambycidae: Coleoptera)

Hosts of commercial importance: Moringa

Identification and biology: Grubs are stout, about 100 mm long, yellowish in colour with well-defined segmentation. Adults are medium sized beetles and yellowish brown with white spots on elytra. Eggs are laid singly in cracks or crevices in the bark of the tree. Pupation takes place within the tunnels. Egg, grub and pupal periods last for 1 to 2, 24 to 28 and 12 to 24 weeks respectively. There is only one generation in a year.

Nature of damage: Grubs make zig-zag burrow beneath the bark, feed on internal tissues, reach sapwood and cause death of affected branch or stem. Adults feed on the bark of young twigs and petioles.

Management:

a. Clean affected portion of tree by removing all webbed material, excreta etc.

b. Insert in each hole, cotton–wool soaked in monocrotophos 36 WSC 5 ml or any good fumigant like carbon disulphide, carbon tetrachloride, chloroform or even petrol and seal treated hole with mud.

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Microbial Induced Calcite Precipitation (MICP) and its Application in Self-Healing Concrete

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Introduction

Microbially Induced Calcium carbonate Precipitation (MICP) has become an exciting field of research in the last couple of decades. Calcium carbonate is precipitated by many bacteria as a by-product of various microbial metabolic pathways. In recent times, MICP has extensively been examined for its application in Self-healing concrete. In this process Calcium Carbonate Precipitation (CCP) capable bacteria and their required nutrients are embedded inside the concrete or mortar. And whenever a crack forms in this type of concrete these CCP capable bacteria heals the cracks in situ by precipitating calcium carbonate.

Microbial Induced Calcium Carbonate Precipitation

To understand how MICP can induce self-healing property in concrete, it is important that we first look into the CCP process in different bacterial systems. There are two principal ways for CCP to take place in different bacterial systems.

The most common way is through different metabolic pathways which include ureolysis, Deamination of Amino Acids, Sulfur cycle, etc. In addition to metabolic pathways, extracellular polymeric substances (EPSs) and cell wall can trigger CCP by providing nucleation sites (Dupraz *et. al.,* 2009). Amongst the common metabolic pathways that lead up to MICP, ureolysis and Ureolytic bacteria have been examined extensively. Urease (the principal enzyme involved in Ureolysis) is a well-conserved enzyme across bacteria. The availability of urea and efficiency of urease enable MICP has been examined in laboratory conditions to be used in self-healing concrete (Wang *et. al.,* 2016).

Bacillus and *Sporosarcina* genera are commonly used to study ureolysis and its application in MICP induced Self-healing concrete. However, ammonia produced from ureolysis is detrimental for the mechanical strength of concrete structures (Eq.1) which is why novel non-ureolytic bacteria have been explored for applications in self-healing concrete (Lee *et. al.,* 2017).

$CO\ (NH_2)_2 + 2H_2O + Ca^{2+} + Cell \rightarrow 2NH_{4+} + Cell\text{-}CaCO_3$ (Eq. 1).

Deamination is one of the most prominent metabolic pathways that is under consideration as it is more viable than ureolysis in field experiments. Deamination of Amino Acids produces ammonia and carbonate ions, which in turn generates alkaline pH and DIC rich environment that favors MICP (Eq. 2). Deamination via asperginase activity produces less ammonia than urease activity (Li *et. al.,* 2015). Calcium carbonate precipitation by *Myxococcus xanthus* and *Brevundimonas diminuta* results in the production of ammonia by oxidative deamination of AAs (Rodriguez-Navarro *et. al.,* 2012).

$C_4H_8N_2O_3 + 2H_2O + Ca^{2+} + Cell \rightarrow C_3H_7NO_2 + NH_{4+} + Cell\text{-}CaCO_3$ (Eq. 2)

Applications of CCP-Capable Bacteria in Concrete

Generally, two methods are used to apply MICP in construction materials such as concrete: exterior application which involves treating the concrete surface with CCP capable bacteria culture and interior application where bacteria and nutrients are mixed directly with cement paste. The exterior application is not a feasible option anymore as spraying bacterial culture on wall materials is simply not viable.

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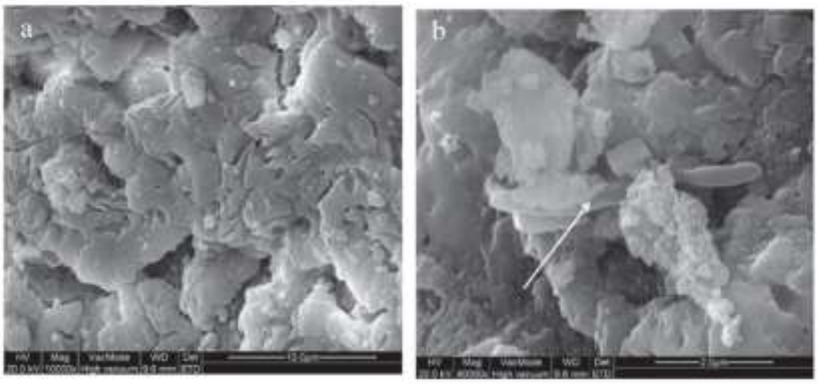

Fig 1: EDS of precipitation in the cracks of specimen (a: Calcite precipitation with bacterial traces on the surface; b: bacterial remains in between. (Wang *et. al.*, 2014).

The biggest challenge in the application of CCP bacteria into concrete is that bacteria must endure high temperatures and higher pH as well as long periods of inactivated lifestyle embedded in the concrete before cracks appear. Two different approaches have been studied to solve this particular problem of CCP bacterial application in self-healing concrete. The first approach is to use gram-positive bacteria CCP capable bacteria. This approach relies on the ability of the gram-positive bacteria to produce spores that can endure high pH and temperature inside concrete mixture. Though this approach had shown promise in the initial stages, in the latter stages spores also became susceptible to the stressful microenvironment of concrete. The second approach however is showing great promise. Specialized carriers have been developed to encapsulate CCP capable bacteria in order to protect them from the stressful microenvironment of concrete and at the same time provides the encapsulated bacteria with required nutrients. In recent studies, Hydrogel-encapsulated spores have shown superiority in healing cracks in mortar. Based on recent findings, calcium lactate and calcium acetate are recommended as bacterial nutrient inside concrete (Tziviloglou et. al., 2017).

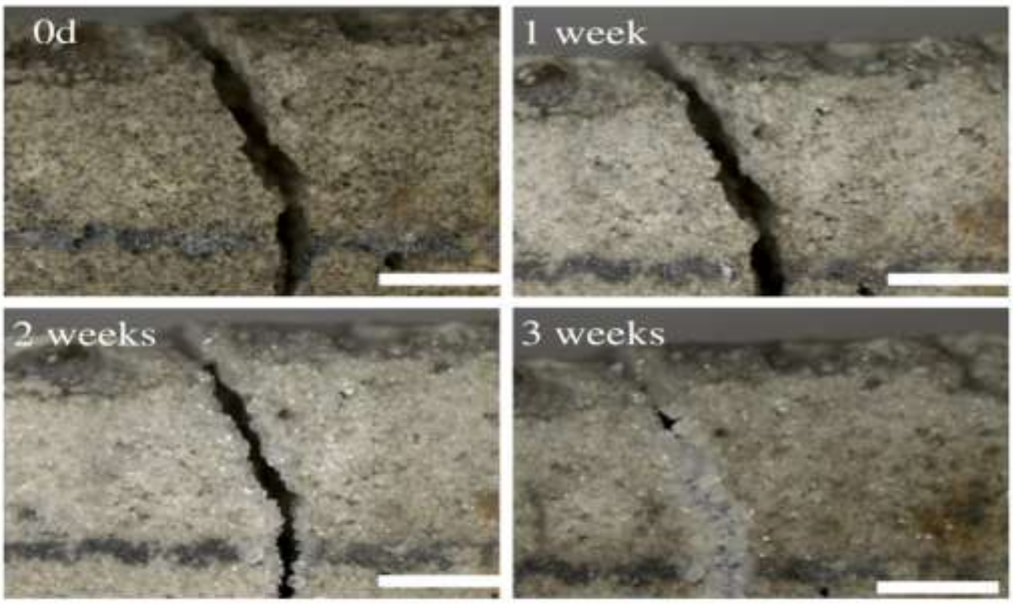

Fig 2: An example of a crack healing process (Wang *et. al.*, 2014)

Factors Affecting MICP Process Inside Concrete

There are four major factors that govern MICP: pH, calcium ion concentration in the microenvironment, Diluted Inorganic Carbon (DIC) concentration in the bacterial microenvironment and nucleation site availability in the EPSs and cell wall. Apart from these four principal factors Bacterial species, biomass of the CCP capable bacteria, temperature of the microenvironment, oxygen concentration, etc plays a major role in determining MICP process inside concrete and mortar.

Application of Self-Healing Concrete

Despite the ubiquitous usage of concrete as construction material, the frequency at which cracks appear in concrete generally leads to significantly decrease in construction durability as well as high replacement and maintenance costs (Seifan et. al., 2016). On the other hand, environmental concerns over cement production industry is constantly rising. It has been estimated that cement production along accounts for 7% of man-made CO_2 emissions (Jonkers et. al., 2010). Thus, by applying CCP capable bacteria in concrete both these problems can be reduced to a minimal level in the years to come.

Economic Feasibility of Self-Healing Concrete

The merit of concrete as a construction material is embedded in the fact that it is of low cost compared to other materials. The conventional price of concrete is $100 per cubic meter. Thus, for MICP self-repair technique to be economically viable, it must add less cost construction. Recent developments of encapsulation techniques have cut the self-healing concrete production cost by 50% bringing it down to $105 per cubic meter (Jonkers, 2017). With new avenues opening in terms of providing better protection to CCP capable bacteria inside concrete, it is likely to further reduce the production cost of self-healing concrete in the coming years making it a viable option of construction material.

Conclusion

Although, laboratory studies have advanced the understanding of MICP, its viability as an emerging engineering solution for healing cracks in concrete still is in the very early stages of field experiments. The viability of this particular area of research is thus dependent on how these encapsulated CCP capable bacteria perform in real life environment inside concrete. Not only survival of the bacteria inside concrete but also analytical tools beyond the ones that are currently available for the evaluation of bacterial microenvironment needs to be developed as well.

MICP has the potential to change the way construction industry uses concrete in the coming years. With the recent developments in encapsulation techniques of CCP capable bacteria inside concrete and determination of perfect nutrient media, it is only a matter of time before self-healing concrete comes out in the market. The only constraint that it had was economic feasibility which has now been resolved as well and thus it is only a matter of time before MICP applied self-healing concrete is adopted in the near future.

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Postharvest Chilling Injury in Fruits and Vegetables and its Alleviation

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Abstract

Low temperature storage is the most common and promising technique for the shelf life enhancement of majority of fruits and vegetables. Low temperature can substantially reduce the rate of respiration and various other metabolic techniques which reduce the rate of deterioration. However, most of the tropical and sub-tropical fruits and vegetables like mango, banana, papaya, tomato, cucumber etc. are sensitive to low temperature storage. The injury caused at low temperature termed as chilling injury. The extent of chilling injury depends upon various factors and varie from commodity to commodity. Chilling injury can be alleviated by following certain measures such as temperature conditioning, intermittent warming, controlled atmosphere storage, waxing, packaging, ultraviolet radiation and by application of some chemicals such as salicylic acid, methyl jasmonate, sodium nitroprusside, and polyamines.

Introduction

Fruits and vegetables are the integral part of human diet. India is the second largest producer of fruits and vegetables in the world after China. However, regardless of high production of fruits and vegetables, a significant amount of this production is lost during postharvest storage due to chilling injury. Chilling injury can be defined as the injury caused by low temperature storage above 0˚C and below threshold temperature for a certain period of time. Generally, low temperature < 10 to 12˚C for tropical and < 7˚C for sub-tropical, cannot be used without any caution to extend postharvest storage life. At low temperature tissues weaken because they are unable to carry out their normal metabolic activities and thereby, various physiological and biochemical alterations take place in sensitive species.

Symptoms of Chilling Injury

The most common symptoms of chilling injury are surface pitting, discoloration of peel, internal discoloration and breakdown, sunken lesions, water- soaked appearances, lenticels spotting (seen in mango), shrivelling, incomplete or impaired ripening, poor colour development, off flavour development, increased susceptibility to microbial attack.

Factors affecting chilling injury: Origin of a commodity (tropical, sub-tropical, temperate), maturity stage, chemical composition of the produce tissue, genetic makeup of commodity, storage condition etc.

Mechanism of Chilling Injury

At low temperature, the liquid crystalline fluid inside the cell membrane get converted into solid gel state which in turn cause cessation of protoplasmic streaming and dissociation of enzymes/ proteins. However, this process is reversible if produce is exposed to normal temperature. These are known as primary events. In contrast, if produce remained at low temperature for the longer period of time than it will cause impaired metabolic processes (respiration, protein synthesis) and ion movements through membranes. This process is known as secondary events and irreversible. Thereafter, when the produce was exposed to normal temperature, it will show the visible symptoms of chilling injury such as necrosis, pitting etc.

Strategies to Alleviate Postharvest Chilling Injury

1. Temperature conditioning: It can be done by two ways- low temperature and high temperature conditioning. In the former the tropical and sub tropical fruits and vegetables was exposed to temperature slightly above critical chilling temperature. Further when the produce was exposed to low chilling temperature during storage, it will cause least damage as produce show adaptive response to low temperature. In case of later, produce was exposed to high temperature which subsequently enhance the tolerance of produce to chilling injury by increasing antioxidant enzyme activity, arginase, polyamine and proline content, accumulation of heat shock proteins.

2. Intermittent warming: In this treatment, produce is removed from low temperature storage for a short period of time and kept at normal temperature thereafter again stored at low temperature. In this method exposure to warm temperature restored the damage of chilled tissues and higher metabolic activities replenish the deficiencies of cells.

3. Waxing and other coatings: Waxes improves the aesthetic appearance of commodities and decreases the rate of transpiration. Various edible waxes such as carnauba wax, bee wax and other coating materials viz., vegetable oil, mineral oil, safflower oil etc. are effective in reducing the extent of chilling injury. Alleviation of chilling injury by the applications of waxes is related to their anti- transpirant activity and some waxes possess anti- oxidant capacity.

4. Controlled atmospheric storage: In CAS system the level of oxygen is maintained at low level, while the level of carbon dioxide at high level. The effect of CAS can be effective, detrimental or ineffective depending upon variety.

5. Packaging: Packaging by plastic films modifies the atmosphere surrounding commodity by decreasing oxygen and increasing carbon dioxide. In addition, it also reduces the transpiration rate. The lesser moisture loss from the tissue inhibits the collapse of epidermal and underlying cells and prevents pitting.

6. Postharvest application with chemicals: Various chemicals such as salicylic acid, methyl jasmonate, sodium nitroprusside, polyamines etc. are known to possess anti-oxidant capacity which enhances the tolerance of commodities towards chilling injury. Some of these chemicals produces stress proteins and increases phenolic content of the commodities.

7. UV radiation: Short term treatment of UV-C and UV-B is effective in alleviating chilling injury and considered non- harmful for human being. It subsequently delays microbial infestation and senescence.

8. Genetic alterations: It can be achieved by isolating chilling resistance genes from a wild species and incorporating it in a chilling sensitive species.

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Vermitechnology: A Waste Management Process

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Introduction

The day by day increase of waste production has created a serious problem in the environment. Thus to overcome this problem, an economically affordable and environmentally sustainable technology known as vermitechnology can be used. It is an innovative eco-technology which converts all the biodegradable wastes into biofertilizers in the form of vermicompost.

This low cost and environmentally sound waste management process uses earthworms as natural bioreactors. Vermitechnology is based on the principle that the earthworms during feeding fragment the raw material which helps in increasing the surface area for further colonization of microbes. The humus like finely granulated and stabilized product of vermitechnology can be used as a soil conditioner to improve the organic matter of the agricultural soils.

The potential raw material for vermitechnology could be farm wastes, kitchen wastes, non-toxic wastes of industries. Parameters like quality of raw material, pH, temperature, moisture, aeration, type of vermicomposting system, and earthworm species used decides the success of vermitechnology. There are various physical processes involved like substrate aeration, mixing, and grinding while biochemical processes which include decomposition of waste by various enzymes present in the gut of earthworms and is affected by microbes present in their intestine.

Earthworms are major component of the soil system and are known to accumulate toxic residues from soil/substrates. The earthworms play a major role in sustainable farming as these organisms assist in the recycling of organic nutrients.

Substrates for Vermicomposting

Cattle dung, plant products (sawdust and leaf litter), kitchen waste, city refuge, non- toxic waste of industry, biogas slurry, horticultural waste and agricultural residue etc. can be used as raw material for vermicomposting.

Selection of Suitable Earthworm Species

Selection of suitable earthworm species is most important aspect of vermitechnology. Different earthworm species which exhibit significant variation in respect of nutrient composition are used for production of vermicompost. *Perionyx excavates*, *Eisenia fetida*, *Eudrilus eugeniae* and *Metaphire posthuman* are most widely used species of earthworms for vermicomposting. These earthworm species exhibit more tolerance in extreme atmospheric conditions than any other species of earthworms. Tolerance range in case of high temperature is upto 42°C and low soil temperature below 5°C.

Process of Vermicomposting

Selection of suitable organic waste material is the first step of vermicomposting process. Earthen pots or pits, cemented tanks, wooden boxes lined with either plastics or stones can be used for vermicomposting. Earthworms grow faster and produce more cocoons in slightly darker and humid places with 40-50% moisture content in beds, neutral pH and slightly decomposed organic matter having high nitrogen content.

Degradation of organic waste material can be done by enzymatic digestion and enrichment by excrement of nitrogen. The initial 5-10% of raw material is taken up by the tissue of the earthworms for their physiological activities and the remaining is excreted in the form of vermicompost. The decomposition process continues even after the excretion of the cast by the establishment of microbes.

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The large number of microorganisms, hormones and enzymes already present in the intestine of earthworms converts the partially degraded organic substrates rapidly in vermicompost. The final product of vermicomposting is rich in nutrients, much stabilized and potential organic manure which helps in upsurge the fertility of soil and used as stimulator for growth of plants, and is suitable for agricultural application.

Benefits of Vermitechnology

1. Reduces the poisonous solid waste.
2. Agricultural and industrial waste can be recycled and managed efficiently.
3. Biofertilizers with major macro and micro nutrients can be produced by vermicomposting.
4. Reintegrates soil properties and nutrients.

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Rangeland Management

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Introduction

Rangeland is uncultivated land that is suitable for grazing and browsing animals. Rangeland is one of the major types of land in the world. (other types are: forest, desert, farmland, pasture, and urban/industrial.) Rangelands are the principal source of forage for livestock, and they also provide habitat for a great variety of native plants and animals. Rangelands are also used by people for recreational purposes. Some plant species of rangelands are used in landscaping, and as sources of industrial chemicals, pharmaceuticals, and charcoal.

Generally, rangeland is not fertilized, seeded, irrigated, or harvested with machines. Rangelands differ in this respect from pasturelands, which require periodic cultivation to maintain introduced (non-native) species of forage plants. Pasturelands may also need irrigation or fertilization, and they are usually fenced. Rangelands were originally open, natural spaces, but much of their area has now been fenced to accommodate human uses, particularly livestock grazing. In addition, livestock grazing often utilizes rotation systems that require partitioning.

Rangelands were distinguished at the turn of the century by their native vegetation. Today, however, many rangelands support stands of introduced forage species that do not require cultivation. Rangelands are vast natural landscapes in the form of grasslands, shrub lands (bushy lands), woodlands, wetlands, and deserts. Types of rangelands include tall grass and short grass prairies, desert grasslands and shrub lands, woodlands, savannas, chaparrals, steppes, and tundras. It is perhaps easier to define rangelands by clearly describing what they are not. Rangelands are not barren desert, farmland, closed canopy forests, or land covered by solid rock, concrete and/or glaciers.

Basic Rangeland Management Concepts

1. Grazing land is a renewable resource.
2. Energy from the sun can be captured by green plants which can only be harvested by the grazing animal.
3. Grazing land supply us with food and fibre at a very low additional energy cost.
4. The amount and kind of forage available is determined by the type of soil and the climatic conditions. A given set of soil and climatic conditions define a “range site”
5. Grazing lands supply us with multiple products: food, fibre, fishing, hunting, sightseeing, minerals, timber, and water.

Four Basic Principles in Rangeland Management

1. Proper stocking rate.
2. Proper distribution of grazing animals.
3. Proper kinds of grazing animals.
4. Proper grazing system.

Proper stocking rate or correct animal numbers is considered the most important part of range management.

Types of Rangeland

Prairies: Prairies are considered part of the temperate grasslands, savannas and shrub lands biome by ecologists, based on similar temperate climates, moderate rainfall, grasses, herbs, and shrubs rather than trees, as the dominant vegetation type.

Grasslands: are areas where the vegetation is dominated by grasses and forbs (non-woody plants). Grasslands occur naturally on all continents except Antarctica.

Steppe: The term is used to denote the climate encountered in regions too dry to support a forest, but not dry enough to be a desert.

Pampas: are the fertile South American lowlands that include the part of Argentine. The climate is mild, with precipitation of 600 mm, more or less evenly distributed through the year, making the soils appropriate for agriculture. These plains contain unique wildlife because of the different terrains around it.

Shrub land: is a plant community characterized by vegetation dominated by shrubs, often also including grasses, herbs and geophytes. Shrub land may either occur naturally or be the result of human activity.

Woodland: is a low-dense forest forming open habitats with plenty of sunlight and limited shade. Woodlands may support an understory of shrubs and herbaceous plants including grasses.

Savanna: is a grassland ecosystem characterized by the trees being sufficiently small or widely spaced so that the canopy does not close. The open canopy allows sufficient light to reach the ground to support grasses.

Desert: (less than 250 mm rainfall per year) is a landscape or region that receives an extremely low amount of precipitation, less than enough to support growth of most plants.

Tundra: is a biome where the tree growth is hindered by low temperatures and short growing seasons. The term tundra means treeless mountain tract. In tundra, the vegetation is composed of dwarf shrubs, grasses, mosses, and lichens. Scattered trees grow in some tundra. The eco-tone (or ecological boundary region) between the tundra and the forest is known as the tree line or timber line.

Importance of Rangelands and Grasslands

Rangelands, primarily covered by natural vegetation, provide grazing and forage for livestock and wildlife. The fertile soil that characterizes many grasslands make the areas well suited to cultivating crops.

Rangeland and grassland ecosystems provide benefits vital to agriculture and the environment including:
1. Land for farming.
2. Grazing and forage for livestock and native animals.
3. Watersheds for rural and urban uses.
4. Habitat for plants, insects, and animals.
5. Water for sustainable landscapes.
6. Areas for recreational activities.
7. Potential renewable energy and mineral resources.

Uses of Range and Pasture Lands

Rangelands provide the greatest benefit to society when they are used for multiple uses rather than for a single purpose. Globally rangelands are used to raise livestock for food and fiber, harvest renewable and non-renewable energy and mineral resources, provide habitat for wildlife, and open space for human enjoyment and recreation.

The grasses, forbs and shrubs that grow on rangelands are an important source of forage for grazing animals. Livestock efficiently convert these forages into high-density meat protein to feed our growing global population. Domestic livestock grazing often reduces fine fuels which if left unchecked create a greater risk of wildfire. Some grazing by domestic livestock protect important habitat for rare and endangered flora and fauna species. Rangelands are also critical to preserving open space for aesthetics, recreation and providing important habitat for many species of wildlife. Additionally, rangelands provide renewable resources such as clean water and wind for energy production and non-renewable resources like oil, coal, and other minerals. Finally, you will discover how rangelands play an important ecological role by reducing the effects of carbon dioxide on the atmosphere through carbon sequestration.

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Soil Erosion and Conservation: A Threat to Crop Production and Environment

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Summary

Erosion is termed as a natural and accelerated process, depend upon a situation, if the rate of soil erosion or loss of soil does not exceed the soil formation known as natural or if the rate of soil erosion does exceed the soil formation then it is known as accelerated soil erosion. Soil erosion is a two-way process as detachment and transportation of soil sediments. It affects both agriculture and the natural environment. The causal agent of soil erosion is water and wind. Soil erosion can be conserved by various biological, agronomic, and mechanical measures.

Introduction

Soil erosion is the most destructive process that occurs in nature causes great loss for crop production and the environment. Firstly, detachment of soil particles occurs after that transportation of these soil sediment found. It causes loss of the fertile layer of soil degrading the environment. In the world 2.5 billion people are involving in small scale farming, 70% of them live below the poverty line. soil erosion with the combination of other environmental threats mostly affects these farmers by decreasing their farm yield.

The causal agent causes the type of soil erosion: water erosion (soil erosion by water), wind erosion (soil erosion by wind)

Significance of Soil Erosion

1. Loss of fertile soil.
2. Loss of crop productivity.
3. Causes of water pollution.
4. Causes loss in reservoir capacity
5. Causes flash flood and mudslides.

Type of Soil Erosion

1. Type of water erosion:

a. Splash erosion: Due to raindrop impact, scattering of detached soil particle occurs; so, break down soil structure. Dispersed soil particle lifts to the height of 60 cm and moves up to 1.5 m from their initial phase.

b. Sheet erosion: Removal of the upper layer of soil. It is the most dangerous water erosion because it cannot be seen by farmers.

c. Rill erosion: This type of erosion is easily removed by tillage operations. Small channels of <30 cm deep are formed in this type of erosion.

d. Gully erosion: Many small channels that are formed by rill erosion are combined and form a big channel; this is known as gully erosion. It is an advanced stage of rill erosion.

e. Ravines erosion: It is a network of gullies; the severe stage of ravines is an advanced stage of a ravine.

f. Landslide or slip erosion: In this type of erosion rocks movement occur towards gravity.

2. Type of wind erosion:

a. Surface creep: Rolling of soil particle along the ground surface. 0.5 to 2 mm diameter size of particles eroded by this type of erosion.

b. Saltation: 50 to 70% of the total movement of soil occurs by saltation. It is a process of movement of a particle in a series of jumps. Particles are going up to the height of 1 meter.

c. Suspension: Movement of fine particles of size less than 0.2 mm in diameter by floating in the air is known as suspension.

Causes of Soil Erosion

Soil erosion is mainly due to the following reasons:

1. Deforestation.
2. Overgrazing by livestock, there is a great chance of soil erosion.
3. Inappropriate cultivation practices, soil erosion occurs.
4. Intensive tillage operation.
5. Population pressure, soil erosion occurs.

Factors Affecting Soil Erosion

Climate: Climate variables as rainfall, temperature, wind humidity, solar radiation affects soil erosion. Rainfall characteristics that can affect the erosion most are amount, intensity, raindrop size, distribution.

Wind erosive: Wind characteristics- velocity, frequency, duration, and turbulence affect wind speed required.

Landforms: landscape features as field length, exposed topographic location, field orientation affect wind erosion.

Soil: Soil physical properties as structure, texture, water retention, and transmission properties affect the resistance of soil to erosion.

Principles of Soil Conservation

Some basic principles that are required to conserve soil are given below:

1. Covering the soil to protect it from rainfall- by doing this we can reduce the impact of rainfall and this can be achieved by mulching.
2. By increasing the infiltration capacity of soil to reduce infiltration.
3. Improving the aggregate stability of the soil. Or by increasing surface roughness to reduce runoff.

Figure1: Diagrammatic representation of soil conservation techniques

Figure2: diagrammatic representation of soil erosion and conservation

Agronomic Measures

Agronomic measures can affect both detachment and transportation of soil sediments. It is less expensive, can reduce runoff, increase infiltration, decrease raindrop effect, and reduce water velocity. It includes:

1. Cover crop.
2. Strip cropping.
3. Vegetation barriers.

4. Selection of crop species and crop rotation.
5. Shifting cultivation.

Mechanical Measures

Engineering and mechanical methods are used to support agronomic and soil management measures. It is ineffective because it cannot prevent the detachment of soil particles. It includes:

1. Contouring.
2. Soil pitting and range pitting.
3. Contour bunds.
4. Terracing.
5. Waterways.

Some other measures are used to control soil erosion or to conserve soil:

1. Windbreak and shelterbelts.
2. Managing landslides and mass movement.
3. Gully control measures.
4. Sand Dune management.

Soil Erosion: A Threat to Crop Production and Environment

1. 10 MH cropland is lost every year due to soil erosion, therefore due to reducing cropland crop production also reduces.
2. Due to the occurrence of accelerated soil erosion i.e. soil lost 10-40 times faster than soil formation, it destroying future human food security and the environment.
3. Soil erosion is an environmental threat to the productive capacity of agriculture.
4. Soil erosion causes increased pollution and sedimentation in streams and rivers, clogging these waterways and causing declines in fish and other species.
5. Degraded land is unable to hold water and causes a flood.

Conclusion

Soil erosion causes loss of soil fertility and productivity. It not only destroys agricultural land but also offsite. Offsite as: eutrophication of water bodies, loss in storage capacity of natural sources, flash floods, mudslides, etc. we need to adopt proper management strategies that are required to manage the soil or can reduce these losses that are occurred by erosion.

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Tomato Diseases: Introduction Symptoms and their Control Measures

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Introduction

Tomato (*Solanum lycopersicum* L.) is the second most important vegetable crop next to potato in the world, with estimated production reaching as 170 million MT in 2014, where China accounts for 31% of the total, followed by USA, India, and Turkey as the major producers (http://www.fao.org/). Apart from being the important vegetable crop worldwide, tomato is also used as a model plant for genetical studies related to fruit quality, stress tolerance (biotic and abiotic), and other physiological traits. This is widely adapted to a variety of agro climate spanning from the tropics to temperate regions (Panthee and Chen 2010). Presently, the production and quality of tomato are known to be largely affected by the pathogens in the field or post-harvest processing (Walker 1971; Ramyabharathi *et al.* 2012). Disease development during field or/post-harvest storage and shipment without the effective inhibitor of microbial growth results in huge economic loss. Therefore, a critical need of sustainable approach for the plant disease management is necessary. In this context, soil or plant microbial inoculants of plant growth promoting bacteria (PGPB) seem to be promising approach for disease management in different crops and vegetables (Kumar et al. 2015a, c).

The goal of plant disease management is to reduce the economic and aesthetic damage caused by plant diseases. Specific management programs for specific diseases are not intended since these will often vary depending on circumstances of the crop, its location, disease severity, regulations and other factors. Plant disease management practices rely on anticipating occurrence of disease and attacking vulnerable points in the disease cycle (i.e., weak links in the infection chain). Therefore, correct diagnosis of a disease is necessary to identify the pathogen, which is the real target of any disease management program.

Important Diseases in Tomato

Currently, more than 200 pests and diseases have been identified in tomato, causing losses in their production directly or indirectly (Nowicki *et al.* 2013). Diseases caused by fungi, nematodes, bacteria, and viruses are of the most severe concern in cereal crops and vegetables, which not only affect their nutritional contents, but also human health and overall economy. Some of the most important diseases in tomato caused by fungal pathogens are late blight, *Sclerotinia* rot, *Fusarium* wilt, *Fusarium* crown, and root rot. Late blight caused by the *Phytophthora infestans* is one of the most destructive diseases of tomato resulting in significant economic loss (20–70%) (Foolad *et al.* 2008; Nowicki *et al.* 2012, 2013). *Sclerotinia* rot, caused by *Sclerotinia sclerotiorum*, is another one of the important diseases affecting the tomato crop productivity. Wilt, crown, and root rot diseases in tomato caused by *Fusarium* species have been most intensively studied (Laurence *et al.* 2014; McGovern 2015). *Fusarium* wilt is common vascular disease caused by *Fusarium oxysporum*, resulting in extensive (10–80%) yield loss in many tomato producing countries (Kesavan and Chaudhary 1977.

Fusarium Wilt of Tomato

Causal agent: *Fusarium oxysporum* f.sp lycopersici.

Symptoms: First symptoms are yellowing of the foliage, beginning with the lower leaves and working upward. Yellowing often begins on one side of the vine. Infected Leaves later show downward curling, followed by browning and drying. The top of the vine wilts during the day and recovers at night, but wilting becomes progressively worse until the entire vine is permanently wilted.

Cultural and Biological Control: Raise soil pH to 6.5–7.0 and use sources of nitrate nitrogen (for example, calcium nitrate) rather than sources of ammonium nitrogen. Use clean equipment to avoid infesting new fields. Application of bio control agents like *Trichoderma viridae* or *Trichoderma harzianum* along with FYM at the time planting (1 kg mixed with 200 kg of FYM for one acre of land).

Chemical Control:

Chemical Name	Dosage (g/ml/litre)	Remarks
Copper oxycloride (Blitox)	3g/litre	Used as drenching in the soil; for large scale application drenching is not feasible.
Carbendazim (Bavistin)	1g/litre	Used as drenching in the soil: for large scale application drenching is not feasible.

Bacterial Wilt of Tomato

Causal agent: *Ralstonia solanacearum.*

Symptoms: Mature, fruit-bearing plants are affected in mid-summer. The first symptom is wilting of a few leaves. This often goes unnoticed. Soon thereafter, the entire plant wilts suddenly and dies. The roots will exhibit varying degrees of decay.

Cultural and Biological control measures:

a. Before plantation: Consider an effective weed control in and around tomato fields and aquatic weed control around irrigation ponds. Apply 3-4 years rotation and cover crops for infested fields to reduce *R. solanacearum*, weeds and nematodes. Do not irrigate rotation and cover crops with *R. solanacearum* contaminated pond or surface water, avoider infestation.

b. During production: Exclude the pathogen by applying strict sanitation practices (pathogen free irrigation water, transplants, stakes, machinery, etc.). Chlorinate your irrigation water continuously if you are using surface water or R. solanacearum infested pond water.

Early Blight of Tomato

Causal Agent: *Alternaria solani.*

Symptoms: The leaves, stems and fruit on the vine may be affected. Symptoms on leaves are most likely to appear on the older foliage. Small dark spots enlarge into circular lesions consisting of concentric rings. The tissue surrounding the lesions becomes yellow and the spots later become irregular in shape. Lesions at the base of emerging seedlings can cause a collar rot. If this arises simultaneously on many seedlings, it may indicate contamination of tomato seeds or soil used for planting.

Cultural and biological control: Minimize plant injury in transplants by controlling insects and by avoiding sandy soils. Avoid extended periods of leaf wetness on plants. Trellis tomato vines and avoid dense plant populations in fields to allow for good ventilation between plants. Use furrow or drip irrigation rather than overhead irrigation. Use a three or four-year rotation with non-solanaceous crops. If possible, remove diseased plants or destroy them immediately after harvest. Alternatively, bury diseased crop debris by deep ploughing to reduce spore levels available for infection of new plants.

Chemical control:

Chemical name	Dosage (g/ml/litre)	Remarks
Azoxystrobin (Amistar)	0.5ml/litre	7- to 21-day interval; alternate after each use; no more than five applications
Chlorothalonil (kavach)	2g/litre	Can be used as a protective application; 5-7 days interval
Copper hydroxide (Kocide)	2g/litre	7- to 14-day interval; no more than four applications per crop
Mancozeb (Dithane M-45)	2g/litre	Used as a protective application; 5-7 days interval
Propineb (Antracol)	2g/litre	5-7 days interval
Difenoconozole (Score)	0.5ml/litre	Used as curative fungicide: No more than 4application per season.
Pyraclostrobin (Cabrio)	1g/litre	7- to 14-day interval; no more than 2 sequential applications;

Late Blight of Tomato

Causal agent: *Phytophthora infestans.*

Symptoms: All aboveground parts may show symptoms. On leaves, small (2–10 mm), irregular-shaped, pale, brown patches, sometimes with a purplish tinge, appear on the upper leaf surface. The margins of these spots are pale green or water soaked. The leaf spots may enlarge and coalesce very quickly until the entire leaflet is killed. Under moist or humid conditions, a downy white mould growth appears near the leaf spot margins on the under surface of the foliage. Lesions on the stem and the petioles appear dark brown and water soaked and can have sporulation.

Cultural and Biological control measures: Remove and destroy blighted tomato or potato plants. Eliminate all tomato or potato cull piles in the vicinity of the tomato field. Reduce leaf wetness by staking tomatoes and using drip irrigation. If drip irrigation is not available, reduce the number of furrow irrigations to a minimum or use sprinkler irrigation in the morning or midday to prevent the foliage from being wet overnight. Avoid Over fertilization of nitrogen. Check plants carefully for the first incidence of the disease particularly after extended periods of leaf wetness and moderate temperatures.

Chemical control:

Chemical Name	Dosage (g/ml/litre)	Remarks
Mancozeb (Dithane M-45)	2g/litre	Used as a protective application; 5-7 days interval
Chlorothalonil (kavach)	2g/litre	Can be used as a protective application; 5-7 days interval
Propineb (Antracol)	2g/litre	5-7 days interval
Dimethomorph (Acrobat)	1g/litre	5-7 days interval , not more than 3 application per season
Metalaxyl +mancozeb (Ridomil MZ gold)	2g/litre	Protective and curative application.5-7 days interval
Azoxystrobin	0,5ml/litre	Used as a curative application.

Damping Off

Symptoms: Affected plants usually occur in patches in nursery beds or in low parts of sloped fields. In level fields, affected plants are generally found in scattered areas. Damping off may occur before and/or after emergence. In pre-emergence damping off, the seeds fail to emerge after sowing. They become soft, mushy, turn brown, and decompose as a consequence of seed infection. In post-emergence damping-off, the seedling emerges from the soil but dies shortly afterwards. The affected portions (roots, hypocotyls and perhaps the crown of the plant) are pale brown, soft, water soaked, and thinner than non-affected tissue. Infected stems collapse. Stunting of plants due to root rot or collar rot may also occur.

Cultural and Biological control: If possible, use plug transplants and a soilless pathogen-free growth medium to avoid damping off. Water seedlings only when the soil or growth medium is dry, preferably in the morning to allow drying to occur by the late afternoon. Avoid contact with ground soil or other sources of contamination. Pots or transplant containers should be new or treated recently with a disinfectant (10% household bleach) or fungicide drenching of Ridomil gold MZ+ Bavistin @ 2+1 g/litre of water for seedbeds, choose well-drained locations. Keep the seedbed well ventilated and dry. Sow on raised beds. Avoid overcrowding of plants and the movement of infested soil or contaminated plant material into the nursery bed.

Nematode Diseases: Root-knot caused by the nematode *Meloidogyne* sp. is the other most devastating and widespread disease in tomato (Hunt and Handoo 2009; Zhou et al. 2016). Nematode not only affects the crop yield directly but also makes the plants more susceptible to fungal and bacterial infections (Ashraf and Khan 2010). It causes up to 30–50% yield reductions of tomato (Yang et al. 2011). This disease also severely reduces productivity of a variety of vegetables and crops worldwide. However, efficient control measures have yet been developed.

Root Knot of Tomato

Causal Organism: *Meloidogyne* sp.

Symptoms: All stages of plant growth are attacked. Aboveground symptoms often develop slowly over time and may go unnoticed until plants are well developed. Symptoms consist of stunting, yellowing and a general unthrifty appearance of plants. Infested plants may wilt or die in hot, dry weather. Belowground, the roots will have obvious galls or knot-like swellings. These swellings prevent movement of water and nutrients to the rest of the plant resulting in stunted plant growth. Plants affected by root-knot nematodes are more easily infected by soil-borne diseases caused by Ralstonia solanacearum (bacterial wilt), Sclerotiumrolfsii (southern blight) Fusarium, Pythium, or Rhizoctonia. This secondary infection may lead to extensive discoloration of internal stem and root tissue, and rapid plant death.

Cultural and Biological control measures: Use resistant varieties. Rotate the tomato crop (susceptible) with other crops such as grasses or brassicas (tolerant), followed by onion (resistant) and then dry fallow during hot, dry weather if possible. Repeated ploughing of the soil at the end of the growing season during hot, dry weather of the fallow period exposes nematodes to desiccation and death. Adding organic matter (compost and manures) to the soil will reduce nematode populations, amendments but they must be applied at 4–10 t/ha to be effective. Solarization for 4 to 8 weeks in small gardens is also possible. It will be most effective when conducted during the hottest season of the year Application of 2 kg of MULTIPLEX Niyantran (Poaecilomyces) in 100 kg FYM and broadcast to 1 acre uniformly. Application of 250-400 kg of neem cake/hac.

Chemical control:

Chemical name	Dosage (g/ml/litre)	Remarks
Methyl bromide	As a fumigant	Preplant, tarped, ormulched for 24-48hours. Application 10-14 days before planting.
Oxamyl (vydate)	2ml/litre	Foliar applications are not effective for moderate and high populations of nematodes.
Arbofuron (Furadan)	4kg/hac	Soil application, application into soil before planting.
Fenamiphos (nemacure)	30L/hac or 1L/100 Litre of water	Soil application Apply anytime from 7 days before up to the time of planting.

Bacterial Disease: Bacterial leaf spot is common bacterial diseases of tomato caused by *Xanthomonas campestris*. It is highly destructive in both greenhouses as well as in field conditions, causing 10–50% yield loss (Kallo 1991). In India, tomato productivity loss has been estimated to range from 10 to 80% (Sharma and Sharma 2005), whereas annual production loss due to this disease is 10–20%, which may rise to 80% in some cases (Sharma and Sharma 2005; Reddy *et al.* 2012). *Ralstonia solanacearum* is the most important soil-borne plant pathogens that cause bacterial wilt in over 200 families of plants, including tomatoes and hampers their production (Huang *et al.* 2013). *Clavibacter michiganensis* infection systemically causes wilting and canker on the stem, while blister-like spots are developed in locally infected leaves causing substantial economic loss in tomato production worldwide. *C. michiganensis* virulence factor plays an important role during blister formation compared to wilting, and also causes local and systemic infection in tomato (Chalupowicz *et al.* 2016).

Viral Disease: Viral disease of tomato includes tomato spotted wilt virus, one of the most important viral diseases which occasionally lead to plant death (Rossello *et al.* 1993). Tomato yellow leaf curl is another viral disease of cultivated tomato in the tropical and subtropical regions worldwide, and losses up to 80- 100% are most frequent. In many regions, tomato yellow leaf curl is one of the limiting factors in tomato production. The causal agents are a group of Gemini virus species belonging to the genus Begomo virus, all of them named as tomato yellow leaf curl virus.

Tomato Yellow Leaf Curl

Symptoms: Plants are severely stunted with shoots becoming erect. Leaflets are reduced in size and pucker. Leaflets curl upwards, become distorted, and have prominent yellowing along margins and/or interveinal regions. Flowers wither. Plants will set very few fruits after infection occurs; therefore, any plants infected before flowering stage will produce extremely low yields. The appearance of the fruit is unaffected.

Control measures: Grow seedlings in an insect-proof net house (50-mesh size or finer) or in a greenhouse, and maintain good control of whiteflies in these structures in order to prevent early infection of seedlings by whitefly feeding. Plant new tomato crops in isolated fields. If feasible, plant a tall border crop, such as maize, around the tomato crop. Use mulches of straw, yellow plastic or UV-reflective material to reduce landing of whiteflies. Other methods include a 1% soap solution carefully applied to the leaf under surface to control the adult vector. Care should be taken to avoid development of phytotoxicity if spraying occurs during very high temperatures. Oil sprays may also be effective in reducing levels of infestation. Neem tree seed extracts control young nymphs, inhibit the growth and development of older adults, and reduce egg-laying by adults. TYLCV-resistant and tolerant tomato varieties for some strains of the virus are commercially available Chemical control methods include the application of systemic insecticides like Confidor (Imidacloprid) @1ml/litre of water as soil drenches or regular sprays during the seedling stage to reduce the population of the whitefly vector. A second application may be necessary to control adults that have emerged from the egg and nymph stage since the application of the first spray.

Tomato Spotted Wilt Virus

Symptoms: Young leaves of slightly infected transplants turn bronze (purplish-brown) and later develop numerous small, dark spots. The bronzing of foliage may extend to large areas of the leaf surface. The bronzed areas may roll inward and the tissue often dies. Heavily infected transplants remain stunted. Shiny, dark brown streaks appear on stems and petioles. Growing tips of plants may die back. Affected fruit have spots about 1 cm in diameter with slightly raised, circular markings. Ripe fruit can be distorted and can have alternate red and yellow bands. Sometimes infected plants are killed by severe necrosis. Host plants and symptoms vary among TSWV strains.

	
Tomato yellow leaf curl	**Tomato spotted wilt virus**

Control measures: The presence of thrips in tomato fields can be monitored using yellow sticky cards. Consider planting a non-susceptible crop if TSWV and thrips populations throughout the area are very high. Maintain seedbeds away from cropped areas and from other susceptible plants. Protect transplants with mesh netting (40-mesh or higher) to exclude thrips. Remove crop debris, weeds and other sources of thrips at the end of each crop. Plow and keep fields fallow for 3–4 weeks to allow thrips to emerge and disperse. Reduce cultivation within the field to avoid movement of thrips from infected plants. Several insecticides like Confidor (Imidacloprid) @ of 1ml/litre of water, applications should be made at 5-day intervals to significantly reduce a thrips infestation. More than one application is necessary. Five-day application intervals are more effective than 7- day intervals.

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Artificial Intelligence Applications in Agriculture

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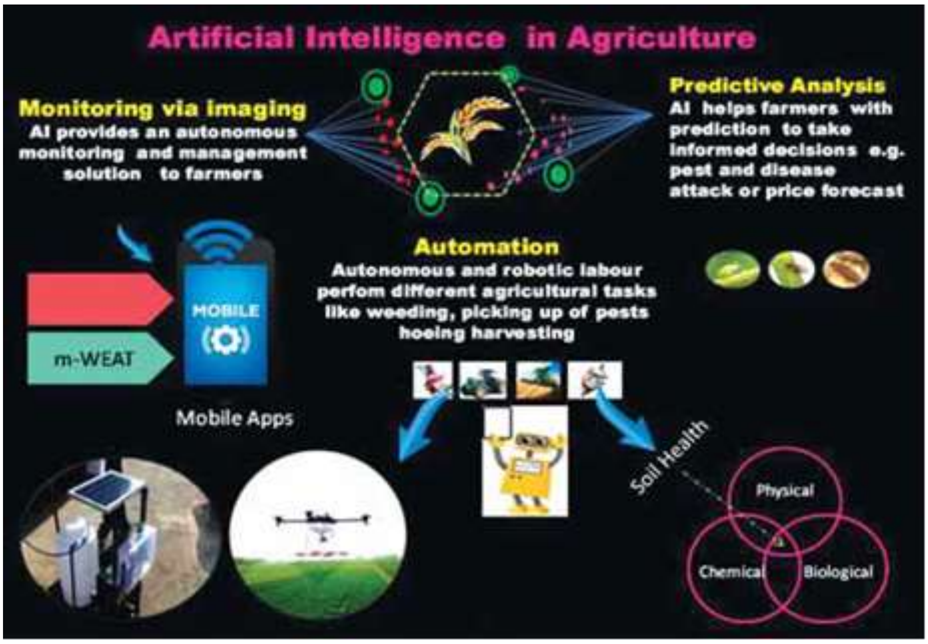
Introduction

Artificial Intelligence (AI) is a branch of science which deals with helping machines find solutions to complex problems in a more human-like fashion. It generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way. A more or less flexible or efficient approach can be taken depending on the requirements established, which influences how artificial the intelligent behaviour appears. Artificial intelligence is a new electronic machine that stores large amount of information and process it at a very high speed. Despite its relatively short life, Artificial Intelligence is seen and remains one of the greatest imperatives. The idea that these problems will be surpassed using the technology goes forward, some opinions advocating that humanity will merge with AI. In the new phase of technical evolution, millions of people still struggling to get access to basic resources, like food, water and shelter. This study outlines the trends of adoption and the development of artificial intelligent in agriculture, focusing on expert systems, sensors for collecting and transmitting data and robots developed for agriculture, in an attempt to reveal their potential impact in this field.

Artificial Intelligence in Agriculture

In recent years, modern and intelligent techniques like aeroponics, wireless sensors, expert systems etc. have achieved significant attention in agriculture. It is applied in agriculture sector to plan the several activities and missions properly by utilising limited resources with minimum human interference. Rapid adoption of Artificial Intelligence (AI) in agriculture both in terms of agricultural products and in-field farming techniques. Cognitive computing in particular, is all set to become the most disruptive technology in agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency.



Providing some of these solutions as a service like expert system chat bot or other conversational platform to farmers will help them keep pace with technological evolution as well as apply the same in their daily farming, and reduce the complicated manually monitoring and controlling process. Microsoft is working with 175 farmers in Andhra Pradesh, India to provide advisory services for sowing, land, and fertilizer and so on. This initiative has already resulted in 30% higher yield/ha on an average compared to 2018. AI models can also be employed in recognizing optimal sowing period in various seasons, statistical climatic data, real time Moisture Adequacy Data (MAI) from daily rainfall statistics and soil moisture to construct forecast charts and also carter inputs on best sowing time to farmers.

Drone Based Technology

One of the most important and promising areas is agriculture, where drones have efficiency to address major challenges. Drone technology is giving agriculture a high-tech makeover. By producing precise 3-D maps for early soil analysis, drones can play a role in planning. Here are six ways drones will be used throughout the crop cycle:

1. Soil and field analysis: It play an important role in seed planting and gathering data for managing irrigation and nitrogen levels in the field.

2. Planting: These systems increase number of shoots with proper growth and nutrients into the soil, providing all the nutrients necessary for growing crops.

3. Crop spraying: Drones are able to scan the ground, spraying in real time for even coverage. The result of aerial spraying is five times faster with drones than traditional equipment.

4. Crop monitoring: Crop monitoring is a huge obstacle in sugarcane agro ecosystem. With the help of drones, time-series animations can show the development of a crop and reveal production inefficiencies, enabling better management.

5. Irrigation: Sensor drones can easily identify which parts of a field are dry or need improvement.

6. Health assessment: By scanning of the crop using both visible and near-infrared light, drone-carried devices can help track changes in plants and indicate their health and alert farmers about pests/disease.

Start Ups in Artificial Intelligence

Blue River technology: Founded in 2011. This California-based start-up combines artificial intelligence, computer vision and robotics to build next-generation agricultural equipment that reduces chemicals and saves costs. The use of sensors that detect weeds, the type of weeds and the right herbicides to apply within the right buffer around the plant. In a research study conducted by the Weed Science Society of America on the impact of uncontrolled weeds on corn and soybean crops, annual losses to farmers are estimated at 43 billion USD.

Harvest CROO robotics – crop harvesting: Harvest CROO Robotics has developed a robot to help strawberry farmers pick and pack their crops. Lack of laborers has reportedly led to millions of dollars of revenue losses in key farming regions such as California and Arizona. In the Hills borough County, Florida region which has been described as the "nation's winter strawberry capital," between 10,000 and 11,000 acres of strawberries are typically harvested in a season. Harvest CROO Robotics claims that its robot can harvest 8 acres in a single day and replace 30 human labourers.

PEAT - machine vision for diagnosing pests / soil defects: The Berlin-based agricultural tech start-up PEAT developed the Plantix app that identifies potential defects and nutrient deficiencies in soil. The app uses images to detect plant diseases, a smartphone collects image which is matched with a server image and then a diagnosis of the plant health is provided. In this way the application uses AI and machine learning to solve the plant pests/diseases.

Farm Bot: Founded in 2011. This company has taken precision farming to a different level by enabling environment conscious people with precision farming technology to grow crops at their own place. The product, Farm Bot comes at a price of $4000 and helps the owner to do end-to-end farming all by himself. Ranging from seed plantation to weed detection and soil testing to watering of plants, everything is taken care of by this physical bot using an open source software system.

Prospera: Founded in 2014. This Israeli start-up has revolutionized the way farming is done. It has developed a cloud-based solution that aggregates all existing data that farmers have like soil/water sensors, aerial images and so on.

Trace Genomics - machine learning for diagnosing soil defects: California-based Trace Genomics, provides soil analysis services to farmers. Lead investor Illumina helped develop the system which uses machine learning to provide clients with a sense of their soil's strengths and weaknesses. The emphasis is on preventing defective crops and optimizing the potential for healthy crop production.

Sky Squirrel technologies Inc. - drones and computer vision for crop analysis: The company aims to help users improve their crop yield and to reduce costs. Users pre-program the drone's route and once deployed the device will leverage computer vision to record images which will be used for analysis. Sky Squirrel uses algorithms to integrate and analyse the captured images and data to provide a detailed report on the health of the vineyard, specifically the condition of grapevine leaves.

Challenges in Artificial Intelligences

The farmers owning lands in developing nations is small so affording the AI solutions in terms of cost is a challenge, and therefore state supported mechanisms can make it possible. Though AI offers vast opportunities for application in agriculture, there still exists a lack of familiarity with high tech machine learning solutions in farms across most parts of the world. Exposure of farming to external factors like weather conditions, soil conditions and presence of pests is quite a lot. AI systems also need a lot of data to train machines and to make precise predictions. In case of vast agricultural land, though spatial data can be gathered easily, temporal data is hard to get. For example, most of the crop-specific data can be obtained only once in a year when the crops are growing. Since the data infrastructure takes time to mature, it requires a significant amount of time to build a robust machine learning model. This is one reason why AI sees a lot of use in agronomic products such as seeds, fertilizer, pesticides and so on rather than infield precision solutions.

Conclusion

AI technologies help farmers to analyse land/soil/health of crop and save time and allow farmers to grow right crop in each season that has best yield. Vertical cropping can reduce water usage, make efficient land usage. It can reduce the problems with labour unavailability. AI based predictions enable suggesting appropriate pesticides/crops/place at right time before large scale incidence of diseases. The amount of data that can potentially be captured by technologies will give agricultural sector a new ability to identify changes and predict opportunities. Additionally, extensive testing and validation of emerging AI applications in this sector will be critical as agriculture is impacted by environmental factors that cannot be controlled unlike other sectors where risk is easier to model and predict. It is anticipated that the agricultural industry will continue to see steady adoption of AI.

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An Overview of Micro Small and Medium Enterprises (MSME)

Article ID: 32063

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Introduction

The economy of any country also depends on the development of enterprises because it created more job opportunities and providing livelihood for the proprietor. Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural & backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

The micro, small and medium enterprises can be defined as:
1. A micro enterprise, where the investment in Plant and Machinery or Equipment does not exceed one crore rupees and turnover does not exceed five crore rupees.
2. A small enterprise, where the investment in Plant and Machinery or Equipment does not exceed ten crore rupees and turnover does not exceed fifty crore rupees.
3. A medium enterprise, where the investment in Plant and Machinery or Equipment does not exceed fifty crore rupees and turnover does not exceed two hundred and fifty crore rupees.

Organizational Setup

Any government set up can have the organizational set up. The MSME is having two Divisions called Small & Medium Enterprises (SME) Division and Agro & Rural Industry (ARI) Division. SME Division is also responsible for preparation and monitoring of Results- Framework Document (RFD) as introduced in 2009 by the Cabinet Secretariat under Performance Monitoring and Evaluation System (PMES). The ARI Division looks after the administration of two statutory bodies viz. the Khadi and Village Industries Commission (KVIC), Coir Board and a newly created organization called Mahatma Gandhi Institute for Rural Industrialization (MGIRI). It also supervises the implementation of the Prime Minister's Employment Generation Programme (PMEGP).

Vision

Sustainable development of globally competitive micro, small and medium enterprises as an engine of growth for the Indian economy.

Mission

Promote growth and development of micro, small and medium enterprises, including Khadi, village and coir industries so as to create new enterprises and more employment opportunities. The long term goal of the ministry is to enhance manufacturing base in the country by improving performance of MSMEs through skill and entrepreneurship development.

Functions

1. Facilitation and credit flow to MSMEs.
2. Improving competitiveness of MSMEs.
3. Improve manufacturing base through upgradation of technology.
4. Promotion of MSMEs through cluster bases approach.

5. Marketing support to MSMEs.
6. Skill development and entrepreneurship development training.
7. Creation of new Micro Enterprises through Prime Minister's Employment Generation Program (PMEGP).
8. Growth and development of Khadi and Village Industries (KVI) sector.
9. Growth and development of Coir Industry.

Major Schemes

1. Prime Minister Employment Generation Programme and Other Credit Support Schemes.
2. Development of Khadi, Village and Coir Industries.
3. Technology Upgradation and Quality Certification.
4. Marketing Promotion Schemes.
5. Entrepreneurship and skill Development Programme.
6. Infrastructure Development Programme.

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Biofortification: A Sustainable Approach for Nutritional Security

Article ID: 32065

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Biofortification Means?

The process of development of crops with more nutritional crops and have accumulated higher amounts of a particular vitamin and minerals. Biofortification can be achieved in three ways viz agronomic biofortification, conventional biofortification and transgenic biofortification. In agronomic biofortification crops micronutrient are sprayed which are temporarily taken up by the edible portion of the crop. In conventional biofortification plant selected with higher amount of micronutrient and crossed with conventional method to produce staple crops. In transgenic biofortification gene are inserted for the accumulation of a micronutrient.

For biofortification using the conventional plant breeding approach to be considered feasible and effective for alleviating micronutrient deficiencies, three conditions should be met.

1. Nutrient density is increased without reducing crop yields
2. When the crops are consumed, the increase in nutrient levels can make a measurable and significant impact on human nutrition.
3. Farmers are willing to grow the crops and consumers to eat them.

Why Biofortification?

Globally, around two billion people suffer from malnutrition, while 815 million people are undernourished. Children are the most affected due to malnutrition; as a result, 151 million children under the age of five are stunted, while 51 million do not weigh enough according to height (wasting). The problem is so widespread that 88 per cent of the countries experience two or three forms of malnutrition. In India, 21.9 per cent of the population lives in extreme poverty, and it is estimated that 15.2 per cent of people are undernourished. As per the National Family Health Survey-4 (2015-2016), 38.4 per cent of the Indian children (<5 yr) are stunted, 21.0 per cent are wasted and 35.7 per cent of the children are underweight. Anaemia is also a serious health issue, where 58.4 per cent of the Indian children (6-59 months) and 53 per cent of the adult women (15-49 yr) are affected from this deficiency. The figure is also alarming among adult males as 22.7 per cent were found to be anaemic. During 2015, the global community further set 'Sustainable Development Goals (SDGs)'which aim to end malnutrition in all its form. Of the 17 goals, SDG2 (Zero Hunger) aims to end hunger through improved food and nutritional security. SDG3 (Good Health and Well-being) aims to ensure healthy lives and promotes well-being of people at all ages.

How Crops are Biofortified?

Early in the conceptual development of biofortification, a working group of nutritionists, food technologists, and plant breeders established nutritional breeding targets by crop, based on food consumption patterns of target populations, estimated nutrient losses during storage and processing, and nutrient bioavailability. The next breeding steps involve developing and testing micronutrient-dense germplasm, conducting genetic studies, and developing molecular markers to facilitate breeding. Genotype x environment interaction (GxE) – the influence of the growing environment on micronutrient expression – is then determined at experiment stations and in farmers' fields in the target countries (orange boxes). The most promising varieties are selected for multi-locational testing over multiple seasons by national research partners, and then are submitted to national government agencies for testing for agronomic performance and release, a process which typically takes two years, sometimes more.

Advantages of Biofortification

Elevations of malnutrition in rural areas: Poor farmers in rural areas grow modern varieties of biofortified crops developed by national agricultural research centres this make easy availability of nutrient enriched grain for food to the rural people. The biofortification approach seeks to put the micronutrient-dense trait in the most cost-effective, highest-yielding varieties targeted to farmers and to place these traits in as many released varieties as is realistic. Biofortification provides a possible means of reaching malnourished populations in relatively remote rural areas, delivering naturally fortified foods to people with limited access to commercially marketed fortified foods, which are more readily available in urban areas. Therefore, biofortification and commercial fortification are highly complementary.

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

Sustainability of biofortification: The nutritionally improved varieties will continue to be grown and consumed year after year and recurrent expenditures are required for monitoring and maintaining these traits in crops but these recurrent costs are low compared with the cost of the initial development of the nutritionally improved crops and the establishment institutionally speaking of nutrient content as a legitimate breeding objective.

Table 1: Details of varieties and Nutrient level achieved through biofortification

Crop	Nutrient	Levels achieved	Varieties
Rice	Zinc	>20.0 ppm	DRR Dhan 45, DRR Dhan 49, CR Dhan 310:
Wheat	Iron	>38.0 ppm	
	Zinc	>40.0 ppm	WB 02, HPBW 01, Pusa Tejas (HI 8759), MACS 4028
Maize	Provitamin A	>8.0 ppm	Pusa Vivek QPM9, improved Pusa HM4, improved Pusa HM8, improved Pusa HM9
	Tryptophan	>0.6%	
	Lysine	>2.5%	
Pearl millet	Iron	>70.0 ppm	HHB 299, AHB 1200
	Zinc	>40.0 ppm	
Sweet potato	β carotene	>13.0 mg/100 g	Bhu Krishna, Bhu Sona
	Anthocyanin	>80.0 mg/100 g	
Lentil	Zinc	>50.0 ppm	IPL 220, Pusa Ageti Masoor
Pomegranate	Vitamin C	>19.0 mg/100 g	Solapur Lal:

How to Popularise the Biofortified Crop?

Strengthening the seed chain to produce and supply good quality seeds is one of the important steps for the popularizing biofortified varieties providing subsidized seeds and other inputs would further contribute to the rapid dissemination of nutritionally improved cultivars among the farmers. Assured premium remunerative price through minimum support price for biofortified grains in the market will encourage the farmers to grow more biofortified crops. Essential interventions required for research, development and popularization of biofortified crop varieties have been discussed below:

Awareness generation: strong linkages with agrifood-processing industry would help in the dissemination of biofortified crops. Strong promotional extension activity such as field demonstration, conveying a message through TV talk, radio shows and live-drama would make the farmers, industry and consumers aware of the existence and benefits of biofortified crops.

Policy support: The central government has recently declared millets (sorghum, pearl millet, foxtail millet, finger millet, kodo millet, proso millet, little millet and barnyard millet) besides two pseudo millets (buck-wheat and amaranthus) which have high nutritive value as 'Nutri Cereals'. The inclusion of biofortified products in these government-sponsored schemes would especially benefit the children, pregnant women and elderly people, and would help in their quick dissemination. Thus, strong policy support from the government would further increase the adoption and acceptance of biofortified crops.

Conclusion

The biofortified along with high yielding crops assume great implication for nutritional security. Biofortification has been successful in improving nutrient intake and status in some areas where micronutrient deficiency is common place. The biofortification strategy seeks to take advantage of the consistent daily consumption of large amounts of food staples by all family members, including women and children, who are most at risk for micronutrient malnutrition. The father of Green Revolution, Prof. M.S. Swaminathan has rightly said that 'we need to move from food security to nutrition security, where not only calories and proteins but also micronutrients are taken care off. All that needs to be done is to bring agriculture, health and nutrition together in a triangular relationship, which can only be achieved through partnerships.

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Azolla– A Potential Source of Fodder to Animal Husbandry Farmers

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Azolla, used mainly as a green manure in paddy has tremendous potential to meet the growing demand for fodder among the small farmers taking up animal husbandry.

Azolla

Azolla is an aquatic floating fern, found in temperate climate suitable for paddy cultivation. The fern appears as a green mat over water. The Blue Green Algae cyanobacteria *(Anabaena azollae)* present as a symbiont with this fern in the lower cavities actually fix atmospheric nitrogen. The rate of nitrogen fixed is around 25 kg/ha. As green manure, *Azollais* grown alone for two to three weeks in flooded fields. Afterwards, water is drained out and *Azolla* fern is incorporated in the field before transplanting of paddy. Otherwise, 4-5 q of fresh *Azollais* applied in standing water one week after planting of paddy.

Dry *Azolla* flakes can be used as poultry feed and green *Azollais* also a good feed for fish. It can be used as a bio-fertilizer, a mosquito repellent, in the preparation of salads and above all as a bio-scavenger as it takes away all heavy metals.

Advantages of *Azolla*

1. Easily grows in wild and can grow under controlled condition.
2. In both the seasons of Kharif and Rabi, it can easily be produced in large quantity required as green manure
3. It can fix atmospheric CO_2 and nitrogen to form carbohydrates and ammonia respectively and after decomposition it adds available nitrogen for crop uptake and organic carbon content to the soil.
4. The oxygen released due to oxygenic photosynthesis, helps the respiration of root system of the crops as well as other soil microorganisms.
5. It solubilises Zn, Fe and Mn and make them available to the rice.
6. *Azolla* suppresses tender weeds such as Chara and Nitella in a paddy field.
7. *Azolla* releases plant growth regulators and vitamins which enhance the growth of the rice plant.
8. *Azolla* can be a substitute for chemical nitrogenous fertilizers to a certain extent (20 kg/ha) and it increases the crop yield and quality.
9. It increases the utilisation efficiency of chemical fertilizers.
10. It reduces evaporation rate from the irrigated rice field.

Nutritive Value of *Azolla*

Azolla is very rich in protein (25-35%), Calcium (67 mg/100g) and Iron (7.3 mg/100g).

Azolla Fodder Plot

In addition to their farming activity, small and marginal farmers are generally capable of rearing 2 to 3 units of cow/ buffaloes. For traditional methods of rearing, the feed requirements are met out from agriculture residues and very rarely the farmers can afford to provide green fodder and oil cakes. In rare cases, green fodder is provided to the animals in the form of grass collected from the field or in few cases fodder is grown in the backyard. Even then the supply of green fodder is restricted to 5 to 6 months when water is available. *Azolla* fodder plot, if set up by these small farmers can cater to the fodder requirements of remaining part of the year. *Azolla* can be supplemented with regular feed of the animal @ 2-2.5 kg of *Azollaper* animal.

Azolla, if grown for fodder is essentially required to be grown in hygienic environment and there should be regular supply throughout the year. The fodder plots should preferably be near the homestead, where the female member of the family can attend to nurturing and maintenance.

Azolla - Production Techniques

The biomass production under natural condition i.e. in rice field is only 50 g/sq.m/day as against optimum production of 400 g/sq.m/day. The production efficiency can be increased by reducing contamination and competition with other algae. This can be achieved by growing *Azolla* in pits lined with synthetic polythene sheet in courtyard /back yard preferably in open space or on terrace where availability of sunlight is adequate. Even the water bodies, ditches in the vicinity can also be used for production of *Azolla*.

Azolla cultivated for fish feed, is grown in situ in the pond. A part of the pond is earmarked and is cordoned off by rope made up of straw. Once the mat is formed *Azolla* is released slowly to the pond by lifting the rope.

Setting up of *Azolla* fodder plot does not require expertise and farmers themselves can handle it with ease. If set up in backyard, the area should be levelled and lined with bricks. The side of the plots should be raised to enable the water to stand. Alternatively, the fodder plot can be in a pit with depth of 0.2 m. A polythene sheet is spread over the bed in such a way that 10 cm of standing water can be maintained. Width of the bed is maintained at 1.5 m to enable the cultural operation from both sides. Length may be varied depending upon the fodder requirement of the unit. For two cows, two units of beds of length 2.5 m each with an area of around 8 sq. m can meet 50% of the green fodder requirements.

Once the bed of size 2.5 m x 1.5 m is ready, about 15 kg of fine sieved soil is spread over the bed, which will provide nutrient to the *Azolla* plant. About 5 kg of pre-decomposed (2 days) cow dung is mixed with the water, which provides carbon source for the *Azolla*. About 40 g of nutrient mix (made by mixing 10 kg Rock phosphate, 1.5 kg Magnesium salt and 500 g of Murate of potash) is added to the *Azolla* bed. The solution is fortified with micronutrient of desired quantity. This not only takes care of the micronutrient requirement of *Azolla* but also the cattle when it is fed with the *Azolla*. Sufficient water is added to make the water level of the bed to 10 cm.

About 1.5 kg of mother culture of *Azolla* seed material brought from *Azolla* mother nursery is spread uniformly over the bed after stirring the water in the *Azolla* bed. Care should be taken about the source of the *Azolla* seed. Initially, *Azolla* will spread over the entire bed and will take the shape of thick mat within seven days. Ideally it will give 10 kg of *Azolla* within seven days. During the initial seven days *Azolla* is not harvested. Water level is maintained by applying water every day. After the seventh day, 1.5 kg of *Azolla* can be harvested every day. *Azolla* should be harvested in plastic trays with sieve. Harvested *Azolla* should be washed in fresh water before it is fed to the cattle. Washing is necessary to remove the smell of cow dung. The *Azolla* wash can be used as bio-manure for plants grown nearby. *Azolla* harvested can be mixed with the commercial feed in 1:1 ratio.

Cow dung and mineral mixture removed by *Azolla* mass has to be supplemented at least once in seven days after harvest. A mixture made of cow dung, mineral mixture, soil and water should be added once in seven days.

After every 60 days, soil is removed from the bed and another 15 kg of fresh fertile soil is added into the bed to avoid nitrogen build up and also provide nutrient to the *Azolla*. Fresh inoculation of *Azolla*after removing soil and water should be made at least once in six months repeating the whole process afresh.

Precaution to be Adopted

1. Maintenance of pure culture free from contamination is essential for good yield.
2. *Azolla* should be harvested regularly to avoid overcrowding.
3. Temperature is an important factor for good growth. It should be around 35^{o} C.
4. Places with direct and adequate sunlight should be preferred. A shady place yield less.
5. pH of the medium should be between 5.5 to 7.
6. Suitable nutrients such as cow dung slurry, micronutrients should be supplemented as and when required.

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Costing of Fodder Plot

The cost involved in setting up fodder plot varies between Rs 1500 to Rs 2000. The primary cost is in the form of manual labour, which can be contributed by the family labour. While estimating the cost of fodder plot, two units of fodder beds have been considered to maintain regular yield of *azolla* fodder. Number of units can be increased depending upon the number of cattle and fodder requirements.

Individual dairy farmer can take up this activity to supplement feed requirement of the cattle. Alternatively, an entrepreneur can take up *azolla* cultivation as income generating activity in larger scale to supply feed to dairy farmers in a cluster.

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Importance of Vaccination in Poultry

Article ID: 32067

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Introduction

Vaccine is a preparation of killed microorganisms, living attenuated organisms, or living fully virulent organisms that is administered to produce or artificially increase immunity to a particular disease and administration of this vaccine is known as vaccination. Vaccine plays an important part in the health management of the poultry flock. It helps to prevent a particular disease by triggering or boosting the bird's immune system to produce antibodies that in turn fight the invading causal organisms. Vaccines are generally fragile products, some of which are live but in a state of suspended animation. Others are dead. All have a finite life that is governed by the way they are handled and used. Handling and administration procedures also influence the potency of many vaccines and consequently the level of immunity the bird develops.

Qualities of Good Vaccine

1. It should elicit good immune response for particular pathogen for which it has been administered.
2. It should provide long term protection.
3. It should not produce any adverse effect on patient.
4. Inexpensive.
5. Vaccine should be stable.

Types of Vaccines

1. Based on preparation:

a. Live vaccine: The active part of the vaccine is the live organism that causes the disease. As such, it is capable of inducing the disease in birds that have not had previous contact that organism. Vaccinated birds, in many cases are able to infect non-vaccinated birds if housed together. Eg: New castle disease live vaccine.

b. Attenuated vaccine: This type of vaccine the organism has been weakened by special procedures during manufacture so that it has lost its ability to cause the serious form of the disease. At worst, the birds may contract a very mild form of the disease, however, the vaccine still has the ability to trigger the immune system to produce antibodies. Eg: New castle disease B1 strains.

c. Killed vaccine: With this type of vaccine the organism has been killed and is unable to cause the disease, although the ability to trigger the immune system remains. In many cases, the level of immunity produced by this form of vaccine is weaker than that produced by live and attenuated vaccines. Inactivation is achieved by using beta propiolactone, formaldehyde cross links proteins etc chemicals. Eg: Infectious coryza.

d. Subunit Vaccine: It does not contain whole vaccine; it contains only a part of virion that acts as antigen stimulant.

e. Recombinant vaccine: Here gene coding for immunogenic antigens of various viruses (or other microorganisms) are introduced into the genome of other non- pathogenic viruses. Eg: Mareks disease vaccine.

2. Based on their content:

a. Common viral vaccines: MDV, ND, IBV, IBDV, Reovirus, ILTV, etc.

b. Common bacterial vaccines: MG, MS, Cholera, Coryza, E.coli, Salmonellaenteriditis, &S.typhimurium, etc.

c. Protozoal vaccine: Coccidiosis.

Vaccine Preparation

1. Liquid vaccine: It is in fluid form ready to use.

2. Freeze dried vaccine: The vaccine is stored as one pack of freeze-dried material and one pack of diluents, often a sterile saline solution. These have to be combined before use.

3. Dust: Vaccine is prepared for administration in the dry form. Vaccines are sold in dose lots, the number of doses being the number of fowls that may be vaccinated with that amount of vaccine when using the recommended technique.

Vaccines Handling

Vaccines are fragile in many respects and require very careful handling to ensure they retain their potency. Poor handling procedures will, in most cases, result in a rapid decline of potency.

Important Handling Requirements on the Farm

Once vaccine is received to farm following things hast be checked.

1. Whether vaccine has been transported in the recommended manner which is usually in the chilled or frozen state. Prolonged exposure to atmospheric temperature will result in rapid loss of potency.
2. Type of vaccine – is it the same vaccine which you have ordered.
3. Whether the numbers of doses are correct delivered.

The expiry date of the vaccine As soon as possible place the vaccine into recommended storage conditions.

Care should be taken During Vaccination

1. Vaccine storage: Read the instructions to find out what these are. However, freeze dried material should be kept at a temperature below freezing and its diluent at a temperature just above freezing. Liquid vaccines are generally kept at temperatures just above freezing.
2. Protect the vaccines after mixing by holding them in an ice bath. Place ice in a small container and place the container of mixed vaccine in the ice
3. Some vaccines have a very short life once mixed. For example, Marek's Disease has a life of about 1.5 hours after mixing if held in an ice bath. It is much shorter if held in higher temperatures.
4. Use the recommended administration techniques and do not vary these without veterinary advice.
5. Always clean and sterilise the vaccinating equipment thoroughly after use.
6. Always destroy unused mixed vaccines after the task has been completed. Some vaccines have the potential to cause harm if not destroyed properly.
7. Do not vaccinate birds that are showing signs of disease or stress.

Pre-Vaccination Care

1. Vaccinate only healthy birds. If birds are sick postpone vaccination.
2. Handle the birds gently, and avoid overcrowding.
3. Vaccinate in cool hours (morning) of the day.
4. Keep records of all vaccination, including batch , brand, and manufacturer.
5. Prepare vaccines in suitable diluents, preferably one supplied by manufacturer
6. Never mix two unrelated vaccines together to save time and labour.
7. Provide 1week interval between vaccinations.
8. Destroy left over vaccine, empty vials, needles, etc.

Post Vaccination Care

1. You may need to add vitamins, minerals, and an appropriate broad-spectrum antibiotic in the water to reduce stress of vaccination for at least 4 days.
2. Examples are vitamins and minerals pack, one percent vinegar and glucose.

Factors that Govern the Vaccination Schedule

1. Follow vaccine manufacturer's recommendations.
2. Expired vaccines should never be used.
3. Storage and transport: stored at 2-80^{o} C. never store above 80^{o} C. and transport in closed insulated container with ice pack.
4. Avoid vaccine exposure to direct sunlight
5. Do not vaccinate during high temperature. Above 300^{o} C may affect vaccine potency.

Vaccination Schedule in Poultry (Layers)

SL. No	Disease	Schedule	
		Primary vaccination	Booster dose
01.	Marek's disease	Day old	---
02.	Ranikhet disease		
a)	Lasota	1st week	4th -5th week
b)	R2B	8th week	18th week
03.	Gumboro disease	2nd -3rd week	18th – 20th week
04.	Infectious bronchitis	4th week	14th week
05.	Fowl pox	6th week	14th – 16th week
06.	Infectious coryza	8th week	12th week
07.	Fowl cholera	8th week	12th week
08.	Spirochaetosis	Above 6thweek	-----
09	Egg drop syndrome	15th – 18th week	----

Vaccination Schedule in Poultry (Broilers)

Sl. No	Disease	Schedule		Dose and route
		Primary vaccination	Booster dose	
01	Marek's disease	Day old chick	----	0.2ml sc, im
02	Ranikhet disease- Lasota	1st week	4th-5th week	1 drop in nostril/eye
03	Gumboro disease	2nd -3rd week	----	1 drop in nostril/eye

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Food Supply Triggering "Food Protectionism" During Global Pandemic (COVID-19): A Threaten to Small and Marginal Farmers

Article ID: 32068

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Introduction

The current health crisis around COVID-19 has affected all occupations from production growth, international transportation to market demand, and so on. It has also disrupted the food supply chains tremendously, and these disruptions have major implications for international food assistance (Kerr, W. A., 2020). A major demand shock combined with the unparalleled supply shock to create humanitarian crisis (fear of food insecurity among people) (Cardwell, R., 2020). A sharply visible demand-side shock evident in many countries has been panic buying or hoarding behaviours by consumers and on the other hand, the potential supply side disruptions to food supply chains due to labour shortages, disruptions to transport networks and thickening of border with respect to the movement due to the fear of infection. During this Covid-19 pandemic, an increasing number of countries are signing commitments to resist export controls and other obstacles to food movement and other necessities i.e. food supply chain triggering "food protectionism".

However, if this disruption to food supply chain continues it might result in food crisis and the need for food assistance will grow in the nearer future until no effective treatment is available to overcome the health crisis around COVID-19 (Hobbs, J. E., 2020). According to the Global report on Food Crisis (Food Security Information Network, 2020) prediction, the number of people experiencing acute hunger will increase by 130 million by 2020 because of this pandemic the severity of changes to food security is largely unknown, since travel restrictions impede real-time monitoring. The World Food Programme (WFP) has appealed for US$1.9 billion to cover expected costs over the next several months. More funding will be required to meet longer-term needs (Cardwell, R., 2020).

In addition to the direct health effects of COVID-19, measures to contain the spread of the coronavirus are creating recessionary economic conditions in almost every country.

In its most recent forecast, the International Monetary Fund (IMF) projects a 5% decline of the world economy in 2020 (IMF, J., 2020)-a much deeper global recession than during the global financial crisis of 2008-2009. The economic fallout is hurting developing countries through declines in trade, oil, and other commodity prices and restrictions on international travel and freight, compounding the economic costs of poorer nations' own COVID-19 related restrictions (Laborde, D.et al., 2020).

Incomes are falling; the economies of most countries are in stasis. The large shares of workers in these countries who rely on income from the informal sector are disproportionately affected. Given the continuing restrictions on the movement of people and the traffic of vehicles, concerns have been raised about the negative effect of the COVID19 pandemic on the farm economy, as poor sections of society are often hardest hit in any disaster or pandemic situation.

With about 85% of Indian, farm households being small and marginal farmers and they spend around 70% of their incomes on food and have limited access to financial markets, making their food security particularly vulnerable to income shocks. The focus of the Government therefore has to be to protect the lives of every citizen. However, people living on farming and related activities, especially those who lose their income from informal employment during this lockdown period, must have alternate avenues (cash transfers) before the economy bounces back. In order to all these, this article mainly emphasize that how the global pandemic (COVID-19) mainly affecting small and marginal farmers through supply chain disruption and import restrictions across countries.

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Effect of Food Supply Chain Disruption to Farmers

Small and marginal farmers are an integral part of the food supply chain and a vital component of the global food system. The COVID-19 pandemic has brought new risks, which threaten these smallholder farmers' livelihoods as well as food security. The vulnerability of food supply chains varies greatly across food systems, depending on their priority (Laborde, D. et al., 2020).

Winners and losers are emerging among small farmers, too, said Jennifer Hashley, director of the New Entry Sustainable Farming Project. If we talk about India, there are around 120 million small and marginal farmers contributing around 40% of the country's total grain production and almost half of the Indian population depends on agriculture for their livelihood. Every year, Indian farmers face risks including low rainfall, market volatility and growing debts. However, the threats from the COVID-19 pandemic pose new challenges to the sector. The nationwide shutdown came at an unfortunate time for farmers, as this was the winter crop harvest season. The lockdown has generated both a shortage of labour and equipment, migrant workers as usually this time small wageworkers shifts to the rural areas and smallholder farmers rent harvesting equipment because it is cheaper than buying it. Accordingly, farmers are not able to harvest their crops on time this season. In some places, the crop is dumped, while in other the harvest came more than a month late with limited and more expense labour. Besides this, "Farmers with a lot of storage crops, and items like value-added dairy products, such as yoghurt and cheese that they can manufacture throughout the year, if they have the ability to sell directly to customers, are seeing a significant demand increase. But all of this is very difficult for those who don't have the technical skills or distribution infrastructure to go from dropping down several boxes and food pallets at institutions to selling to one customer at a time.

Moreover, it has been reported that while India's food bank has more than three times the required operating buffer in stock, supply and access is a critical problem. Long supply chains were severely affected, particularly at the start of the lockdown when transport was restricted. In the centre of interstate highways, drivers abandoned lorries full of produce. Markets gradually started running out of stocks, owing to food being rotted in transit or never being sold to the market.

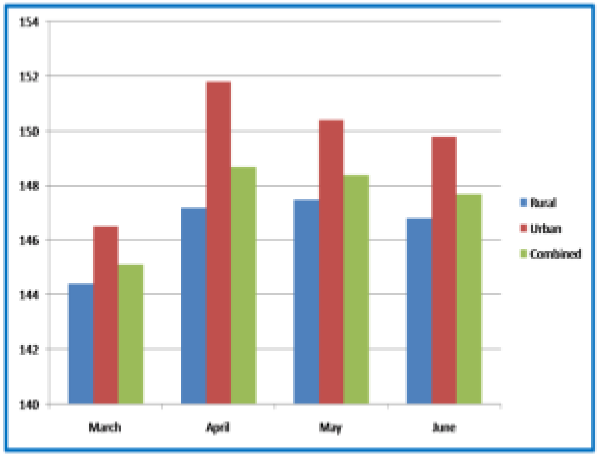
Besides, this the availability and access to seeds, fertilizers and pesticides for the next crop season is another problem for the smallholder farmers which is of concern. Farmers plan for the next crop season in May to post the winter harvest in April. However, the disturbances caused by COVID-19 have decreased the production potential for farm inputs and led to price rises, rendering these resources inaccessible to smallholder. The COVID-19 crisis is not lasting but it has magnified the flaws that already exist in India's food system. By taking stock of the problems, governments and companies will help build stronger, more sustainable supply chains and support initiatives for smallholder farmers who are vital to the food supply chain.

Figure1: Diagram showing Food Supply chain disruption during COVID-19 pandemic

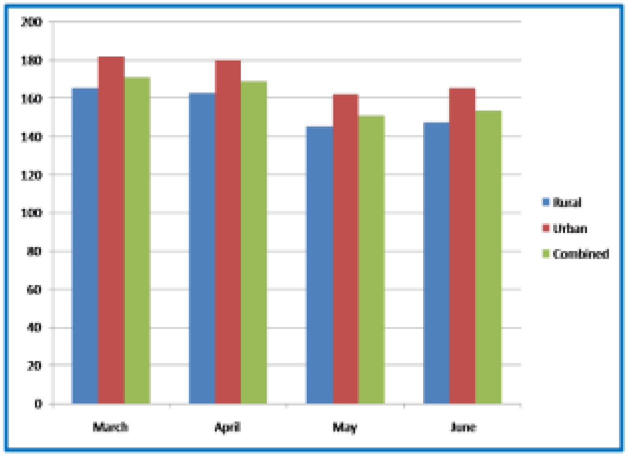
Effect of Food Protectionism to Farmers

Agricultural protection (restriction in movement of agriculture items/goods across countries) in developing countries have been depressing international prices of farm products for many decades, thereby lowering the earnings of farmers and associated rural businesses in developing countries. These policies almost certainly have added to global inequality and poverty, since historically at least three-quarters of the world's poorest people have depended directly or indirectly on agriculture for their main income (Anderson, K., 2015). In the COVID-19 scenario, wholesale prices of fruits, vegetables, wheat, rice, pulses and sugar have fallen up to 75% in India, since the start of the nationwide lockdown due to subdued demand, particularly from wholesalers in other states, restaurants and institutions. The prices are likely to remain weak till mid-June because of continued transportation issues with many state borders sealed, preventing traders from travelling to other states to make wholesale purchases. Within two weeks of the pandemic, prices of wheat, rice and pulses have fallen about 15%, sugar price dropped about 5%, Maize prize fallen by 30%, similar downfall in price has been reported in case of vegetables. These all are anticipating big losses for farmers as the country expected to harvest a bumper crop of winter season.

In case of global markets, markets are well supplied with goods, stocks are healthy, production of key staples is unlikely to be disrupted, and prices have remained relatively stable. Trade is allowing production to move from areas of surplus to areas of shortage, avoiding the drastic shortages and food insecurity associated with dependence only on local production still there is serious threats to the access of the poor to food because of lost income from lockdowns and other restrictions (Glauber, J., 2020). The food price crisis of 2007-2008 shows, however, that policy concerns about food availability can easily turn into a serious price crisis. At the time, some countries responded by imposing export restrictions, which pushed up world market prices of staples and together with them leading other grain exporters also to limit exports in efforts to insulate their consumers from the initial food price rises. Food importing countries worried about the higher cost of food, in turn, lowered import tariffs on food, supporting demand and but keeping upward pressure on world prices. As a result, instead of containing price increases, these policy responses only drove world market prices higher. In the case of rice, these policy responses contributed almost half of the world price surge in 2007-2008. Unfortunately, once again several countries are considering export restrictions. Kazakhstan, one of the world's largest wheat flour shippers, has just banned exports of that source of meal along with others including carrots, sugar and potatoes. Vietnam's customs department reportedly ordered a stop to exports of rice to ensure security of domestic food. Serbia has halted its sunflower oil and other commodities flows. Russia, the world's biggest grain market player, leaves the door open to shipping bans. These restrictions, even if temporary, seem unnecessary. Both countries produce far more than they consume and have ample stocks. An export ban by two key exporters would limit global supply and will certainly push up world prices of staple foods if others follow it.



CPI: Cereals & Products (March-June 2020)



CPI: Vegetables (March-June 2020)

Figure 2: Graphical Representation of Consumer Price Index (CPI) on Base 2012=100 for Rural, Urban and Combined for the month of March 2020-June 2020. [Data adapted from Government of India (Ministry of Statistics and Programme Implementation), National Statistical Office]

The above graph shows the price of cereals & products which were initially declined in the month of March and then picked up during the months of April and May in both the rural and urban sectors and in case of vegetables initial price was seen during the month of March and April.

Conclusion

The COVID-19 pandemic has a major impact on economic activity and in terms of economy the farm economy and poor sections (Small and marginal farmers) of society are often the hardest hit. There is a serious threat to the access of food to poor because of lost income from lockdowns and other restrictions. These problems should be addressed through initiatives that help sustain access to food, rather than through policies as export bans, and in order to avoid immediate concerns about the lack of farm labour, policies must encourage the easy availability of machinery with appropriate incentives through state agencies, Farmer Producer Organizations (FPOs) or Custom Hiring Centres (CHCs). It is also suggested that National Rural Employment Guarantee Programme (NREGS) funds be leveraged to pay part of the farm labour (with farmers paying the balance wage amount) to reduce the monetary burden on the farmers, while ensuring landless laborers and workers wage employments.

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Endophytes and Phytochemicals: Potential Alternative for Biodegradation of Aflatoxin

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Abstract

Aflatoxin, the carcinogenic mycotoxin, has threatened human and animal life by deteriorating food and feed quality. Researchers have developed much potential technology for detoxification of aflatoxin through the degradation of its structure using thermal treatment such as irradiation by ultraviolet (UV) light and gamma radiations, breeding resistant variety or genome editing tool etc. But all these methods are costly as well as specially trained person is needed for the purpose. So, Biodegradation is only option which is safe, farmers friendly and cost effective. Integration of endophytes-the beneficial microbes present in the plant system and plant extract from potential medicinal plant species can be one of the alternatives for reducing aflatoxin contamination. With this approach, the food or feed material will retain its nutritive values and remain palatable.

Introduction

Mycotoxins are toxic secondary metabolites that are produced by some group of fungi which contaminates agricultural commodities and food. *Aspergillus, Penicillium, Alternaria and Fusarium* is considered as mycotxin producing group of fungi. World Health organization (WHO, 2018) reported that 25% of world's food is affected by mycotoxin. Aflatoxin, Fumonisins, Ochratoxin A, Zearalenone, Patulin, Citrinin, Deoxynivalenone are the examples of important mycotoxin contaminating food and feed. But the important fact is that farmers or consumers are less aware about this mycotoxin and probable health hazards due to consumption of this mycotoxin. Aflatoxin- is not only carcinogenic to human health but also it is mutagenic and immunosuppressive also. More interestingly the presence of aflatoxin does not reflect in taste, smell or appearance. The presence of mycelia or spore is the only visible symptom of *Aspergillus* contamination. But, the presence spore or mycelia of *Aspergillus* may not lead to aflatoxin production or absence of pathogen does not imply absence of aflatoxin.

Aspergillus can contaminate almost all crops like maize, ground nut, chilli, rice, sorghum, walnut etc. especially in storage condition. This is the neglected part of farmers as because the presence of the *Aspergillus* not directly link to the yield reduction. But if the aflatoxin enters into the food chain it can transmit from feed to egg and milk that threatens human life. Keeping this in view, the agricultural science has evolved with modern technology like use of radiation technology to detoxify aflatoxin. By adopting this technology, toxin may be degraded but the quality of food material and viability of seed material is destroyed. Besides that, the incorporation of recent technology- genome editing tool for breeding resistant variety is also too expensive and specially trained person is required for the purpose. So, the only alternative is the integrated approach for biodegradation of aflatoxin using endophytes and phytochemicals. This approach is safe to the environment, economically feasible to the farmers and easy to adopt.

Endophytes as an Inhibitor of Aflatoxin

Recently, in biological management of plant diseases, the guest endophytes play a vital role. These are the beneficial creatures of nature which are present inside the living plant tissue, without producing any symptom; maintains a symbiotic relationship with the plant species by secreting some plant secondary metabolites which make the plant species resistant to many biotic and abiotic stresses. Evidences said that these endophytes can be successfully employed for biodegradation of Aflatoxin. El deeb *et. al.,* (2013) first reported Aflatoxin detoxification using endophytic *Bacillus* sp. isolated from maize grain from Saudi Arabia. High Performance Liquid Chromatography (HPLC) was used to determine the reduction in aflatoxin concentrations and it was observed that *Bacillus* sp. TUBF1 had the strongest ability to detoxify aflatoxin to 81.5% and 100% after 48 and 72 hours of incubation, respectively. They have performed biosafety assessment which indicated that the crude enzymes from *Bacillus* sp. TUBF1 had the high ability to detoxify aflatoxin. Likewise, Sudharshana *et. al.,* (2019) reported that *Alternaria alternata* isolated from *Catharanthus roseus* leaves having ethyl acetate (EA) and *p*-coumaric acid that have the capacity to reduce aflatoxin at 400 µg/mL by strongly inhabiting the synthesis of the membrane-bound ergosterol from *Aspergillus flavus.*

Phytochemical as an Inhibitor of Aflatoxin

Nature is so rich that it has the potentiality to break down the toxic material of Aflatoxin. The plant system consists of different kind metabolites which can be utilized for biodegradation of Aflatoxin**.** Many researches have identified those specific plant species and the phytochemical extracted from those particular species can successfully employed to detoxify aflatoxin. Vijayanandraj *et. al.,* (2014), from Tamil Nadu, India has reported that leaf extract of *Adhatoda vassica* have more than 98% degradation capacity of aflatoxin after incubation for 24 hr at 37°C. Detoxification of aflatoxin B1 was confirmed by liquid chromatography-mass spectrometry analysis. Ponzilacqua *et. al.,* (2018) reported that leaf extract of *Ageratum conyzoides*, *Chenopodium ambrosioides*, *Cinnamomum tamala*, *Curcuma longa* and seed of *Cuminum cyminum* has the antifugal activity against aflatoxin. Nogueira *et. al.,* (2010) found that nearly 48% inhibition of *A. flavus* growth in sabouraud agar with 5.0 µL in a 6mm diameter of filter paper disk of the *Ageratum conyzoides* extract. Sultana *et. al.,* (2015) reported from Faisalabad, Pakistan that neem leaves at 20% concentration fully inhibited the synthesis of aflatoxin B1 for 2 months, G1 for 3 months and B2 and G2 for four months in Maize.

Conclusion

Detoxification of aflatoxin can be possible by biological means with integration of endophytes and certain phytochemicals which is safe to the nature. The integrated approach is a farmer's friendly technology. There is an immense scope for development of phytoproduct or bioformulation for detoxification of aflatoxin. This approach helps the farmers for entrepreneurship development and makes them aware about the possible health hazards due to aflatoxin contamination. In combination to that, good agricultural practices and effective post-harvest storage management practices will certainly eradicate the aflatoxin contamination from feed and food material.

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Opportunity for Women Coir Artisans – MCY

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Introduction

With more than 80% workforce engaged in coir industry being women, the industry is a woman oriented traditional industry. It is rural based and the workers engaged in the industry are mostly below the poverty level. Spinning sector is one of the vulnerable sectors of the industry employing predominantly women who derive their primary income from spinning coir yarn. The traditional method of spinning using ratt (traditional spinning wheel) involves drudgery, strain and low returns because of low productivity.

Mahila Coir Yojana is the first women-oriented self-employment scheme being implemented by the Coir Board for the empowerment of women artisans in the coir sector. The scheme facilitates proliferation of the industry into new regions where raw material potential exists. The scheme was first introduced in 1994 during the IXth Five Year Plan. It is well accepted not only in traditional coir producing States but elsewhere even. The conversion of coir fibre into yarn on motorized ratts in rural households provides scope for large scale employment, improvement in productivity and quality, better working conditions and higher income. Skill upgradation and Mahila Coir Yojana is one of the crucial ones under the scheme Coir Vikas Yojana. Mahila Coir Yojana in particular aims at women empowerment through the provision of spinning equipment at subsidised rates after appropriate skill training.

Eligibility and Objectives

The programme, "Skill Upgradation & Mahila Coir Yojana" consists of two distinct components. Viz. (a) Skill Upgradation, (b) Mahila Coir Yojana. Not more than one artisan per household would be eligible to receive assistance under the scheme. Women artisans need to have successfully completed training programme in spinning of coir yarn through any of the training centers of the Coir Board. The Objectives of the scheme are to:

1. Train personnel in the cadres of Supervisors/ Instructors/ Artisans and to meet the requirement of skilled man power for the development of coir industry.

2. Help in transfer of technology to non-traditional areas through development of skill of coir workers.

3. Assisting the trained women artisans for procuring spinning equipments/coir processing machineries from the PMEGP.

4. Provide self-employment to rural woman artisans in regions producing coir fibre and enabling them to get better returns through improvement of productivity and quality. Providing them with a better work environment and elimination of drudgery involved in the traditional methods of spinning and product manufacturing.

5. Encourage new entrepreneurs both in traditional and non-traditional areas under Entrepreneurship Development Programmes to venture into coir industry and trade and thereby accelerate the development of the industry in the existing and new areas.

6. Aim at inculcating quality consciousness among the workers at grass root level and to educate them on proper methods of producing standard quality fibre, yarn and products.

7. Create awareness among the coconut growers, entrepreneurs etc. to set up coir-based units and to modernize the existing units for better productivity, quality and also enhance earnings.

8. Contribute to generate employment in rural areas of the coconut producing States.

Coir Board, Kochi is the Nodal Agency. The scheme will be implemented through the Regional/ Sub-regional offices/ training centres of the Board. The scheme will be monitored by Coir Board and the feedback (Monthly/ Quarterly/ Half yearly and Annually Report) will be regularly furnished to the Ministry of Micro, Small and Medium Enterprises by the Head Office of the Board.

Implementation

The Coir Board will continue to impart training in processing of coir to artisans and workers engaged in the coir industry through its training centres, i.e., National Coir Training and Design Centre (NCT&DC), Kalavoor, Alleppey and Research-cum-Extension Centre, Thanjavur, and Field Training Centres of Regional Officers/ Sub Regional Officers of the Board located at various parts of the country.

The in-house training programmes organized by Coir Board at its training centres exclusively for orientation training on the basis of the request from trade and industry and Govt. sponsored agencies are not provided with stipend. All other field level training programmes are stipendiary. The stipend per trainee for the skill development programmes will be limited to Rs.3,000/- per month and in the case of training programmes of less than one-month duration, stipend will be disbursed on prorata basis. Coir artisans and workers engaged in the coir industry may avail of the financial assistance for procurement of machines / equipment under PMEGP scheme for setting up of new coir units for which the maximum project cost is Rs.25 lakhs. The officer-in-charge of the Regional Extension Centre will handle selection of trainees for training programmes conducted at the Regional Extension Centres. Trade Associations, Unit Owners, NGOs, Co-operatives and Industries Department will sponsor such candidates and recommend them for training.

Conclusion

In order to develop coir industry in coir producing States, particularly in the non-traditional coir producing States like Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, West Bengal and Tripura where there is substantial potential for development of coir industry and generation of rural employment on account of raw material availability, the training programme for the development of skills of artisans have to be continued vigorously with greater participation of co-operatives, NGOs and other recognised training institutions. There is no agency other than Coir Board having the expertise to conduct skill development training in coir sector.

Women coir workers are under privileged and exploited lot. They typify women workers in under developed rural areas where primitive and unorganised sector of the industry dominate. The introduction of motorised ratt and motorised traditional ratt for spinning coir yarn improved the productivity and income earning capacity of rural women coir spinners. This would, in turn, improve their working condition, working environment and lift them above poverty line. Therefore, the development of coir industry has a pronounced aspect of empowering rural women and enlisting their participation in the development of the nation. Thus, the scheme has enhanced the earnings, livelihood and socio-economic status of women and has created new employment for women.

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Characteristics and Function of Insecticides

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Introduction

Indian economy is principally a horticulture based. Roughly 18 percent of the food grains go squander as a result of the plant pathogens, irritations, weeds and rodents. To limit these misfortunes various pesticides are utilized. Pesticides are agrochemicals, utilized for forestalling, repulsing, relieving or annihilating any irritations. It incorporates bug sprays, fungicides, rodenticides and herbicides and so on. Among these bug sprays are of synthetic or organic starting point that controls the creepy crawly. Control may bring about the type of slaughtering the creepy crawly or in any case keeping it from dangerous practices. Bug sprays are either regular or combined and are applied to target bothers in a bunch of plans (EC, WP, SP, FP, G and so on.) and conveyance frameworks (showers, goads, slow-discharge dispersion, dust, and so on.). As of late, the bacterial qualities coding for insecticidal proteins have been consolidated into different yields that managed the mortality of the irritations benefiting from them. Numerous other eco-accommodating techniques for creepy crawly bug control viz. IPM (Integrated Pest Management), utilization of bio-pesticides and so forth., are getting mainstream. Bio-pesticides and IPM have a decent development later on, as there is developing worry for the eco-accommodating agribusiness and could be accomplished through Good Agriculture Practice.

The initial four many years of the twentieth century saw a huge improvement in the union of bug sprays. Synthetic bug control changed drastically following the revelation of insecticidal properties of dichlorophenyl trichloro ethane that later on prominently known as DDT. This was finished by Paul Muller of J.R. Geigy Company in 1939. Its first significant use was to control jungle fever and typhus by the Western partners during World War II. This denoted the period of the chlorinated hydrocarbon bug sprays, with the resulting union of hexachlorocyclohexane (HCH) and the cyclodiene mixes. These chlorinated hydrocarbons were invited toward the start, however their steadiness and their hydrophobicity brought about the defilement of the earth and bioconcentration in the assemblage of numerous creatures, consequently they were confined being used or restricted later on. The original bug sprays, i.e the chlorinated hydrocarbons are still being used, however in created nations, their utilization has been limited or restricted. India has as of late prohibited the utilization of DDT and HCH in farming.

Blend of organophosphorous bug sprays was therefore done on an overall scale (beginning from Germany). Three of these mixes HETP, Parathion and Schradan credited to Gerhard Schrader, were widely utilized. They were not steady, and, in endeavors to bring down the mammalian poisonousness and increment the viability, many other OP bug sprays have been orchestrated. In this manner the most significant gathering of bug sprays is as yet the organophosphorous mixes.

The presence of another class of bug sprays, the carbamates, was foreshadowed by Swiss specialists in 1940, yet the primary significant achievement was with the presentation of the American bug spray carbaryl in 1950. It was trailed by blend of numerous different carbamates. They are all nerve harms and explicitly acetylcholinesterase inhibitors, just like the organophosphates.

Regardless of serious natural weights, the world market for pesticides has developed incredibly. There is a blast in the worldwide pesticide showcase and new bug sprays, herbicides and fungicides and their definitions are being presented with more prominent degree of action, be that as it may, with cognizant endeavours for limiting the risks to the people and the earth.

Materials and Method

Toxicology of insecticides: Investigation of the unfriendly impacts of synthetics on living framework. Here bug spray is a poisonous concoction. Poison on uses of synthetic substances relies upon the idea of toxicant, courses of introduction (oral, dermal and inward breath), portion and creature. Harmfulness of bug sprays typically communicated as far as LD50 or LC50. Its qualities are communicated in term of milligram per kilogram body weight or ppm individually.

Results

1. LD_{50} (Lethal Dose 50 percent): The term LD_{50} is communicated, as the single presentation portion of the toxic substance per unit weight of the living being required to execute 50 % of the test populace, where the populace is hereditarily homogeneous. It is applied with a certain goal in mind under expressed test conditions.

It is typically communicated as far as mg poison per kilogram body weight of the test creatures. Under specific conditions, the term micrograms per creepy crawly (µg/bug) might be utilized when synthetic is applied topically to the bug.

The LD_{50} can be found for any course of passage or organization however dermal (applied to the skin) and oral (given by mouth) organization strategies are the most well-known.

It is an oftentimes used to proportion of intense poisonousness of a bug spray on a life form.

It is likewise critical to realize that the real LD_{50} worth might be distinctive for a given concoction relying upon the course of presentation e.g., oral, dermal, inward breath.

2. LC_{50} (Lethal Concentration 50 percent): LC_{50} is the centralization of the concoction in the outer medium (normally air or water encompassing test creatures), which causes 50 % mortality of the test populace, where the populace is hereditarily homogeneous.

This worth is utilized when the specific portion given to the individual is difficult to be resolved.

LC_{50} is communicated as the percent of dynamic element of the substance in the medium or as parts per million (ppm).

Dose Response Relationships

In toxicology, the portion is significant which decide its effect on living being. It is the portion which makes substances a toxin. The correct portion separates a toxic substance and a cure. At high dosages, all the synthetic concoctions are poisonous, at judicious portions they are helpful and at low dosages they don't have a perceivable harmful impact.

1. A portion reaction relationship depends on the accompanying significant presumptions.
2. There is consistently an edge portion underneath which no impact happens.
3. Once impact happens, reaction increments as portion increments.
4. Once a greatest reaction is reached, any further increments in the portion won't bring about any expanded impact.

Evaluation of Toxicity in Insects and Animals

The poisonousness assessment process or harmful associations of any substance and any given organic framework are portion related. At amazingly high fixations, most synthetic concoctions effect sly affect natural frameworks. The toxicology of harmful synthetic compounds can be named as the study of portions.

Conclusion

The poisonousness of bug sprays to a life form is typically communicated as far as the LD_{50} (deadly portion 50 percent) and LC_{50} (50 percent deadly focus). What's more, the connection of poisonous concoction with a given organic framework is portion related. Along these lines, it is the portion which makes substances poison. The correct portion separates a toxic substance and a cure. At high dosages, all the synthetics are harmful, at suitable intermediates portions they are helpful and at low enough portions they don't have a noticeable poisonous impact. There are sure pesticides (for example DDT) known today, as a result of the drawn-out introduction to them at portions that don't quickly kill the living being indicated extreme impacts like Carcinogenic, Mutagenic and Teratogenic impacts.

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Nano-Fertilizers: A Novel Approach for Increasing Crop Productivity and Nutrient Use Efficiency

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With the global upsurge in population and rapid urbanization, farmers across the globe are left with the daunting task of feeding more mouths every year it has prompted the large-scale use of fertilizers. As a result of resource constraints and low use efficiency of fertilizers, the cost to the farmer is increasing dramatically. Nanotechnology offers great potential to tailor fertilizer production with the desired chemical composition, higher nutrient use efficiency that may reduce environmental impact and boost the plant productivity. Nano-fertilizers are very effective for precise nutrient management in precision agriculture by matching with the crop growth stage for nutrient and by providing nutrient throughout the crop growth period.

Introduction

Intensive farming practices introduced and evolved since the inception of green revolution have been deemed unsustainable as the utilization efficacy of applied chemicals including mineral fertilizers has remained below 30% (Albanese et. al., 2012).

Fertilizers play a pivotal role in agricultural production and contribute to the tune of 35-40% of the productivity irrespective of crops. In contrast to this the extent of multi-nutrient deficiencies are alarmingly increasing year by year which is closely associated with a crop loss of nearly 25–30%.

Because of the limitation in arable lands and water resources, the development of agriculture sector is only possible by increasing of resources use efficiency with the minimum damage to production through effective use of modern technologies. In this context nano-fertilizers may be used as a strategy to regulate smart release of nutrients that commensurate with crop requirement in addition to higher-absorption rate, utilization efficacy and minimum losses.

Zeolite based nano fertilizers are capable of releasing nutrients especially $NO3^-$ – N for more than 50 days while nutrient release from conventional fertilizer (urea) ceases to exist beyond 10 – 12 days. They also provide more surface area for different metabolic reactions in the plant which increases the rate of photosynthesis and produce more dry matter and yield of the crop in addition to preventing plant from different biotic and abiotic stress. Thus nano-fertilizers have potential to fulfil plant nutrition requirements by maintaining sustainability in crop production systems without compromising the crop yields.

Classes of Nano-Fertilizers

A nano-fertilizer is any product that is made with nano-particles or uses nanotechnology to improve nutrient efficiency (Mikkelsen, 2018). In short, encapsulation of fertilizers with nano-particles offers wide perspective for developing plant nutrient sources with greater absorption and nutrient use efficiency. Generally, three classes of nano-fertilizers have been proposed which are as follows:

1. Nano-scale fertilizer: In which plant nutrient sources are encapsulated within the nano-particles of varying nature and chemical composition.

2. Nano-scale additives: In which particles having dimension in the range of nano-particles are used as additives in preparation of traditional fertilizers.

3. Nano-scale coating: In which nano-particles such as polymer film are used as thin coating materials for traditional fertilizers.

Advantages of Nano-Fertilizers Over Conventional Fertilizers

Mineral nutrients if applied to crops in the form of nano-fertilizers hold potential to offer numerous benefits for making the crop production more sustainable and eco-friendlier (Subramanian et. al., 2015). Some of prominent advantages are:

1. They feed the crop plants in a controlled manner in contrast to quick and spontaneous release of nutrients from chemical fertilizers.

2. They are more efficient in terms of nutrient absorption and utilization resulting in lesser losses in the form of leaching and volatilization.

3. They become available as soon as plants are in position to internalize the released nutrients. Also, fertilizers coated with thin layer of polymer avoid premature contact with soil and water that leads to negligible loss of nutrients.

4. Nano-particles results in higher uptake of nutrients due to free passage from nano sized pores and by molecular transporters as well as root exudates.

5. Comparatively higher solubility and diffusion that impart superiority of nano-fertilizers over conventional synthetic fertilizers.

6. They are required in smaller quantities in comparison to synthetic fertilizers because of their higher use efficiency.

7. In addition to above ones, they also increase the stress tolerance capacity of crops by nearly 10 times.

8. They offer lower risk of environmental pollution.

9. In general ultimately increases the crop yield by 17-54%.

Limitations of Nano-Fertilizers

Despite many advantages, nano-fertilizers are also associated with few drawbacks which are as follows:

1. Absence of stringent monitoring and lack of legislation are prime limitation in rapid development and adoption of nano-particles as a source of plant nutrients.

2. The production and availability of nano fertilizers in required quantities is another important limitation in their adoption as a source of plant nutrients.

3. The higher cost of nano-fertilizers is another hurdle in their adoption under varying soil and climatic conditions.

4. Lack of recognized formulations and standardization leads to contrasting effects of the same nano-fertilizers under various soil and climatic conditions.

5. Implementation of uniform size of nano-particles (1–100 nm) is required as many products are being claimed as nano but in fact are submicron and micron in size.

Conclusion

Nano-fertilizers applied alone or in conjunction with organic materials have the potential to increase the use efficiency of plant nutrients and to reduce the soil toxicity, adverse effects of excessive use of chemical fertilizer in addition to reduced fertilizer application frequency leads to a way for sustainable crop production with higher productivity that will helps to feed the generations. However, their general adaptation as a source of plant nutrients depend on various factors like effective legislation, production as per requirement and associated risk management. Hence further research work related to these aspects is required for their large-scale adoption in crop production in effective manner.

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Off-Season Vegetable Cultivation

Article ID: 32073

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Agriculture is considered as the backbone of Indian Economy. It plays a strategic role in the process of economic development. As per the Economic Survey 2019- 2020, the agriculture sector has contributed about 16% to Indian GDP at current prices. Contribution of Agriculture sector in Indian economy is much higher than world's average (6.4%).Growth in agricultural sector may be well judged by the increase in the agricultural production over time. India is expected to achieve the ambitious goal of doubling farm income by 2022.Cultivation of fresh vegetables after or before their normal season is called as off-season vegetable cultivation, which means cultivation of crop outside their regular cropping calendar i.e. when the supply is low and prices are high. The concept of off-season vegetable cultivation is a bit new to the growers and they don't have complete knowledge regarding it. This is one of the modern practices which can give farmer higher profit and satisfy the requirement of consumers at any time anywhere with more choices. The main objective of off-season vegetable cultivation is to produce and supply the vegetables to the market during their lean period.

The Off-Season Vegetable Production Can be Obtained by Different Ways Such as

1. Availing and using different agro climatic conditions.
2. Selection of improved varieties.
3. Adjustment of planting time.
4. Creating controlled environmental conditions by making plastic tunnels, polythene houses, permanent glass houses etc.

Off-Season Vegetable Planting have Various Advantages Like

1. It helps in better/proper utilization of land and farm resource.
2. The outcome obtained by the off-season planting per unit is high.
3. Nowadays consumers prefer fresh vegetables even in the off season, this demand of consumer can be satisfied by off season vegetable production.
4. Sometimes it is possible to export fresh vegetables and earn foreign exchange.
5. It is a source of rich protective food and it adds to the nutritional security.
6. It is suitable for seed production.

It Also Offers Many Benefits to the Farmers Like

1. This method of production is suitable to small and marginal farmers.
2. This engages the farmer throughout the year which solves the problem of unemployment.
3. Farmers can learn specific techniques of vegetable production, which enhances their knowledge and interest towards it.
4. It develops confidence amongst farmers which make vegetable production as their main profession.

Due to Off-Season Vegetable Production

1. Government is supporting this by introducing new policies.
2. Co-operative marketing societies are also involving in this development process.
3. The women are able to contribute equally in marketing activities.
4. Farmers also started to establish linkage with the wholesalers and retailer in local market etc.

Apart from Advantages there are Some Disadvantages of Off-Season Vegetable Production Like

1. The production cost of vegetables is higher.
2. It requires more money to construct the plastic houses.
3. It requires expensive seeds.
4. It is possible on commercial scale, only in areas where marketing is not a problem.
5. It requires regular supervision.
6. It requires skilled knowledge than the normal season production.
7. Sometimes it is also risk due to possibility of incidence of disease and pest.
8. It can become a source of pollution.

There are Many Others Problems Too in Off Season Vegetable Planting Which May Limit to Some of the Farmers for Growing Off-Season Vegetables and it is Necessary to Know About that Also

1. Lack of continuous support of improved technologies.
2. There is also unavailability of proper of proper packaging materials.
3. There is no access of market information system.
4. There is no crop insurance for this production.
5. The production is affected by the government regulations.
6. Unorganized market centres at the production area.
7. There is also lack in marketing education and marketing extension system.

Even though Off-Season Vegetable Production has Various Disadvantages and Flaws then Also there are Many Opportunities in Growing Off-Season Vegetables

1. It provides more open export markets to farmers and traders than the existing opportunities to traders at local regional and global level.
2. It provides opportunities for exporters and various stakeholders.

Vegetables which can be Cultivated as Off-Season are

1. Cabbage.
2. Leafy vegetables.
3. Cauliflower.
4. Beans.
5. Capsicum.
6. Pointed gourds.
7. Tomato.
8. Turnip.
9. Brinjal.
10. Okra.
11. Cucumber.
12. Radish.
13. Summer squash.
14. Carrot.
15. Watermelon.
16. Potato.
17. Bitter gourds.
18. Chilli.
19. Green peas.

20. Garlic.
21. Swiss Chard.
22. Onion.

Off-Season Vegetable Production is Nothing but Just Adjustment of Sowing and Harvesting of Crop

Example: Summer vegetables are sown about 2 months earlier than the normal season for early crop.

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Crop Diversification - A Way for Food and Nutritional Security

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Crop Diversification

Crop diversifications means adopting the crop mix which is flexible and help a farmer in taking that decision which is based on the principle of profit maximization. Through it the farmer reallocates his productive resources from a traditional crop mix into a new crop mix due to any definite factors. It can be shift from:

1. Low value crop to high value crop.
2. Single crop to multiple crops.
3. Water loving crop to water saving crop.
4. Labour intensive crop to employment generating crop.
5. Low income generating crop to high income generating crop.
6. Low average income of major crop (per hectare) to high average income of minor crop (per hectare).
7. Primary good to value addition & processing.

Broadly we can categorize crop diversification into three types.

1. Horizontal diversification (broadening the base):

a. Crop substitution: Instead of low value adoption of high value crop

b. Crop intensification: Addition of more crops to crop mix.

2. Vertical diversification (downstream activities): Other than cropping e.g. canning, juicing of the fruits, natural colorants, herbs and essence etc.

3. Other diversification: Based on land, water and variety.

Need of Crop Diversification

Literature has provided us several benefits of crop diversification ranging from short run to long run. The short run benefits are:

1. Improves food security.
2. Shifts consumption pattern.
3. Increases and ensures availability of sustainable income.
4. Risk mitigation.
5. Employment generation.
6. Poverty alleviation.
7. Improving productivity and efficiency in scare resources use (e g : drip irrigation or vertical gardening)
8. Export promotion.
9. Conservation of natural resources particularly land and water help in switching farmers from illegal narcotic producing crop (like cocaine) to alternative crop production for their livelihood.

These short-run benefits of crop diversification ensure long-run benefits such as regional equity, growth prospects in agriculture and sustainable farming systems.

Factors Influencing Crop Diversification

One or many of the factors which act as an incentive for the farmers to diversify.

1. Resource/climate related: Irrigation, rainfall & soil erosion.

2. Tech related: Seeds, fertilizer, storage, processing.

3. Household related: Food & fodder self-sufficiency + investment capacity.

4. Price related: Factor affecting price directly/ by industry.

5. Institutional & infrastructure related: Farm size, govt. regulation, credit access, and farm extension services, post-harvest and production facilitation, marketing and trade.
6. Social factors: Farmers age, education & experience, peer pressure.

The factors responsible for crop diversification can be divided into three broad categories viz:
1. Economic factors consisting all economics and finance side factors.
2. Social factors consist of social factors which make a farmer to take decision towards diversification depending on the condition of risk aversion, income enhancement, and increase in productivity or subsistence.
3. Biological factors have all those factors which come into natural factors for crop production.

A farmer can go towards crop diversification depending on the absence or availability of any factor mentioned above.

Diversification is mostly adopted as the risk mitigating tool. It stabilizes the farm income through cultivation of high-value crop with a bonus of less investment requirement. It can be through:
1. Area augmentation.
2. Crop substitution.

Sources of Crop Diversification

1. Area augmentation: By increasing cropping intensity, utilizing fallow lands, rehabilitation of degraded lands and deforestation (an environment concern), CD can be attained through source of area augmentation.
2. Crop substitution: It refers to replacing one crop for another crop keeping in mind profit, demand, price and physical condition required for the crop.

Food Security

The World Food Summit in 1996 indicated that:
"When all people at all times have physical and economic access to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life".

Literature revealed that the term 'food security' currently has more than 200 definitions and 450 indicators of food security. It has multiple dimensions covering Quantitative (having enough quantity of food), Qualitative (reliance on inexpensive nutritious foods), Psychological (no anxiety/stress associated to meet daily food needs) and Social (acquiring food through socially acceptable means not as charitable assistance, buying food on credit, and stealing) dimensions. Irrespective of the dimension, Food security is one of the major issues in current global economic and social scenario. It is not the problem of a single economy rather it refers to global world.

Studies have Divided Food Security in Following Broad Categories

1. Food Availability.
2. Food Accessibility.
3. Food Absorption (Safe & Healthy food and Nutrition).
4. Food Stability.

Food Availability

1. Food availability is a sufficient and constant amount of food which should be available for every individual.
2. Food availability is a serious concern for war zone areas, non-agriculture land areas and flood & drought areas
3. Moreover, climate greatly influences the food availability as Al-Niño is a reality now which is badly hitting agriculture.

Food Accessibility

1. Food Accessibility means every household has sufficient amount of food within their economic resources.
2. Economic accessibility and household income is associated with the acquisition of food, to meet sufficient calorie requirement.

3. Food accessibility is related to prices of food and income of general public. If prices increase while income remains constant then food will be beyond the access of public.

Food Absorption

Food absorption refers to food utilization. It means utilization of safe & nutritious food, clean drinking water, proper sanitation and proper health care.

Biological food absorption can be influenced in two ways:
1. First food preparation and health condition of an individual that further influenced by sanitation condition and clean drinking water.
2. Second is related to the knowledge of the household regarding proper food storage, processing and basic nutrition needed (Ahmed M & Farooq 2010).

Food availability and accessibility may improve by increasing production and income or by reducing food prices but food nutrition requires special conditions; provision of health care facilities, clean drinking water and sanitation.

Food Stability

1. Food stability refers to the constant availability and accessibility of food.
2. Fluctuations in production of agriculture product effect food availability and thus accessibility.
3. When production is low government has to import in order to ensure proper availability of food.

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Agrivoltaic Farming for Energizing Agriculture

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Food and energy are the two essential requirements for human population and the demand for these two resources are increasing at a fast rate (Santra et al., 2018). Therefore, the competition for land may arise in future for food and energy production. Hence to overcome these two challenges, it can be through to produce both simultaneously from a single land unit through the concept of agrivoltaics.

Agrivoltaic

Co-developing the same area of land for both solar photovoltaic power as well as for agriculture.

History of Agrivoltaic

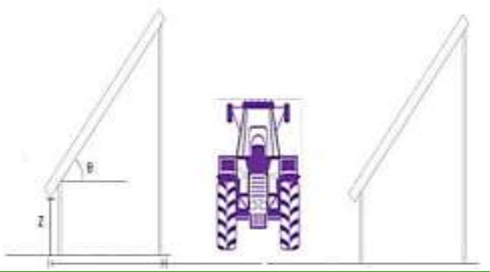
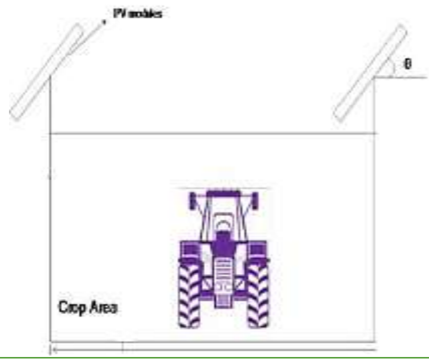
1. In the year 1982, two german scientists Adolf goetzberger and Zastrow were the first to introduce the concept of dual use of land for solar energy production and crop cultivation to increase overall production.
2. Akhira Nagashima suggested to combine photovoltaic systems and farming to harvest excess of light and he developed the first prototype in the year 2004.
3. The term agrivoltaic was used for the first time in a publication in the year 2011 (Dhyey et al., 2019).

Agrivoltaic Methods

Agrivoltaic methods can be classified into three basic types viz:
1. Mounted on ground system
2. Mounted on elevated structure
3. Semi- transparent roof type structures.

Mounted on Ground System and Mounted on Stilts

The solar photovoltaic modules can be either mounted on the ground with space between the rows of solar modules used for agriculture and large enough to accommodate a standard farming equipment or it can be mounted on stilts with the space underneath stilt used for farming. The height of stilt and the spacing between the stilt is such that, a standard farming equipment can easily pass through it (Harshavardan and Pearce, 2016).

	
Mounted on ground	**Mounted on stilt**

Where,
X- Distance between the rows of PV module used for agriculture.
Y- Horizontal projection of solar panel.
Z- Stilt angle.
Θ- Tilt angle (Angle of solar panels).

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Agrivoltaics and Arid Region

Agrivoltaics has very good potential in arid regions specially in arid western India comprising of western parts of Rajasthan, north western part of Gujarat and some parts of Haryana and Punjab because these regions receive more solar radiation when compared to rest of the country and also most of days in a calendar year are cloud free which makes these regions more advantageous for harnessing the solar radiation. Installation of such system in farmers may fetch addition income by the sale of solar radiation in addition to crop cultivation.

Low growing and shade tolerant crops can be successfully grown under AVS system.

Agrivoltaic Farming at CAZRI, Jodhpur

Central arid zone research institute designed and developed 105 kW agrivoltaic with an annual income of 7 lakh rupees from photovoltaic electricity generation and rainwater harvesting system from top surface of PV module has also been developed (`1.5 lakh litres from 105 kW system. Harvested water is enough to provide irrigation of about 37.5 mm in 1-acre land. Suitable crops for agrivoltic include cluster bean, brinjal, spinach, Aloe vera, cumin etc. (Santra et al., 2018). Beena et al. (2015) studied the crop cultivation between the solar panels of 3MW power plant in Aravali district of Gujarat and the experiment resulted average revenue generation of INR 38,16,668/- per acre per year from the photovoltaic electricity generation. As for net profit in crop cultivation, they reported a net profit of INR 80,415 per acre.

Some of the crops that can be successfully grown are enumerated in the table.

Vegetable crops	Medicinal and aromatic crops, spices	Fruit crops
Lettuce	Isabgol	Grape
Spinach	Cumin	Strawberry
Cluster bean	*Aloe vera*	
Chilli	Sonamukhi	
Cabbage	Shankapuspi	
Onion	Turmeric	
Garlic	Ginger	
Brinjal		
Tomato		

Agrivoltaic farming at CAZRI, Jodhpur

Field Photographs (Beena et al., 2015)

Semi-Transparent Roof Type Structures

This type of photovoltaic module is basically developed for greenhouse roof applications.

Research reports on agrivoltaic farming:

Sl. No.	Crop	Effect	Reference
1	Grape	Agrivoltaic system may increase economic values of grape farms > 15 times as compared to conventional farming and can make significant impact by generating 16000 GWh of electricity.	Malu et al., 2017 (Nasik, Maharashtra)

2	Tomato and Cucumber	Water use efficiency of crops grown under AVS can be increased by selecting crop varieties which cover soil quickly, thereby reducing evaporation from soil and leaving more amount of water for plant evapotranspiration, thereby increasing biomass production.	Marrou et al., 2013

High capital investment during initial establishment and as compare to income from sale of electricity the income agricultural activity is quite less. Apart from this it has several benefits as mentioned below.

Benefits of Agri-Voltaic System

1. Increased income from farm land.
2. Rainwater harvesting.
3. Improvement in microclimate for crop cultivation and optimum PV generation.
4. Reduction in soil erosion by wind.
5. Reduction in dust load on PV panel.

Future Prospects

Loaning through banking sector need to be initiated for instalment of agrivoltaic system. As the capital investment on agrivoltaic system is quite high and therefore subsidy may be introduced to promote such system. Optimization of agrivoltaic systems by plant breeding, selection of crop, adaptation in cropping practices and by specific arrangement of Photo voltaic panels to find the best compromise between food production and electricity production on same piece of land.

1. Improvement in land equivalent ratio.
2. Soil moisture conservation.
3. Reduction in GHG emission.

Agrivoltaic Research in India

1. CAZRI, Jodhpur.
2. AAU, Navasari, Gujarat.
3. Amity University, Noida.
4. Jain irrigation, Maharashtra.

Conclusion

The agrivoltaic system has huge potential in farmers' field specifically in those areas where solar irradiation is available in plenty and relatively low crop yield and there is scope of improving the land equivalent ratio (LER) by installation of agrivoltaic system.

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Bats of Byatha-Seresandra

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'Halloween or horror bats' portray bats as agents of evil, mostly linked to the Dracula character. In fact, of the 1000 odd species of bats reported there are only three species of vampire bats that drink blood of birds and mammals. The vampires have mastered this art of lapping blood not waking their sleeping donor (in most cases) by a painless bite using their razar sharp incisors. Bats have become the 'pandemic hot potato' in the covid era for their supposed role as vectors. A pathogen like a virus may occur naturally in a 'reservoir' animal population with little to no ill effect on the animals carrying it. A spill over event occurs when the pathogen is transmitted to a novel host, such as another animal species or directly to humans. The Ebola (1976-Sudan and Congo), Nipah (1998-Malaysia), SARS (2002-China), MERS (2012-Saudi Arabia) and the COVID-19 (2019-China) spill overs to humans are recent records of pandemic zoonotics. Bats (reservoir) may have an immune system that lets them harbour many such disease-causing viruses on the flip side millions of bats have succumbed to fatal diseases caused by pathogens. On the other side of this grim reputation, bats render ecosystem services including suppressing agricultural pests, aiding in pollination (chirophily) and seed dispersal. They also act as indicator species indicating changes in biodiversity or the local environment. Chiropterists studying the range distribution involve community as part of citizen science in their own backyards.

Drive around 20 kilometres from the Bengaluru city towards rural side of north Bengaluru leads to Hessaraghatta and 4-5 km drive-in leads to Seresandra - Byatha binary villages. Seresandra is home to a big banyan tree with a colony of India's largest bat species, the Indian flying fox, *Pteropus giganteus*. They are classified under the megachiroptera (macro/megabats) suborder belonging to the order chiroptera (bats) under class mammalia. Bats constitute 1/5th of all the mammal species and are capable of active flight like birds. When most people have negative perceptions about bats, and issues such as bats roosting in the roof causing smell and noise, to bats stealing fruit crops, these villagers are tolerant and are proud of their 'winged mammal' neighbour. Flying foxes are known to live in close association with human population. This colony we observed has around 70-80 individuals a number the locals say is diminishing over the years. There were seven such roosting trees now reduced to only three in number. The mighty banyan tree stands next to the 'Dhalamma' temple, the village deity. The temple had visitors from different parts of Bengaluru seeking divine blessings on the New Year day. Despite their routine some elders and the devotees responded to our queries about their perceptions of the 'hometree' of the bavaligalu (Bats in kannada). The flying foxes roost in such taller trees with large diameters serving as shelter from weather, protection from predators and seclusion for rearing their young. The cutting of trees would have reduced roosting opportunities and foraging habitat, a factor the locals also agree. This loss of roosting site may propel the bats to find new roosting sites or may act as bottlenecks making them vulnerable to population changes. As of now no such large roosts are found in the surrounding villages.

Villagers have broken the myth that roosting in a tree in the village will bring bad luck on the community, on the contrary they deem it a good omen. Although not revered, the villagers don't disturb by bursting crackers during festivities. But there are instances the flying fox is considered sacred by the local villagers in Puliangulam, near Madurai in Tamil Nadu. There were bat hunters from the neighbouring villages who have now stopped doing so. The tree is home to diverse array of birds and a troop of bonnet macaques. The villagers quietly watch the daily rhythm of these frugivorous bats leaving their roost to forage around horticulture crop ecosystems in dusk and diligently return in the dawn. They are planning to plant banyan saplings to act as roosting sites in future. Existing information on the diversity and distribution of bats in North eastern states requires to be updated.

Protecting bats and their habitats can reduce the risk of zoonotics. Loss and fragmentation of habitat, destruction of roosts, disease outbreaks, hunting for meat or medicine, diminished food supply are factors threatening bat density. When watching bats in their roosting sites, avoid making noises and maintain a safe distance (chances of individual infected with rabies or they could bite in self defense). There are not only conservationists 'batting for bats' but also admirers in the literary world,

Twinkle, twinkle, little bat!
How I wonder what you're at!
Up above the world you fly,
Like a tea tray in the sky.
Twinkle, twinkle, little bat!
How I wonder what you're at!
– Lewis Carroll.

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Guava Diseases and their Management

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Guava Wilt

Disease symptoms: First symptoms start with the onset of monsoon. Appearance of light-yellow foliage with loss of turgidity and epinasty. Plants, at a later stage, show unthriftyness. Subsequently, premature shedding and defoliation. Some of the twigs become bare and fail to bring forth new leaves or flowers and eventually dry up. Fruits of all the affected branches remain underdeveloped, hard and stony. Later, the entire plant is defoliated and eventually dies.

The roots also show rotting at the basal region and the bark is easily detachable from the cortex. Light brown discoloration is also noticed in vascular tissues. The pathogen attacks young as well as old fruit bearing trees but older trees are more prone to the disease.

Wilted plants and yellowing of leaves

Survival and spread:

1. Through movement of plants containing sick soil in virgin areas.
2. Short distance spread is by water.
3. Root injury predisposes wilt disease.

Favourable conditions:

1. High rainfall during August/ September.
2. Stagnation of water in guava field for long duration.
3. Maximum and minimum temperature ranges 23-32oC with 76% RH are conducive.
4. Lack of timely application of suitable control measures.

Fruit Rot

Disease symptoms: The symptom starts at calyx disc of the fruit during rainy season. Affected area is covered with whitish cotton like growth which develops very fast as the fruit matures and pathogen is able to cover almost the entire surface within a period of 3-4 days during humid weather.

Under high relative humidity, the fruits near the soil level covered with dense foliage are most severely affected. The fallen fruits are badly affected. The skin of the fruit below the whitish cottony growth becomes a little soft, turns light brown to dark colour.

Survival and spread:

1. Rain and the wind are conducive for spread.

2. The pathogen produces a great number of sporangia and spores on the surface of diseased tissues principally when the temperature is near 25°C and this is an important source of inoculum in the development of epidemics.
3. Spores spread from the infected plant material or soil by rain splashes.

Symptoms on fruit and leaves

Favourable conditions: Cool, wet environmental conditions with high soil moisture favour disease development. High humidity, temperature from 28 - 32°C (25°C), poorly drained soils and injuries are favourable for initiation of disease. Close plantation.

Management: Bordeaux mixture – 0.4% or Copper oxychloride – 0.2 %, Zineb – 0.2%.

Dieback and Anthracnose

Disease symptoms - Die back phase: The plant begins to die backwards form the top of a branch. Young shoots, leaves and fruits are readily attached, while they are still tender. The greenish colour of the growing tip is changed to dark brown and later to black necrotic areas extending backwards.

The fungus develops from the infected twigs and then petiole and young leaves which may drop down or fall leaving the dried twigs without leaves.

Fruit and leaf infection phase: Fruit and leaf infection is generally seen during rainy season crop. Pin-head spots are first seen on unripe fruits, which gradually enlarge. Spots are dark brown in colour, sunken, circular and have minute black stromata in the centre of the lesion, which produce creamy spore masses in moist weather. Several spots coalesce to form bigger lesions.

The infected area on unripe fruits become corky and hardy, and often develops cracks in case of severe infection. Unopened buds and flowers are also affected which cause their shedding. On leaves, the fungus causes necrotic lesions usually ashy grey and bear fruiting bodies at the tip or on the margin.

Disease symptoms on riped and unriped fruits

Survival and spread:
1. Infection spreads by wind borne spores develop on dead leaves, twigs and mummified fruits in the orchard.
2. Dense canopy is congenial for germination of spores due to high moisture condition.
3. Movement of planting material through infected foliage.
4. Transportation of fruits from high disease prone area.

Favourable conditions:

1. Closer planting without canopy management.
2. Dew or rains encourages spore production and its dispersal around canopy.
3. Temperature between 10 to 35oC with best 24 to 28oC. Stem canker and dry fruit rot.

Management: Spraying the trees with Bordeaux mixture 0.6 % or Copper oxychloride 0.2% before the onset of monsoon reduces the disease incidence.

Fruit Canker *(Pestalotia psidii)*

Disease symptoms: *Physalopara psidii* causes stem canker and the imperfect stage *Diplodia netalensis* dry fruit rot. Pathogen attack main branches and stem on which it causes cracking of lesions. Affected branches wilt as the stem tissues are killed. Fungal perithesia small brown to black structures may develop on the infected stem. On fruit disease symptoms appears as light brown spots generally at the stalk or calyx end. With four days the entire fruit become dark brown to black and mummified. wing bearing infected fruits show die back.

		
Brown colour necrosis	**Necrosis on epidermis**	**Fruit canker**

Survival and spread:

1. Pathogen survives beneath the bark which becomes active during favourable condition.
2. It may spread from plant to plant through air.

Favourable conditions: Rainy season is the favourable for disease development. Fruit canker *(Pestalotia psidii Pat).*

Management:

1. 1% Bordeaux mixture or lime-sulphur (1in 25) – 3 or 4 sprayings.
2. PH wash with aureofungin (200ppm) can protect fruits for 5 days.
3. The fruit rot can be checked by dip treatment of the fruits with are tan.

Algal Leaf and Fruit Spot

Disease symptoms: Alga infects immature guava leaves during early spring flush. Minute, shallow brown velvety lesions appear on leaves especially on leaf tips, margins or areas near the mid vein and as the disease progresses, the lesions enlarge to 2-3 mm in diameter.

	
Algal spot on leaves and fruits	

On leaves the spots may vary from specks to big patches which may be crowded or scattered. On immature fruits the lesions are nearly black. As fruits enlarge, lesions get sunken and get cracked frequently on older blemishes as a result of enlargement of fruits, lesions are usually smaller than leaf spots. They are darkish green to brown or black to colour.

Survival and spread: The pathogens are primarily a wound parasite and avoids injury to fruits.

Favourable conditions: Germination of spores is maximum at 30o C & do not germinate below 15oC or above 40oC with RH above 96%.

Management:

1. Algal leaf spot can be reduced by maintaining tree vigour with cultural techniques such as proper fertilization and irrigation, proper pruning to enhance air circulation within the canopy and sunlight penetration, managing weeds and wider tree spacing.
2. Managing insect, mite and other foliar diseases increases tree vigour and lessens susceptibility to this disease.
3. Periodic applications of a copper-based fungicide will reduce the disease severity.

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Wick Irrigation System: A Novel Method for Water Sustenance

Article ID: 32078

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Introduction

The importance of organic vegetable cultivation is highly rising in the current society. The event of over use of pesticides and fertilizers added to the health awareness factor where pure vegetables are necessary. Individual households and complexes are coming forward to produce vegetables for family requirements both in urban and rural areas. Grow bag cultivation of vegetables on terrace of buildings are gaining popularity. But the major problem faced is with regard to timely application of water especially in those containers grown plants along with the problem of limited rooting media where frequent replenishment is required. The usual practice of watering has its own limitations as well as the family cannot leave the plant unwatered for few days. Improper irrigation water management leads to a number of physiological disorders and diseases. Water stress can occur from too much as well as from too little water. Stress caused by too little water reduces yield, with the level of reduction depending on when stress occurs in relation to crop development. Quality can also be affected. Over irrigation may also stress the crop through reduced soil aeration and cause similar consequences.

Excess watering leads to the reduced amount of available nitrogen in the root zone. Also, there is lack of adequate knowledge on actual water requirement of crops at varying growth phases. Hence, 'wick irrigation', a user-friendly irrigation method was developed which is cheap as well as water efficient. The main principle behind this method is capillary action. Water tends to move toward dry objects using this principle. 'Wick irrigation' is a latest technique developed by Kamalam Joseph, a scientist at the Centre for Water Resource Development and Management (CWRDM) in Kozhikode, with an aim to facilitating farming even when there is scarcity of water. 'Wick Irrigation' (termed Thiri Nana in Malayalam) reduces the water consumption in agriculture to a great extent which is specifically designed for terrace cultivation, of mostly vegetables, in grow bags. A specially designed wick of 30-cm length and 1.5 inches width is inserted through a hole at the bottom of the grow bags. Half of its length goes up to the surface of the soil while the rest is inserted into a bottle containing water. The wick sucks up the water supplying only what is necessary for the plant. It was reported that sub-irrigation systems which supply water from below the root zones are more efficient watering techniques (Elliot 1992, Dole et. al., 1994, Morvant et. al. 2001).

Wick Irrigation Tackles the Following Problems

When plants are raised in grow bags/ containers on the roof top, the growth is extremely good if optimum quantity of water is supplied, which becomes difficult always.

1. Water is not available adequately for the domestic purposes and hence cannot be spared for irrigation.
2. Wetting of roof floor while watering the plants can result in fungal growth and leaching and ultimately reduce the strength of the structure.
3. The prevalence of high temperature, solar radiation and wind on roof tops necessitates irrigating the plants in the morning and evening.
4. Non availability/ high cost of materials such as bricks needed as stand for the pots/ bags causes reluctance to go for grow bag cultivation.
5. There is doubt that weight of bricks used as stands on the roof can be problematic to the strength of the concrete structure.

Components of Wick Irrigation System

The main component of the irrigation system is the wick, which carries water from the water container to the rooting medium as per the requirement to keep it wet. Different types of materials were tried for the wick and a material similar to glass wool was found to be the best in terms of capillarity, durability and cost. A hole sufficient to insert the wick (about 2 cm) is made at the bottom centre of the grow bag and the wick is inserted into the grow bag through the hole such that 10cm will be inside the bag and the rest protruding out. Then the grow bag is filled (15-20 cm) with potting mixture. The stand for keeping the filled grow bag is made by filling plastic wastes (available in all the houses in plenty) in the 10 cm long used plastic bottle pieces (each 1 litre used plastic water bottle is cut into 2 equal cylindrical pieces leaving the neck portion). Used plastic water bottles of 2 litre capacity are used as water containers, one each for one bag/ one plant. In the container bottle 2 holes (2 cm diameter) are put, one for the wick to enter and the other for pouring water. The unit is properly placed on stand such that the protruding portion of the wick is inserted into one of the holes. The seedling/ seed is planted in the pot/ bag and water is sprinkled first to wet the medium, since wick will take some time to be fully functional. Later there is no need for surface irrigation, since the wick takes water from the container and transports to the growing medium as per requirement. Plants absorb water from the moist soil and grow optimally without any stress since there will not be surplus or deficit. Thus, this serves as a natural automatic irrigation system.

Features of Wick Irrigation System

In surface irrigation, much more water than what is required for the plants is usually given so as to ensure complete coverage of the entire crop to the point of full saturation of the root medium. Under certain conditions, up to 75% of the water and fertilizer applied by overhead irrigation may be wasted or leached from potted plants (Yelanich and Beirnbaum, 1994). Generally potting mixtures have a limited capacity to hold water against gravity. This limit is referred to as field capacity. Water in excess of field capacity is subject to drainage or removal by gravity. At field capacity, plant roots can easily absorb water. As roots absorb water and the soil becomes drier, movement of water towards the root is slowed. Water absorbed by the root moves into the plant at a slower rate than the rate of water used by the plant. After 3-4 hours of bright sun, the medium will become dry which makes the plant progressively wilt. Alternate wetting and drying of the growing medium will have adverse effect on plant growth. Drip irrigation, in which all the pots/ grow bags will be supplied the same quantum of water. It will not help in terrace cultivation as they have different crops with different stages. Only a portion of the water applied to the soil by the irrigation system is stored in the crop root zone where it can be used. The other common method of irrigation is sprinkler irrigation. It leads to non-uniform water application because of evaporation, wind drift and deep percolation.

Benefits of Wick Irrigation Over Other Methods of Irrigation

1. It is a low cost/ no cost technology when compared to the material and installation cost of drip and sprinkler systems and the high labor cost of surface irrigation. There is no involvement of electricity cost in wick irrigation.

2. In wick irrigation, the surface will always remain dry as the wetting will be mostly in the lower part of the growing medium or the root zone.

3. The surface soil acts as a mulch and thereby the evaporation loss is almost nil in wick irrigation.

4. In surface irrigation method, as water flows down during each irrigation, a part of the dissolved nutrients also will flow down with the leachate. The runoff of water, fertilizer, and pesticides resulting from these irrigation methods are a potential risk to the quality of the environment in proximity to a greenhouse operation. In wick irrigation, such loss will be nil. Instead, nutrients if added to the irrigation water in the bottle in the dissolved form will be carried to the root zone of the plants for the plants to absorb. Pipe sub irrigation systems were reported to be more efficient in terms of nutrient use (Kent and Reed, 1996).

5. By adopting wick irrigation, an environment most conducive for water absorption is developed through adequate aeration of the root zone, which is not the case in surface (alternate wetting and drying created) or drip methods (wetting zone is wetted) of irrigation.

6. Since used plastic bottles are used as stand for the pots/ grow bags, as water container and as funnel for pouring water and closing the hole (without exposing the water), there is great scope for reuse of the waste plastic.

7. This method can be adopted by the rich and the poor, young and old and so many innovations can be brought out in future. Thus, gender equity, social equity, age equity and financial equity can be ensured.

8. In the long run, it will keep the building cool and protect it from direct sun, which will add to the life of the roof. If done scientifically, the urban roof top farming will revolutionaries the vegetable production in the urban areas.

9. Maintaining greenery on the roof will help to increase amount of oxygen in the air and at the same time reduce the indoor temperature by 6-8 degree.

10. Roof top gardening will help to relieve stress and strain especially with the easy irrigation technique and hence good for physical and mental health.

11. This method ensures the maximum crop growth and production using the waste water and other waste materials.

12. The minimal surface evaporation can be stopped by mulching the surface of growing medium using waste plastic papers (reuse of plastic waste).

13. This will help to quantify the water requirement of different plants at different growth stages (measured quantity of water can be added and the other losses can be made nil). The frequency of filling the water container depends on the extraction of water by plants. The interval of filling will be more in the seedling stage and will decrease as the water demand of plants increase.

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Post-Harvest Processing of Foods on Food and Nutrition Security

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Introduction

Food and nutrition security are a global challenge, and a prerequisite for a healthy and peaceful society. Food security exists when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". Nutrition security "exists when secure access to an appropriately nutritious diet is coupled with a sanitary environment, adequate health services and care, in order to ensure a healthy and active life" (FAO, IFAD, & WFP, 2015). About 795 million people in the world were undernourished in 2014-16 (FAO, IFAD, & WFP, 2015) while more than 2 billion people were overweight or obese in 2013 (Ng et al., 2014). To be able to feed the world population that is expected to increase from 7.3 billion today to 9 billion in 2050, an increase in agricultural productivity by 30-40% is required by 2050 just to meet the dietary energy needs.

The energy gap can be addressed by reducing demand, lessening the current level of food waste or increasing food production (Keating, Herrero, Carberry, Gardener, & Cole, 2014). While considering food demand in terms of calories to fulfil energy needs is one way to examine global food requirements, fundamental requirements of macronutrients and micronutrients for good health need to be met. It is essential to take into account the potential overconsumption of nutrients, changing demographic structure, consumer choice and cultural context of diets.

Over the past 50 years, feeding our rapidly growing global population was achieved through increases in agricultural productivity (DeFries et al., 2015).

Although intensification of agricultural production while minimizing 79 environmental degradation will still be critical, this alone may not be sufficient to meet the nutritional demands of the projected population expansion. Food processing is required to increase useful life of foods, optimize nutrient availability and food quality, and reduce losses and waste. Biodiversity, ecosystems and cultural heritage are a consideration when developing affordable sustainable diets for all people. Sustainable diets have low environmental impacts and contribute to healthy life of present and future generations (Johnston, Fanzo, & Cogill, 2014). Reducing the prevalence of food insecurity today and in future will require technological solutions through collaborative efforts across agriculture, food, nutrition and health that are acceptable to society. It is clear that many considerations need to be factored into a discussion of food and nutrition security, which also include effective distribution channels between where food is produced and required, the differing food regulations in various regions, the role of indigenous foods, religion and culture, urbanization, biodiversity and climate change (Rolle, 2011; Burlingame & Dernini 2012, Muchenje & Mukumbo, 2015). An integrated multi-sectorial systems approach to food supply chain efficiency and sustainable diets is needed (Lake et al., 2012; van Mil, Foegeding, Windhab, Perrot, & van der Linden, 2014; Wu, Ho, Nah, & Chau, 2014). The focus of this review is on the role of innovative and sustainable primary production systems and food processing in addressing challenges in food and nutrition security.

Primary Production Systems

Resilient production systems for sustainable diets have to 103 be developed and managed whilst mitigating climate change, preserving biodiversity and the environment, while taking into account societal needs and expectations. The productivity of food systems should focus on innovation for improving nutritional needs, and providing aid to farmers to adopt innovations for sustainable intensification and novel food sources (Ingram et al., 2013). Consideration of multiple desirable endpoints requires consideration of synergies and trade-offs in the competing demands in production systems and sustainable diets so that food security is not compromised (Garnett, 2013).

1. Crop Production Systems: Biofortification of crops is one of the approaches that may be used for alleviating global nutrition insecurity (Arsenault, Hijmans, & Brown, 2015). Biofortification of crops that are part of the staple diet of local populations is an effective approach to improve the nutrient density and nutritional quality of the agricultural produce. The use of conventional plant breeding or transgenic methods may be used for introducing desirable nutrient traits into food crops. HarvestPlus, an interdisciplinary global alliance, has developed varieties of food crops with higher levels of micronutrients. Biofortified crops developed and released in the HarvestPlus program include cassava, maize and sweet potato high in vitamin A, high-iron beans and high-zinc wheat, millet and maize (www.harvestplus.org). These biofortified food staples which are denser in micronutrients provide a greater percentage of the recommended daily allowance and reduce malnutrition, especially in rural communities. The technical feasibility of providing micronutrient dense crops without affecting agronomic traits has been demonstrated and may be a cost-effective method for reducing micronutrient deficiencies in vulnerable populations (Nestel, Bouis, Meenakshi, & Pfeiffer, 2006). The fortification of crops with the essential amino acids, lysine and methionine, has attracted attention because of the potentially limited supply of these amino acids, especially in developing countries where poor populations do not consume sufficient protein from animal sources.

Advanced breeding methods have yielded higher protein maize. Transgenic approaches have been successful in increasing the level of lysine in Arabidopsis seeds, rice and soybean while increases in methionine have been obtained in Arabidopsis, alfalfa and potato leaves as well as in the storage proteins of canola, rice, soybean and rice. However more work is required to enable production of crops with increased levels of lysine and methionine with a normal phenotype (Galili, & Amir, 2013).

Foods rich in dietary fibre and resistant starch have the potential to reduce the incidence of Type 2 diabetes and cardiovascular disease and improve metabolic and gut health and this led to interest in improving cereal grain carbohydrates for health outcomes (Lafiandra, Riccardi, & Shewry, 2014). Conventional plant breeding can produce barley grains with high levels of resistant starch and beta-glucan, and a low glycaemic index (Morell et al., 2003). A high beta-glucan, high amylose barley has been incorporated as an ingredient into a range of processed food products. A high resistant starch wheat has also been produced (Regina et al., 2015). The benefits of long chain polyunsaturated omega-3 fatty acids (LC-PUFAs) for maintenance of good health, brain and eye development in early childhood and reducing the risk of cardiovascular diseases and inflammatory diseases are well recognised (FAO, 2010; Lorente-Cebrian, Costa, Navas-Carretero, Zabala, Martinez, & Moreno-Aliaga, 2013). Gene technology has been used for 153 the production of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in plants (Petrie et al., 2010). The ability to achieve a sustainable crop source of LC-PUFAs will reduce the reliance on fish and other marine sources.

2. Livestock production systems: Livestock is an important contributor to global diets. Meat and livestock are good source of dietary protein. The consumption of meat and livestock products is increasing due to increasing population, especially in the developing world, with a demand for these foods, a growth in economic wealth and urbanisation. Strategies for improving the resilience of animal production systems need to be considered in the face of climate change, as higher temperatures affect the sustainability of livestock production and the quality and yield of animal products such as milk and eggs (Nardone, Ronchi, Lactera, Ranieri, & Bernabucci, 2010). For livestock production systems, there are challenges for achieving balance by resource minimization strategies which address the impact of land management on the ecosystem. A recent example is the use of tannin-rich ruminant feedstock to improve the production yield and quality of animal products in semi-arid areas (Mlambo, & Mapiye, 2015). Improving the productivity and efficiency of livestock systems requires an understanding of the interactions between animal genetics and the environment and between the livestock, the plants and the soil within pastoral ecosystems (Greenwood, & Bell, 2014, Herrero, & Thornton, 2013). Plant-based diets generally require less energy, land and 176 water to produce compared to meat-based diets and from this perspective, lacto-ovo-vegetarian diets may be considered to be more sustainable than meat-based diets (Pimentel, & Pimentel, 2003). However, livestock production provides the ability to generate food from environments unsuitable for other food production. Notably livestock efficiently converts low quality forage into energy dense meat and milk food products. Improving livestock productivity will assist in meeting the dietary needs for protein and the preferences of many consumers. Sustainable livestock production systems can provide efficient conversion of feeds on land unsuitable for other forms of agriculture, maintain biodiversity, and minimize carbon footprints whilst ensuring good animal welfare (Broom, Galindo, Murgueitio, & Fernandez, 2013). Ruminant livestock can form an important component of mixed livestock-cropping systems to broaden the commodity base, increase biodiversity and optimise nutrient cycling and biomass utilization. The efficiency of the intensive livestock industry has shown remarkable gains in productivity. For example, in Australia the annual milk yield per cow has doubled from 2,900 litres to as high as 5,900 litres over the last 30 years, as a consequence of improvements in herd genetics, advances in pasture management and supplementary feeding regimes (http://www.dairyaustralia.com.au/Markets-andstatistics/Production-and-sales/Milk/Yield.aspx). Individual animal productivity continues to increase indicating that there are still substantial unrealised genetic gains. Current efforts to accelerate these gains are primarily focussed on the use of genetic markers to inform breeding decisions. Genetics strategies have been used to improve the meat quality, the health of the animals, the resilience of the livestock to environmental challenges and toimprove livestock production system efficiency. It is known that some traits for meat quality such as tenderness, intramuscular fat and omega-3 fatty acid content are moderately heritable and can be altered by breeding (Hopkins, Fogarty, & Mortimer, 2011). Better matching of elite genotypes to environmental and forage conditions either for improved productivity or health benefits and optimised forage assimilation is expected to provide further improvements. As an alternative to genetic strategies, feeding regimes are already being used to increase the level of unsaturated fatty acid composition in lamb meat (Howes, Bekhit, Burritt, & Campbell, 2015), beef (Mapiye et al., 2015) and omega-3 fatty acids in pork (Dugan et al., 2015). While improving the nutrient profile of livestock and primary produce in a sustainable production system may be achievable, the effects of the altered agricultural produce on the quality, shelf-life implications and its process ability into food products have to be considered to successfully bring the altered produce from the farm to the consumer. For example, there are challenges of making consistent and differentiated dairy products when processing milk with altered composition and structure arising from changed on-farm practices which need to be taken into account during dairy product processing (Augustin, Udabage, Juliano, & Clarke, 2013).

Food Processing

Food processing is any deliberate change in a food that occurs before it is available. Typically, inedible raw materials are processed into more useful, shelf stable and palatable foods or potable beverages for human consumption (International Food Information Council Foundation, 2010). Since prehistoric times, food processing has been a key aspect of the food production 226 chain that links agricultural production with the provision of food to people in the form and at the time it is required (Floros et al., 2010). Some of the common industrial processes used in food manufacturing include milling, cooling/freezing, smoking, heating, canning, fermentation, drying, extrusion cooking. Processing causes changes to the components of food and some of these changes can result in both detrimental as well as beneficial effects on the food quality, depending on the process used (Weaver et al., 2014). Although there has been many reports about the negative aspects of food processing which has focussed on issues such as the detrimental effects of heat treatment on food quality (e.g. formation of acrylamide, nutritional degradation, high sugar in formulated foods, introduction of trans fats into foods), it is essential to have a balanced view which includes the benefits of food processing (van Boekel et al., 2010). Some of the benefits of food processing include destruction of food-borne microbes and toxins, improved bioavailability of nutrients, extension of shelf life, improved sensory characteristics and functional properties (van Boekel et al., 2010). Food processing also encompasses the use of additives which are used to increase quality (e.g. taste and appearance), extend shelf life and improve the safety of foods. The management of risks to food safety and stability constitutes an essential element of food security. Traditionally, brining and pickling were used. A range of chemical additives (e.g. sulphur dioxide for preservation of wine, nitrites in bacon), anti-microbials (e.g. benzoic acid) and antioxidants (e.g. tertiary butylhydroquinone for retarding oxidation of oils) has been employed over the years. However, there is now a trend towards the incorporation of natural preservatives and the phasing out of some synthetic chemical additives. There is increasing interest in the use of natural anti-microbials (e.g. bacteroicins, essential oils), 251 preservatives (e.g. ascorbic acid, citric acid from fruits) and antioxidants (e.g. Maillard reaction products, polyphenols, rosemary extract) to improve food quality and shelf life (Kumar, Yadav, Ahmad, & Narsaiah, 2015; Vergis, Gokulakrishnan, Agarwal, & Kumar, 2015). In addition to the move to natural food additives, newer delivery systems (e.g. nanoencapsulation), smart additives and packages are also being developed as an alternative to direct incorporation of additives to food (Carocho, Barreiro, Morales, & Ferreira, 2014).

1. Traditional food processes: To a large extent, food processing has been used to preserve food, improve food safety and maintain quality. Over the last 100 years, traditional food preparation and preservation processes have been industrialised. The industrialization of food processing, with its economies of scale, has increased the availability of foods in both in local and export markets. For example, spray drying of milk was a means of preservation of milk but also enabled milk to be available in countries which did not have an adequate supply of local milk. The availability of milk powders spawned the growth of recombined dairy products such as recombined evaporated milk in Asia in the 1960's and 1970's (Sanderson, 1970). Recombined dairy products still serve many communities in Asia, the Middle East, Africa and South America Processing can occur at various points along the supply chain. It can be applied proximate to food harvest or capture (e.g. initial processing of agricultural commodities such as flour milling or fish canning) or further downstream when it isapplied in the manufacture of formulated food products (e.g. bread, biscuit, noodles, yogurt). Table 1 provides selected examples of the impacts of common food processing operations and selected examples of processes for converting food materials into final products are summarised in Table 2. The evolution of food processing, particularly traditional food processing technologies, and how processed food has contributed to nutrition over history has been reviewed (Welch, & Mitchell, 2000; Weaver et al., 2014).

2. Emerging food processes: While traditional food processing will continue to play a major role in providing food for people, it is expected that there will also be an increasing role for the application of novel and emerging food processing technology for improving the quality of food and processing efficiency. Novel and emerging technologies, particularly high pressure processing (HPP), pulsed electric field (PEF), cool plasma, UV irradiation and ultrasound have been examined as treatments for improving the shelf life of foods and altering material properties (Sanchez-Moreno, De Ancos, Plaza, Elez-Martinez, & Cano, 2009; Knorr, Froehling, Jaeger, Reineke, Schlueter, & Schoessler, 2011, Tao & Sun, 2015). The application of emerging, non-thermal techniques was shown to potentially reduce energy requirements for food processing and may contribute to improved energy efficiency in the food industry (Toepfl, Mathys, Heinz, & Knorr, 2006). Of the emerging technologies, there has been most commercial application of HPP. In HPP, pressures in the range of 200–1000 MPa are used. HPP disruptsmicrobial cells but retains nutrients and flavour molecules, allowing shelf-life extension without the detrimental effects of high temperatures on food quality whilst retaining the fresh-like character of foods (Hendrickx, & Knorr 2002). HPP has been commercialized as a cold pasteurization process for a range of products including guacamole, processed meats, tomato salsas, oysters and yogurts (Knorr et al., 2011; Tokuşoğlu & Swanson, 2014). However, more investigation is still needed to understand how HPP can be used to modulate enzyme reactions and fermentation, and its effects on food-spoilage viruses and bacterial spores (Knorr et al., 2011). In PEF, short electric pulses are applied to food, causing permeabilization of microbes and the cells of plant and animal tissue. It may be used as an alternative to pasteurization (Knorr et al., 2011). In ultrasound processing, sound waves are transmitted through the food medium. Both low (20-100 kHz) and high (400 kHz and above) frequencies have been used in food processing. Low frequency ultrasound has been applied for disintegration and homogenization of foods, and to enhance extraction of components (Vilkhu, Mawson, Simons, & Bates, 2008, Knorr et al, 2011). Ultrasound may also be used to improve the efficiency of drying, filtration, brining, freezing and thawing processes (Tao & Sun, 2015). High frequency ultrasound, with the creation of standing waves, facilitates the separation of oils from emulsions such as milk (Juliano et al., 2011) and increases the yield of oil in the palm oil milling process (Juliano et al., 2013). HPP, PEF and ultrasound can also enhance extraction of anthocyanins from grape by-products with up to three, four- and two-fold increase in extraction respectively (Corrales, Toepfl, Butz, Knorr, & Tauscher, 2008).

3. Improving resource efficiency of food processing: Most operations in the food processing industry are energy-intensive 325 and do not optimize the use of edible agricultural food sources. The sustainability of the current practice of industrial scale food processing is therefore sub-optimal. There needs to be a re-evaluation about how food processing can be better applied to create food products more efficiently, involving lower resource use and accompanied by lower production of waste (van der Goot et al., 2016). Better integration along the whole food supply chain from the farm to the consumer, with attention to quality, sustainability, logistics, food products and processes is also required (Manzini, & Accorsi, 2013).

a. Food processing to reduce food waste: The amount of food that is wasted along the global supply chain from farm to consumer is about 1.6 Gtonnes (or about one third of the total produced based on weight) and 1.3 Gtonnes of this waste is edible (Gustavsson, Cederberg, & Sonnesson, 2011; FAO, 2011; FAO, 2013). In terms of kcal/person/day, this amounts to 24% of the produced food supply (614 kcal/person/day) that is lost within the food supply which could feed 1 billion people if the food wasted was halved (Kummu et al., 2012). Food may be lost from the supply because of safety and quality considerations, and under-utilization of edible by-products and side streams of food processing. Food losses and waste can occur on farm, between farm to retail, at retail level and after it has reached the consumer. The amounts of food losses and waste along the chain varies with the type of commodities and food products and between various countries. Food losses in developing countries are >40% at post-harvest and processing while in developed countries, >40% of the losses occur at retail and consumer levels (FAO, 2011). Food processing may be used to reduce the amount of food lost by using preservation processes, such as freezing, drying, fermentation, canning, pasteurisation and sterilisation, and packaging technologies to increasing the shelf life of products (Langelaan et al., 2013).

Waste in food processing has partly come about because of the food industry's evolution towards provision of refined single food components (e.g. protein), a food product or ingredient with a defined composition (e.g. whey protein concentrate) or a food product that meets standards for appearance (e.g. acceptable coloured and shaped fruits and vegetables). There are many potentials uses for underutilized edible products. For example, protein-based by-products of animal processing may be used for production of bioactive hydrolysates (Martinez-Alvarez, Chamorro, & Brenes, 2015). Wheat-bran, a by-product of wet milling of wheat is currently underutilized. It contains proteins, minerals, B complex vitamins, and dietary fibre. The protein component itself represents ~ 15.5 million tonnes of high-quality wheat protein that is wasted annually. There is interest in extracting the protein for use an ingredient in food and for conversion into bioactive peptides (Balandrán-Qunitana, Mercado-Ruiz, & Mendoza-Wilson, 2015). By-products of fruit juice processing are another untapped resource. Components in apple pomace such as dietary fibre (pectin, hemicelluloses, cellulose and lignin) and phenolic compounds (flavonols, phenolic acids, dihydrochalcones and anthocyanins) may be extracted and put back into the food chain (Rabetafika, Bchir, Blecker, & Richel, 2014). In the case of the olive oil and palm oil industry, valuable phenolic compounds with antioxidantproperties may be recovered from the oil mill wastewater (El-Abbassi, 373 Kiai, & Hafidi 2012; Rahmanian, Jafari, & Galanakis, 2014).

b. Resource efficient food processing: There are opportunities for reducing water and energy use in food processing and to develop zero discharge processes (van der Goot et al., 2016). An example is process intensification, which result in less water use (i.e. more concentrated processing) by using dry milling processes for separation of components in place of wet milling (van der Goot et al., 2016). In the dairy industry, there has been interest in reducing the energy for milk powder production by increasing the total solids of the milk concentrate that is fed into the dryer. Removal of water by spray drying requires significantly more energy than the removal of water in an evaporator. Increasing the total solids concentration of milk that is fed into the dryer from 50 to 52% solids saves 6 % energy and further increase to 60% solids reduces dryer energy requirements by 26% (Fox, Akkerman, Straatsma, & de Jong, 2010).

Recognition of the global challenge for more efficient use of resources is reflected in Goal 12 of the United Nations sustainable development goals. This goal is to ensure sustainable consumption and production patterns. The food sector uses 30% of the total global energy use and accounts for 22% of the total greenhouse gas emissions. The sector therefore has a responsibility to develop strategies to address this challenge (http://www.un.org/sustainabledevelopment/sustainable-consumption production/).

Processed Food: Intake and Effects on Health

Processed foods are an important component of the food supply (Weaver et al., 2014). Few would argue that the increased bioavailability of macronutrients like starch from the processing of grains to flour and subsequent incorporation into breads, enhanced safety of meat achieved by refrigeration and cooking, improved safety of milk achieved through pasteurization and the year round availability of seasonal fruits and vegetables achieved through preservation, canning and freezing have not been beneficial to society and nutritional security. However, there are also processed foods that are high in salt, refined starch, sugar and fat which present unhealthy food options to the consumer. Strategies to reduce sugar and salt in processed foods are expected to have significant impact in reducing non-communicable diseases (MacGregor, & Hashem, 2014; Webster, Trieu, Dunford, & Hawkes, 2014). Several countries in Europe, the Americas and the Western Pacific Region which have introduced salt reduction programs have reported reductions in salt levels in one or more food categories. The strategies involved working with industry, either voluntarily or mandatorily, and included food categories such as bread, breakfast cereal, soup, sauces (Webster et al., 2014). In Australia salt levels in bread were estimated to be reduced by 9%, in cereals by 25% and in processed meat by 8% during the period 2010 to 2013 (Trevena, Neal, Dunford, & Wu, 2014). To enhance the effectiveness of these strategies further coordination by government to include food reformulation, public education, food labelling, and robust monitoring and evaluation is advocated (Webster et al., 2015).

1. Intake of processed foods: Data from the National Health and Nutrition Examination Survey (2003-2008) on intake of food by Americans showed that minimally processed foods (e.g. washed and packaged fruit and vegetables) contributed about 14% of total dietary energy, and a higher percentage of dietary fibre, vitamin D, calcium, potassium and vitamin B12. Processed foods provided about 57% of total energy intake, and a higher percentage for sodium, added sugars, iron and folate. The other source of food was foods from restaurants and dining halls which provided about 29% of energy intake with a higher percentage for sodium and added sugars (Weaver et. al., 2014). Another recent analysis of the food supply of the United States determined that more than three-quarters of food energy in purchases by households in America came from moderately (15.9%) and highly processed (61.0%) foods and beverages in 2012 (Poti, Mendez, Ng, & Popkin, 2015). The conclusion is that highly processed food is a dominant, unshifting part of purchasing patterns in the United States, but such foods may have higher saturated fat, sugar and sodium contents than less processed foods. A relatively wide variation in nutrient content within food categories suggests better food choices are likely to be beneficial. A food classification system developed in Brazil (Monteiro, 2009) groups food into unprocessed or minimally processed foods (group 1), processed culinary ingredients including oils, fats, pastas, starches and sugar (group 2) and ultra-processed food and drink products which are usually ready-to-eat or ready-to-heat (group 3). In Canada, the mean percentage of total energy intake from ultra-processed foods rose from 28.7% in 1938/39 to 61.7% in 2011 (Moubarac et al., 2013). This trend is spreading with the growing affluence of population groups, as observed by the increased rate of consumption of ultra-processed foods in low- and middle-income countries, compared to high-income countries (Moodie et. al., 2013).

2. Undesirable consequences of current highly processed formulated foods: There is little doubt that processed foods and consumption of excess calories derived from this category, among other factors, have played a critical role in the rising levels of obesity in western society and increasingly, the developing world (Finucane et al., 2011) with its associated legacy of rising prevalence of non-communicable, chronic diseases such as cardiovascular disease (Anand, & Yusuf, 2011), metabolic disease and diabetes (Danaei et al., 2011), as well as certain cancers (World Cancer Research Fund/American Institute for Cancer Research, 2007). It was estimated that halving the intake of ultra-processed food in the United Kingdom by replacing these with minimally processed and culinary ingredients would result in approximately 14,235 fewer coronary deaths and approximately 7,820 fewer stroke deaths by 2030, comprising an almost 13% mortality reduction (Moreira et. al.,2015). A trend towards a low-fat, high refined carbohydrate diet may have contributed to the current epidemic of obesity lipid abnormalities, type 2 diabetes, and metabolic syndrome (Weinberg, 2004). The International Agency for Research on Cancer, the cancer agency of the World Health Organization stated that there is asmall risk of cancer with the consumption of processed meat (International Agency for Research on Cancer, 2015). The partial hydrogenation process increases the degree of saturation of the fat and therefore the hardness of the fat and its oxidative stability, but the process introduces trans fatty acids which are harmful for health (Mensink & Katan, 1990). Partially hydrogenated fats were used for obtaining a desirable texture of margarine, baked goods and increasing the resistance of oils to oxidation during deep frying (Korver & Katan, 2006). On 16th June 2015, the FDA removed partially hydrogenated oils from the "generally recognized as safe" (GRAS) list and food manufacturers will have three years to comply with the legislation that restricts partially hydrogenated fats in human food.

3. Desirable effects of food fortified or enriched during food processing: The fortification and enrichment of foods during processing have beneficial effects on population health. Endemic brain damage, goitre and cretinism can be prevented by correcting for iodine deficiency and provided the rationale for the iodine fortification of salt with associated major impacts on the prevalence of these conditions (Hetzel, 2012).The introduction of commercially produced iodised salt during the middle of the last century substantially reduced iodine deficiency (Pearce, Anderson, & Zimmermann, 2013). Low levels of folic acid in the diet of newly pregnant women causes neural tube defects and severe congenital malformations, affecting the brain and spinal cord in the developing foetus. Reducing the incidence of neural tube defects has been reported in countries following mandated fortification of food with 492 folate, namely Chile, Argentina, Brazil, Canada, Costa Rica, Iran, Jordan, South Africa and the USA; with reductions as high as 58% in Costa Rica, 55% in Chile, 49% in Argentina and 49% in Canada (Castillo-Lancellotti, Tur, & Uauy, 2013). The role of Vitamin D beyond bone health is increasingly being recognized (O'Mahony, Stepien, Gibney, Nugent, & Brennan, 2011). A range of vitamin D enhanced foods such as milk, yogurt, cheese, orange juice, soup and bread have been shown to effectively increase circulating vitamin D levels. Foods that made the greatest contribution to vitamin D intake varied between countries according to habitual dietary patterns (O'Mahony et al., 2011). Long chain omega-3 polyunsaturated fatty acids (LC n-3 PUFAs) are essential for many biological functions, having wide ranging health benefits from brain development and function to heart health and immune function (FAO, 2011; Lorente-Cebrian et al., 2013). However, the capacity of humans to synthesise LC n-3 PUFA de novo is limited (Arterburn, Hall, & Oken, 2006) and their assimilation through the diet is therefore essential. Many people consume fish or other seafood infrequently, resulting in an inadequate intake of LC omega-3 PUFA which may result in sub optimal health (Papanikolaou, Brooks, Reider, & Fulgoni, 2014). The fortification of foods with LC n-3 PUFA could contribute substantially to achieving recommended intakes of this essential fatty acid (Rahmawaty, Lyons-Wall, Charlton, Batterham, & Meyer, 2014).

The difficulties associated with the introduction of the LC n-3 PUFA and other sensitive nutrients without compromising food quality can be overcome by the design of appropriate encapsulation systems (Augustin & Sanguansri, 2015). For example, microencapsulation masks the fishy smell and taste of LC n-516 3 PUFA and protects them against oxidation without loss of bioavailability (Sanguansri et al., 2015). The ability to produce shelf-stable encapsulated fish oil ingredients enabled the incorporation of LC n-3 PUFA into a wide range of food products including infant and toddler formula, breads and baked goods.

Consumer Understanding of Food Processing

The obvious customer for the food industry is the consumer and understanding their attitudes towards food processing is necessary, especially given that underlying attitudes are a major factor in purchase decisions. Without consumer acceptance, otherwise appropriate food processing strategies to address nutrition security risks may ultimately fail.

1. Consumer's needs: In regards to food processing, research on consumers in the United States suggests that people desire foods which are affordable, safe, convenient, fresh (minimal processing and packaging), natural and without preservatives, and without negative attributes (e.g. unhealthy; high fat, salt and/or sugar) (Zink, 1997). Consumers are also increasingly demanding products that not only cause no harm but which may also have protective effects such as reducing risk factors associated with disease (e.g. high cholesterol), and which promote healthy aging through enhanced psychological health and wellbeing (e.g. mood and cognition) 539 (Zink, 1997). This quest for health can have a significant impact on food processors. For instance, today's marketplace has more perishable products and more innovative packaging than in previous decades, and consumer reservations regarding chemical preservation has impacted various preservation methods. Observations from studies in the United States and the United Kingdom demonstrate that sustainable practices undertaken by food manufacturers can influence a customer's decision to purchase, giving positive feedback about the organisation and cost savings arising from implementation of sustainable systems and processes (Zink, 1997; Bhaskaran, Polonsky, Cary, & Fernandez, 2006). Other desired attributes include a shorter distance from the point of primary production and the point of purchase, sustainability of production, and foods that are culturally aligned and provide a pleasurable food experience (Australian Institute of Health and Welfare, 2012).

2. Negative consumer perceptions about food processing: According to a survey of American consumers, there exists a variety of perceptions, both negative and positive, about certain aspects of the role of food processing (International Food Information Council Foundation, 2012). The reasons for negative perceptions about processed foods are many, and include mistrust of technology, low level of understanding of processing, advertising that has at times taken advantage of controversies relating to food processing, the increasing prevalence of obesity in many industrialised countries, the use of chemicals in food production or as additives, and concerns related to specific ingredients including salt and sugar (Floros et.al., 2010). Further to these issues are the observations that many popular processed foods are of poor nutritional value and strongly held beliefs that multinational food companies specialising in processed food control the food intake of large numbers of people (Williams, & Nestle, 2015). It is important that there be more research aimed at obtaining objective information about the effects of processing and to communicate this to the consumer in an unbiased way. Organizations which are seen as trusted advisors with no vested interested are best placed to deliver the objective messages to society.

3. Consumer Food Purchasing Behaviour: Consumer acceptance of new food technologies and processing methods is critical for the commercial success of processed foods. Adequate economic returns to manufacturers are unlikely if food products do not appeal to the needs and desires of end users. Consumer food purchasing behaviour is particularly complex but a number of theories exist which attempt to describe these behaviours. Utility Theory, for example, regards purchasing behaviour as being largely rational (Levin, & Milgrom, 2004). It suggests that consumer choices are based on the expected outcomes of decisions, and that consumers are only concerned with self-interest. Alternate theories regard consumer behaviours as being driven by a wide range of internal factors including need recognition, evaluation of alternatives, the building of purchase intentions, the act of purchasing and subsequent consumption (Engel, Kollat, and Blackwell, 1968). Since the 1950's, it has been increasingly recognized that external factors also play a major role in consumer purchasing decisions. These factors include product marketing, social good and environmental concerns. In addition, whether or not consumers buy food is not only about availability of foods and whether they are healthy. It is influenced by how ingredients and foods can be substituted, and the manner in which they are transformed and marketed (Hawkes, Friel, Lobstein, & Lang, 2012). Both cognitive and emotional factors influence consumer decision to purchase unhealthy foods and contribute to their less than optimal food and beverage choices (Sierra, Taute, & Turri, 2015).Earned (news) media and social media do have a role to play in consumer perceptions and behaviour relating to food processing and technologies. Modern news cycles have a rapid churn rate and individual stories have a relatively short life span. Consumer conversations on social media such as Twitter, Facebook and YouTube can have a marked impact on the food choices and the brands that consumers purchase and thereby be an influencer of healthy choices (Liu & Lopez, 2016). However, medium- and long-term marketing campaigns by food and beverage manufacturers also have a persuasive and pervasive in influencing consumer attitudes and behaviour.

4. Addressing consumer concerns: Looking toward the future, it is important to consider the impact of new food technologies in the marketplace. Whilst sensory perceptions are major drivers of food choice, change in consumer sentiment towards a “fresh is best” viewpoint related technologies, including processing, are met with significant concern (Cox, Evans, & Lease, 2011).

There needs to be clear demonstration of benefits and safety of the new technologies to consumers (Jaeger, Knorr, Szabóc, Hámori, & Bánáti, 2015). Even where new technologies are proven scientifically to produce food safe for human consumption, consumer hesitance is difficult to change (Aoki, Shen, & Saijo, 2010). For example, the impact of positive educational messages around food products differentially changes perceptions, with favourable outcomes (i.e. change from hesitance to acceptance) observed only in individuals who have sufficient trust in the relevant information authority (Loebnitz, & Grunert, 2014).

Conclusion and Future Trends

The challenges to feed the world in 2050 cannot be met through improvements in food production alone. Reduction and recovery of food losses throughout the food chain from production to consumption and improvements in preservation, transportation, nutritional content, safety and shelf life of foods will be key strategies to combat food and nutrition demands of the future. A goal is to improve health of the consumer and to achieve healthier ageing for the population. It is essential to engage society in science to engender the trust of consumer in the food supply and important to ensure ethical food production and responsible consumption for a sustainable ecosystem (European Technology Platform, Strategic Research Agenda 2007-2020, http://etp.ciaa.eu). Global megatrends, which are due to shifts in geopolitical, environmental, economic, social or technology conditions that substantially change the way people live, will shape our world in 635 the next 20 years. Seven global megatrends recently identified are:

1. More from less.
2. Planetary pushback.
3. The silk highway.
4. Forever young.
5. Digital immersion.
6. Porous boundaries.
7. Great expectations (Hajkowicz, 2015).

These megatrends will influence how we deal with food and nutrition security across the food supply chain. It is expected that the digital revolution provides new opportunities in food processing automation, provenance and tracking providing a clear path to monitoring individual and population intakes as well as the ethical and safety aspects of food production. The agricultural sector will continue to increase productivity including through the introduction of novel and improved crops and livestock and the food processing industry will need to be agile to adapt to maximise the benefits for these new feedstocks. Growth in population, economic activity and market opportunities will be greatest in the Asian region, particularly, China and India. There is a need to address the food preferences of all populations, as well as aging demographics, when developing healthy food choices. A growing demand for foods with substantiated health benefits is anticipated. Against the background of climate change and diminishing resources reduction of the use of resources to produce existing and improved foods will be paramount. In order to ensure future food and nutrition security, industry and consumers must be considered in tandem. The challenge for food industry involves the development of new processing technologies which ultimately associate with economic advantage. However, in the absence of tangible positive attributes as perceived by consumers, uptake of the products of new technologies and processes may be lower than expected. The lay-expert gap in risk perception, and the moral and ethical dimensions of how food is produced need to be considered for improved consumer acceptance of processed foods (Lusk, Roosen, & Bieberstein, 2014).

Healthy diets which meet consumer expectations produced from resilient and environmentally sustainable agri-food systems need to be delivered in a changing world with diminishing natural resources, changing demographics and increasing urbanisation in a digital age (Gormley, 2015; Wu et al., 2015). In the future, low value food and underutilized edible biomass may be able to be processed back to their constituent macro- and micro- nutrients that can then be reconstructed into new foods, for example in the form of paints for 3D printing of foods (e.g. for second tier natural food lookalikes) (Kim, Golding, & Archer, 2012). Advances in knowledge regarding the characterisation and modification of the gut microbiome together with developments in food technologies can potentially enhance the in vivo delivery of bioactive ingredients with major impact on many aspects of health (Marchesi et al., 2015).

A multi-sectorial approach to improving food and nutrition security is required to address the complex societal challenge to feed the world responsibly and to minimise global food and nutrition insecurity in a changing world. Engagement and effective communication between all stake holders along the food supply chain, including consumers and government, is essential for delivering innovative solutions for food and nutrition security. There needs to be a closer integration between social science and the sciences that underpin innovations in technology to understand and respond to consumer concerns, opposition to technological solutions and address issues that arise in the complex food supply chain (Lowe, Phillipson, & Lee, 2008, Hinrichs, 2014).

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Artificial Intelligence (AI) – Revolutionizing Approach in Every Sectors

Article ID: 32080

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Artificial Intelligence (AI) – An Introduction

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving. The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal.

AI is continuously evolving to benefit many different industries. Machines are wired using a cross-disciplinary approach based in mathematics, computer science, linguistics, psychology, and more. Algorithms often play a very important part in the structure of artificial intelligence, where simple algorithms are used in simple applications, while more complex one's help frame strong artificial intelligence.

Categorization of Artificial Intelligence

Artificial intelligence can be divided into two different categories: weak and strong.

Weak artificial intelligence embodies a system designed to carry out one particular job. Weak AI systems include video games such as the chess example from above and personal assistants such as Amazon's Alexa and Apple's Siri.

Strong artificial intelligence systems are systems that carry on the tasks considered to be human-like. These tend to be more complex and complicated systems. They are programmed to handle situations in which they may be required to problem solve without having a person intervene. These kinds of systems can be found in applications like self-driving cars or in hospital operating rooms.

How is AI Used?

Artificial intelligence generally falls under two broad categories:

Narrow AI: Sometimes referred to as "Weak AI," this kind of artificial intelligence operates within a limited context and is a simulation of human intelligence. Narrow AI is often focused on performing a single task extremely well and while these machines may seem intelligent, they are operating under far more constraints and limitations than even the most basic human intelligence.

A few examples of Narrow AI include:

1. Google search.
2. Image recognition software.
3. Siri, Alexa and other personal assistants.
4. Self-driving cars.

Artificial General Intelligence (AGI): AGI, sometimes referred to as "Strong AI," is the kind of artificial intelligence we see in the movies, like the robots from Westworld or Data from Star Trek: The Next Generation. AGI is a machine with general intelligence and, much like a human being, it can apply that intelligence to solve any problem.

Artificial Intelligence Examples:

1. Smart assistants (like Siri and Alexa).
2. Disease mapping and prediction tools.

3. Manufacturing and drone robots.
4. Optimized, personalized healthcare treatment recommendations.
5. Conversational bots for marketing and customer service.

Why Research AI Safety?

In the near term, the goal of keeping AI's impact on society beneficial motivates research in many areas, from economics and law to technical topics such as verification, validity, security and control. Whereas it may be little more than a minor nuisance if your laptop crashes or gets hacked, it becomes all the more important that an AI system does what you want it to do if it controls your car, your airplane, your pacemaker, your automated trading system or your power grid. Another short-term challenge is preventing a devastating arms race in lethal autonomous weapons. In the long term, an important question is what will happen if the quest for strong AI succeeds and an AI system becomes better than humans at all cognitive tasks. As pointed out by I.J. Good in 1965, designing smarter AI systems is itself a cognitive task. Such a system could potentially undergo recursive self-improvement, triggering an intelligence explosion leaving human intellect far behind. By inventing revolutionary new technologies, such a super intelligence might help us eradicate war, disease, and poverty, and so the creation of strong AI might be the biggest event in human history. Some experts have expressed concern, though, that it might also be the last, unless we learn to align the goals of the AI with ours before it becomes super intelligent.

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.

1. AI provides more efficient ways to produce, harvest and sell essential crops.
2. AI implementation emphasis on checking defective crops and improving the potential for healthy crop production.
3. The growth in Artificial Intelligence technology has strengthened agro-based businesses to run more efficiently.
4. AI is being used in applications such as automated machine adjustments for weather forecasting and disease or pest identification.
5. Artificial intelligence can improve crop management practices thus, helping many tech businesses invest in algorithms that are becoming useful in agriculture.
6. AI solutions have the potential to solve the challenges farmers face such as climate variation, an infestation of pests and weeds that reduces yields.

Conclusion

Artificial intelligence can dramatically improve the efficiencies of our workplaces and can augment the work humans can do. When AI takes over repetitive or dangerous tasks, it frees up the human workforce to do work they are better equipped for—tasks that involve creativity and empathy among others.

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Water Requirements and Irrigation in Vegetable Crops

Article ID: 32081

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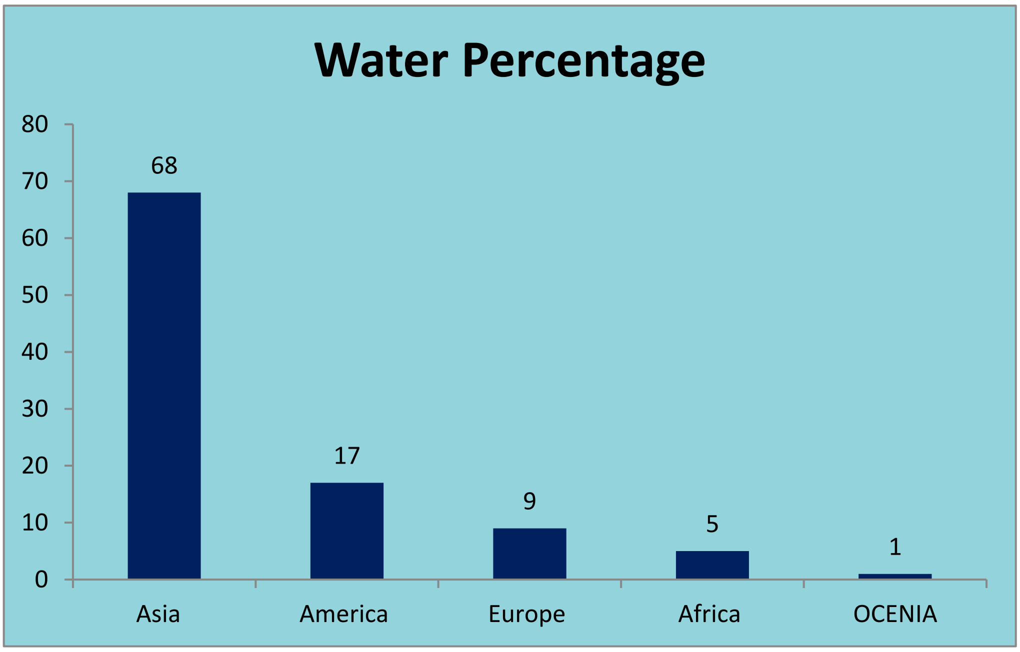
Introduction

The management of irrigation system are critically important in drainage. Vegetables have 80-90% sack of water with amount of flavouring and vitamin. Therefore, best quality and good yield, irrigation is necessary. Maturity will be delay if water stress happens during the crop development and affected the yield.

In case of shallow rooted crop two to three days of moisture stress can damage the marketable value of the crop. Requirement of irrigation are primarily determined by crop water requirements, and depends of characteristics of the irrigation system. Water is absorbed by plant roots from soil through osmosis and diffusion. Requirement of water also varies crop wise and also growth stage of plant.

Two main sources of water to crop are Rainfall and irrigation.

Irrigation Water Percentage of World



Demand of Water According to Season

Water demanding also vary in crops in several growing seasons. Due to high evapotranspiration in summer season, plants need high amount of water requirement in comparison to the cool season vegetable crops. In case of rainy season number of irrigations is decreased but sometimes crops are damaged due to poor drainage facility in crop field. In case of winter season less amount of water irrigates in the field according to the water requirements.

Demand of Water According to Soil

There are different types of soil differ in its ability to retain water. In case of sandy soil, available of soil moisture is less. Therefore, light irrigation should be added. In clay soil, water retain ability is very strong due to its particle size and it retain more water than others. So very less irrigation is needed. In case of fine textured soil moisture availability is more, so heavy and less frequent irrigation needed.

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Drought Tolerance and Irrigation

Plant adopts to drought either by degreasing water loss or maintain water uptake. The process oscillated with in plant cells by osmotic adjustment crops like vegetable tolerant to drought according to its physiology and water requirements. Higher drought tolerance crops can grow in less water availability area and can give commercial yield if irrigation is provided at critical period of growth in crop.

1. **High drought tolerance crop:** Amaranthus, sweet potato, parsnip, asparagus.
2. **Lowest drought tolerance crops:** Cauliflower, raddish, leek, cucumber, pea, beans.

Method of Irrigation

		
Drip irrigation	**Surface irrigation/flood irrigation**	**Sprinkler irrigation**

Most type of crops can survive surface irrigation or flood irrigation, through this method crop get sufficient water. Drip irrigation is adopted to irrigate individual plants due to its highly water use efficient. Vegetables like tomato, chilli, capsicum, okra, spinach, cabbage, cauliflower, cucumber are suitable for drip irrigation system. In basin method each basin is connected with irrigation channel. Water moves ahead after irritating individual basin of plants.

Critical Moisture Period and Irrigation

Generally, most of the vegetables are very sensitive to drought at the time of harvesting and two to three weeks before harvesting. In case of pea irrigation should be avoided during flowering stage for its development. In root crops like radish, carrot, turnip and bulb crop like onion and garlic, irrigation provided before 7days of harvesting for slack of soil moisture. So manual harvesting will be easy and no crop damage will be occurred.

Crops and their Critical Period

1. Asparagus
Critical Period: Adequate time needed for spear growth, most critical is fern growth.

2. Broccoli
Critical Period: During transplant, flower-bud production.

3. Cabbage
Critical Period: During transplant, head development.

4. Carrot
Critical Period: During root enlargement.

5. Cauliflower
Critical Period: During transplant, curd development.

6. Cucumber
Critical Period: During pollination and fruit enlargement.

7. Eggplant
Critical Period: During transplant, flower, and fruit development.

8. Lettuce

Critical Period: Throughout growth.

9. Lima Bean
Critical Period: At blossom and pod enlargement.

10. Muskmelon
Critical Period: During pollination and fruit enlargement.

11. Onion
Critical Period: At planting, and during bulb enlargement.

12. Pea
Critical Period: During pod development.

13. Pepper
Critical Period: During fruit development.

14. Potato
Critical Period: During tuber development.

15. Rhubarb
Critical Period: During petiole formation for harvest.

16. Snap Bean
Critical Period: During blossom and pod enlargement.

17. Spinach
Critical Period: Throughout growth.

18. Sweet Corn
Critical Period: During silking and tasseling, and ear development.

19. Sweet Potato
Critical Period: When slips are set in the field.

20. Tomato
Critical Period: During transplant, early flowering, fruit set, and enlargement.

21. Turnip
Critical Period: During root enlargement.

22. Watermelon
Critical Period: During pollination, fruit enlargement.

Water Demands for Different Vegetables

Legumes and cruciferous vegetables are most sensitive to drought during frost and flower development, fruit set may be reducing if water is limiting . In tuber, rooted bulb vegetables yield depends on product of carbohydrates. So, the critical stage of grown occurs as these storage organ enlargements . Stress of moisture may cause the formation of small and poor flavoured roots. Irrigation may cause root splitting in carrot and early bulbing in onion. Cauliflower, broccoli, cabbage is very sensitive to drought during growth period, causing growth reducing and premature heading.

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Agriculture and Information Communication Technology (ICT)

Article ID: 32082

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Introduction

Agriculture sector is highly responsible for the economic growth of a country like India. Currently, agriculture sector is facing a lot of challenges by climate change, loss of biodiversity, drought, increase of food prices and inefficient supply chain. Though this sector is becoming knowledge-intensive, availability of the right information, at the right time, in the right format, and through the right medium, influences and affects the livelihoods of farmers and other stakeholders involved in field of agriculture. Lots of demonstration reveals that enhancing the ability of farming communities to connect with farming networks, banks, institutions etc. through ICTs has improved their productivity, profitability, food security and employment opportunities substantially.

The major ICT tools for agricultural domain include personal computers, mobile and other telecommunication devices. ICT has many potential applications in delivering agricultural extension and bring new information services to rural areas.

e-Agriculture

It is an emerging field focusing on the enhancement of agriculture through information and communication processes. Agriculture and ICT which is like an umbrella comprising of technologies like devices, networks, mobile, services and applications to exchange information for sustainable agriculture and rural development is e-Agriculture. It involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in rural domain for better agriculture and incomes with reduced risks. e-Agriculture also involve the use of techniques like GIS, remote sensing and various wireless devices.

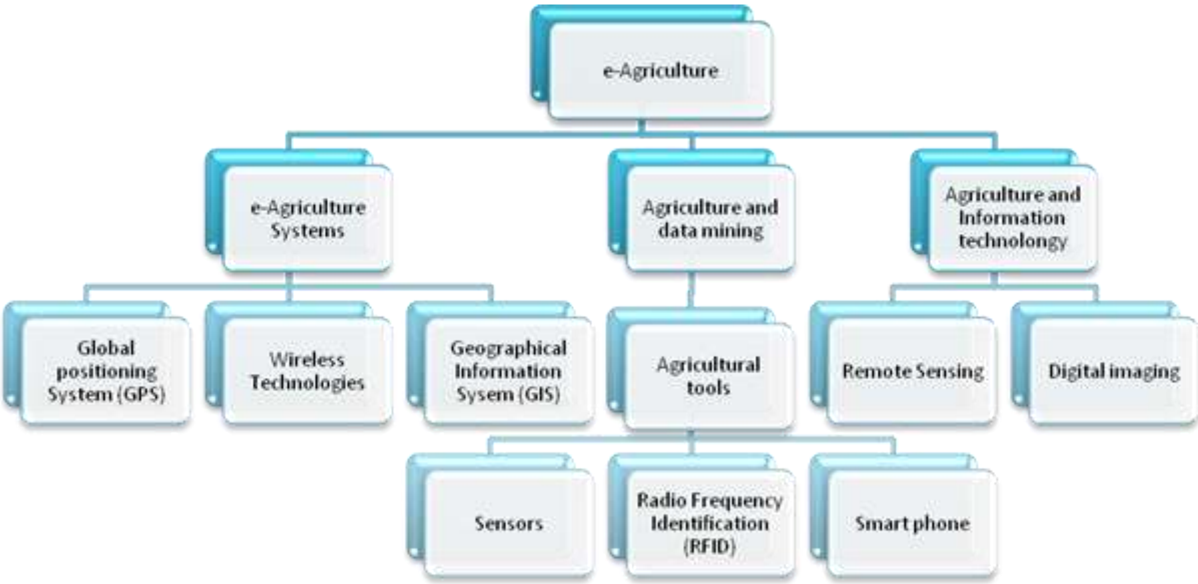

Figure 1 : e-Agriculture

Importance of Agricultural Technology

1. Higher crop productivity.
2. Decreased use of water, fertilizer, and pesticides, which in turn keeps food prices down.

3. Reduced impact on natural ecosystems.
4. Less runoff of chemicals into rivers and groundwater.

Technologies Used in Agriculture

1. Soil and Water Sensors.
2. Weather Tracking.
3. Satellite Imaging.
4. Pervasive Automation.
5. RFID Technology.
6. Vertical Farming.

Role of ICT in Agriculture

Smart Farming: Smart farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and Internet of Things technologies.

Need for smart farming: Smart farming deems it necessary to address the issues of population growth, climate change and labour that has gained a lot of technological attention, from planting and watering of crops to health and harvesting. By making farming more connected and intelligent, precision agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer. Increasing control over production leads to better cost management and waste reduction.

Social media: It refers to internet-based tools for creating, sharing, collaborating, discussing, and exchange information among people in a simulated community and networks, mainly in digital platforms. It involves Web 2.0 environment, which is nothing but ability for people to collaborate and share information online via social media, blogging and web-based communities.

Some of the most popular social media websites include, Facebook, WhatsApp, YouTube, Instagram, Twitter, LinkedIn, Pinterest, Blogs and more. Facebook is the most likely social media for pages and profiles. YouTube videos are most popular for information getting with applications. WhatsApp is the handy use of social media and mostly preferred for related groups. Many officials are having their official pages, blogs, and groups on social media and it helps in getting information and solving the problems.

Thus, Social media provide a quick and responsive network for people involved in agriculture to gather and exchange information. It allows immediate dissemination of important emerging issues and the sharing of positive information among producers and consumers of agricultural products; also, social media allows the agricultural industries to know what people are talking about.

Table 1: Use of ICT Tools and Government Initiatives - ICT in Agriculture

Uses of ICT tools in agriculture	Government initiatives
• Advanced information about adverse weather condition, so that farmers can take precautionary measures. • Real time and near real times pricing and market information. • Information propagation about various government schemes. • Farmers obtain information regarding agrifinance, agriclinics and agribusiness. • Establish online farmer communities.	• National e-Governance Plan in Agriculture (NeGP-A). • Various Touch Screen Kiosks. • Krishi Vigyan Kendras. • Kisan Call Centres. • Agri-Clinics. • mKisan. • Kisan TV and more.

Conclusion

Farmers have lot of issues in adopting ICT for agriculture. Some of barriers in adopting ICT in agriculture include the following:

1. Internet and bandwidth issues.
2. Lack of awareness on ICT tools.
3. Community internet centres are not available.
4. Farmers take time to shift from traditional farm practices.
5. Farmers using internet facility via their smart phones are not aware about how to make the best use of it to access agricultural information.

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Understanding the Interaction of *Sclerotium rolfsii* with *Rhizobium leguminosarum* Biovar *phaseoli* of Common Beans (*Phaseolus vulgaris)*

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Introduction

The rhizosphere is widely considered as a battlefield which may be defined as that portion of the soil which is adjacent to the root system of a plant and is influenced by the root exudates. The area of this zone depends on the soil type and host plant under study and soil environment conditions. The roots exert influences on various types of microorganisms. The stimulatory effect on microorganisms is known as the "Rhizosphere effect" as indicated by the interaction of soil and rhizosphere microbes and their ratio (Manoharachary and Mukherji, 2006). Using beneficial soil microorganism not only reduces input of fertilizers, pesticides and other chemicals but promotes plant growth, control wide pests and diseases but also provides an additional advantage of eco-friendly organic and sustainable agriculture (Akhtar *et al*., 2011). The beneficial plant-microbe interactions in the rhizosphere are primary determinants of plant health (Jeffries et al., 2003), among the different plant symbionts such as arbuscular mycorrhizal (AM) fungi and root nodule bacterium *Rhizobium* spp. are the two important root symbionts. They play a key role in natural ecosystems and influence plant productivity, plant nutrition and disease resistance (Demir and Akkopru 2007).

Common bean (*Phaseolus vulgaris)* is an excellent nitrogen fixer and is rich in proteins, vitamins, carbohydrates and minerals. In addition, it also contains good source of dietary proportion of phosphorus, calcium, potassium, sulphur and iron. The most serious fungal pathogens such as chocolate spot (*Botrytis fabae*)*,* ascochyta blight (*Ascochyta fabae),* downy mildew (*Peronospors viciae), Fusarium, Rhizoctonia solani* and *Pythium* spp. causing as additional threats to common bean cultivation leading to high yield loss. In addition, bean plant also harbours wide range of beneficial microrganisms such as *Rhizobium s*sp., *Arbuscular mycorrhiza, Psuedomonas, Serratia, Trichoderma etc.* It is established as an important determinants of soil fertility and plant health management by the production of phytohormones including root development & growth, control of pathogen by production of antimicrobials, antibiotics and also enhancing availability of nutrients and growth regulators.

Rhizobial Symbiotic Interaction

Rhizobium is rod shaped, motile, gram-negative bacteria belonging to family Rhizobiaceae, order Rhizobiales and class Alphaproteobacteria. The other rhizobial species includes *Bradyrhizobium, Sinorhizobium, Azorhizobium* and *Mesorhizobium* (Willems and Collins, 1993). They live in the soil; infect roots of leguminous plants leading to the formation of lumps or nodules on roots, where nitrogen fixation takes place. Biological nitrogen fixation is the process of reduction of nitrogen gas to ammonia, which is done by nitrogen fixing bacteria both symbiotic (e.g. *Rhizobium, Bradyrhizobium, Frankia)* and free-living organisms (e.g. *Azotobacter, Beijerinckia, Clostridium, Bacillus, Klebsiella, Chromatium, Rhodospirillum*). Several groups of rhizobial species (biovars) specifically nodulate and form a symbiotic relationship with specific leguminous host plants. The rhizobial symbiotic interaction between nitrogen fixing bacteria and roots of leguminous plants occurs by systemic plant invasion by detection of host-released signals in the form of lecitins by rhizobial bacteria, reverse signalling in the form of Nod factors and infection and nodule organogenesis (Garg and Renseign, 2007).

Mechanisms of Antagonistic Properties of *Rhizobium* Spp. Against Various Phytopathogens

1. Physiological and Biological changes: The *Rhizobium* bacterium spp. have been reported to produce many toxic metabolities inhibitory to various phyopathogens. The secondary metabolites produced by root-nodulating bacteria have also been reported to increase the level of phytoalexins (4-hydroxy-2,3,9-trimethoxypterocarpan) which plays an important role in cross-m protection against many pathogens. The inhibitory role of *Rhizobium japonicum* against Charcoal rot of bean *Macrophomina phaseolina* have been reported by the production of toxic metabolite, rhizobitoxine (Chakaraborty and Purkayastha 1984). Similarly, inoculation of pea with *R. leguminosarum* leads to reduction of *Fusarium solani* f. sp. *pisi* by increased production of phytoalexins. *Rhizobium* spp. have also been reported to bear the capability of the production of trifolitoxin which have the antimicrobial properties against wide plant pathogens by the production of antibiotic bateriocin molecules (Breil *et al.,* 1996).

2. Change in Root Growth and Morphology: *Rhizobium* is widely known for its ability to increase the nodulation in leguminous plants by a sequence of highly regulated and coordinated events, initiated by an exchange of specific signaling compounds between both partners, which further increases plant vigor as well as protect roots from the attack of pathogens (Huang and Erickson 2007).

3. Activation of Plant Defence Mechanisms: *Rhizobium* spp. has been reported in activation of plant defence mechanisms by production and accumulation of various defence related compounds. It induces the expression of defence-related genes and involves in the synthesis of phytoalexins and priming of seedlings from subsequent pathogen infections. Interactions of *Rhizobium* treated alfalfa and *Colletotrichum trifolii* and *Phoma medicaginis* resulted in an increased accumulation of defence related genes and disease reduction in alfalfa (Saunders and O Neil, 2004). Researchers have also reported the production of Phenolic compounds in *Rhizobium* treated seedlings which confers a strong mechanism of resistance against various fungal pathogens (harborne, 1988). Phenolic acids are carbon- based compounds which have the ability to bind with protein, thus forming soluble and insoluble complexes and conferring resistance either directly or indirectly through activation of post infection responses in host plants (Mole and Waterman, 1987).

Sclerotium rolfsi showed significant negative effects on plant growth due to severe root colonization and causing root rot, stem rot, wilt and foot rot diseases on more than 500 species of cultivated and wild plants. Microbial antagonists *viz., Rhizobium, Bradyrhizobium, Trichoderma* spp. showed greater residual effect and reduced the infection as well as enhanced the growth of mungbean as compared to the soil infested with the respective pathogen (Yaqub and Shahzad, 2011). Interaction of *R. leguminosarum* Biovar *phaseoli* with *Sclerotinia sclerotiorum* has shown reduced nodulation and reuced disease severity by 10.3-24.1%. Such interactions have also enhanced its biological properties as well as increased total control contents of P and N in treated plants as compared to control (Aysan and Demir, 2009).

Application of fungicides also affects the efficacy of microbial symbionts in controlling root infecting fungi in chickpea. *Bradyrhizobium* sp. in combination with Benlate or bavistin showed better control of *F. solani* infection on chickpea, whereas, *Bradyrhizobium* sp. showed complete control of *Macrophomina phaseolina* and captan was found more effective with *Rhizobium* against *R. solani* (Siddiqui *et al.,* 1998). The multidrug efflux pump genes resembling mutualistic symbiont of *Phaseolus vulagris* in *Rhizobium etli* were identified as *rmrA* and *rmrB* aftyer screening of transposoons generated fusions that are inducible by bean- root released flavonoids. Mutants of *rmrA* was observed in 40% nodules in bean and mutants of *rmrA* and *rmrB* enhanced sensitivity to phytolaexins, flavonoids, salicyclic acid as compared to wild strains (Pasayo and Romero, 2000).

Biotic as well as abiotic factors may influence the biocontrol activity and population density of *Rhizobium* sp. and its efficacy against bean damping-off caused by *R. solani.* An interaction of two *Psuedomonas flourescens* isolates UTPF68 and UTPF109 in the biocontrol of damping off of bean in combination of rhizobia isolates (RH3 to RH7) reduced significant diseases severity and synergistically interaction in their positive biocontrol activity (Samavat *et al.,* 2011). In addition to that, the synergistic interaction of *Rhizobium leguminosarum* and *Trichoderma* sp. have also been exploited in the management of chocolate spot disease caused by *Botrytis fabae* by 57% as well as induction of nodulation, physiological activities and yield production by 23%, thus emerging as potential; candidate of biological control (Saber *et al.,* 2009).

The potential of *R. leguminosarum* bv. *Phaseoli* in the management of common bacterial blight in French bean have been exploited for its capacity to trigger resistance to bacterial blight caused by *Xanthomonas axonopodis* pv. *Phaseoli* under greenhouse and field conditions (Osdaghi *et al.,* 2011). In Bush bean (*Phaseolus vulgaris),* foot and root rot caused by several pathogens *viz., F. oxysporum, F. solani, S. rolfsii, S. sclerotiarum* and *R. solani* has resulted in 90% plant mortality. The use of biological control such as antagonistic rhizobial strains has provided a great scope in controlling seed and soil borne pathogens and in addition, enriches soil nitrogen level through biological nitrogen fixation. Rhizobial strains as well as biofertilizers showed in highest germination of plants as well as reduction of disease severity (Khalequzzaman & Hossan, 2008).

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Damping Off of Vegetables

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Introduction

1. A very common disease occurring in the seed beds of most of the vegetables like cabbage, cauliflower, spinach, okra, chilli and tomato.
2. Damping off occurs not only in the nursery beds of orchard under open environment but also in the plastic houses.

Plate 1: Damping off of vegetables

Causal Organism

Two fungi separately cause damping off:

1. *Pythium* spp.: *P. aphaniderамtum* and *P. debaryanum* Hesse are more prevalent in moist and humid conditions of soil.

2. *Rhizoctonia solani* Kuhn: Prevalent under dry conditions of soil.

Symptoms

1. Disease symptoms are of two types:

a. Pre-emergence damping off: Germinating seeds are decayed and killed prior to their emergence. Therefore, patches are observed in the nursery beds due to poor germination and stand (Plate 2).

Plate 2: Pre-emergence damping off and damping off symptom just after emergence

b. Post emergence damping off:

i. Soft stem of the seedlings is constricted and dried up at collar region resembling (Plate 3) hard string (wire stem symptom).

ii. Small water-soaked lesions appear or stem of the seedling constricted on the stem (soft rot symptom) near the soil surface and finally seedling toppled on the ground within two or three days (Plate 4).

iii. Infected necrotic rotten seedlings toppled down on the ground.

iv. If rotting continues, tender foliage and root system are also totally destroyed.

v. Dense population of the seedlings in the nursery beds increases the disease incidence.

Plate 3: Dark colored lesions and constrictions on the infected seedlings near soil line

Plate 4: Seedlings showing soft rot symptoms and infected seedling toppled down to the ground

2. Survival of the pathogens:

a. Both fungi can survive in soil. Pythium spp. can survive in the form of oospores and chlamydospores.

b. *Rhizoctonia solani* survives in the form of sclerotia in dry soil.

3. Management:

a. Raise seedlings in raised nursery beds and treat the beds with 4% formaldehyde solution or Bordeaux mixture and cover with polythene.

b. Treat the seeds with Thiram or Captaf or Mancozeb @ 3g/kg of seeds or *Trichoderma viride* formulation (Ecofit or Ecoderma etc.) as seed treatment @ 4g/kg of seed.

c. Drench the soil with Mancozeb 0.2% or with Carbendazim 0.05%.

d. Better to apply the mixture of Mancozeb (0.2%) and Carbendazim (0.05%) into the soil, which can protect seedling from infection of both the fungi.

e. Drench the collar region of the seedlings with a suspension of *T. viride* @ 5g/l.

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Fungal Vectors in Viral Diseases of Plants

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Introduction

Thirty soil borne viruses or virus like agents are transmitted by five species of fungal vectors i.e. soil inhibiting fungi or protists. Known vectors are from members of class *Plamodiophoromycetes* in the division *Myxomycota* & class *Chytridiomycetes* in the division Eumycota. The mechanism behind fungi acting as a vector for viral diseases in plants depends on the virus- fungi vector relationships. There are two types of Virus-Fungal vector relationships that are categorized by the method of virus acquisition as well as the location of virions relative to resting spore.

It plays an important role in understanding the epidemiology of a viral disease and to find the possibilities for its management.

1. In Vitro Transmission:

a. Involves In Vitro acquisition;
b. Acquisition begins when virus-free zoospores released from resting spore or vegetative sporangia encounter virions from soil water.
c. Virons are not located within the resting spore.
d. Virons particles- tightly & specifically adsorbed to the zoospore membrane.
e. Adsorption- involves receptors in the zoospore membrane & particular coat proteins of the virions.
f. Enter the zoospore cytoplasm when the flagellum is reeled in.
g. Found between isometric viruses of *Tombusviridae* & two *Olpidium* species.
h. E.g.- (*Olpidium brassicae** Tobacco necrosis virus).

2. In Vivo Transmission:

a. Involves In Vivo acquisition.
b. Virus is located within the resting spore.
c. Virus is taken in by the fungus thallus while its growing in a virus infected host.
d. Virus is within the zoospore when they are released from vegetative sporangia or resting spore & infects the new hosts.
e. E.g.- (Olpidium brassicae* Lettuce Big vein virus.)
f. (Polymyxa betae* Bean Necrotic yellow vein virus.)

Different types of vectors involved in viral-fungal vector relationship are known as zoosporic vectors.

Zoosporic Vectors

1. Survive from crop to crop as resting spores.
2. Produce Zoospores & infect host.
3. Thalli-embedded in host cytoplasm (from which they are separated by only a membrane in the early part of infection cycle).
4. Movement of viruses between host plants & fungal vectors occurs before a thallus forms a wall.
5. Holocarpic (entire thallus is converted into vegetative sporangia or resting spores)
6. Obligate parasites of plant roots & have similar development stages (Endoparasites).
7. There are two types of zoosporic vecctors:
    a. Chytrid vectors.

b. Plasmodiophoral vectors.

Chytrid Vectors

1. Endobiotic Thallus (remains inside host cells).
2. Holocarpic (entire thallus is converted into a Zoosporangium or a resting sporangium, which on germination give rise to Zoospores.)
3. Inoperculate Sporangium.
4. Sexual reproduction is by fusion of two isogametes.
5. Biflagellate diploid zygote penetrates the host.
6. Posteriorly uniflagellate zoospores have "jerky" swimming characteristic.
7. Single celled resting spores (Remain viable for 8 years)
8. Habitat- Water or Wet soil.
9. Parasitizes algae & roots of higher plants.
10. Vectors of viral diseases.
11. Transmit viruses with Isometric particles.
12. 2 species: *Olpidium brassicae* (Plate 1) and *Olpidium bornovanus* (Plate 2).

	
Plate 1: Lettuce big vein virus transmitted by O. brassicae	**Plate 2: Melon necrotic spot virus transmitted by O. branovirus**
	
Plate 3: Wheat spindle streak mosaic virus transmitted by P. graminis	**Plate 4: Potato mop top virus transmitted by Spongospora subterranean sfp. subteranea**

Plasmodiophoral Vectors

1. Biflagellate, Heterokont zoospores.
2. Remain viable in soil for >15 years.
3. Form Cytosori consisting of single celled resting spores formed by division of thallus.
4. Trasmit Rod-shaped or filamentous viruses.
5. Endoparasitic Slime Mould.
6. 3 species: *Polymyxa graminis* (Plate 3), *Polymyxa betae* and *Spongospora subterranea* fsp. *Subterranean* (Plate 4).

List of Viruses Transmitted by Fungi

Fungal vector	Viruses
Olpidium brassicae	Lettuce big vein, Tobacco necrosis, Tobacco stunt, Chenopodium necrosis, Lisianthus necrosis.
Olpidium bornovanus	Cucumber necrosis, Melon necrotic spot, Cucumber leaf spot, Cucumber soil borne virus.
Polymyxa graminis	Soil-borne wheat mosaic, Wheat spindle streak mosaic, Rice necrosis mosaic, Oat mosaic etc.
Polymyxa betae	Beet necrotic mosaic, Beet soil borne virus.
Spongospora subterranea f.sp. Subterranea	Potato mop top virus.
Spongospora subterranea f.sp. nasturtii	Watercress yellow spot, Warecress chloretic leaf spot.

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Homa Farming - A Vedic Touch to Morden Agriculture

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Homa farming has its origin from Vedas, it's conjointly called the Maharishi religious text organic agriculture. Since it had been earlier mentioned in "Atharvaveda" and it was practiced successfully by rishi and maharishis. Principle of homa farming states that “you heal the atmosphere and the healed atmosphere will heal you”. It's known as "revealed science". The fundamental side of homa farming is that chanting of Sanskrit mantras (Agnihotra puja) at specific times in a day before a holy fire. The timing is most important. There is no specific agricultural practice related to homa farming, however the farm and household it's practiced in, is energized and awakened. The ash that results from the puja is employed to energize composts, plants, animals, etc. Homa Organic Farming is holistic healing for agriculture and might be utilized in conjunction with any smart organic farming system. It's very cheap and simple to undertake however needs discipline and regularity. Agnihotra (Sanskrit: agni means fire, hotra means healing) is that the basic homa fire technique, supported the bio-rhythm of sunrise and sunset, and might be found within the ancient sciences of the Vedas. Agnihotra has been simplified and adapted to modern times, therefore anybody can perform it. During Agnihotra, dried cow dung, ghee (clarified butter) and brown rice are burned in an inverted pyramid-shaped copper vessel along with a special mantra (word-tone combination) is sung. These days it's in the main practiced by organic farmers in South America and India however is additionally gaining increasing attention in North America and Europe.

In recent Days Homa farming is being popularized by Sri. Vasant P. Paranjpe and Deshpande have been used with minimal cost for improving the climate and crop production.

The Fundamental Process Employed in Homa Farming is Agnihotra

Materials Required:

a. Pyramid: Copper pyramid that has capability to hold all the electricity energies and others.

b. Rice: solely unbroken rice ought to be used.

c. Cow Ghee: It's a really special medicative substance, when cow ghee is burned with rice it purifies atmosphere and conjointly induces rain.

How to Prepare Agnihotra Fire

Smear few cow dung chips with ghee (arrange them in the Agnihotra pot in such a way to permit free passage of air).

↓

Begin the fire few minutes before sunrise/sunset while uttering the agnihotra mantras (after the word swaha add a few grains of rice grains coated with ghee to the fire).

↓

Agnihotra will be completed within 10 minutes and it is preferable to sit quietly or mediate until the fire goes out. (Don’t used any mineral oil or blow through mouth to create fire).

The ash residue left after the performance of agnihotra is collected on a daily basis in a cloth. The fine sieved ash is "the miracle powder " employed in homa farming as a growth promoter and pesticide.

Agnihotra Mantras

Morning Agnihotra: Sooryaya swáahá, Sooryáya idam na mama (add first pinch of rice) Prajápataye swáahá, Prajápataye idam na mama (add second pinch of rice).

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Meaning: Unto the sun I am offering this offering. This is not mine; this is Thine.

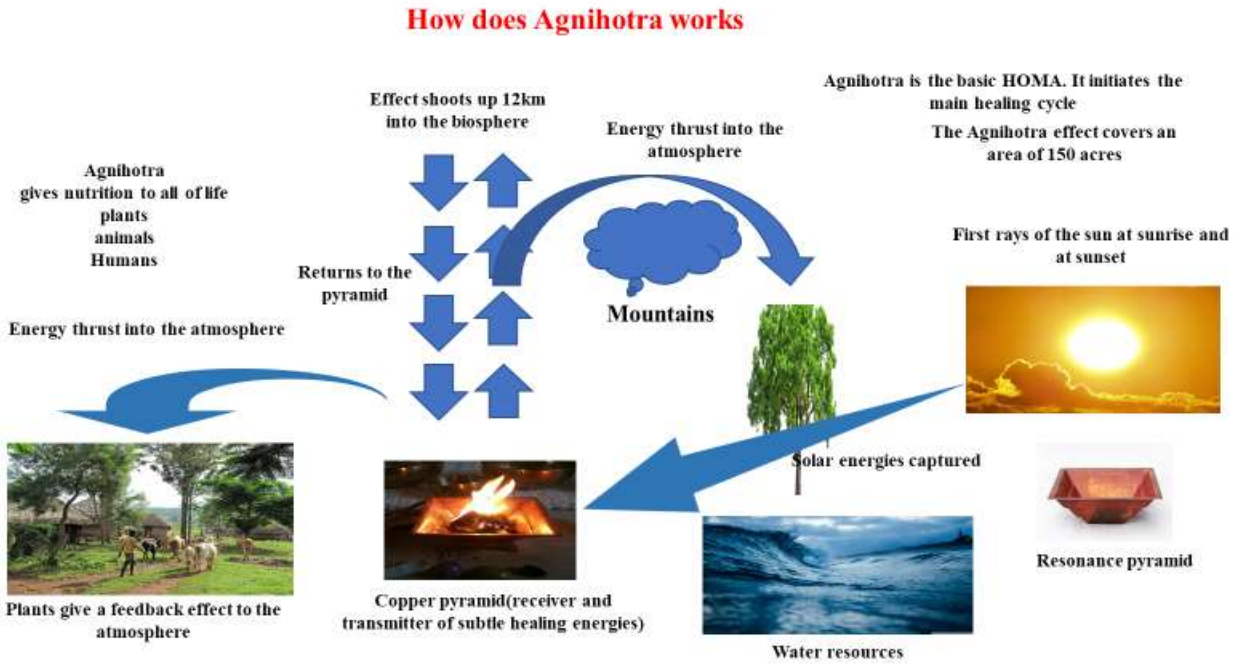
Evening Agnihotra: Agnaye swaáhá, Agnaye idam na mama (add the first portion of rice) Prajápataye swaáhá, Prajápataye idam na mama (add second pinch).

Meaning: Unto the fire I am offering all. This offering is not mine it is Thine.

Precautions Need to be taken During Agnihotra Fire

1. The exact timing must be maintained for individual yajna.
2. Only whole kernel rice ought to be used. Best when brown rice is used.
3. Only copper and gold pyramid should be used.
4. Only dried cow dung can be mixed and content ought to be mixed in proper ratio.

How Does Agnihotra Works



The sun brings or takes the energy, that makes all conditions contributing to associate with anti pollutionary change. It calms the globe. The pyramid is that the generator, the fire, the turbine. Simply at morning Agnihotra all the electricities, energies, ethers are attracted to the pyramid in its shape. At sunset these energies are thrust out in same form. This flow of sunrise energies produces powerful purifying effects on all levels everywhere it touches the Earth. Agnihotra amplifies these purifying effects within the following way: This flood of subtle energies carries music with it. The morning Agnihotra Mantra is the absolute sound of that flood. If you then prepare a fire within the prescribed copper pyramid, utter these mantras and offer the rice mixed with ghee to the fire, then a channel is formed in the atmosphere and PRANA – the energyof life is purified. At Agnihotra time, massive quantities of energy are gathered around the Agnihotra copper pyramid. The pyramid is that the generator, fire and therefore the turbine. A magnetic type field is created, one that neutralises negative energies and reinforces positive energies. When Agnihotra fire is burnt there's not just energy from the fire. The rhythms and Mantras produce hidden energies that are impelled by fire into the atmosphere. Conjointly consider the quality of materials burnt wherein lies the complete result of this healing HOMA. A lot of healing energy emanates from the Agnihotra pyramid. An aura energy field is formed around plants throughout Agnihotra. Thus, plants become stronger and resistant to diseases. Once the flamme dies the energy in the resulting ash is trapped. This ash is employed for preparing several folk medicines. Therefore, by regular performance of morning and evening Agnihotra, you produce a positive energy pattern on all levels.

Uses of Agnihotra Ash (Miracle Powder) in Agriculture

1. Soil preparation: (a) For fields irrigated prior to sowing: 5 kg of agnihotra ash per acre spread on the fields. (b) For fields with no pre sowing irrigation: ash should be mixed with water and solution should be sprayed on the fields 2-3 days prior to sowing.
2. Seed treatment: 20 g Ash + Cow urine + 1 kg seed → Shade dried.
3. Irrigation: during each irrigation, the ash should be tied in a cotton cloth and suspended over the irrigation channel in such a way that the rushing water dissolves the ash and carries it into the field.
4. Crop protection: 100 L water + 5 L cow urine + 2 kg ash → Stirred 2-3 times per day with stick → 3rd day ash settles down at the bottom → without shaking and disturbing sediment pour off all liquid with a cloth → spread on the crop.
5. Storage of crops: cereals and pulses can be mixed with ash prior to storage.

Advantage

1. It is a complete organic farming with assured yield.
2. Improves the soil health, healthy flora and Good yield.
3. Restores natural taste, colour and flavour of the yield and therefore the cookery quality of rice.
4. Reduces the incidence of pests and diseases.
5. Poison – free fodder and food, no environmental pollution and ecological disturbance safe to handle by the plant protectors these are cost effective (200-300) less than chemicals so it's pretty much useful to small and marginal farmers.
6. Results to sustainable agriculture.

Effect of Homa Farming on Soil and Crop

By applying the energetic ash, the soil quality is improved successively from year to year the soil structure very friable, has good water retention capacity and contain ample quantity of essential nutrients. (4 tablespoons of agnihotra ash and up to 4 tablespoons of pulverised, dried cow dung are stirred in approximately 5 litres of water and then applied to plants):

1. Fertility of the soil is also increased, water refined.
2. Some scientists find out that agnihotra ash contain 94 elements.
3. The ash acts sort of a catalyst on plant growth, in homa atmosphere plants develop leaf vein that are cylindrical and bigger than normal because of this water and nutrients are more easily assimilated by the plant. Agnihotra ash will increase the quantity of water-soluble phosphorus available to the plant in the soil this have great impact on growth and reproductive cycle of crops.
4. Homa atmosphere is additionally conducive to the production of chlorophyll in order that they support photosynthesis and respiration this successively promotes the proper oxygen cycle in nature.
5. Useful micro-organisms in the soil is also increased. Earthworms proliferate in these surroundings because of increase in their hormonal production, they distribute moisture in the soil and supply it with humus.

Effect of Homa Farming on Environment and Human Beings

1. Homa application are a practical contribution to environment protection as a result of the purify the atmosphere and improve the of air, water and soil.
2. The pyramid made up of copper act as a generator of negative ions these ions have a harmonizing result on the atmosphere and a positive impact on people's wellbeing.
3. Cow dung contains the substance similar to antibiotic (penicillin) that incorporates a disinfecting effect and reduces disease causing bacteria and also reduces the radioactive radiation.
4. Bees also are drawn to the homa energies and they fulfil their task of pollinating plants in more effective means.

Conclusion

Agnihotra – an age ancient vedic solution to new age challenges.

The potential of homa farming and agnihotra ash specially to boost the solubility of P and therefore the supply of soil P is clearly visible. Larger the number of individuals engaged within the practice of agnihotra at a location, greater and quicker shall be the impact. Prof. Hernandez considered that agnihotra neutralises toxicity, modifies the environment touching each the physical and mental state. Thus, homa therapy acts sort of a silent psychotherapy.

As a result of agnihotra a lot of people have stopped drinking alcohol and smoking.

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Smart Farming: The Future of Agriculture

Article ID: 32087

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Summary

Technological development, such as the use of electronic systems and data transmission, has introduced radical changes to the agricultural working environment in recent years. These changes demand updated information from production systems and from markets and agents involved in production to provide decision-making information for production as well as for the strategic and managerial issues involved. Smart farming (SF), based on the incorporation of information and communication technologies into machinery, equipment, and sensors in agricultural production systems, allows a large volume of data and information to be generated with progressive insertion of automation into the process. Smart farming relies on data transmission and the concentration of data in remote storage systems to enable the combination and analysis of various farm data for decision making.

Introduction

SF is a concept that originated with software engineering and computer science that arrived with the addition of computing technologies and the transmission of data from agriculture, within an overall environment of virtually ubiquitous computing. These computing elements are embedded in objects and interconnected with each other and the internet. The use of SF tools is possible due to the use of sensors in agriculture. A sensor is an electrotechnical device that measures physical quantities from the environment and converts these measurements into a signal that can be read by an instrument. Among the measurements read by sensors are the following: temperature, humidity, light, pressure, noise levels, presence or absence of certain types of objects, mechanical stress levels, speed, direction, and object size.

Fig: The cyber-physical management cycle of Smart Farming enhanced by cloud-based event and data management (Wolfert et al., 2014)

These features typically include intelligent assistance with the implementation of technology and its maintenance and use. The concept of smart farming is summarized in Figure 1, together with the management cycle as a cyber-physical system, leading eventually to smart online devices capable of controlling a range of farming systems.

The first step to develop our management platform is to know the variable inputs the system has and how they have to be processed by using the rules. Taking into account that the final goal is to enhance the sustainability and competitiveness of the activity, the system also includes business process management (BPM) and business rules. It is also important to define the platform architecture. The server-based decision-making structure for decision making on irrigation device settings, which processes data inputs on edaphic and environmental conditions, images of crop growth, and crop status is of foremost importance.

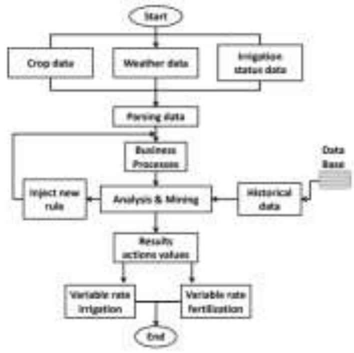

Fig : Farming smart decision systems (SDS) flow diagram

Automated Smart Farming and Fuzzy Logic

The automated smart farming refers to a farm system that can work on its own without human intervention. Making an automated smart farming can be done in several techniques; the most popular technique is to use Fuzzy Logic (FL). FL is a technique of reasoning that resembles human reasoning. FL achieves the definite output from the possible levels of inputs.

It has four main parts:

1. Fuzzification process: it translates the inputs, which are crisp inputs, into fuzzy sets, and splits the single input into five levels such as NH (Negative High), NL (Negative Low), Z (Zero), PL (Positive Low) and PH (Positive High).
2. Knowledge base: rules (IF-THEN) that are created by experts regarding the problems being considered.
3. Inference engine: it simulates the human reasoning by using fuzzy inference and knowledge base against the inputs.
4. Defuzzification process: it transforms the fuzzy set acquired from inference engine into a crisp output.

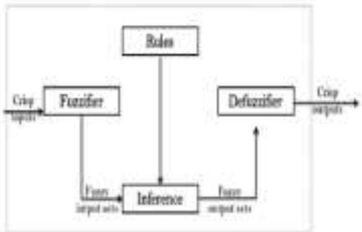

Fig : Fuzzy logic system architecture

Orchid Smart Farming

Orchids grow well in the rainy season with the environments. The climate change will affect the growth of orchids. The model had the possibility to forecast the growth rate of the orchid on a regular season (No climate change).

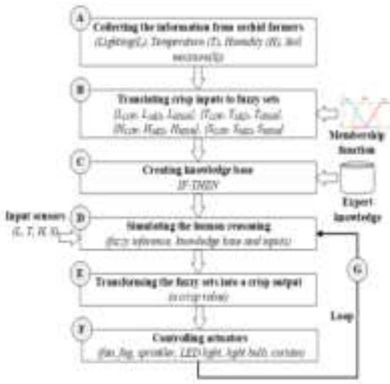

Fig : Processes to build an automated smart greenhouse

Monitoring the climatic variables inside the orchid greenhouse with the wireless sensor network was contributed in order to collect information for improving the growth of orchids. The system reported environmental conditions such as temperature, lighting, oxygen, and other parameters without any control.

Smart Farming with IoT

The smart farming is a subset of precision agriculture, which is designed to control the suitable environments for crops inside a greenhouse by using the least resources. It combines modern technologies (IoT) with agriculture to resolve problems for farmers. There are several research clusters about the smart farming like: The first example cluster concerns the energy used in the greenhouse. For example, an alternative electrical supply for a smart agricultural greenhouse, called the photovoltaic. In addition, the small off grid solar cell system applied to the farm. The second group deals with smart farming frameworks, for example, modern farming (Agri-IoT) with real-time stream processing, analysis and reasoning based on semantic web technologies. This claimed that Agri-IoT supports large-scale data analytics and event detections on the web. In the third cluster, the communication techniques used by the smart farms is considered to be a very important. ZIGBEE communication standard is design and implemented on greenhouse for monitoring water, climate and light. Low power Bluetooth and Low Power Wide Area Networks (LPWAN) communication standard can be included with the wired communication network to reduce energy and increase the mobility of sensor and actuator devices.

It is difficult to affirm whether this new set of technologies, in the context of SF, will keep pace with the increasing yields that have been accomplished by previous revolutions, such as the green revolution. SF have the potential to change both the farm structure and the wider food chain in unexplored ways, which is what occurred with the widespread adoption of tractors and the introduction of pesticides in the 1950s. In the coming years, smart farming is projected to create a massive impact on the agricultural economy by bridging the gap between small and large-scale businesses. The trend is not only pertinent in developed countries but developing countries have also realized its immense importance as well.

In countries such as China and Japan, wide-scale deployments of smart phones and internet of things (IoT) systems have led to a rapid adoption of precision agriculture solutions. The governments of several countries have also realized the need for, and the advantages of these technologies, and thus, their initiatives to promote precision farming techniques are expected to drive the growth of the market further.

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Impact of Grey Water on Crop and Soil

Article ID: 32088

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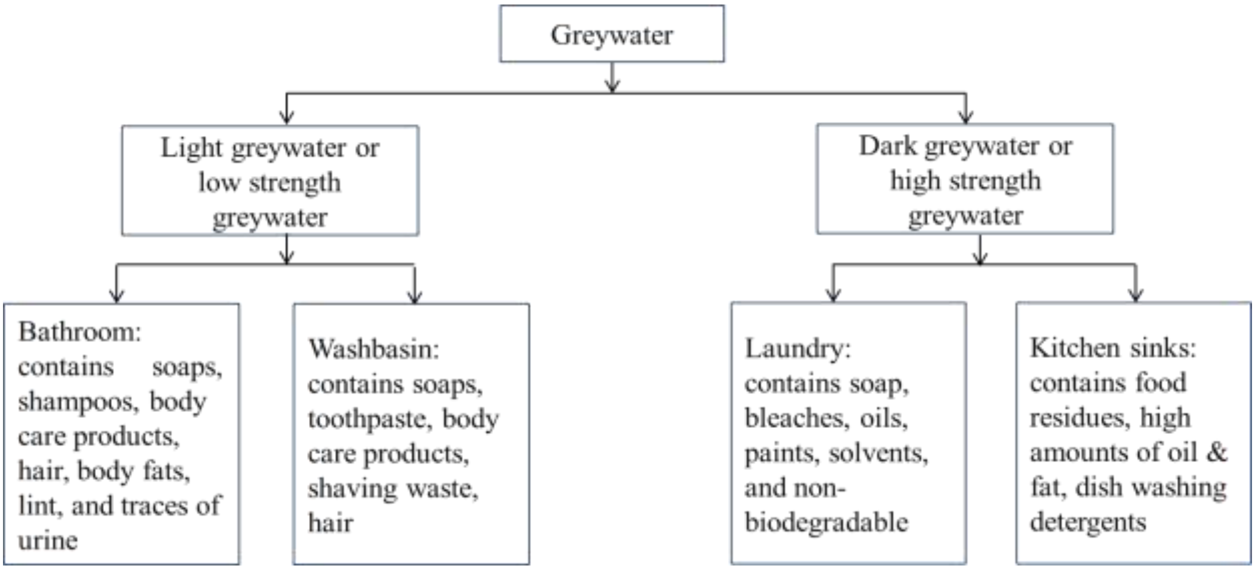
Introduction

Grey water is defined as wastewater that came from baths, showers, hand basins, washing machines, dishwashers, and kitchen sinks, but not from streams from toilets. Bathroom water like showers and tubs water, is termed light grey water. Grey water that includes more contaminated waste and from laundry facilities, dishwashers and, in some instances, kitchen sinks is called dark grey water (Birks and Hills, 2007).



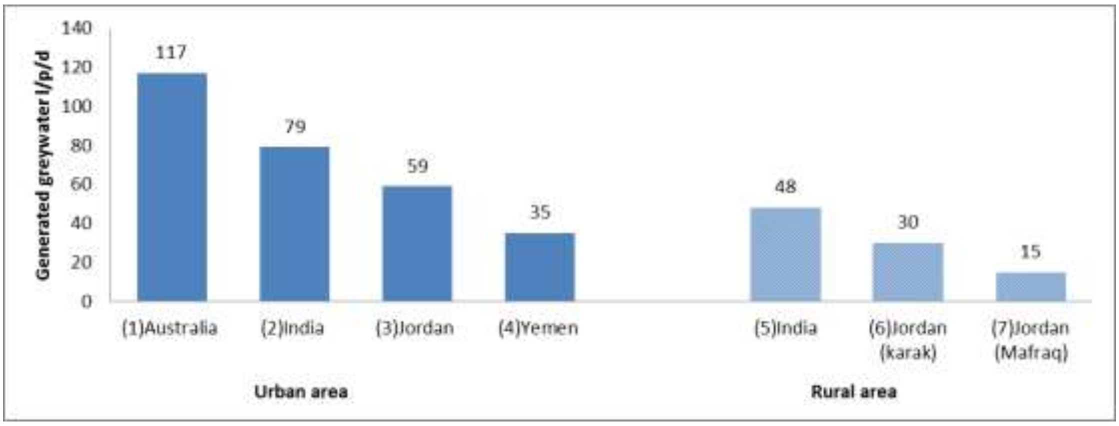
Grey water is water of poor quality collected from different household, which contain different type of elements. These elements are essential for plant to complete it life cycle. As per the guidelines of FAO, grey water contains enough amount of organic matter which has improving the soil health. The characteristics of grey water are varying from house to houses. This water is not classified as fresh water and dark water. It can call as neutral water. Some studies, it found that grey water contain more than enough quantity of salt that can degrade soil health as well as plant injuries. Such type of water can treat first before use and then apply on the farm. The different types of technologies are available to reduce the harmless of grey water like physical, chemical and biological method. After treatment grey water can use in agriculture as irrigation source.

Importance of Grey Water

1. Water used for toilet flushing, gardening and floor cleaning.
2. It is alternative source of irrigation.
3. Grey water contain macro and micro nutrient.
4. It is a good source of organic matter.
5. Grey water can save 30% of the total water consumption.
6. It can improve the soil fertility.
7. It will increase the crop production.

Quantity of Grey Water

Water consumption always depends on the water availability and life standards. The quantity of grey water generation depends on the population structures (i.e., age, gender), resident habits, total water consumption, living standard, and water installations of a given population. Grey water production varies from 50% to 80% of the wastewater volume produced by households and over 90% if vacuum toilets are installed. The volume of grey water production varies from 90 to 120 l/p/d. The volume of grey water in low income countries was 20–30 l/p/d.



Effect of Grey Water on Crop

1. Seed germination: Germination capacity and velocity of seed of different crops were lower in grey water irrigation compare to fresh water irrigation. Germination capacity and velocity of seed were more in dechlorinated grey water than chlorinated grey water.

2. Dry matter production: Dry matter production of many crops was increased with the grey water irrigation. Treated grey water can increase dry matter production of maize crop over untreated grey water. In some cases, dry matter production was decreased with grey water compare to fresh water due to presence of detergent in large amount.

3. Water use efficiency: Water use efficiency of crops with grey water irrigation was not increased or decreased. It means water use efficiency of crops with grey water irrigation near about equal to water use efficiency of crops with fresh water irrigation

4. Crop yield: Most of crop yield was increased with the application of 75% grey water and 25 % fresh water. Crop yield can decline with increase of grey water quantity in irrigation. Most favourable combination of grey water and fresh water to get highest grain yield is 75% and 25% respectively.

Effect of Grey Water on Soil Quality

1. Physical parameter: Soil bulk density greatly depends on the organic and inorganic fraction of soil and the degree of compaction. A slight decrease in the BD was observed in the plots irrigated with the gray water. The probable reason for the decrease in bulk density might be increase in organic carbon content of soil due to the application of organic matter through wastewater. The bulk density of soil depends on the organic carbon content of soil, which improves total porosity and in turn reduces the bulk density of soil (Pandey et al., 2014). Porosity was found increasing with grey water concentration at the lower range of grey water concentration but started to increase in the higher range of concentration. This is because of the washing of the fine particles increases the overall void spaces in the soil. But when the concentration increases, the surfactant monomers first saturate different interfaces (i.e. soil/liquid and air/liquid) and then starts to form micelles after certain concentration (i. e., critical micelle concentration) and it reduces the average void spaces for the retention of water content.

2. Chemical parameter: Soil pH, EC, Available Nitrogen and Phosphorus content in soil was increased with grey water application due to the basic properties of grey water.

3. Biological parameter: Low concentration of grey water in irrigation was increases phosphatase activities in soil. High concentration of grey water in irrigation was increase the harmful bacteria in soil.

Conclusion

Grey water is poor quality nutrient rich water which increases yield of crops as well as Nutrient uptake (N, P, K and micronutrient) in plant with grey water application. Long term application of grey water can change soil quality. Physical properties i.e., bulk density; porosity and water retention capacity were decreases with grey water application. Physicochemical properties i.e., OC, pH, EC and SAR were increases with grey water application. Application of grey water with fresh water in definite proportion can be good source of irrigation, which has been helpful to reduces the EC and SAR.

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Stem Nesting Bees - Notes on Nesting Behaviour of *Ceratina hieroglyphica* in Cashew

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In nature, only five per cent of the crops are self-pollinated and remaining 95 per cent are cross-pollinated. At least 100,000 species of fauna act as pollinators of the estimated 250,000 species of flowering plants in the world. Animals, birds, insects, wind and other biotic and abiotic agents serve as pollinating agents. Among all, insects (Entomophily) especially bees play a key role in pollination of several flowering plants. Bees include honey bees as well as several wild bees. Plenty of wild bee species present in an ecosystem serve as pollinators of wide range of crops and flora. All social and solitary bees make nests in a variety of habitats with amazing type of materials. They may be ground nesters, wood and pith nesters or cavity nesters (stem nesting bees). The majority of bee species nest in the ground, either using existing cavities or building their own nesting tunnels eg., bees belonging to Andrenidae and Halictidae. While most wood nesting bees either rely on existing tunnels left behind by beetles and other insects, or they themselves chew and excavate their own nests eg., carpenter bees. Around 30% of native bees are cavity nesting such as leafcutter bees and mason bees. Stem nesting bees build their nests in solid wood, pithy stems, dead wood, hollow stems, or brush piles and other similar materials.

Fig. 1. *Ceratina hieroglyhica*, sitting at its nest entrance, a cut end of cashew stem

By looking at the material used to divide the nest cells and to close the entrance tunnel and the size of entrance hole, it is possible to say to which group a bee nest belongs. In the genus *Osmia*, known as mason bees (and including the orchard bees) use mud and sometimes chewed plant material for their nest divisions. Leafcutter bees (*Megachile* sp.) cut leaves and flower petals as wrapping for their egg cells. The resin bees (*Hoplitis* and *Heriades)*, seal their nest with plant resins. The tiny yellow-faced bees (Colletidae) make their own cellophane-like substance as nesting material. This material is produced from glands on their body, and is astonishingly strong, waterproof, and has anti-fungal properties. The common bumble bees (*Bombus* sp.) makes nests in abandoned mouse nests, cavities in the soil, in trees and buildings. Bees of Genus *Anthidium, Xylocopa, Ceratina, Anthidiellum, Dianthidium, Euodynerus* are other stem nesting bees.

Cashew (*Anacardium occidentale* L.) native of Brazil, is an important tree nut crop grown widely in several countries including India. Cashew is a cross pollinated crop requiring insects especially bees for successful pollination. Among the cashew pollinators, *Ceratina hieroglyphica* Smith (Apidae: Hymenoptera) serves as one of the common pollinators of cashew. Field observations revealed that *C. hieroglyhica* makes nest in the dried sticks of cashew and the cut ends of pruned trees. Peak forging activity of these bees was noticed in cashew flowers between 11.00 and 13.00 hrs and the foraging rate was 3-5 flowers/ trip. Nests of *C. hieroglyphica* can be easily identified with circular entrance hole of 2.5-3.5 mm diameter. Its nest is a narrow simple burrow in the pithy region of a dried cashew twig. Most *C. hieroglyphica* nests were found in dried thin twigs of cashew of 5.0 – 20.0 mm thickness. Nests were commonly seen on the twigs with exposed pith especially on the pruned cut ends. The nests had typical compartments known as cells of 7.1±0.48 mm length, arranged linearly along the stick, and separated by cylindrical partitions made of fine wood particles of 1.0 -2.5 mm thickness. Cell length was almost equal to the length of adult bees, and the cells were of equal size except for a very few. They were continuous without any empty spaces.

The nests invariably had only one entrance with older ones present near the inner end and the younger ones towards the entrance. A maximum of six adults were seen in a nest. The egg stage lasted for 3-4 days. The first instar larvae were translucent, rested on top of nearly intact food masses and ate the pollen provision. Post-defecating larvae were identified by feces evident inside the cells before pupation. The larval stage lasted for 8-10 days. Pupal stage was completed in 7-9 days. The total life cycle lasted 26-34 days.

Fig. 2. Life stages of *Ceratina hieroglyphica* inside the cashew stem

How to Conserve the Stem Nesting Bees

1. Proving bee flora, reducing pesticide usage, protecting and creating bee habitats are important ways to conserve bees.
2. Dead trees, plant stems of dormant perennials and grasses from edges can be left in the plantations as long as they are not problematic, as they serve as nesting habitats.
3. Logs from cut trees (especially those containing burrows) can be piled up so as to allow larvae of beetles, ants and wood wasps make nests, and to provide abandoned tunnels later for nesting bees.
4. One way that we can conserve stem nesting bees is to build a “bee hotel.” Bee hotels generally consist of different nesting materials for cavity and wood-nesting bees under a roofed enclosure. One can use tubes, bamboo, drilled wooden blocks, bricks, or any other materials that provide a range of holes for different species of stem nesting bees.

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Remote Sensing: As a Tool Used in Weed Management

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Remote Sensing

Remote sensing is an art and science of obtaining information about an object or feature without physically coming in contact with that object or feature. There are two types of remote sensing- Active and Passive. In the case of active remote sensing, energy is generated and sent from the remote sensing platform towards the targets are recorded using sensors onboard the remote sensing platform. In the case of passive remote sensing, here, the energy source is natural i.e. the Sun.

Main Stages in Remote Sensing

Energy source or Illumination, Radiation and the Atmosphere, Interaction with the Target, Recording of Energy by the Sensor, Transmission, Reception and Processing, Interpretation and Analysis and Application.

Components of a Remote Sensing System

1. Energy Source: Illuminates or provide electromagnetic energy to the target.
2. Target: The object or material need to being studied. The components in the system work together to measure and record information about the target.
3. Sensor: A remote device that record and collect electromagnetic radiation. Sensor can be used to measure energy given by the target.
4. Transmission path: The resulted set of data is transmitted to a receiving station where data are processed into usable format, which is most often as an image.

Weed Management in Inaccessible Area

Weed management is the application of certain principle and suitable methods that will improve the vigour and uniform stand of the crop and at the same time discourages the invasion and growth of weeds. In inaccessible areas like forest remote sensing is only method for identification and spread of invasive weeds in forest that threaten the forest species diversity.

Site Specific Weed Management

1. Site specific weed management is the method to limit the application of herbicide only to area occupied with weed.
2. Accurate sensing and mapping of weeds is pre-requisite for site specific weed management.
3. The weed maps provide actual location and density of weeds and patches of weed in the crop.

Weed Sensing

Weed sensing is the use of machine or instrument to detect the weed. It is achieved by an optical sensor directed at the ground level, using light reflectance to detect the presence weed as the sensor unit light it up. There are two type of weed sensors.

Optical Spray Technology (OST) System

Optical Spray Technology (OST) System are used for broad spectrum weed control for summer weed and fallow weed control. This type of sprayer is widely accepted in broad acre cropping situations. OST use Near Infra-Red

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(NIR) and red-light sensing technology to detect living green material on the ground. There are two commercial OST units currently use in the market:

a. WEEDit.
b. Weed Seeker units.

WEEDit	**Weed Seeker units**

WEEDit

WEEDit are generally tow behind units; to eliminate boom height variation. WEEDit used one sensor eye with five lenses controlling five nozzles per one meter spacing on the bar. The working of WEEDit is given below:

First red light passed over live plant matter.
↓
Chlorophyll in the plant absorb some red light and fluoresces.
↓
Near Infra-Red Light (NIR) back out to environment.
↓
In response to presence or absence of green plant the sensor controls the nozzle.
↓
Switching on and off as it detects green plant.
↓
Then spraying only those areas by weed.

Weed Seekers

Weed Seekers can be fitted to tow behind or self-propelled sprayers. Weed seeker uses one sensor for each nozzle:

Light emitting diodes produce invisible infrared + visible red light which is projected onto the target.
↓
Light reflected from the target is captured by a detector.
↓
Sophisticated electronic circuit inside the sensor analyse the reflected light.
↓
Electronic circuit determine it matches the light reflected by green plants.
↓
Green plants reflectance is identified.

The sensor wait until the plant is under spray nozzle.

↓

Then triggers the fast-fire solenoid valve.

↓

Sprays the plant.

In Crop Weed Detection

Following tools are used in In Crop Weed Detection:

1. Drones and Aircrafts.
2. Satellites.

Benefits of Drones & Aircraft

1. Drones are used to produce maps on a need basis.
2. Price of suitable drone is reducing.
3. Can produce high resolution imagery.
4. Relative rapid turnaround time for production of paddock maps.
5. Ease to use software controlling drones.

Limitations of Drones & Aircrafts

1. Limited flight time.
2. Tight flight conditions are required.
3. Requirement for high speed internet connection for upload of images for processing.
4. Inconsistency and lower quality data from drones requiring higher processing due to variations caused by clouds, time of day-sun angle etc.

Benefits of Satellite

1. Satellite maps are very cheap per unit area.
2. Satellite maps are quality controlled for data – altitude, angle and luminosity.

Limitations of Satellite

Cloud cover at satellite fly over, delays timely production of images. (Some regions and years of experience significant cloud cover through winter growing season resulting in extended periods between satellite images.

Conclusion

In India or other developing country farmers has marginal land, weed management through remote sensing requires larger land holding for efficient working. Implementable technologies of remote sensing should infiltrate into agricultural sector at micro level for greater and sustainable benefits.

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Advantages of Artificial Seeds for Plant Propagation

Article ID: 32091

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In-vitro produced somatic embryos encapsulated in a nutritive protective coating as seed coat having capabilities to grow in young plantlets are termed as artificial seeds. This artificial seed technology has great potential towards rapid, cost-effective mass propagation of commercial/elite plant accessions/varieties. They also provide a new channel for the plant lines that are being produced by harvesting new in-vitro biotechnological advances that can be directly delivered to the glasshouse, greenhouse, and in the field conditions without the hardening process. The artificial seed production technology can be defined as a rapid, in-vitro cost-effective mass propagation method that can maintain the genetic fidelity of the plants.

Introduction

There are many plants and newly produced synthetic varieties which cannot be directly propagated by seeds. To solve this problem, the shoots, shot apical meristem, somatic embryos generated through micropropagation can be harvested for artificial seed production.

The greenhouse vegetative propagation through stem cuttings is another way but it is labour-intensive, less in numbers with the limitation of multiplication factor due to the size of the mother/donor plant.

These limitations may be shorted out using artificial seed technology which utilizes somatic embryos through the in-vitro somatic embryogenesis process which was first reported in 1958 for rapid multiplication of thousands of embryos having the potential to form a plant.

What are Artificial Seeds

They are defined as artificially generated seed-like living regenerative structure, by utilizing a tissue culture technique in which somatic embryos, shoot tips meristematic tissue or axillary meristem bud having ability to generate into a young whole plant under in vitro and field conditions are utilized for encapsulation (Capuano et al., 1998). Functionally, they can be defined as the meristematic somatic embryos/shoot buds encapsulated into an artificial gelatinous covering for commercial plant production (Ara et al., 2000).

Historical Aspects of Artificial Seed Production

In the year 1958, F. C. Steward (USA) and J. Reinert (Germany) simultaneously discovered somatic embryogenesis in carrot. Then in 1977, Toshio Murashige formally presented his ideas on artificial seeds for horticultural purposes in a conference hosted in Belgium.

The first use of somatic embryos for plant propagation was reported by Murashige (1978). Later, somatic embryos conversion into artificial seeds were initiated by Kitto and Janick (1985), Redenbaugh (1986), and Gray (1987), etc. Drew in 1979 proposed the active methods for commercial propagation of crops using somatic embryos. It was also found that shoot bud based artificial seeds may also be used for plant propagation.

Concept of Artificial Seeds

Artificial seeds mimic the structure of conventional zygotic seeds as these are comprised of both, regenerative explants (Somatic embryo) and a chemical coating behaving as a seed coat. The chemical coating is composed of a gelling agent along with some added nutrients, growth regulators, antipathogenic substances, bio controller agents, etc. (Fig. 1) resembles the endosperm of the natural seed imitation of the zygotic embryo.

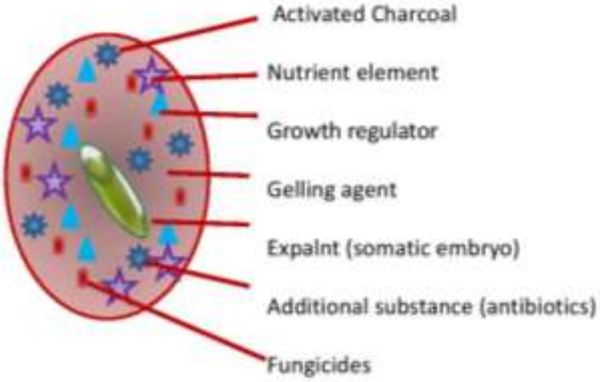

Fig. 1: Diagrammatic representation of components of an Artificial Seed

Types of Artificial Seeds

The available literature reveals the development of two types of artificial seeds:

1. Desiccated.
2. Hydrated artificial seeds (Bhojwani and Razdan,2006).

The desiccated artificial seeds were produced from somatic embryos, which were either naked or encapsulated with polyethylene glycol for their desiccation (Corrie and Tondon, 1993). These desiccated artificial seeds are only produced for plants that have desiccation-tolerant somatic embryos production capacity. The desiccation tolerance in somatic embryos can be induced/ altered using a variety of nutrient mediums with high osmotic potential. It utilizes high gel strength along with the addition of permeating osmoticants like glycerol, mannitol, sucrose, etc. On the other hand, hydrated artificial seeds are produced by hydrated somatic embryos that are nonquiescent therefore must be germinated immediately after production or stored under moist conditions for only very short periods. They are fragile and sometimes require careful handling that increases the cost per artificial seed. To avoid this, they are sometimes germinated in vitro under well-controlled conditions and transferred manually through various hardening-off procedures before transplantation to the greenhouse.

Preparation of Good Quality Artificial Seeds

The artificial seeds can be prepared by the establishment of callus culture, induction of somatic embryogenesis, synchronous production of somatic embryo followed by its maturation, and encapsulation. (Fig. 2).

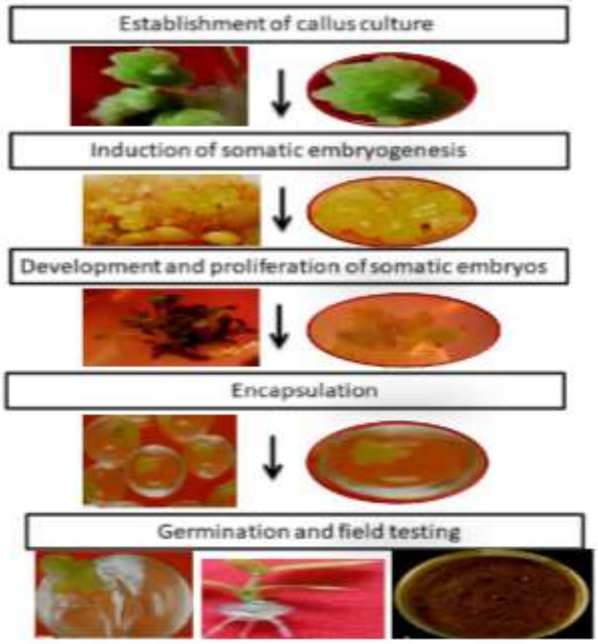

Fig. 1: Diagrammatic representation of generation of artificial seed and its germination

Synthetic Seeds as Tool for Germplasm Conservation

The artificial seeds are the germplasm having information related to a species' genetic makeup, and can have a valuable technology for conservation of natural resource to preserve plant biodiversity in-vitro . The genetic information, contained in plant parts like meristematic tissues, embryos are genetically alike due to somatic in nature and devoid of sexual reproduction process. Therefore, this technology can also be harvested for production of clones i.e. genetically alike plants.

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Organic Farming: A Need of Era During COVID 19 Pandemic

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Organic farming is an agricultural system which originated early in the 20th century in reaction to rapidly changing farming practices. Certified organic agriculture accounts for 70 million hectares globally, with over half of that total in Australia. Organic farming continues to be developed by various organizations today. It is defined by the use of fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting. Biological pest control, mixed cropping and the fostering of insect predators are encouraged. Organic standards are designed to allow the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances. For instance, naturally occurring pesticides such as pyrethrin and rotenone are permitted, while synthetic fertilizers and pesticides are generally prohibited. Synthetic substances that are allowed include, for example, copper sulphate, elemental sulphur and Ivermectin. Genetically modified organisms, nanomaterials, human sewage sludge, plant growth regulators, hormones, and antibiotic use in livestock husbandry are prohibited Organic farming advocates claim advantages in sustainability, openness, self-sufficiency, autonomy/independence, health, food security, and food safety. Organic agricultural methods are internationally regulated and legally enforced by many nations, based in large part on the standards set by the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for organic farming organizations established in 1972.

Organic Agriculture can be Defined as

An integrated farming system that strives for sustainability, the enhancement of soil fertility and biological diversity while, with rare exceptions, prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones. Since 1990 the market for organic food and other products has grown rapidly, reaching $63 billion worldwide in 2012. This demand has driven a similar increase in organically managed farmland that grew from 2001 to 2011 at a compounding rate of 8.9% per annum. As of 2018, approximately 71,500,000 hectares (177,000,000 acres) worldwide were farmed organically, representing approximately 1.5 percent of total world farmland. 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..."— International Federation of Organic Agriculture Movements. Organic farming methods combine scientific knowledge of ecology and some modern technology with traditional farming practices based on naturally occurring biological processes. Organic farming methods are studied in the field of agroecology. While conventional agriculture uses synthetic pesticides and water-soluble synthetically purified fertilizers, organic farmers are restricted by regulations to using natural pesticides and fertilizers. An example of a natural pesticide is pyrethrin, which is found naturally in the Chrysanthemum flower. The principal methods of organic farming include crop rotation, green manures and compost, biological pest control, and mechanical cultivation. These measures use the natural environment to enhance agricultural productivity: legumes are planted to fix nitrogen into the soil, natural insect predators are encouraged, crops are rotated to confuse pests and renew soil, and natural materials such as potassium bicarbonate and mulches are used to control disease and weeds. Genetically modified seeds and animals are excluded.

While organic is fundamentally different from conventional because of the use of carbon-based fertilizers compared with highly soluble synthetic based fertilizers and biological pest control instead of synthetic pesticides, organic farming and large-scale conventional farming are not entirely mutually exclusive. Many of the methods developed for organic agriculture have been borrowed by more conventional agriculture. For example, Integrated Pest Management is a multifaceted strategy that uses various organic methods of pest control whenever possible, but in conventional farming could include synthetic pesticides only as a last resort.

Crop Diversity

Organic farming encourages Crop diversity. The science of agroecology has revealed the benefits of polyculture (multiple crops in the same space), which is often employed in organic farming. Planting a variety of vegetable crops supports a wider range of beneficial insects, soil microorganisms, and other factors that add up to overall farm health. Crop diversity helps environments thrive and protects species from going extinct.

Soil Management

Organic farming relies heavily on the natural breakdown of organic matter, using techniques like green manure and composting, to replace nutrients taken from the soil by previous crops. This biological process, driven by microorganisms such as mycorrhiza and earthworms allow the natural production of nutrients in the soil throughout the growing season, and has been referred to as feeding the soil to feed the plant. Organic farming uses a variety of methods to improve soil fertility, including crop rotation, cover cropping, reduced tillage, and application of compost. By reducing tillage, soil is not inverted and exposed to air; less carbon is lost to the atmosphere resulting in more soil organic carbon This has an added benefit of carbon sequestration, which can reduce greenhouse gases and help reverse climate change. Plants need a large number of nutrients in various quantities to flourish. Supplying enough nitrogen and particularly synchronization so that plants get enough nitrogen at the when plants need it most, is a challenge for organic farmer] Crop rotation and green manure ("cover crops") help to provide nitrogen through legumes (more precisely, the family Fabaceae), which fix nitrogen from the atmosphere through symbiosis with rhizobia bacteria. Intercropping, which is sometimes used for insect and disease control, can also increase soil nutrients, but the competition between the legume and the crop can be problematic and wider spacing between crop rows is required. Crop residues can be ploughed back into the soil, and different plants leave different amounts of nitrogen, potentially aiding synchronization. Organic farmers also use animal manure, certain processed fertilizers such as seed meal and various mineral powders such as rock phosphate and green sand, a naturally occurring form of potash that provides potassium. Together these methods help to control erosion. In some cases, pH may need to be amended. Natural pH amendments include lime and sulphur, but in the U.S. some compounds such as iron sulphate, aluminium sulphate, magnesium sulphate, and soluble boron products are allowed in organic farming.

Mixed farms with both livestock and crops can operate as ley farms, whereby the land gathers fertility through growing nitrogen-fixing forage grasses such as white clover or alfalfa and grows cash crops or cereals when fertility is established. Farms without livestock ("stockless") may find it more difficult to maintain soil fertility, and may rely more on external inputs such as imported manure as well as grain legumes and green manures, although grain legumes may fix limited nitrogen because they are harvested. Horticultural farms that grow fruits and vegetables in protected conditions often rely even more on external inputs.

Biological research into soil and soil organisms has proven beneficial to organic farming. Varieties of bacteria and fungi break down chemicals, plant matter and animal waste into productive soil nutrients. In turn, they produce benefits of healthier yields and more productive soil for future crops. Fields with less or no manure display significantly lower yields, due to decreased soil microbe community. Increased manure improves biological activity, providing a healthier, more arable soil system and higher yields.

Conclusion

Organic farming is a prerequisite need of era because it not only increases crop production but also it is eco-friendly, cheaper to use as require less cost of cultivation, and nourishes the soil to increase its productivity.

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Climate Change, Pandemic and its Impact on Indian Agriculture

Article ID: 32093

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Climate change is the biggest challenge for sustainable agricultural productivity which is very closely associated with global warming causing strong storms, cyclones, floods, cold conditions, droughts, heatwaves, and other extreme weather changes. It is also responsible for the appearance of various endemic and pandemic diseases of crops as well as humans. Agriculture is highly vulnerable to the present state of climate variability and also to the projected extreme changes in the climate (George, 2011). Climate change majorly induced by global warming will affect all dimensions of food security such as food availability, food utilization, food accessibility, and food systems stability that have a negative impact directly on human health, food production, and distribution channels. Both short term and long term impact can be seen by these environmental changes on agriculture food security. Climate change is also an important determinant for the appearance of vector/pathogen borne disease of both crop plants and human by creating a favourable environment for (i) vector/pathogen survival, reproduction and migration, (ii) the vector's/pathogen biting and spreading rate, and (iii) the incubation/infection rate of a pathogen within the spreading organism. As vectors/pathogens and its hosts each survive and reproduce within a range of optimal climatic conditions such as temperature, precipitation, wind, and daylight durations, etc. further, the rainfall can also directly influence the spread/transport and dissemination of infectious agents, while temperature affects their growth, reproduction, and survival. Even very small changes in average temperatures can induce a significant effect on plant and human health. The direct visual impact of changing climatic conditions on the environment and well-being of humans can be described in terms of the challenges that occur in ecosystem services due to climate-induced biodiversity changes such as food, feed, and agriculture. Further, the drastic changes in weather patterns, shrinking habitat, and land degradation that are induced by climate change have a direct effect on the emergence of new pandemic diseases. Agricultural produce, food, and proper nutrition have a sharp impact during pandemic situations in the countries that are more populous like India. Though the recent crisis in the form of the COVID19 pandemic has shown no serious impact and disruption to the food system and its supply, however, this situation directs us to reboot and reform the current Indian agricultural policies as India is currently facing the synergistic agricultural challenges due to climate change. The COVID-19 pandemic has also exposed fragilities in the agriculture food system that is likely to worsen with the impact of climate change by lowering agricultural productivity.

Models of crop production indicate that global warming leads to the exposure of major crops to high-temperature stress which has a direct impact on growth potentials and yield of crops (Figure 1). Uncertainties in precipitation rate, rainfall period, temperature, dry spell humidity, and its span, water holding capacity of soils, plantation rate, and deforestation like several factors are presently affecting the agriculture productivity directly or indirectly. Gradual minor changes in the climate are responsible to lower the agricultural productivity and output of produce in India and other countries. For example, major grain crops such as wheat, rice, maize, pulses, beef, fish dairy, and sugar production can show a decline of 2 -6 % by 2030 and 5-11 % by 2050 due to a rise in temperature and global warming. Currently, we have also witnessed serious economic losses of farmers in India due to unpredicted weather disturbances such as heavy rain, drought, and cyclones. The prime objective of the present article is to identify the things of serious concerns about climate change for Indian agriculture and related agricultural policies.

In India impact of climate change would affect directly plant growth and development and also reduce crop duration which could considerably affect crop yield and productivity. The simulation results suggest that

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increasing temperature and decreasing solar radiation, change in precipitation levels pose a serious threat in decreasing the growth and yield of crops (Aiken, 2009). The agriculture sector is difficult to handle for climate change and its mitigations in India due to the sheer size of land areas of different geographical systems and the large differential variation in agro-ecosystems and farming patterns. There is a need for continued efforts and policies for the sustainable growth of the agricultural sector to maintain continued productivity growth against climate change and variability to cope up with the emerging potential pressures. To meet the above expectations, various adaptation measures, including improved sustainable agricultural technologies, will be particularly important in reducing the potential negative impact of climate change. Further, to respond against climate change in an efficient productive manner and to maintain and enhance the productivity/international competitiveness of Indian agriculture, further research and sustainable development is highly required for both climate change adaptations, mitigation technologies, and control measures.

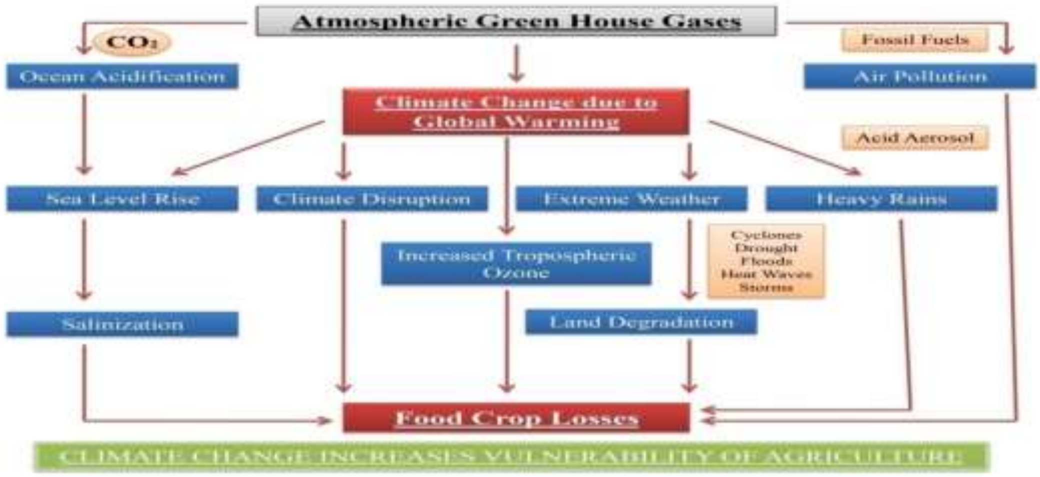

Figure 1: Global warming-induced climate change and its impact on food crop losses

In recent years several symposiums and seminars have been organized by Govt. of India through different Institutions and institutes. Several recommendations were also given by the great academician and scientists of India and abroad. After scientific discussions, two things are very much established that a gradual rise in the atmospheric temperature and growth of the Indian population is posing a serious cause of manipulating major factors that are responsible for climate change.

Figure 2: Annual Indian grain production (Source: Indian Ministry of Agriculture and Farmers Welfare)

We also continuously observing that most of the climatic changes have been brought about by the human anthropogenic activities in nature, which are also termed as Anthropogenic Climate Changes (ACC). The potential serious impacts of climate change on Indian agriculture are 1) Decrease in productivity of cereals because of gradual rising of temperature, CO2 and inadequate water availability for irrigation purpose, 2) the 10C increase of environmental temperature can reduce yields of major food crops by 3 to 8 percent, 3) estimated projected loss of 10-40% in crop production by 2100, 4) Length of crop growing period in rain-fed areas is going to likely to reduce especially in peninsular regions. The government's National Communications (NATCOM) also clearly admits that erratic monsoon and heavy rain will have "serious effects" on rain-fed agriculture, peninsular rivers, water food, and power supply. Data showed that the annual grain production in India has remained relatively stable, however, a decline in production was observed between 2014 and 2016 due to drought (Figure 2). According to 2020-2021 projected demand for crop production from 2010-15 is enlisted in table -1.

Table1: Domestic production and projected demand (2020-21) of crop production.

Commodity	Domestic production 2010-15 (million tons)	Project demand 2020-21 (million tons)
Cereal	205.9	365.0
Pulses	14.3	29.1
Foodgrains	225.1	391.1
Oilseeds	25.6	53.7
Vegetables	120.8	200
Fruits	58.9	180
Sugar cane	305.1	445.3
Milk	102.9	241.5
Fish	6.9	25.2
Egg	50.9	10.4

The Production of horticulture crops in India was estimated at a record 320.48 million metric tonnes in 2020 while having the largest livestock population of around 535.78 million, which translates to around 31 percent of the world population. Milk production in the country is expected to increase to 208 million tonnes in 2021 from 198 million tonnes in 2020, registering a growth of 10 percent. But it is very tough to touch the projected production of 2020-21 in the present changing climate and pandemic scenario. Climate changes by 2°C will induce early flowering and lesser yield compounded by high temperature/drought, cold, and flood in tropics (Cline William, 2007). Several other problems occurred in crops likely- pollination, fruit-setting, incapability sterility, stone size incensement and pulp decrease, fruit size, shapes, and colors are major incensement in post-harvest losses. Other factors such as a decrease in self-life, losing keeping quality due to fast chemical changes are also affected by high temperature/climate change. To transform Indian agriculture into an ecologically sustainable climate-resilient production system and at the same time, exploiting its fullest potential thereby ensuring food security is a prime concern today at the national level. Climate change mitigations are required to reduce the anthropogenic forcing of the climate system, it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks. On the other hand, wider objectives should be defined for alleviating poverty and improving access to food rather than just safeguarding the production of food is needed in India. Now seeing the above factors there is a strong need to focus on the following fields to minimize the negative effect of climate change and sustainable production of crops under gradual changes of climate (Figure 3).

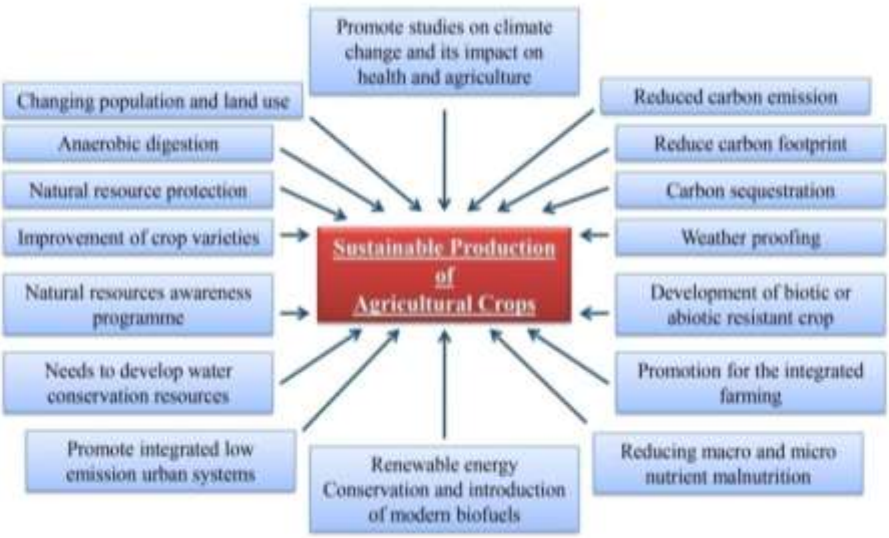

Figure 3: Different strategies for sustainable agricultural production of food crops

According to a recent publication from Harvard University, COVID-19 patients from areas that had very high levels of air pollution, are more likely to die than patients in comparison to pollution-free cleaner parts of the country. But how we can prevent such global pandemics, loss of agricultural produce, and other health hazards in the future? One of the serious threats due to climate change to Indian agriculture is a serious large swarm of locust invasion due to various climatic changes. The traditional form of locust control is the use of pesticides. To prevent the negative impact of pesticides extensive research is presently going on regarding biological control specifically focused on various pathogens and insect growth regulators. The Government and ICAR activities towards boosting organic agriculture are presently going on and recently, a proposal has been also recommended to ban 27 pesticides, including organophosphates that have a serious hazard to human health.

In conclusion, we can say that appropriate policy and budgetary support for mitigation and adaptation actions are needed to protect our agricultural system from the impact of global warming. Multiple food and livelihood strategies are also needed in rural areas to minimize serious risk issues. It will worsen with climate change as more frequent and unpredictable droughts and floods will result in shortfalls in food production. The real challenge to the future Indian agriculture however will have to be met by rapid and targeted adaptation strategies.

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Lesser Known Carotenoid: Astaxanthin

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Introduction

Carotenoids are one of the essential secondary metabolites which has primary function in photosynthesis along with chlorophyll. Carotenoids belongs to class of tetraterpenes (40 carbon terpenes) and comprises of more than 600 pigments which are widespread in photosynthetic tissues of plants, mosses, algae, bacteria and fungi. These carotenoids are involved in light harvesting process and protection against photo-oxidative damage of photosynthetic apparatus caused by reactive oxygen species (ROS). ROS may be free radicals like superoxide (O2.), hydroxyl (.OH), peroxyl (RO.) or nonradicals like hydrogen peroxide (H2O2), ozone (O3), proximities (ONOO-), singlet oxygen (1O2). Based on presence or absence of oxygen, carotenoids can be classified into carotenes (without oxygen) and xanthophylls (with oxygen). Xanthophylls are further classified as Zeaxanthin (OH), Canthaxanthin (oxi group) and Astaxanthin (OH and oxi group). Here we like to highlight about the structure, function and the practical application of Astaxanthin.

Distribution and Biosynthesis of Astaxanthin

Astaxanthin is omnipresent mainly in marine environment and can be found in salmon, trout, krill, shrimp, crayfish, algae and yeast. Microorganism source of astaxanthin mainly include, Microalgae like *Haematococcus pluvialis*, *Chlorella zofingiensis, Chlorococcum* sp., Red yeast like *Phaffia rhodozyma* and Marine bacterium like *Agrobacterium aurantiacum.* This astaxanthin is produced by two different pathways in microorganism from β-carotene (Fig 1; Han et al. 2013). But higher plants lack *denovo* synthesis pathway for astaxanthin.

BKT: β-carotenoid ketolase.
CrtR-b: β-carotenoid hydroxylase.

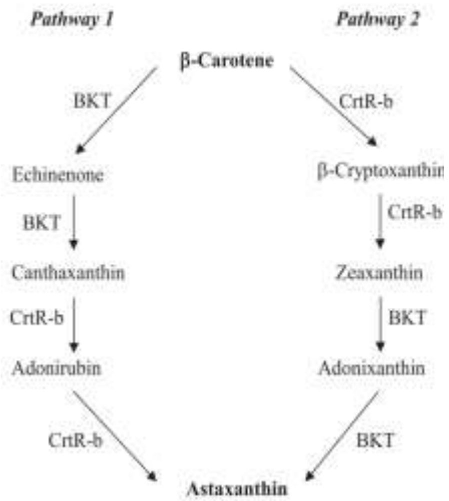
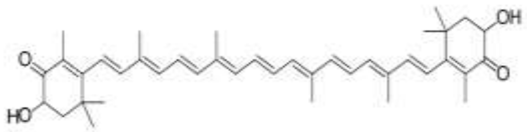


Fig 1. Biosynthesis of Astaxanthin

Biochemistry and Mechanism of Action

Astaxanthin is a lipid soluble ketocarotenoid chemically known as 3,3'-dihydroxy- β, β'-carotene-4,4'-dione. It consists of two hydroxyl group, two carbonyl group and eleven ethylenic double bonds (Urich, 1994). The unique feature of astaxanthin includes more polar nature, esterification ability and the antioxidant property which is ten times more than the other known carotenoids like zeaxanthin, lutein, anthaxantin, β-carotene and hundred times more than α-tocopherol. Because of its higher antioxidant property astaxanthin called as 'Super Vitamin

E'. The unique property of astaxanthin is due to the ionone rings consisting of hydroxyl and keto group. In nature, astaxanthin exists in both cis and trans isoform, but trans isoform has greater bioavailability than cis form. Chelation of bivalent cations like Cu^{+2} or Zn^{+2} or Fe^{+2} at the 3,3' site, which is favorable action of site in astaxanthin lead to shift in absorption maximum to 492nm from 480nm. This will further inhibit the production of hydroxyl and hydroperoxyl radical from Fenton reactions (Timoshnikov et al. 2015).



Benefits of Astaxanthin

Apart from showing major role as an antioxidant, astaxanthin has also shown promising health related benefits. It improves the functioning of eyes (including deep vision, visual activity, reduce the eye soreness and blurred vision), reduce tiredness and improve the skin of the human beings. It has a role in improving central nervous system as well as cardiovascular system. Promising results were also observed in inhibition of cancer in mice and improving male fertility in humans (Ambati et al. 2014).

Bio-Fortification of Astaxanthin

Though astaxanthin showed promising health related benefits, but higher plants lack the production of astaxanthin. Till recently astaxanthin was supplemented in tablet form or soft gel to overcome some of the diseases. Recent development in bioengineering techniques helped to transfer some of the genes related to astaxanthin biosynthesis into higher plants. Introduction of two genes *BHY* (β-carotene hydroxylase) and *BKT* (β-carotene ketolase) led to biosynthesis of astaxanthin in Tobacco (*Nicotiana tabacum*), Carrot (*Daucus carota*), Tomato (*Solanum lycopersicum*), Lettuce (*Lactuca sativa*), Potato (*Solanum tuberosum*) and Maize (*Zea mays*). As rice endosperm doesn't have carotenoid precursor in the endosperm, it was relatively difficult for introduction of astaxanthin biosynthesis in rice grains. Recently Zhu et al. (2018) introduced the 4 genes; *sZmPSY1* (Phytoene synthase) from Maize, *sPaCrtI* (Phytoene desaturase) from *Pantoea ananatis* (*Erwinia uredovora*), *sHpBHY* (β-carotene hydroxylase) from *Haematococcus pluvialis* and *sCrBKT* (β-carotene ketolase) from *Chlamydomonas reinhardtii* into rice endosperm with endosperm specific promoters by agrobacterium mediated transformation. Successful transformation of these genes led to synthesis of 16.2 mg/g DW of Astaxanthin (74% of total carotenoids) with no compromise in any other physiological and agronomical traits.

Future Perspectives

Astaxanthin has a profound role in microorganisms and plants. Though bio-fortification with astaxanthin overcame the constraint of its synthesis in higher plants, but how these biofortified foods will be metabolized in human beings need to be unrevealed.

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Segregation of Calcium form Eggshell and Aggumulated into a Flavoured Power (Health Mix)

Article ID: 32095

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Summary
Nowadays people who having aversion of milk they are facing calcium deficiency that leads to osteoporosis and several diseases. To overcome this, we can intake calcium in the form of health drink according to our favourite flavour.

Introduction
This Calcium deficiency leads to hypocalcaemia that includes numbness, and tingling in the fingers, muscle cramps, convulsions, lethargy, poor appetite and abnormal heart rhythm if this left untreated then may over the long term this inadequate causes osteopenia. So, getting enough dietary calcium is necessary and that's to easily achieved by cheapest sources of calcium by processed eggshell powered.

Women over 50 and all adults over 70 should ingest1,200mg a day of calcium. If choosing supplements to augment your dietary calcium, the national institute of health recommend 1000 mg daily for most of the adults required. This requirement can be achieved by this eggshells powder.

Calcium in Eggshell
A hard covering eggshell has a rich calcium carbonate and this eggshell are have roughly 40% of calcium with each gram providing 381-401mg. A half an eggshell may provide enough calcium to meet the daily requirement for adults, which is 1000may per day . Other than calcium the eggshells contains small amounts of protein and other organic compounds. Studies in rat and the piglets proves that eggshells are rich in calcium carbonates.

A study in isolation cells found that calcium absorption was up to 64% greater from eggshell Powder compared to pure calcium carbonate. Not only calcium other than that in addition we can found some protein and other minerals that's including strontium, fluoride, magnesium and selenium . Just like calcium this mineral also play a vital role in bone health.

It Reduces the Risk of Osteoporosis
Osteoporosis in the senses bone weakness that's leads to bone fractures. In general, it affected an estimated 54 million older Americans are suffering from that. For postmenopausal women with osteoporosis will be cured with is eggshell Powder, along with vitamin D3 and magnesium, strengthened their bones by improving bone mineral density. Another study in Dutch, postmenopausal women found that eggshells Powder improved bone mineral density in the neck compared to a placebo.

The Eggshells Membrane Consists of

The eggshells membrane consists of protein collagen and also it contains small amounts of chondroitin sulphate, glucosamine and other nutrients and this eggshell membrane supplements may benefit for your joints.

Disadvantages or Risk to have Eggshell Powder

If the eggshell Powder is not properly processed then it contains Salmonella enteritidies . Which will cause food poisoning.

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CRISPR/Cas9: A Contemporary Gizmo for Genome Editing

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CRISPR/Cas9

CRISPR-Cas9 is an extraordinary innovation that empowers geneticists and clinical scientists to alter portions of the genome by eliminating, including or modifying areas of the DNA sequence. It is right now the easiest, generally adaptable and exact technique for genetic manipulation and is thusly causing a buzz in the science world.

Advantages of CRISPR Genome

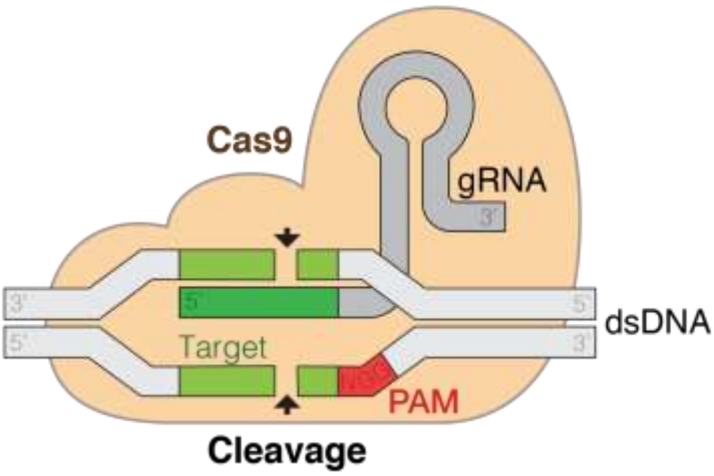
CRISPR/Cas9 over other genome editing innovations is its effortlessness and productivity. Since it very well may be applied legitimately in embryo, CRISPR/Cas9 lessens the time needed to alter target genes contrasted with quality focusing on advances dependent on the utilization of embryonic stem (ES) cells. Improved bioinformatics tools to distinguish the most fitting groupings to configuration manage RNAs and enhancement of the trial conditions empowered exceptionally strong strategies which ensure fruitful presentation of the ideal mutation.

Limitations of the CRISPR/Cas9 System

The molecular mechanism exploited to put in DNA fragments (e.g. cDNAs) is mediated by DNA repair machinery activated by the double strand break introduced by Cas9. Since the scope of the DNA repair system is not to integrate DNA fragments in the genome, targeted alleles often carry additional modifications, such as deletions, partial or multiple integrations of the targeting vector, and even duplications.

Secondary unwanted mutational events at the target locus plague standard ES cell-based projects as well, and researchers have learned how to avoid generating mice carrying passenger mutations. To identify the correct recombination events in ES cells, most laboratories use a combination of positive and negative selection procedures and validation procedures aimed at detecting additional mutations at the target site (Li et al., 2015; Pavlovic et al., 2016).

When performing the CRISPR/Cas9 procedure directly on embryos, on the other hand, it is impossible to select for the desired event, greatly limiting the possibility to identify the desired allele. Moreover, the mosaicism observed in founder mice generated using the CRISPR/Cas9 approach makes the identification of unwanted genomic modifications at the target site very challenging (Yand et al., 2013; Yeng et al., 2014).



CRISPR Performance in the Field

CRISPR/Cas9 in embryos works extremely well for the generation of simple alleles such as constitutive knockout and knock in of point mutations (Pavlovic et al., 2016), but is not the technology of choice for the introduction of more complex modifications relying on homologous recombination over larger regions, such as introduction of paired loxP sites or cDNAs.

Although Taconic Biosciences and others have been successful in introducing complex modifications in the mouse genome using CRISPR/Cas9 in embryos, the complexity of the genome editing and validation procedures for these projects can result in increased timelines and costs, reducing or even cancelling out the intrinsic advantages of the technology (Singh et al., 2015).

Future Applications

To harness the full potential of CRISPR/Cas9 to modify the mouse genome, an intriguing option is to take a step back and use it to genetically engineer ES cells rather than embryos.

The main advantage of using CRISPR/Cas9 in ES cells, compared to the traditional gene targeting approaches, is that Cas9-induced DNA damage increases the frequency of homologous recombination events by many orders of magnitudes. As a consequence, there is no need to identify ES cell clones carrying the modified allele, which streamlines procedures for generating the targeting vector, ES cell screening, and validation.

By isolating clonal populations of cells, it is possible to avoid mosaicism and perform in-depth quality control procedures to verify that the modified allele does not carry any passenger mutations. Since no selection marker cassettes are present in the targeted ES cells, chimaeras derived from the validated clones can be directly used in rapid colony expansion to expedite the generation of mouse models.

Conclusions

CRISPR/Cas9 genome engineering technology has provided researchers with an invaluable tool to accelerate the generation of mouse models for biomedical in vivo research. The furious pace of CRISPR development, combined to its versatility and ease of use, have already left a mark in the field of molecular genetics. Its combination with established technologies will greatly expand opportunities for the generation of new and valuable genetically engineered mouse models for basic and translational research.

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Nanotechnology and its Utilizations in Vegetable and Fruits

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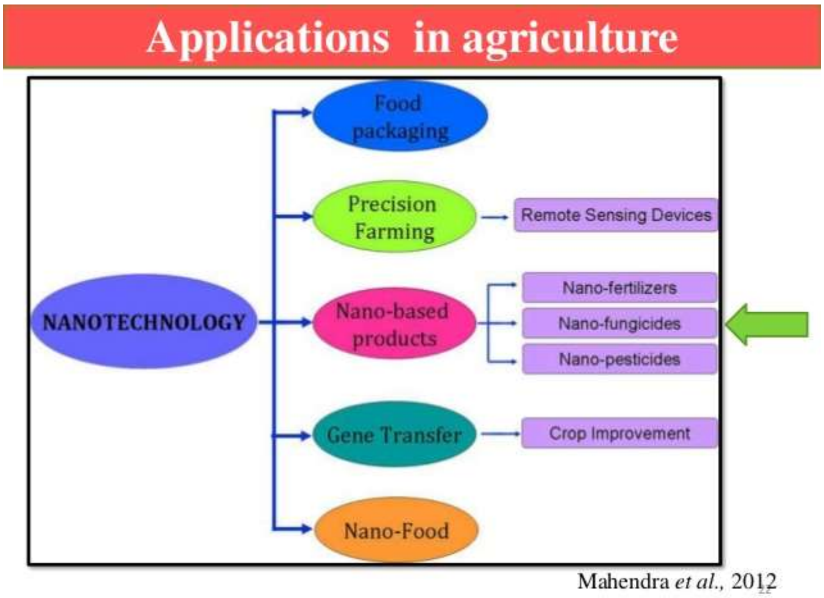
What is Nanotechnology?

The word Nanotechnology was first termed by Taniguchi Tokyo scientist in 1974.Nano means-"very small, minute " and technology means-the application of scientific knowledge for practical purposes. The unique physicochemical properties of nanomaterials, that is, catalytic reactivity, high surface area, size and shape, have the potential to open new paradigms and to introduce new strategies in agriculture. Nanotechnology is a branch of research that has gained much momentum in recent years due to its wide application of its principles and production. The application of nanomaterials in agriculture aims in particular to reduce applications of plant protection products, minimize nutrient losses in fertilization, and increase yields through optimized nutrient management. For a country like India, applications could be in the areas of nano inputs, nanofood systems, nanobiotechnology, and nano remediation, although nanotechnology is likely to overwhelm all spheres of agricultural activities: from tillage to silage, pre-sowing field preparations to post-cooking and food serving, and seed germination to germplasm manipulation.

Why we Need Nanotechnology?

1. To enhance the efficiencies of various practices in agriculture as plant production to plant protection.
2. To increase profit by reducing economics of additives in horticultural crops.
3. Many chemicals which we are using may be banned in the coming future due to their hazardous impact on environment.



Use of Nanotechnology in Horticultural Crops

1. Increasing production efficiency and decreasing post-harvest wastage with using the findings of novel scientific researches such as biotechnology and nanotechnology in products.

2. Nano-ZnO, nano-silicon and nano-$CaCO_3$ were used in post- harvest fruit preservation.

3. Bio-degradable bio-nanocomposites prepared from natural biopolymers such as starch and protein exhibit advantages as a food packaging material by providing enhanced

4. Organoleptic characteristics such as appearance, odour, and flavour (Zhao et al., 2008).

5. Chitosan (Poly b-(1-4)N-acetyl-d-glucosamine), a deacetylated form of chitin, is a natural antimicrobial compound known to reduce postharvest decay of fruit and vegetables (Benhamou, 1996; Mlikota Gabler and Smilanick, 2001; Romanazzi et al. 2002; Liu et al., 2007).

6. Nano molecular silver arrangement decreased the rate of root maladies, thus helps in enhancing the development and soundness of different plants.

7. Nanomaterials enhance the productivity of crops by increasing the efficiency of agricultural inputs to facilitate site-targeted controlled delivery of nutrients, thereby ensuring the minimal use of agri-inputs.

8. Nanotechnology can help us in some grounds, e.g. controlling growth and development of microorganisms, introducing a new generation of packaging and controlling influence of gases and the harmful rays (UV), increasing strength, quality and packaging beauty, and using the multiple chips (Nanobiosensors) for labelling products that considered as fundamental step to automated control of storages.

9. Nanotechnology helps in enhancing shelf life of horticultural crops.

10. For the exploitation of the green nanotechnology, a number of plant species and microorganisms including bacteria, algae and fungi are being currently used for nano particle synthesis. For example, Medicago sativa and Sesbania plant species are used to formulate gold nanoparticles.

11. Herbicides inside nano particles are developed that can be timed- released or have release linked to an environmental trigger.

12. Nano particles Improves germination of horticultural crops: Cañas and co-workers (2008) reported the effects of functionalized single-walled carbon nanotubes (SWCNTs) and non-functionalized SWCNTs on root elongation of six different crop species, such as cabbage, cucumber, carrot, onion, lettuce, and tomato.

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Soil-Less Agriculture: Need Future in India

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Summary

Soilless growing is that unlike soil-based agriculture, where farmers have to use fertilizers to increase crop yield and spray pesticides to keep weeds and pests away, crops grown in a soilless medium are more protected from pests and weeds.

Introduction

India spreads over an area of about 3.28 million sq. km. The mainland of India extends between 8°4′ and 37°6′ N latitude and 68°7′ and 97°25′ E longitude. The Tropic of Cancer 23°30′ N divides India into almost two halves. Also, the total length of the coastline is 7,517 kilometres. The Indian peninsula tapers southwards resulting in the division of the Indian Ocean into two water bodies. They are the Bay of Bengal and the Arabian Sea.

India, being a vast fertile country, situated in the southern-part of Asia. India population in 2020 is estimated to be 1.38 Billion (138 Crores), The live clock shows the closest projection of population of India and its second largest in the world after China Currently population growth rate is 1.13% as on 2017 and expected to rise more than 1.5 billion people by 2030, and is set to reach 1.7 billion by 2050. India has more than 65% of its population below the age of 35 compared to 38 in China Population and 49 in Japan.

Impact of Soil and Soil Fertility

Soil degradation refers to decline in the soil's productivity through adverse changes in nutrient status, soil organic matter, structural attributes, and concentrations of electrolytes and toxic chemicals. Soil degradation is a process, which lowers the current and/or future capacity of the soil to produce goods or services. It has also been defined as the rate of adverse change in soil qualities resulting in decline in productive capacity of land due to processes induced mainly by human intervention.

Thus, it implies a decline in soil's productivity, deterioration in vegetative cover, qualitative and quantitative decline of water resources, degradation of soils, and pollution of air. Degradation is a point of evolution which leads to a reduction of resource potential. About 7.40 m ha arable lands globally turn to degraded lands yearly as result of climate change and deforestation. The problem of soil degradation has been ever since cultivation of soils started. However, it is greatly aggravated in recent decades because of increasing population of India at the rate of about 1.8%, requiring marginal areas to be brought under the plough to meet the growing food demand. Such marginal soils are particularly vulnerable to degradation, further lowering their quality and overall productivity. The present paper provides a brief account of degraded and wastelands, causes, major threats, and management options for combating soil degradation in India.

1. Soil Erosion
2. Salinization and Alkalization
3. Acidity
4. Soil Organic Carbon Losses
5. Nutrient Imbalance
6. Pollution/Contamination by Toxic Substances
7. Soil Sealing and Capping
8. Socio-Economic Impacts and Future Challenges.

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Soilless Agriculture

Soilless agriculture can be defined as growing vegetables in greenhouse systems in solid environments other than soil which is enriched by nutritional solutions.
(OR)

Soilless potting mix might look like soil, but it's actually just a mix of organic matter like peat, wood chips, or coco coir, perlite and/or vermiculite, and often a slow-release fertilizer. There's no inorganic matter like sand, silt, or clay involved, which means that the mix technically isn't soil. When water travels through soil, it takes those nutrients with it to the plant roots. In soilless agriculture, such as hydroponics, we simply deliver these same nutrients that have been pre-mixed into a water reservoir, along with high levels of oxygen, efficiently to the plant roots.

Soilless farming systems, i.e., hydroponics, aquaponics and aeroponics, have many advantages that are bound to appeal to farmers, agronomists and consumers. A quick overview of these systems. Certain forms of horticulture, unlike in-ground crops, are soilless. These systems can be used to grow plants at home, as well as on a more commercial scale, and are suitable for various vegetables (leafy vegetables, tomatoes, etc.), fruit (mainly strawberries), aromatic herbs and ornamental plants.

Three Methods

In hydroponics, the plants grow on a neutral, solid and inert substrate. This can include materials such as clay balls, sand or even rockwool. A nutrient-enriched aqueous solution provides the plants with the water, oxygen and minerals they need to grow.

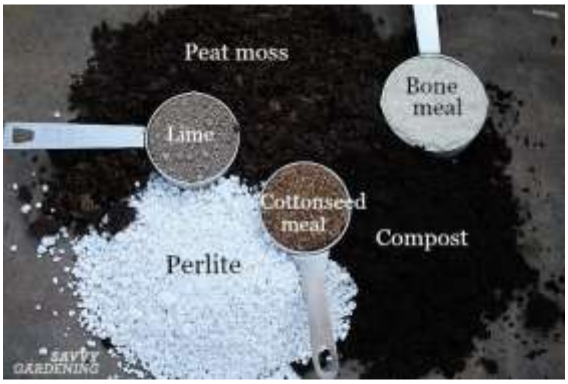
Aeroponics is different from hydroponics in that it uses no substrate. The nutrient solution is permanently and directly sprayed onto the plants’ roots.

You don’t need a large space for these techniques and the infrastructure is relatively light (geotextile pots, bags, gutters etc.). That is why these methods work so well in urban spaces, including in gardens, on roofs, on balconies and façades.

Aquaponics, finally, refers to the combination of hydroponics and aquaculture (fish farming). When combined, these two techniques become complementary, allowing farmers to establish a loop that is almost closed, producing fish and plants.

What Is Soilless Potting Mix and Why is it so Important?

In principle the soilless medium is a substrate that is part of an artificial system of cultivation in which plants are grown without soil. The medium provides plants with physical support, regulates the water flow, serves as reservoir of nutrients and permits gas exchange to and from the roots.



What is a Soilless Mix?

Gardening with soilless potting mix does not include the use of soil. Instead, plants are grown in a variety of organic and inorganic materials. Using these materials rather than soil allows gardeners to grow healthier plants without the threat of soil-borne diseases. Plants grown in soilless mixes are also less likely to be bothered by pests.

Types of Soilless Growing Mediums

Some of the most common soilless growing mediums include peat moss, perlite, vermiculite, and sand. Generally, these mediums are mixed together rather than used alone, as each usually provides its own function. Fertilizers are also commonly added to the mix, providing important nutrients. Sphagnum peat moss has a coarse texture but is lightweight and sterile. It promotes adequate aeration and holds water well. However, it's usually difficult to moisten on its own and is best used with other mediums. This growing medium is ideal for germinating seeds. Perlite is a form of expanded volcanic rock and is usually white in colour. It provides good drainage, is lightweight, and holds air. Perlite should also be mixed with other mediums like peat moss since it does not retain water and will float to the top when plants are watered. Vermiculite is often used with or instead of perlite. This particular form of mica is more compact and, unlike perlite, does well at helping to retain water. On the other hand, vermiculite does not provide as good aeration as does the perlite. Coarse sand is another medium used in soilless mixes. Sand improves drainage and aeration but doesn't retain water. In addition to these common mediums, other materials, such as bark and coconut coir, can be used. Bark is often added to improve drainage and promote air circulation. Depending on the type, it is reasonably lightweight. Coconut coir is similar to peat moss and works much the same way, only with less mess.

Benefits of Soilless Systems

Soilless systems are especially interesting when the arable land is polluted, as is often the case with urban and peri-urban soil. These systems can also be useful in geographical areas where the soil is not fertile or there is no access to soil. Moreover, these systems require less water than soil-based cultivation, which helps preserve this valuable resource. The installation of such systems is also an option in areas with limited access to water resources. A third important advantage is that these systems generate a higher yield compared with traditional agriculture. According to the FAO, the vegetable yield of soilless systems is 20 to 25% higher than in traditional systems, because the former confine the roots in smaller spaces, which means the number of plants per square metre is higher.

Success Story: Sustainable Farming

Traditional soil-based farming has many problems. Farmland is getting increasingly fragmented [as families expand, successive generations own less land per person]. Land is also getting infertile due to the heavy use of fertilizers, and climate change is having its own adverse effets. Soilless farming, on the other hand, uses just 10% of water as compared to the traditional method, says Mr. Yelmalle. There is no drainage of water or fertilizers into the ground, and all the nutrients are re-circulated within the system. Mr. Yelmalle says soilless farming gives a higher yield as all the parameters such as pH nutrient concentration and water temperature are controlled within the required levels. The produce in soilless farming is also more uniform.

As for the costs involved, he says, "Hydroponics [providing crops synthetic nutrients in the right quantity and combination for the highest yield] is very technical and scientific and requires a very high investment. It is more suitable for urban areas and rich farmers who can afford to employ skilled manpower. Aquaponics, where fish and vegetables are grown together, is a more organic method; after the initial training, a farmer can work it out on his own. The cost of inputs could be reduced drastically with innovation." A kitchen garden made with recycled material works out to a few thousand rupees, while the cost of a commercial farm runs into a few lakhs.

Further, these technologies require minimal use of nutrients and no pesticides, thereby reducing input costs and giving pesticide-free produce, which has a premium in the market in terms of pricing as well as demand. The technologies also reduce the incidence of crop failures due to drought, thanks to the minimal use of water and inspect or pest attack due to the use of protected growing environment such as shade net, greenhouse, etc.

The Concept

In hydroponic farming, crops are given synthetic nutrients calculated to meet their requirement. In aquaponics, fish and plants are grown together with the single input of fish feed. Fish are reared in tanks and the water is circulated to vegetable roots. All other nutrients required for plant growth are provided by the fish excreta.

The Advantages

Vertical farming: utilising scarce land in cities to get a greater higher yield per sq ft Eco-friendly: Urban farms have a smaller carbon footprint as produce is grown locally.

Potential Drawbacks

1. High cost (i.e. initial capital cost, cost to run, and 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.

Conclusion

Soilless farming systems, i.e., hydroponics, aquaponics and aeroponics, have many advantages that are bound to appeal to farmers, agronomists and consumers. A quick overview of these systems. Certain forms of horticulture, unlike in-ground crops, are soilless. These systems can be used to grow plants at home, as well as on a more commercial scale, and are suitable for various vegetables (leafy vegetables, tomatoes, etc.), fruit (mainly strawberries), aromatic herbs and ornamental plants.

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Bio Fortification

Article ID: 32099

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Introduction

Bio fortification is the process of adding nutritional value to the crop. It refers to nutrient enrichment of crops to address the negative economic and health consequences of vitamin and mineral deficiencies in humans. The term "hidden hunger" has been used to describe the micronutrient malnutrition inherent in human diets that are adequate in calories but lack vitamins and/or mineral elements. The diets of a large proportion of the world's population are deficient in Fe, Zn, Ca, Mg, Cu, Se, which affects human health and longevity and therefore national economies. For this reason, the biofortification of crops through the application of mineral fertilizers, combined with breeding varieties with an increased ability to acquire mineral elements, has been advocated.

Need of Bio-Fortification

1. The world population was continuously increasing; suffer from lack of food, so that fighting hunger continues to be a challenge for humanity.
2. On the other hand, the world health organisation estimates that, worldwide, 1.5 billion people are overweight (WHO 2011).
3. Increasingly these two forms of malnutrition, underweight and overweight are occurring simultaneously with in the countries.
4. Vitamin A deficiency (VAD) is an important health concern in developing countries among children and women of childbearing age and is estimated to account for > 600,000 deaths each year globally among children <5 years of age.
5. According to Government of India statistics provided to the World Health Organization (WHO) 62% of all preschool-age children are VAD.
6. Iron (Fe), zinc (Zn), and selenium (Se) deficiencies are serious public health issues and important soil constraints to crop production, particularly in the developing countries.

Methods of Biofortification

1. Conventional Plant Breeding: Orange-fleshed sweet potatoes (OFSP) promoted through the Harvest Plus program in Africa, have been successfully selected and developed for both nutrient and (at least rainy season) yield traits (Unnevehr et al. 2007).

2. Mutation Breeding: Mutation breeding has been used extensively in developed and developing countries to develop grain varieties with improved grain quality and in some cases higher yield and other traits. This technique makes use of the greater genetic variability that can be created by inducing mutations with chemical treatments or irradiation. Varieties produced using mutagenesis can be grown and certified as organic crops in the United States, whereas transgenic crops developed using recombinant DNA (rDNA) technology cannot.

3. Agronomic Bio fortification: Application of fertilizers to increase the micronutrients in edible parts. The degree of success in agronomic bio fortification is proportional to the mobility of mineral element in the soil as well as in the plant (White and Broadley 2003). Most suitable micronutrients for agronomic bio fortification Zinc, (foliar applications of Znso4), Iodine (Soil application of iodide or iodate), Selenium(as selenate).

4. Molecular Breeding: Also called marker-assisted breeding, this is a powerful tool of modern biotechnology that encounters little cultural or regulatory resistance and has been embraced so far even by organic growers because it relies on biological breeding processes rather than engineered gene insertions to change the DNA of plants. The use of molecular breeding has increased dramatically both by private seed companies and government plant breeders in developed countries, and it is gradually spreading to developing countries (Pray 2006).

5. Genetic Engineering: Genetic engineering is the latest weapon in the armoury against mineral deficiency and uses advanced biotechnology techniques to introduce genes directly into breeding varieties. The genes can come from any source (including animals and microbes) and are designed to achieve one or more of the following goals (Zhu et al., 2007):

a. Improve the efficiency with which minerals are mobilized in the soil.
b. Reduce the level of anti- nutritional compounds.
c. Increase the level of nutritional enhancer compounds such as inulin.

Examples

1. Orange sweet potato (OSP): To increase targeted level of 30 ppm of provitamin A in sweet potato, International Potato Centre (CIP) in south Africa and Uganda (Harvest plus) + National agriculture Research and Extension System (NARES) started project in 2002-2007 and the first variety released in 2002. This variety have ability to grater provitamin A retention more than 80% after boiling or steaming and at least 75% after solar or sun drying but also high yielding and drought tolerant.

2. Bio Cassava: Project on Bio Cassava Plus initiative started in 2009 by Donald Danforth Plant Science Center to target Nigeria, Kenya with 6 major objectives namely to increase the minerals zinc and iron, vitamins A and E, protein contents and decrease cyanogen content, delay postharvest deterioration, and develop virus-resistant varieties. The scientists of Nigeria have developed three new yellow colour varieties of cassava by hybridization and selective breeding methods. The se varieties can produce higher amount of beta-carotene which helps to fight against vitamin A malnourishment in the region and release of the varieties will be in 2017.

3. Potato: CIP (International centre for potato) started project on development of Fe rich potatoes by conventional bio fortification method in 2009 and the varieties will be release in 2017. Cow pea Pioneer research on biofortifcation of cow pea has initiated G.B. Pant University of Agriculture and Technology, Pantnagar, India. Two early maturing high iron and zinc fortified varieties namely Pant Lobia-1 (82ppm Fe and 40ppm Zn), Pant Lobia-2(100ppm Fe and 37 ppm Zn) has been developed by conventional plant breeding and released in 2008 and 2010. Pant Lobia-3 (67 ppm Fe and 38 ppm Zn), Pant Lobia-4(51ppm Fe and 36 ppm Zn) released in 2013 and 2014 respectively. Brazil also released three varieties of high-iron cowpeas, developed by Embrapa, in 2008 and 2009 and bio availability.

4. Nutri banana: Breeding banana/plantain (Musa) is complex, as commercial varieties are sterile triploids (3X). Among the fertile groups, a high degree of cross incompatibility can exist. Further, the Musa crop cycle is long. Genetic engineering method of bio fortification is suitable for banana because most of the edible bananas are vegetative propagated and transgene outflow are minimum and therefore genetically modified bananas can be grown alongside non-GM bananas in the same field. Also, since the GM bananas are sterile, the existing diversity of bananas in India will not be affected and there won't be any heritable mixing of GM and non-GM cultivars in nature. Unfortified bananas have 0.4 mg/100 gm Fe of banana while the fortified banana would supplement this to 2.6 mg/ 100grams

5. Beans: Iron (Fe) content in common bean is about 50 parts per million (ppm) and target in bio fortification of bean by conventional breeding is 94 ppm, bio fortified beans provide about 60% of the Estimated Average Requirement (EAR). Average bean yields in Rwanda. Non-bio fortified beans produce approximately 0.8 tons/hectare (bush and climbers combined) but bio fortified bush beans yield around 1.5 t/ha and biofortified climber beans 2–3 t/ha.

Conclusion

Bio fortified crops, either by conventional breeding methods or by modern biotechnological tools, are not a solution for malnourishment. The ultimate aim in global nutrition remains a sufficient and diverse diet for the world's population. However, bio fortified crops can complement existing micronutrients interventions; can have a significant impact on the lives and health of millions of people, especially those most in need.

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Fortenza Duo (Cyantraniliprole + Thiamethoxam)

Article ID: 320100

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It is a next-generation seed treatment insecticide that delivers long-lasting insect control both above and below the ground. Applied as a seed treatment and is quickly taken up by the roots and moves upward in the plant through the xylem system, controlling a broad range of above ground insects. The product is also distributed into the soil around the root zone forming a bulb of protection against below ground insects. It is a soil systemic product. Insects are controlled mainly by ingestion but some contact activity can also be observed. FORTENZA Duo provides excellent crop protection resulting from a rapid feeding inhibition and long-lasting residual effect. Dual mode of action with no known cross-resistance. Strong root uptake and highly systemic in the xylem. Complements insect traits and improves yield potential. Help manage insect resistance to chemicals and GM traits. Liquid formulations that are specifically designed for seed treatment. Safe to seeds, rhizobium, selective for beneficial arthropods. Efficient movement around and within the plant.

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Genetically Modified Crops: Issues and Challenges

Article ID: 32101

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Introduction

The issues relating to the Genetically Modified Foods have generated intense public debate in many parts of the world. Even though the issues under debate include the costs and benefits of the GM crops and the inherent safety concerns, the outcome of the debate differs from country to country, depending on its geographical location, strength and resilience of the farm sector, attitudes of people towards food, and so on.

In India also, this debate has engaged the attention not only of the Government but also of the farming community and the civil society. Though, it is widely claimed that biotechnology, particularly genetically engineered food offers dramatic promise for meeting some of the 21st century's greatest challenges; like all new technologies, it also poses certain apprehensions and risks, both known and unknown. It is, therefore, paramount in this context, to know the basic processes involved in genetic modification for proper appreciation of the related issues and challenges.

Genetically Modified Organisms (GMOs)

Genetically Modified Organisms, are the ones in which the genetic material (DNA) has been altered in such a way as to get the required quality. This technology is often called 'gene technology', or 'recombinant DNA technology' or 'genetic engineering' and the resulting organism is said to be 'genetically modified', 'genetically engineered' or 'transgenic'. GM products (current or those in development) include medicines and vaccines, foods and food ingredients, feeds and fibre etc.

GM Crops / Food—Relevant Issues

1. Commercial venture: The first commercially grown GM fo5od crop was Tomato (called Flavr Savr), modified to ripen without softening by a Californian company Calgene, which took the initiative to obtain approval for its release in 1994. Currently, a number of food crops such as soybean, corn, cotton, tomatoes, Hawaiian papaya, potatoes, rapeseed (canola), sugarcane, sugar beet, field corn as well as sweet corn and rice have been genetically modified to enhance either their yield, or size, or durability, etc. Scientists are also working on crops which they hope will be useful for industry, such as plants that produce oil for the cosmetics industry, crops with altered nutritional value, and even crops that produce pharmaceutical drugs. Major producers of transgenic crops include USA, Argentina, Brazil, India, Canada, China, Paraguay, South Africa, among others.

2. Issues of crop protection: The initial objective for developing GM plants was to improve crop protection. The GM crops currently in the market are mainly aimed at an increased level of crop protection through the use of one of the three basic traits:

a. Resistance to insect damage.
b. Resistance to viral infections.
c. Tolerance towards herbicides.

All the genes used to modify crops so far are derived from micro-organisms.
1. Insect resistance is achieved by incorporating into the food plant the gene for toxin production from the bacterium *Bacillus thuringiensis* (Bt). This toxin is used as a conventional insecticide in agriculture and is safe for human consumption. GM crops that permanently produce this toxin have been shown to require lower quantities of insecticides.

2. Virus resistance is achieved through the introduction of a gene from certain viruses which cause disease in plants. Virus resistance makes plants less susceptible to diseases caused by such viruses, resulting in higher crop yields.

3. Herbicide tolerance is achieved through the introduction of a gene from a bacterium conveying resistance to some herbicides. In situations where weed pressure is high, the use of such crops has resulted in a reduction in the quantity of the herbicides used.

Risks and Benefits

The risk-benefit analysis of the GM crops can be summarized as below:

Benefits	• Improved resistance to diseases, pests and herbicides. • Improved tolerance to cold/heat. • Improved tolerance to drought/salinity. • Reduced maturation time. • Increased nutrients, yields, quality and stress tolerance. • Food with greater shelf life or food with medicinal benefits, such as edible vaccines—for example, bananas with bacterial or rotavirus antigens. • Increased food security for growing population
Issues of concern (Human health risks and environmental safety concerns)	• Potential impact on human health including allergens, transfer of antibiotic resistance markers and 'outcrossing'. • The movement of genes from GM plants into conventional crops or related species in the wild (referred to as 'outcrossing'), as well as the mixing of crops derived from conventional seeds with those grown using GM seeds, may have an indirect effect on food safety and food security. It has been found that genes inserted into GM food survive digestive processes and are transferred into the human gut. • Potential impact on environment, including transfer of transgenes through cross-pollination, unknown effects on other organisms (e.g., soil microbes), and loss of flora and fauna biodiversity.

Some Other Concerns

Critics of genetically modified food have also pointed out certain other aspects apart from human health risks and environmental safety concerns. These are:

Access and Intellectual Property Rights	• Critics claim that patent laws give developers of the GM crops a dangerous degree of control over the food supply. • Domination of world food production by a few companies. • Increasing dependence of developing countries on industrialized nations. • Biopiracy, or foreign exploitation of natural resources.
Ethical concerns	• Violation of natural organisms' intrinsic values by mixing among species. • Objections to consuming animal genes in plants.

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Invasive Alien Species and Causes of their Invasion

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Exotic Species / Alien Species

Exotic species are organisms (plants, animals, and microorganisms) that are not native to a particular region. The impact of exotic pests varies considerably depending on the species and the area being invaded. The exotic species can be intentionally introduced or may come in accidentally. Some species are able to rapidly colonize an area and become serious pests, often because they are no longer under control of predators or diseases that limited their numbers in their native habitat. Species that rapidly colonize an area are often called exotic invasive.

Once established, invasive species are extremely difficult to eradicate and can cause not only ecological disruption, but economic problems as well.

The introduction of an exotic insect into a new region away from its natural enemies may have disastrous results. Many of the insect pests that attack our forests, fields, and livestock are natives of other countries. These imported species may have profound effects on the environment by competing with native species, decreasing biological diversity, reducing crop yields, modifying habitat, or spreading disease pathogens.

Conditions that Lead to Invasion

Scientists include species- and ecosystem factors among the mechanisms, that when combined establish invasiveness in a newly introduced species.

1. Species-based mechanisms: While all species compete to survive, invasive species appear to have specific traits or specific combinations of traits that allow them to outcompete native species. In some cases, the competition is about rates of growth and reproduction. In other cases, species interact with each other more directly. Researchers disagree about the usefulness of traits as invasiveness markers. One study found that of a list of invasive and non-invasive species, 86% of the invasive species could be identified from the traits alone. Another study found invasive species tended only to have a small subset of the presumed traits, and that many such traits were found in non-invasive species, requiring other explanations. Common invasive species traits include:

a. Fast growth.
b. Rapid reproduction.
c. High dispersal ability.
d. Phenotypic plasticity (the ability to alter growth form to suit current conditions).
e. Tolerance of a wide range of environmental conditions (Ecological competence).
f. Ability to live off of a wide range of food types (generalist).
g. Association with humans.
h. Prior successful invasions.

Typically, an introduced species must survive at low population densities before it becomes invasive in a new location. At low population densities, it can be difficult for the introduced species to reproduce and maintain itself in a new location, so a species might reach a location multiple times before it becomes established. Repeated patterns of human movement, such as ships sailing to and from ports or cars driving up and down highways, offer repeated opportunities for establishment (also known as a high propagule pressure). An introduced species might become invasive if it can out compete native species for resources, such as nutrients, light, physical space, water or food. If these species evolved under great competition or predation, the new environment may host fewer able competitors, allowing the invader to proliferate quickly. Ecosystems in which all available resources are being used to their fullest capacity by native species can be modelled as zero-sum systems, where any gain for the invader is a loss for the native. However, such unilateral competitive superiority (and extinction of native species with increased populations of the invader) is not the rule. Invasive species often coexist with native species for an extended time, and gradually the superior competitive ability of an invasive species becomes apparent as its population grows larger and denser and it adapts to its new location. An invasive species might be able to use resources previously unavailable to native species, such as deep-water sources accessed by a long taproot, or an ability to live on previously uninhabited soil types. For example, barbed goatgrass *(Aegilops triuncialis)* was introduced to California on serpentine soils, which have low water-retention, low nutrient levels, a high Magnesium/Calcium ratio, and possible heavy metal toxicity. Plant populations on these soils tend to show low density, but goat grass can form dense stands on these soils, crowding out native species that have not adapted well to serpentine soils.

2. Ecosystem-based mechanisms: In ecosystems, the amount of available resources and the extent to which those resources are used by organisms determines the effects of additional species on the ecosystem. In stable ecosystems, equilibrium exists in the use of available resources. These mechanisms describe a situation in which the ecosystem has suffered a disturbance which changes the fundamental nature of the ecosystem. When changes such as a forest fire occur, normal succession favours native grasses and forbs. An introduced species that can spread faster than natives can use resources that would have been available to native species, squeezing them out. Nitrogen and phosphorus are often the limiting factors in these situations.

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Germplasm to Genome Engineering

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Genetic engineering is the future of Agriculture and Livelihood

Introduction

Plant genetic resources (PGR) are reproductive or vegetative propagating material of cultivated varieties, obsolete varieties, wild relatives, wild species and special genetic stocks (elite breeding lines, mutants or transgenic lines) (FAO, 1983). PGR according to the Convention for Biological Diversity are genetic materials of actual and potential values (CBD, 1992). Occasionally, DNA fragments, RNA and genes are also included under the purview of genetic resources. So, PGRs are ultimate source of genetic diversity that provides valuable traits needed to meet the challenges of developing new varieties and hence to ensure food security.

Agriculture today is faced with many challenges such as climate change, land degradation, increasing human population, genetic diversity loss and growing food insecurity. Although, conventional breeding methodologies continues to contribute to yield improvement in majority of crops but future of food security will increasingly rely upon a more extensive utilization of plant genetic resources through modern genomics and biotechnology tools.

Recent advances in gene and genome engineering technologies are sparking a new revolution in agricultural research. Broadly, genome engineering refers to the process of making targeted and precise modifications in the genome, its contexts (e.g., epigenetic marks), or its outputs (e.g., transcripts). CRISPR mediated editing technologies of genome have huge potential of transforming modern agriculture. Researchers can now directly edit or manipulate the function of gene(s) in their endogenous context in virtually any organism of choice. It helps researchers to dissect the genome function at the systems level, as well as identify causal genetic variations associated with variations. These gene editing technologies allow genetic material to be added, removed, or altered at desired and specific locations in the genome. Of the current generation of genome editing technologies, the most rapidly developing and recent one is the class of RNA-guided endonucleases known as CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats-Cas9) from the microbial adaptive immune system i.e., adapted from a naturally occurring genome editing system in bacteria. In addition, CRISPR is being heavily used for advancing our fundamental understanding of plant biology. Great hopes are pinned on the precision and speed of genome editing particularly on potential of CRISPR to complement or substitute GM trait with non-GM trait. Integration of conventional breeding techniques with genomics assisted breeding, genetic and genome engineering tool such as CRISPR-Cas system is the way forward to develop high yielding climate smart crops and meet nutrition need for feeding the world in 21st century.

Applications and Implications in Plant Breeding

Plants are ultimate source of food, animal feed, medicines, chemicals, renewable materials and biofuels. The domestication of plants has involved the development of strategies to improve the performance of crops and tailor their properties. Conventional breeding relies on existing natural genetic variation and extensive back-crossing programs to introgressive the selected traits into an elite background. The availability of useful alleles in nature therefore limits the progress made through conventional breeding. New alleles can be introduced by random mutagenesis, but this must be followed by the time-consuming screening of large populations to identify mutants with desirable properties. Genome editing technologies have shown a great promise to accelerate plant breeding by allowing the introduction of precise and predictable modifications directly in an elite background, and the CRISPR/Cas9 system is faster, cheaper, precise and highly efficient in editing genomes and particularly beneficial because multiple traits can be targeted simultaneously (Wang M. et al., 2018). Presently, CRISPR-Cas9 is also being used to produce site specific mutagenesis or targeted transcriptional regulation in various crops.

CRISPR/Cas9 technologies have been used to target the genes of the mildew resistance locus (MLO) in wheat and successfully knocked out all three MLO homoalleles, producing plants resistant to powdery mildew disease. CRISPR-Cas also allow targeted molecular trait stacking, i.e., the addition of several genes in close vicinity to an existing transgenic locus. This makes it feasible to introduce multiple traits into crops with a low risk of segregation, which is difficult to achieve by classical breeding or even conventional genetic engineering. Once stacking has been achieved, the entire array of transgenes can be mobilized into another germplasm by crossing because it behaves as a single locus.

To improve crop yield in the changing climate, researchers are looking for ways to engineer plants to generate climate resilient crops. By using CRISPR/Cas9 technology, a group of scientists at Cold Spring Harbour Laboratory (CSHL) precisely engineered the promoter sequence of genes that control quantitative traits in tomato and have generated a wide range of new alleles that improved fruit shape, size as well as plant architecture (Rodríguez-Leal et al., 2017). In rice, Xu et al. (2016) simultaneously mutated three genes (GW2, GW5, TGW6) in rice, and achieved increase in seed size significantly (up to 30% in triple mutants) and similar effort has been made by Wang et al. (2018) to increase seed size in wheat by targeting all homeologs of TaGW2 gene. Similarly, transgene-free low-gluten wheat has recently been engineered with CRISPR/Cas9 by Sánchez-León et al. (2018). Phytoene desaturase genes, RAS-PDS1 and RAS-PDS2 were recently mutated by the application of CRISPR/Cas9 with a 59% success rate in bananas (Kaur et al., 2018).These success stories indicate that CRISPR/Cas9 has high promise for the improvement of various traits of crop plants to finally ensure food security.

Although the specificity of the CRISPR/Cas9 technology remains to be investigated in detail, it is already clear that the frequency of off-target mutations is well below that caused by chemical and physical mutagenesis techniques. Indeed, the use of site-specific nucleases could remove much of the regulatory burden associated with transgenic plants by addressing one of the main causes of concern, namely, the random integration of transgenes and the resulting potential for unintended effects such as disrupting host metabolism and/or producing toxic or allergenic compounds. The complex regulatory process and the requirement for time-consuming and expensive safety analysis have resulted in a de facto moratorium on the development and commercial release of transgenic plants with the exception of large companies that have the resources to fund long development programs. The potential to introduce transgenes at a specific and predetermined chromosomal position using site specific nucleases should all but eliminate the risk of such unpredictable events.

Morever, the CRISPR/Cas9-mediated genome editing technology has also opened a new opportunity for rapid development of disease resistant crop varieties by either stacking of disease resistant (R) gene(s) or disruption/deletion of susceptibility (S) genes. Wang and colleagues targeted the rice OsERF922 gene and developed mutagenized rice lines possessing enhanced blast resistance using CRISPR/Cas9 technology (Wang et al., 2016). Similarly, knockout of rice bacterial blight susceptibility genes, OsSWEET11 and OsSWEET14 and fungal pathogen *Magnaporthe oryzae* OsSEC3A gene using CRISPR/Cas9 has been achieved (Jiang et al., 2013 and Ma et al. 2017).

Conclusions

One further application of CRISPR/Cas9 that is likely to expand in the future is the targeted insertion of transgenes in the fields of metabolic engineering and molecular farming, where plants or plant cells are used as factories for the production of specific metabolites or proteins. Further, the availability of the CRISPR/Cas9 technology will facilitate both forward and reverse genetics and will enhance basic research. It will allow the growing amount of genomic and systems biology data to be exploited more comprehensively, speeding up both gene discovery and trait development in many plant species. Together with well-defined and programmable DNA parts, plant genome engineering has great potential to facilitate ambitious synthetic biology projects, including introducing nitrogen fixation into cereals and improving the photosynthetic capacity of rice. To date, the primary application has been the creations of gene knockouts. Indeed, successful development of tools for targeted gene modification and genome editing holds significant promise for advancing fundamental knowledge of plant biology as well as for creating crop plants with valuable new agronomic, nutritional and novel traits for the benefit of stakeholders.

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Biparental QTLs Mapping Approach: A Boon for Plant Breeding

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Introduction

A QTL is defined as "a region of the genome that is associated with variation of a quantitative trait." So, a QTL can be a single gene, or it may be a cluster of linked genes that together affect the traits.

Thrust Areas of QTLs Mapping

1. To identify region of genome that affect trait of interest.
2. To analyse effect of QTL on trait of interest.
    a. How much variation in the trait is caused by a specific region?
    b. What is gene action associated with QTL?
    c. Which allele is associated with favourable effect?

Principles Behind QTL Mapping

QTL analysis is based on the principle of detecting an association between phenotype and the genotype of markers. The markers are used to partition the mapping population in to different genotypic classes based on genotypes at the marker locus, and apply the correlative statistics to determine whether the individual of one genotype differ significantly with the individuals of other genotype with respect to the trait under study. A significant difference between phenotypic means of the two / more groups depending on the marker system and type of population indicates that the marker locus being used to partition the mapping population is linked to a QTL controlling the trait.

QTL Mapping Steps

The process of QTL mapping involves the four major steps:

1. Development of mapping population: A suitable mapping population generated from crossing phenotypically contrasting/ divergent parents is prerequisite for QTL mapping. The mapping population could vary based on the objective of study, the time frame line and resources available for undertaking QTL mapping. The ability to detect QTL in F2 or F2 derived populations and RILs are relatively higher than other mapping populations. The F2:3 families have additional advantage of measuring the effects of additive and dominant gene actions at specific loci. The RILs are essentially homozygous and only additive gene action can be measured, the advantage with RILs is that the experiments can be performed at several locations in multiple years.

2. Generating saturated linkage map: Linkage map indicates the position and relative genetic distance between markers along the length of chromosomes. Segregation patterns for each of the markers are analyzed by screening the mapping population using polymorphic molecular markers, which is referred as genotyping.

3. Phenotyping of mapping population: The target quantitative traits have to be measures as precisely as possible. The data is pooled over location and replication to obtain a single quantitative value. It is also necessary to measure the target traits in experiments conducted in multiple locations to have better understanding of the QTL x Environment interaction.

4. QTL detection using statistical tools: The tests for QTL or trait association are often performed by the following approaches.

SMA (Single Marker Analysis) / SF-ANOVA

The advantages of single marker analysis include:

1. It is the simplest method of QTL detection.
2. Analysis can be performed using basic statistical software.
3. Analysis does not require a complete linkage map.

The limitations of Single Marker Analysis:

1. The farther a marker is from a QTL, the more difficult the QTL is to detect, due to recombination between the marker and QTL.
2. QTL effects may be underestimated due to recombination between the marker and QTL.

The major disadvantage is that the farther QTL is from a marker, the less likely it will be detected. This is because recombination may occur between the marker and the QTL. The effect of QTLs is likely to be underestimated because these are confounded recombination frequencies. These limitations may be overcome by using a large number of molecular markers spread throughout the genome.

Simple Interval Mapping (SIM)

SIM method makes use of linkage maps and analysis intervals between adjacent pairs of linked markers along the chromosomes, simultaneously, instead of analysing single marker. Presence of a putative QTL is estimated if the logarithm of odds ratios (LOD) exceeds a critical threshold which is more often fixed as ≥3. The use of linked markers for analysis compensates for recombination between the marker and the QTL, and is considered statistically more powerful than SMA. However, when multiple QTLs are segregating in a cross, SIM fails to take into account genetic variance caused by other QTLs.

In the single-factor ANOVA method, the presence of a QTL is tested only at marker positions, which may be 20 cm or more apart on the chromosome map. QTL positions and effects are therefore determined imprecisely. Simple interval mapping (SIM) is an improvement because it tests for QTL presence every 2 cm between each pair of adjacent markers. Thus, the most likely position of a QTL and the size of its effects are estimated more accurately than with single-factor analysis. At each test position, the SIM method calculates a LOD score, which indicates the probability that a QTL is present at that position. LOD scores are plotted along the chromosome map, and those that exceed a threshold significance level suggest the presence of a QTL in that chromosome region. The most likely QTL position is interpreted to be the point where the peak LOD score occurs.

The following information is obtained from the SIM method of QTL detection.

1. Estimate of QTL position, typically tested every 2 cm, but this can be adjusted by the user.
2. Measure of statistical significance: LOD score or likelihood ratio.
3. Percent variance explained (%R2).
4. Source of desirable alleles (Parent A or Parent B).
5. Estimates of additive and dominance effects.

Limitations of Simple Interval Mapping:

1. It requires that a linkage map be constructed first, using Mapmaker.
2. It requires specialized QTL analysis software.
3. The indicated positions of QTLs are sometimes ambiguous, or influenced by other QTLs.
4. It can be difficult to separate effects of linked QTLs.

Composite Interval Mapping (CIM)

To overcome some of the shortcomings of SIM, composite interval mapping (CIM) was developed. The basis of this method is an interval test that attempts to separate and isolate individual QTL effects by combining interval mapping with multiple regressions. It controls for genetic variation in other regions of the genome, thus reducing background “noise” that can affect QTL detection. To control background variation, the analysis software incorporates into the model 'cofactors', a set of markers that are significantly associated with the trait and may be located anywhere in the genome. They are typically identified by forward or backward stepwise regression, with user input to determine the number of cofactors and other characteristics of the analysis.

Information obtained from Composite Interval Mapping (CIM):

The following information is obtained from the CIM method of QTL detection. Many of these are similar to the results described previously for single-factor ANOVA.

1. Estimate of QTL position, typically tested every 2 cM, but this can be adjusted by the user. Because of the use of cofactors to reduce background noise, QTL positions are estimated more accurately than with SIM.
2. Measure of statistical significance: LOD score or likelihood ratio.
3. Percent variance explained (%R2).
4. Source of desirable alleles (Parent A or Parent B).
5. Estimates of additive and dominance effects.

Limitations of Composite Interval Mapping:

1. It requires that a linkage map to be constructed first.
2. Using it requires specialized QTL analysis software.
3. Because of the intensive computations involved, CIM can be slow, especially on older computers, requiring an hour or more to complete a genome-wide analysis.

The advantages of CIM are as follows:

1. Mapping of multiple QTLs in one dimension.
2. By using linked markers as cofactors, the test is not affected by QTL outside region so increased precision of QTL mapping.
3. Eliminate genetic variance by other QTL so increased power of QTL detection.

However, CIM is highly dependent on background markers and permutation is slow.

Multiple Interval Mapping (MIM)

It is the extension of interval mapping to multiple QTLs; just as multiple regression extends analysis of variance. MIM allows one to infer the location of QTLs to position between markers makes proper allowance for missing genotype data and can allow interaction between QTLs.

Software for QTL analysis:

MAPMAKER/QTL, QGene, MapQTL, PLABQTL, MQTL, MapManager, QTL Cartographer, QTLMapper, QTLNetwork etc.

1. QTL information: Utility and prospects.
2. Genotype building/QTL pyramiding.
3. QTL introgression.
4. Finding superior genotypes – choice of genotypes in hybrid breeding.
5. MARS.
6. Understanding basic mechanisms.

Advanced Backcross QTL (AB-QTL) Analysis

Advanced backcross QTL analysis is proposed as a method of combining QTL analysis with variety development. It is tailored for the discovery and transfer of valuable QTL alleles from unadopted donor lines (e.g., land races, wild species) into established elite inbred lines. Following this strategy, QTL analysis is delayed until the BC2 or BC3 generation and, during the development of these populations, negative selection is exercised to reduce the frequency of deleterious donor alleles. Simulations suggest that advanced backcross QTL analysis will be effective in detecting additive, dominant, partially dominant, or over dominant QTLs. Epistatic QTLs or QTLs with gene actions ranging from recessive to additive will be detected with less power than in selfing generations. QTL-NILs can be derived from advanced backcross populations in one or two additional generations and utilized to verify QTL activity. These same QTL-NILs also represent commercial inbreeds improved (over the original recurrent inbred line) for one or more quantitative traits. The time lapse from QTL discovery to construction and testing of improved QTL-NILs is minimal (1-2 years). If successfully employed, advanced backcross QTL analysis can open the door to exploit unadopted and exotic germplasm for the quantitative trait improvement in number of crops.

Conclusions

There are still some important gaps regarding QTL analysis. Only the QTLs of large effects and those closest to a marker locus, will show statistically reliable associations. It may be difficult to estimate even the presence of QTL if they interact strongly in their effects. Also, the regions to which a QTL is localized can be quite large (several cm). Such regions may contain many genes, and there is no guarantee that a QTL will correspond to only a single gene. Thus, with QTLs in hand, much further work is necessary to truly dissect quantitative variation at the mechanistic level. Particularly, important is fine mapping or high-resolution mapping of the QTL, once fine mapped QTL can serve as useful tools for comparative genomics, functional genomics and evolutionary studies.

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Groundnut Bruchid (*Caryedon serratus*, Olivier): A Threat in Groundnut Storage

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Introduction

Groundnut (*Arachis hypogaea* Linnaeus) is an annual legume crop belongs to Leguminoseae family. Among various oilseed crops, groundnut alone accounts for 45% of the oilseeds area and 55% of total production in India (Subbarayudu, 1996).

Groundnut seed contains up to 50% of a non-drying oil, 40-50% fat, 20-50% protein and 10-20% carbohydrate. Insect pests are major threat in field and storage condition, of which more than one hundred species of insect pests have been recorded in stored groundnut (Redlinger and Devis, 1982).

The major storage pests of groundnut are bruchid, rust red flour beetle, saw toothed grain beetle, rice moth and almond moth. Among them, bruchid (Carydon serratus Olivier) is a serious pest of groundnut in storage (Davey, 1958). Infestation of bruchid not only reduced the weight of groundnut and its nutritional value but also adversely effects the quality of oils and its shelf life.

Quantitative Losses

The quantitative losses due to groundnut bruchid was up to 83% (Conway, 1974), 19 to 60 % (Dick, 1987), 60-70% (Matokot et al., 1987), 87% (Reddy, 1990), 80-100% (Mkouka, 1991), 84% (Anon., 1991) and 65% (Kapadia, 1994) reported by various research workers.

Qualitative Losses

Mittal (1991) reported 0.50, 1.90 and 0.50% loss in fat, whereas 3.87, 2.10 and 8.76% losses of protein was recorded in groundnut varieties i.e. Exotic 5, Improved Spanish and RS-1, respectively due to infestation of C. serratus. Radadia (1995) recorded higher losses of oil content, free fatty acid, germination and protein content in three-hole kernels than healthy kernels.

Distribution and Host Range

It was reported from South India (Fletcher, 1914), Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Uttar Pradesh (Mittal and Khanna, 1974) and Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Tamil Nadu and Kerala (Arora and Singhal, 1978). *Carydon serratus* has wide host range *viz.*, *Cassia grandis, C. fistula* (Beeson, 1918), *Tamarindus indica* (Mittal and Khanna, 1968) and *Acacia nilotica* (Satyavir and Jindal, 1996).

Seasonal Occurrence

Bruchids normally occur during June to December in areas where warm humid condition prevails. Further, the bruchid population increases with the increase in temperature and humidity. However, the combination of 28±2°C and 70±5% RH is highly conducive for growth and development of bruchids. The increase in temperature from 25 to 40°C results in shortening the time required for generation doubling by three times.

Marks of Identification

Adult beetle is reddish brown with small black markings on the elytra. It has large prominent eyes, serrate type of antennae which are readily distinguished from the other storage pests. Broad hind femur bears a conspicuous comb of spines. Elytra did not cover the abdomen completely.

Nature of Damage

The first sign of attack is the appearance of 'windows' cut on the pod wall by the larva. The larva burrows through the pod wall and eats the seeds. Thus, groundnut seeds are too badly damaged and not useful for human consumption or oil expulsion. The larva of *C. serratus* invariably cut through its shell and later burrowed into the kernel (Davey, 1958). Attack of C. serratus was found more at the bottom of the stock followed by the surface (Conway, 1974).

Biology A

The total span of life cycle varies from 65 to 80 days at 28±2°C and 70±5% RH. The adult longevity for males is 20 days, whereas for females is 17 days. The pre-oviposition period is two days, the oviposition period is 7 days and the post-oviposition period is 9 days. Maximum number of eggs were laid during first four days after the adult emergence and the average fecundity per female is 67 eggs.

The incubation period of egg is 4 days; the grubs upon hatching scrape the pod or kernel surface and penetrate the pod to feed on kernels. The grubs pass through four larval instars before pupation, viz., first, second, third and fourth which complete in 13, 9, 13 and 17 days, respectively finishing total larval period in 52 days.

The fully grown grubs emerge out by making an exit hole and construct a tough silken cocoon on the surface of pods or kernels. Grubs pupate inside silken cocoons, where pupation lasts for 12 days. Generally, sex ratio in bruchids is recorded being 1: 0.7 (female: male). Irrespective of egg density (number of eggs laid), only two adults emerge out of one-seeded pod/kernel, however four and five adults can emerge out of two- and three-seeded pods, respectively.

The females survived longer than males and sex ratio was 1 female: 1.78 males **(**Kapadia, 1995). Fourth instar consumed a greater number of kernels than other instars (Singh *et al.*, 2002). Jaiphal (*Myristica fragrans* Houtt) was most preferred for egg laying but as oviposition preference had no relation with adult emergence of bruchid **(**Sundria and Kumar, 2004). Duration of total life cycle from egg to adult emergence was found up to 46 days **(**Devi and Rao, 2005).

Favourable factors: Protecting the seeds from damage caused by insect-pests requires the information on the bio-ecology of insect-pests a favourable factor that are responsible for their establishment and infestation. The infestation of bruchids starts from the field, which later becomes critical during storage.

The most favourable factors for the growth and development of bruchids are temperature (28±2°C), relative humidity (70±5%), seed moisture content (>9%) and the presence of previously infested/broken seeds in produce. The bruchid infested pods and kernels including broken seeds are highly prone to damage by the secondary insect-pests.

Management

Resistant varieties: Groundnut variety J 11 was found tolerant for development of bruchid population than JL-24, GG-2 and GAUG 10 (Kapadia, 1995). The frass produces and frass produced per grub was higher in groundnut varieties GG 2 and PBS 16, respectively (Radadia, 1995). The pod of genotypes ICGS 11 and ICGS 76 exhibiting low fecundity and high developmental period of the beetle with low index of susceptibility, low weight loss and damage were grouped as least susceptible, whereas genotypes ICGV 86325, ICGS 5 and K 134 grouped as moderately susceptible, genotypes FDRS 10 and TMV 2 were highly susceptible to C. serratus (Haritha et al., 1999). Kadiri 3 was less preferred for oviposition, adult emergence, survival and fecundity than AK 12-24 (Pattanaik and Singh, 2008).

Physical control: Under storage condition, the adults of C. serratus laid most of the eggs up to 12.5 cm depth as compared to deep storage of 50 to 62.5 cm (Mittal and Khanna, 1968). Polyethylene lined bags and metal bins showed no infestation even after 180 days of storage followed by open heap and gunny bag (Radadia et al., 1992).

Biological control: Groundnut pod treated with *Metarhizium anisopliae* up to 1.0 g conidia/50 g seed gave 100% mortality in CPD 4 treatment (Ekesi *et al.,* 2001). *Uscana carydoni*, a larval parasitoid of *C. serratus* was observed in stored groundnut seeds (Delobel, 1989). Verma (1993) observed a *Pachyneuron* sp. parasite on *C. serratus. Anisopteromalus calandrae* was found to be highly potential in parasitizing the pupae and larvae of bruchid (Basu, 2002).

Botanical control: Delobe and Malonga (1987) noticed that *Tephrosia vogelii* and *Chenopodium ambrosioides* plant powders gave higher mortality of groundnut bruchid. Tripathy *et al.* (2004) reported that vegetable oils of neem and pongamia @ 4 ml/kg seed, plant powder of *Lantana camara* and tulsi leaves @ 4 g/kg seed reduced oviposition, adult emergence and weight of adults as well as gave high mortality with no effect on seed germination. Oils of eucalyptus, citronella, lemon grass, ginger grass and palmarosa provided total protection to groundnut pods by inhibiting oviposition of bruchid up to five months of storage (Mishra and Dash, 2009).

Chemical control: If stored in gunny bags, then spray safe pesticides like, deltamethrin 2.5 SC @ 0.5 ml/L or malathion 50 EC @ 5.0 ml/L or spinosad 45 SC@0.3 ml/L on the gunny bags, Keep aluminium phosphide 56% @ 1 pouch (10 g)/ton of pods in airtight godowns. Seeds fumigated with aluminium phosphide allowed least number of groundnut beetles to survive than ethylene dibromide **(**Vijayanna, 2006).

Integrated management: Mittal (1994) mentioned some important steps for the control of bruchid infestation in groundnut. Increase cleaning the warehouse or godown from inside and outside before storing groundnut. Reduce moisture content of seeds by sun drying. Made 3 to 4 cm sand layer on the top of groundnut container. Used gunny sacks should be checked for the presence of the insect before filling again.

Conclusions

Carydon serratus is serious pest of stored groundnut having wide host range. Whitish colour eggs are laid on the pods which hatch out within 6 to 12 days. Larva make holl on the pod/kernel and cause heavy damage. Larva does not leave an unshelled nut before it is fully grown. Life cycle is completed within 30 to 80 days. It can be effectively controlled by using less susceptible varieties i.e. J 11 and Kadiri 3, neem and pongamia oils as well as tulsi leaves. To check the incidence of this pest for domestic purpose insect removal bins are useful. Drying of pods before storage mitigate the infestation of *C. serratus*. For chekingl post infection, fumigation with aluminium phosphide should be carried out.

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Artificial Intelligence: Strengthening the Future of Farming

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Introduction

Agriculture plays a very significant role in the economic sector. The world's population is assumed to be nearly 9 billion by 2050, feeding the entire humanity will require a 50 percent increase in food production and other agricultural products (FAO, 2017), but only 4 percent additional land will come under cultivation by then. Agriculture is haunted by various limitations posed by erratic factors such as climate change, frequent infestation of pest and diseases, population growth, and food security concerns. Addressing these challenges requires innovative approach and use of latest technologies. Artificial intelligence (AI) can be an effective way for overarching these challenges.

AI is an area of computer science that emphasizes the creation of tangible or intangible systems which not only behave intelligently but also display behaviour to the same level as human beings think and act, achieving human-like performance in all cognitive tasks using purely logical reasoning. AI-based equipment and machines has a lot of direct application across industries and can also bring a paradigm shift in today's farming and has taken today's agriculture system to a different level. It also plays a critical role along with remote sensing technology in wide scale implementation of climate smart agriculture. These techniques can also be the enabler of the paradigm shift of location based advisory services to the personalized and context specific advisory for the millions of farmers. Automation, sensors, drones, solar power aided with AI provide new opportunities for entrepreneurs and various others stakeholders to deliver innovative solutions as service at affordable prices to the farmers. This technology has enhanced crop production and improved real-time monitoring, harvesting, processing and marketing (Yanh et al., 2007).

Precision farming is one where we can benefit from AI and it can also help farmers to maximise the space they have, to be more precise about the types of crops, weather pattern and when and where they should go for raising crops. The best thing that AI can do in agriculture is to avoid drudgery and tedium from many agricultural operations. AI based technological solution has enabled the farmers to produce more output with less input and even improved the quality of output.

Various Contribution AI in Agriculture Sector

1. Farm data analysis: Farm produce thousands of data daily. Farmers are using sensors and soil sampling to gather data for better processing and analysis. It has enhanced the farmers to analyse a wide range of data such as weather conditions, temperature, water usage or soil conditions collected from their farm so as to take better decisions. Farmers also use AI to create seasonal forecasting models in order to improve accuracy and increase productivity.

2. Improving harvest quality: AI systems also help in improving the harvest quality and improve accuracy. It also helps in identifying diseases in plants, pests, and poor plant nutrition on farms. AI sensors can detect and target weeds helping the farmers in deciding the right herbicides to apply within the right buffer zone. It assists to thwart applications of herbicides and extreme toxins that find their way in today's food.

3. Agricultural Robotics: Agricultural robots are built in order to deliver high valued application of AI in agriculture sector. The core purpose behind this technology is to replace human labour and produce effective benefits on small as well as large scale productions (Manivannan and Priyadharshini, 2016). AI companies are developing robots that can easily perform numerous tasks in the field of farming. The robots are performing various agricultural operations autonomously such as weeding, irrigation, guarding the farms for delivering effective reports, ensuring that the adverse environmental conditions do not affect the production, increase precision and manage individual plants in various unfamiliar ways.

4. Drones in Agriculture: Drones are being implemented in agriculture for crop spraying, crop health monitoring, irrigation, equipment monitoring, weed identification, herd and wildlife monitoring and disaster management (Ahirwar et al., 2019). Remote sensing with the use of unmanned aeronautical vehicle for image capturing, processing and analysis is also making an enormous impact on agriculture.

Conclusion

AI-driven technologies are emerging to help in improving efficiency and also to address the various challenges pose by different sectors. The use of AI in agriculture is allowing farmers to work more efficiently, enabling farms of all sizes to operate and function with keeping the world fed.

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Grafting in Vegetable Crops: - A Boon for Farmers

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Abstract

Grafting is a technology which includes joining together living plants parts to produce single living plants. It is an alternative approach used in vegetable production to fight against soil borne diseases such as *Fusarium wilt,* bacterial wilt and nematodes since 1920s in countries like Japan and Korea. In vegetable crops, it has become popular in past few decades for commercial vegetable production. Grafting as a technology for the commercial vegetable production was later on adopted by countries such as Europe, Middle East, Northern Africa, Central America and other parts of Asia. The first interspecific, herbaceous grafting was performed in 1920 for watermelon in Japan and in other solanaceous vegetables it took more than 30 years i.e. around 1960s to commercialize grafting technology. The first record of eggplant (*Solanum melongena*) grafted on scarlet eggplant (*Solanum integrifolium*) was reported in the 1950. Further, another example is of muskmelon grafted to interspecific hybrid squash (*Cucurita moschata*) had resistance against vine decline caused by *Monosporascus spp.* and it is tolerant to Charcoal rot too.

Introduction

India is the second largest producer of vegetable crops in the world followed by China. Area under vegetables is 10.29 million ha with production of 176.17 million tonnes (NHB 2017-18). Vegetable production estimated to rise 1.6% at around 187.36 million tonnes in 2018-19. Vegetable production is expected to increase by 2.64 % in 2019-20 over 18-19. Dieticians recommend taking 300g of vegetables per day to make our balanced diet better and healthy. From this 125g include leafy vegetables, 100g root and tuber vegetables and 75g other vegetables (ICMR, New Delhi). Vegetables are mainly herbaceous plant which include annual, biennial and perennial whose plant parts such as leaves, stems, fruits, flowers, petiole, root etc. are used as culinary or consumed as raw generally. The researchers are now being directed for improvement in quality of horticultural produces. The grafting is old tools for sustainable vegetable production by using resistant root stock. Grafting is a method of propagation where two pieces of living plant tissues are joined together to develop as a single plant. In Olericulture, vegetable grafting is relatively new technique but in Pomology, grafting of fruit trees has been practiced from past many decades, which is century old technique. The upper plant part which produces fruits is called scion and the lower part is known as root stock. The root stock contributes vigour and disease resistance while the scion is chosen for fruit and its quality. The serious crop loss is caused by soil borne diseases. In many fruit bearing vegetables such as cucumber, melon, tomato, eggplant, pepper etc., the use of grafted seedlings has become increasing the yield of susceptible cultivars. This technique is eco-friendly for sustainable vegetable production and by resistant root stock, it reduces dependence on agrochemicals. To induce resistance against low and high temperature, grafts were generally used. Vegetable grafting also induce vigour, precocity, better yield and quality, survival rate, reduce infection by soil borne pathogens, enhance nutrient uptake, enhanced water uptake, tolerance against abiotic stress by using desired root stock.

However, in India, grafting work has been started in Indian Institute of Horticultural Research, Bangalore by Dr RM Bhatt and his associates. Their work was on identification of rootstocks for waterlogged conditions. IIHR Bangalore organized first ever short course on vegetable grafting during the year 2013. NBPGR regional station, Thrissur, Kerala have done work on cucurbit grafting by taking *Momordica cochinchinensis*, a dioecious plant.

The female plants were grafted on to the male plants to increase its production. Graft success was 98%. CSKHPKV, Palampur initiated work on grafting and identified more than 22 rootstocks of brinjal, chilli, tomato and cucurbits for importing resistance to bacterial wilt and nematodes.

Influence of Vegetable Grafting

1. Resistance to biotic and abiotic factors: Grafting technique is used as tool for reducing the effect of biotic and abiotic stresses. The watermelon grafted onto bottle gourd rootstock in heavy or loamy soils enhances flooding tolerance. Cucurbits grafted on pumpkin provide drought tolerance in sandy soil. It was found that cucumber grafted on Shintoza-type rootstock (*Cucurbita maxima* Duchense × *Cucurbita moschata*) has shown low temperature resistance and copper toxicity resistance. The watermelon grafted onto saline-tolerant rootstocks increases around 81% yield under greenhouse production. To induce resistance against low and high temperature, grafts were generally used**.** Figleaf gourd rootstock has been used commercially to increase the tolerance of cucumber, watermelon, melons and summer squash to low soil temperature. Grafting led to salt and flooding tolerance, improved water use efficiency, increased nutrient uptake and alkalinity tolerance. It helps in the survival of plants under low temperature because of the presence of more content of Linolenic acid (Singh and Sultan, 2016). Chilli gave highest yield under high-temperature conditions when grafted on sweet pepper rootstocks. Grafting minimizes the negative effect of boron, copper, cadmium, and manganese toxicity. In tomato, grafting resulted in the formation of a greater number of internodes and flowers in outdoor cultivation and number and total weight of fruits in indoor cultivation.

2. Tolerance to soil-borne diseases: Grafting is used to get rid of many soil-borne diseases such as *Fusarium* wilt in cucurbitaceous crops such as cucumber, melon etc. and Bacterial wilt in solanaceous crops (tomato, pepper etc.). Grafting is a quick method in melon for controlling race 1 and 2 of *Fusarium oxysporum f. melonis*. It is an effective tool for disease resistance by using rootstocks resistant to both *Phytophthora* blight and bacterial wilt. Pepper scion grafting onto breeding lines ('PR 920', and 'PR 921', and 'PR 922') resistant to both *Phytophthora* blight and bacterial wilt showed greater rate of survival when they were inoculated with *Phytophthora capsici* and *Ralstonia solanacearum***.** When the susceptible commercial pepper variety (cv. Gedon) grafted onto rootstocks resistant to *Rhizoctonia* root rot and *Fusarium* wilt grown in the infested soil was less attacked with wilt disease, while ungrafted plants were severely infected.

3. Effect on fruit quality: Grafting is an effective approach to improve fruit quality under both optimum growth conditions and salinity. In soilless tomato cultivation, grafted plants gave higher marketable yield, fruit quality and pH content of fruits depending on rootstock. Grafting of eggplant onto *S. torvum* increased the fruit size and had no effect on quality and yield. In cucumbers, especially for export, bloom development and external color are important quality factors. These can be greatly influenced by the rootstock. The grafting technique affects various quality aspects of vegetables. Rootstock/scion combinations should be carefully selected for specific climate and geographic conditions. Appropriate selection can help to control soil borne diseases and also increases yield and fruit quality.

4. Greater adaptability to environmental stresses: Due to succulence of vegetable crops, these are highly susceptible to environmental changes. It can be said that production of vegetable crops is challenging under climate change because alter in temperature, erratic rainfall cause drought, flooding which led to serious loss to vegetable crop production. In such situations, grafting a plant is a surgical technique has effectively been used to mitigate broad spectrum of various environmental pressures.

5. Higher yield: When vegetables are cultivated in problematic soils, grafts have been used to improve yield. In greenhouse as well as in open-field, grafted plants gave more yield than non-grafted ones. Tomato plants grafted onto 'Heman' and 'Primavera' produced higher yield in the greenhouse and the open field. Water use efficiency and yield were higher in grafted plants. The researchers of Korea and Japan have reported increases of 25 to 50% in yield of grafted tomato, melons, pepper, eggplant and watermelon compared to non-grafted plants (Ranjan et al. 2019).

In India more than 400 vegetable producers in states like Andhra Pradesh have taken to cultivating grafted vegetables in an attempt to double their incomes through increased yields. Farmers are reporting around 30-50% increase in yields from use of grafted varieties over traditional varieties.

Pre-Requisites for Vegetable Grafting Technique

1. Selection of the right rootstock/scion: Select the desirable rootstock and scion having the same stem size (diameter). Grafting should be done at 2-3 true leaf stage.

2. Graft compatibility: Compatible rootstock and scion minimizes the mortality rate even in later stage of growth. Rapid callus formation takes place between scion and rootstock and leads the formation of vascular bundles.

3. Grafting aids or tools: Commonly used aids to perform grafting i.e., Grafting clips, Tubes, Pins, and Grafting Blade.

4. Screening house: Used for growing seedlings prior to grafting. It should be constructed with 60-mesh nylon net. Arrange double door, the upper half of the structure should be covered with a separate UV resistant polyethylene to prevent UV light penetration.

5. Healing of grafts: Healing is most critical to provide favourable conditions to promote callus formation of grafted seedlings. In healing chamber, temperature should be 28-290C with 95% relative humidity for 5-7days in partially shaded place (darkness for 1-2 days) to promotes callus formation at union. It helps in formation of better graft union by reducing transpiration, maintains high humidity, maintains optimum temperature and reduces light intensity. The main aim is to initiate environment by controlling temperature and humidity.

6. Acclimatization of the grafted plants: Acclimatization is essential for healing and survival of grafted plants. After the callus has formed and the wounded surfaces are healed, plants may be put under a mist system, greenhouse or placed under a clear plastic cover for acclimatization to prevent leaf burning and wilting.

Methods of Vegetable Grafting

Selection of grafting method depends on the crop, the farmers experience, personal choice, the number of grafts required, the purpose of grafting, access to labour and the availability of machinery and infrastructure facilities. Tomato and eggplants are mostly grafted by cleft and tube grafting. Tongue approach is used in grafting of cucurbitaceae vegetables especially for cucumber. Slant-cut grafting is easier and has recently become popular for watermelon and melon.

1. Cleft grafting: It is also called apical or wedge grafting. The seeds of the rootstock are sown 5-7 days earlier than those of the scion. Here scion plants are pruned with 1-3 true leaves and the lower stem is cut to slant angle to make a tapered wedge and clip is placed to make contact between scion and rootstock after placing scion into split made. This method is most widely used in solanaceous vegetable crops.

2. Tongue Approach Grafting: In this method, seeds of cucumber are sown 10-13 days before grafting and pumpkin seeds 7-10 days before grafting, to ensure uniformity in the diameter of the hypocotyls of the scion and rootstock. The shoot apex of the rootstock is removed so that the shoot cannot grow. The hypocotyls of the scion and rootstock are cut in such a way that they tongue into each other and the graft is secured with a plastic clip. The hypocotyls of the scion are left to heal for 3-4 days and then crushed between the fingers. The hypocotyl is cut off with the razor blade three or four days after being crushed. This method is labour intensive and requires more space but seedling survival rate is high, hence, most widely used by farmers and small nurseries.

3. Hole insertion / Top insertion grafting: This is most popular method in cucurbits scion and rootstock should have hollow hypocotyls are preferred in this method. This method is preferred for grafted watermelon transplant production because the size of watermelon seedlings is relatively small than rootstock of bottle gourd or squash. This method requires optimum temperature of 21-36˚C up to transplanting. This method is very

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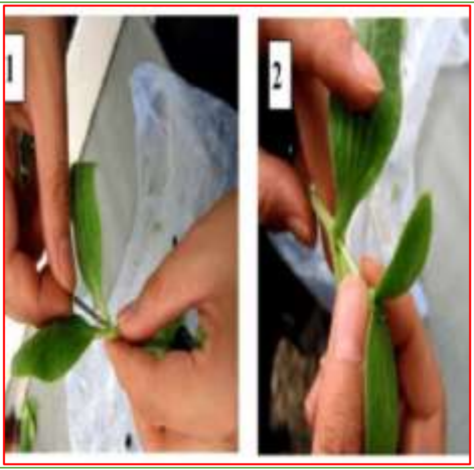
popular in China because it results in a strong union and vascular connection compared with the tongue grafting approach.

4. Tube or Japanese Grafting: This grafting has been developed for vegetable seedlings grown by plug culture. This method makes possible to graft small plants grown in plug trays two or three times faster than the conventional method. The smaller the plants, the more plants can be fitted into healing chambers or acclimation rooms. Cut rootstock under cotyledons in a 450 or sharper angle. Prepare the scion with matching hypocotyls width cut in the same angle at about 5- 10 mm below the cotyledons. Place one tube a half way down on top of the cut end of rootstock hypocotyls. Insert the scion into the grafting tube so that cut surface aligns perfectly with that of rootstock. Move the tray filled with grafted plants to proceed for healing up to 7 days.

Cleft Grafting



Hole insertion Grafting

Tongue Approach Grafting

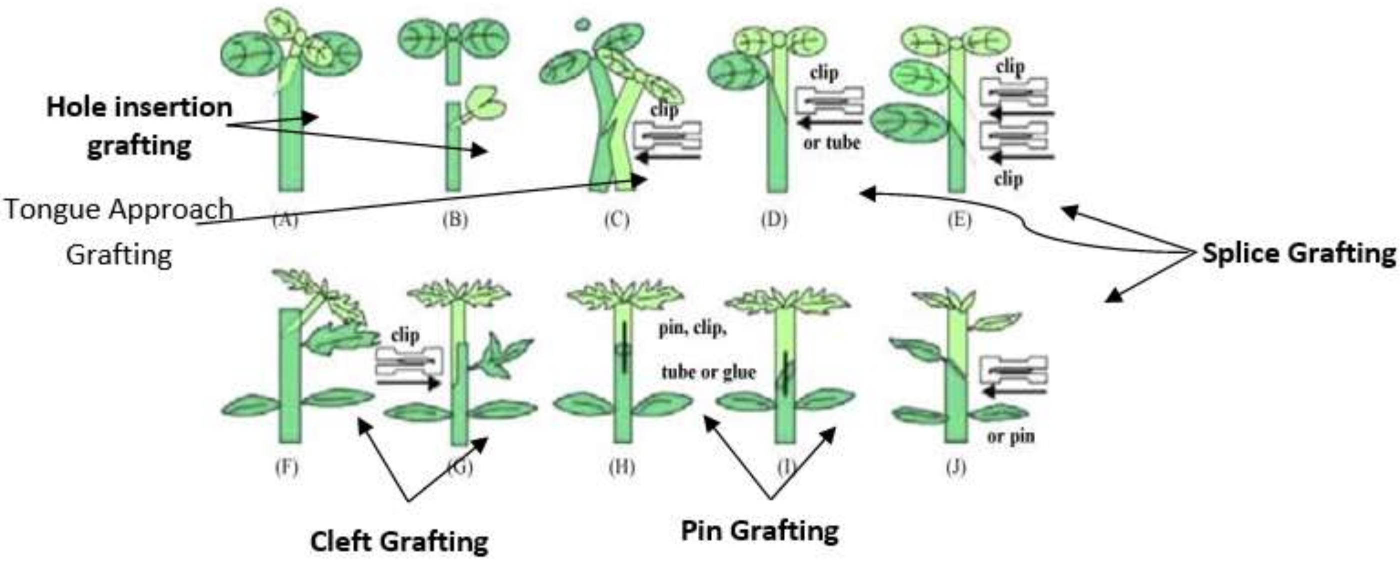


Table: Commonly Used Grafting Methods and Rootstocks in Different Vegetables

Scion Plant	Rootstock	Method
Eggplant	*Solanum torvum, S. sissymbrifolium, S. khasianum*	Tongue and Cleft grafting
Tomato	L. *pimpinellifolium, S. nigrum*	Cleft grafting
Cucumber	*C. moschata, Cucurbita maxima*	Hole insertion and Tongue grafting
Watermelon	*Benincasa hispida, C. moschata, C. melo C. moschata × C. maxima, Lagenaria siceraria*	Hole insertion, Cleft method and Splice Grafting

Bitter gourd	*C. moschata, Lagenaria siceraria*	Hole insertion and Tongue grafting

Drawbacks of Vegetable Grafting

Various drawbacks associated with the production and management of grafted transplants is as following:

1. It is a labour-intensive technique and required specialized trained workers.
2. Requires time management for rootstock and scion seeds sowing.
3. Require a controlled environment for graft healing.
4. Poor rootstock-scion compatibility mat results in blocking of the transport of photosynthates from scion to rootstock. This may lead to reduction in yield, poor fruit quality
5. Grafting can increase the risk of pathogen spread, especially for seed borne pathogens in the nursery.
6. Workers performing grafting within a greenhouse and growth chamber face the problems of heat stress and discomfort, especially during April-June, September and October.

Conclusion and Future Perspectives

Vegetable grafting technique is the positive effects of dynamic interspecific effect of rootstocks on scion. Identification of compatible disease resistant rootstocks with tolerance to abiotic stresses is the basic requirement for continued success. Healthy grafted seedlings at reasonable price are the key point for wider use. Methods/techniques should be of low cost so that these could be adopted by farmers for commercial production. More research is needed to minimize post grafting losses. There is a scope for vegetable breeders and private companies of India to develop resistant rootstocks. It is tolerant to diseases like Bacterial wilt, Phytophthora blight, Mosiac virus etc. Researches, extension specialists and seed companies need to work together to integrate this modernized technology as an effective tool for producing high-quality vegetables. Sharpening of grafting skills and healing environment need to be standardized for its application on commercial scale. This technique has the potential to solve the problems of vegetable industry of India and can boost farmer's income by improving the crop yield and reducing the cost incurred on purchasing of huge amount of fertilizers and pest and disease control products. Grafting is an eco-friendly technology which promotes organic vegetable production. Fruit texture can be highly affected by grafting as manifested most consistently in the case of watermelon grafted on interspecific cucurbit rootstocks which generally increase pulp firmness; whereas loss of firmness in melon can reflect latent rootstock–scion incompatibility. Nursery production and management is labour intensive. To solve this problem, scientists must focus on developing and popularizing facilities, equipment and grafting robots to increase the efficiency of grafting and reduce labour cost. Storage technology for grafted transplants demands the consideration of researchers the developments of databases, software, mobile applications and crop models related to grafted vegetables will assist nursery managers and farming communities in the selection of suitable scion and rootstock cultivars, in the international market the trading of grafted transplants is rapidly increasing, with the development of grafted vegetable industry in India this option can be availed to earn foreign exchange.

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Intellectual Property Rights in Indian Agriculture

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Introduction

In the world with an ever-expanding population, innovations in the agricultural sector are vital to increasing crop productivity and secure the global food supply. It is being known that some of these challenges can be overcome by developing more innovative approaches. Thus, in the India new farming systems compare to traditional one was implanted first time with the discovery of Green Revolution. In Asia, the basis of IPRs (Intellectual Property Rights) was laid by the Green Revolution (1960s), when the semi-dwarf varieties of wheat, rice were introduced with the farm management practices including, fertilizer management, irrigation system, and disease and pest management. This led to an increase in the growing area and thus increased crop production worldwide. From the Green Revolution, the creation of a private seed industry was an easy step to produce more hybrid seeds. Hybrids are a crucial piece of the privatization puzzle, the industrial sector's surging interest in the Asian seed market, and its demands for intellectual property protection. It is known that some of the existing agricultural and non-agricultural practices have led to stress on natural resources importantly, water and soil that affect crop growth and thus productivity. We will need the second Green Revolution with more innovative approaches to make agriculture more sustainable in terms of an increase in crop productivity in adverse conditions without seriously damaging the environment. Thus IPR (Intellectual Property Rights) are intended to promote research and development by providing incentives for the investment in the creative methods and encourage access to inventions to produce elsewhere.

Intellectual property rights (IPRs) means the legal rights established and given to a person over their creative or inventive ideas. IPR represents the product of mind, a product of intelligence. Such legal rights generally allow right holders to eliminate the unauthorized commercial use of their creations/inventions by third persons. A major financial attraction of biotech in crop improvement is the opportunity it provides for companies to claim ownership of their own innovation. Whereas conventional plant breeding relies on natural modes of reproduction and has some disadvantages, genetic engineering has some advantages over natural processes of reproduction by transferring foreign strands of DNA from one organism to another recipient organism and, even across species barriers. The biotechnological processes/methodology of genetic engineering, the genes sequences, use for crop improvement in the breeding program, and the end product, such as a new plant variety, are generally regarded as "new constructs" of human intelligence and therefore intellectual property. Seed companies can use plant variety protection, material transfer agreements, and more frequently, patents to protect such intellectual property. The agricultural and agricultural biotechnology sectors in that they can be used to protect goods or services, methods/techniques, products, etc. Patents, plant breeder's rights, trademarks, geographical indications, and trade secrets are mainly used to protect the inventions in the agriculture sector as described below.

Patent

A patent is a monopoly right granted by the Government for a novel invention to an inventor for his/her disclosed invention for a 20 years period of time. This right is valid only within the territorial limits of a country of grant. The exclusivity of right implies that no one else can make, use, manufacture or market the invention without the permission of the patent holder. It is granted to agricultural goods; provide the strongest protection for patentable plants, animals, biochemical and biotechnological processes, genes, microorganisms, crop varieties, and bioproducts for their production. But the criterion to get patent is the patentable products should have novelty, non-obviousness, and usefulness. Patents should be available in WTO member states for any invention, in all fields of technology, under the World Trade Organization's (WTO) TRIPS (Trade-Related Aspects of Intellectual Property Rights) The agreement provided they are new, involve an inventive step, and are capable of industrial use.

Plant Variety Rights

Plant Variety Rights (PVRs)/Plant Breeders Rights (PBRs) are the legal protection used to protect the new plant variety and to encourage the plant breeders, and privet sectors to develop the new varieties with more different improve traits with the current environmental issues. Any plant variety that fulfills DUS criteria i.e. variety should be Distinct, Uniform and Stable is eligible for protection under IPR. The idea to protect the plant varieties originated from farmers, companies, and plant breeders was led in 1961 during the convention by the International Union for the protection of New Varieties of Plants (UPOV), an intergovernmental organization, shares its headquarters with WIPO in Geneva. In India, the Protection of Plant Variety and Farmers Right Act, 2001 (PPVFR Act) of the Parliament of India that was passed for the protection of plant varieties, the rights of farmers and plant breeders, and to encourage them to development of new varieties of plants. The period of protection varies with the type of plant under protection, for Kharif/rabbi crops are 15 years and for trees and vines the protection period is 18 years and for notified varieties, it is also 15 years from the date of notification under section 5 of Seeds Act, 1966. The rights granted to inventors under this Act are special right to produce, sell, market, distribute, import, and export the variety of there invention.

Trademarks

In India, Trademarks Act was led in 1999 with the objective is to provide better protection of the trademark for goods and services and also to prevent fraudulent use of the mark. It includes a total of forty-five classes for different goods and services. Class 31 protects businesses that sell a wide variety of natural Agricultural, Horticultural, and forestry products e.g. breeding animals, fresh fruits and vegetables; unprocessed seeds, natural plants, and flowers; foodstuff for animals, silkworm, fish spawn, etc. After registration, a trademark is valid for 10 years from the date of filing, which can be renewed from time to time.

Geographical Indications

India, as a member of the World Trade Organization (WTO), passed the Geographical Indications (GIs) of Goods (Registration & Protection) Act, 1999 has led which is effective from 15th September 2003. Geographic Indications is an indication in the form of name or sign, used on the goods that have a specific geographic origin. The GI's rights only grant a right to use the indication to prevent its use by the third party. For example, Darjeeling Tea Geographic Indication was protected by producers of Darjeeling city only. A registered Geographic Indication property rights are valid for 10 years and can be renewed on payment of renewal fee.

Trade Secrets

A trade secret is an information having commercial/industrial value and should fulfill the three essential conditions such as information must be secret, information should have commercial value, and information must be the subject of reasonable steps by its owners to keep it secret for an indefinite period as long the secret is not revealed to the public. Information such as pattern, method, technique, or process is protected under the trademark IPR. The Trade Secret act came into force in 1970, the information relating to the companies which are not generally known to the public is protected under this act.

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Mushroom Cultivation as Alternative Farming for Double Income of the Farmers in North-East India

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The seven sisters of North-East India along with Sikkim, present a challenge to the researchers as well as the planners in terms of developing and selecting agro – based programmes for the economic development and socio – economic security of the poor masses. Wide variations in the demography and physiographic cause further exasperation. in today's world of free market economy, one cannot force the private sector to open industries in this otherwise terrain – hostile region. The government too are slowly reducing their role as public entrepreneurs. The scenario can be transformed by agro based ventures and enterprises. Keeping in view the different ethnic groups, difficult terrain with predominant tribal population. Mushroom production is an option with rich potential above all the climatic conditions.

The NE States located between 22°N – 29.5°N and 87.7°E – 97.3°E in India, have a population of about 4.5 crores (as per estimated on 2001 census over an account of 2% growth annually) very thinly spread in an area of 2.55 lakhs sq.km. The region is not easily accessible by water transport or normal surface transport, which is one of the reasons which inhibit the rapid economic development of this region. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura constitute the so – called NE, but for developmental programmes, Sikkim has also been added. As industries are almost non-existent and agriculture is of subsistence in kind in most parts, unemployment and underemployment prevails in the vision. Any program for economic development of this region might take into account the probability of the venture, employment generation, sustainability of the climate and liking of the people. Venture like mushroom which is a high value – low volume commodity production is perhaps a highly suitable agro – industrial venture. It is highly profitable, labour – intensive and above all not dependent on arable land. Mushrooms can be raised indoors, rooms or huts or otherwise idle land such as slopes and is highly suited on womenfolk. The youths are attracted to this venture as it is highly profitable and labour intensive. NE hills are familiar to mushrooms unlike in rest of India. In short, the market for mushrooms in the NE hills is readymade. All the neighbouring countries except perhaps Bangladesh are also very good markets for the mushrooms.

Why Mushroom Cultivation?

1. Mushroom cultivation has become a small – scale agriculture alternative farming for many in North – East India.
2. Suitable climatic condition.
3. Does not require access to agricultural land.
4. Indoor farming.
5. Income generation.
6. Profitable venture.
7. Viable activity.
8. Nutrition enhancement.
9. Medicinal value.

Though many types of mushrooms are being commercially produced everywhere, the button mushroom *(Agricus bisporus)*, Oyster (*Pleurotus* spp.), Paddy straw mushroom *(Volvariella volvaceae)*, milky mushroom *(Calocybe indica)* are the most popular with the growers and consumers in India. Shiitake *(Lentinula edodes)* is produced and collected only from the NE in India. The above-mentioned mushrooms require different climate regimes specially the temperature, and therefore, can be grown in various regions and seasons in the NE. To illustrate the point further, button mushroom should be grown during the winters or in the hilly regions when the temperature is between 13-19°C which should be followed by the oyster mushroom when it is between 20-30° C, and paddy straw mushroom (28-35°C). Milky mushroom is suitable when it is hottest (30-40%). In this way a crop rotation of mushrooms in the NE Region can be designed for different regions with a view to providing gainful employment throughout the year.

Advantage of Mushroom Cultivation in NE India

1. Varied climate (5-35%C) suitable for all mushroom.
2. Abundant agro – wastes (raw materials).
3. Excellent domestic (local) market.
4. Mushrooms as food are very popular with the NE people.
5. High humidity (always above 60%).
6. Access to the market in the neighboring countries (like China, Myanmar, and others can be attempted).

Suggestions to Enhance Mushroom Cultivation

1. Suitable machineries for mushroom production should be developed indigenously at reasonable cost in the country.
2. Establish good linkage between mushroom industry and R& D establishments.
3. Value added products of mushrooms should be popularized.
4. Interaction with government officials, entrepreneurs, farmers, marketing agencies and processing industries can help in realizing the potential of the venture to provide unique solutions to handle the problems of poverty, unemployment and malnutrition prevalent in the region.
5. An integrated approach, missionary zeal and concerted efforts various public institutions, departments and NGO's are of paramount importance to make the NE a mushroom bowl of the country.

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Conservation of Biological Control

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Biological Control

1. Biological control or bio-control is a method of controlling pests such as insect, mites, weeds and plant diseases using other organisms.

2. It relies on predation, parasitism, herbivory, or other natural mechanisms, but typically also involves an active human management role.

3. It can be an important component of integrated pest management (IPM) programs.

Three Important Strategies in Biological Control

There are three basic strategies for biological pest control:

1. Classical (importation), where a natural enemy of a pest is introduced in the hope of achieving control.

2. Inductive (augmentation), in which a large population of natural enemies are administered for quick pest control.

3. Inoculative (conservation), in which measures are taken to maintain natural enemies through regular reestablishment.

Natural enemies of insect pests, also known as biological control agents, include predators, parasitoids, pathogens and competitors.

Conservation

The conservation of existing natural enemies in an environment is the third method of biological pest control. Conservation is defined as the manipulation of the environment to favour natural enemies, either by removing or mitigating adverse factors or by providing lacking requisites.

How to Conserve the Natural Enemies?

Environmental modifications may be made to increase natural enemy effectiveness. These modifications include:

1. Construction of artificial structures.
2. Provision of supplementary food.
3. Provision of alternative hosts.
4. Improvement of pest-natural enemy synchronization.
5. Control of honeydew-feeding ants.
6. Modification of adverse agricultural practices.

Construction of Artificial Structure

1. This has been done to increase the densities of predaceous insects, birds, and insectivorous vertebrates such as shrews, mice, squirrels, etc.

2. The best-known example of using artificial structures to enhance predaceous insect populations was that of using "nesting shelters" for protection of *Polistes* wasps around tobacco fields in North Carolina for control of the tobacco hornworm, *Manduca sexta*.

Provision of Supplementary Food

Inter-planting of certain crops has been used to provide nectar and pollen sources for natural enemies. It is known that *coccinellid* species such as *Hippodamia* shift over to pollen when aphids become scarce. Unfortunately, they cannot reproduce on a diet of only pollen. The late Kenneth Hagen, University of California, Berkeley, conducted many studies on providing supplementary food sources by spraying solutions of sugar/honey and yeast hydrolysate directly on crops.

Provision of Alternative Hosts

Fundamentally, alternate hosts reduce conditions of asynchrony between preferred hosts and their non-specific parasites and predators:

Crops	Predators/ Parasitoid	Family
Guava (sole crop)	*Chrysoperla zastrowi* *Coccinella septempunctata*	Chrysopidae Coccinellidae
Guava + cowpea (intercrop)	*Mallada boniensis* *Chrysoperla zastrowi* *Brumus suturalis* *Coccinella transversalis* *Anagyrus dactylopii* *Coccidoxenoides*	Chrysopidae Chrysopidae Coccinellidae Coccinellidae Encyrtidae Encyrtidae
Sapota (sole crop)	*Chrysoperla zastrowi*	Chrysopidae
Sapota + clusterbean (intercrop)	*Cardiastethus* sp. *Orius* sp. *Scymnus coccivora*	Anthocoridae Anthocoridae Coccinellidae

(Wright et al., 2019).

Artificial Infestation or Inoculation of Crops with Pests has been Used to Augment Effective Natural Enemies

The best example was with the cyclamen mite, *Steneotarsonemus pallidus*, on strawberry. Early inoculation of this species allowed its predator *(Typhlodromus reticulatus)* to build up prior to it reaching economic levels.

Control of Honeydew-Feeding Ants

In Hawaii, an excellent example of this is with the *Dysmicoccus mealybugs* (the pink and gray pineapple mealybugs) that infest pineapple and that are tended by the big-headed ant, *Pheidole megacephala* ant baits eliminate the ants, and allow the mealybugs' natural enemies to attack.

Application of Chemical Insecticides

1. Avoid persistent chemicals- damage to micro hymenopterans
2. Activity of natural enemies were reduced.
3. Citrus orchards are fumigated - black scale, *Saissetia oleae*, all parasitoids are eliminated.

Preservation of Inactive Stages

Cereal leaf beetle, *Oulema melanopus* in Michigan - *Tetrastichus julis* overwintered in the soil of oat stubble so the portion of oat stubble was not allowed for ploughing.

Maintenance of Diversity and Necessary Hosts

1. The maintenance of diversity is frequently a necessary part of many other measures since it may provide needed hosts, sources of food, over wintering sites, refuges etc.

2. Parasitization of *Helicoverpa zea* eggs by *Trichogramma pretiosum* females was relatively high in plots of tomato but almost non-existent in adjacent plots of corn. Because it uses the volatiles from corn so it can parasiting tomato *H. armigera* also.

Reduction of Undesirable Predators

Desirable natural enemies are selectively fed by predators thereby affecting the efficiency of the parasitoid. Eg: Walnut aphid, *Chromaphis juglandicola* – parasitised by *Trioxys pallidus* from Iran- affected *Trioxys pallidus* is parasitized by the Argentine ant, *Iridomyrmex humilis*.

Favourable Temperature

High or extreme temperature affects survival, sex ratio of parasitoids. Eg. *Trichogramma chilonis* beyond 31^{o}C means it only produces males.

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Antinutritional Factors in Tuber Crops

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Introduction

Tuber crops are carbohydrate rich food source of humans and animals and also used for industrial purposes. The major factor that reduces the consumption of this crop is the presence of antinutritional factors in tubers/roots as well as in other parts such as leaves. Antinutrients are compounds that can interfere with the absorption of nutrients which are beneficial for the growth and development. These can be seen in food crops at a lower dose, but if level goes beyond limit, it will definitely affect the uptake of beneficial nutrients. These can cause toxic effect when accumulating in excess quantities. Therefore, proper care must be taken to avoid these factors.

Major Antinutritional Factors Present in Tuber Crops

Antinutrient	Tuber crop	Part of the plant
Cyanogens	Cassava	Roots, leaves
Trypsin inhibitors	Sweet potato	Tuber
Alkaloids	Yams (greater yam, lesser yam)	Tuber
Tannins	Yams	Tuber
Oxalate crystals	Aroids (colocasia, xanthosoma)	All parts (leaf sheath, stem, corms)
Saponins	Yams (Potato yam)	Tuber

Cyanogens

Cassava can produce cyanogenic glucosides (CG) in quantities that are harmful to consumers. This can be occurring mainly in two forms – linamarin (93 %) and lotaustralin (7 %). This CGs can produce hydrogen cyanide (HCN) by hydrolysis. HCN is very toxic to humans at high concentration and cause neurological disorders. The lethal dose of HCN ranges between 0.5 mg/kg and 3.5 mg/kg body weight when taken up by orally. Cyanogenesis is the process of release of hydrogen cyanide from a damaged plant tissue when linamarin brought into contact with the enzyme, linamarase. This HCN content is responsible for the bitterness and reduces the organoleptic quality of cassava tubers. Bitterness may vary according to genotypes and environmental conditions. Cassava cultivars are divided into sweet (< 100 mg total cyanogens/kg peeled fresh tubers) and bitter (> 100 mg total cyanogens/kg peeled fresh tubers) based on its cyanogenic content.

Trypsin Inhibitors

Trypsin is a protease enzyme for the digestion of proteins. Trypsin is produced as an inactive form, trypsinogen by pancreas and converted to active trypsin at small intestine. This is very much useful for the breakdown of proteins to peptides and amino acids. So, presence of trypsin inhibitors in sweet potato affects this digestion process. Sweet potato has trypsin inhibitor activity in the range of 90 percent in some varieties to 20 percent in others.

Alkaloids

Alkaloids are compounds which are mainly seen in wild yams and potato. Alkaloids cause gastrointestinal and neurological disorders. Dioscorine is the alkaloid present in yams, especially in wild yams. These secondary metabolites protect them from predators, but are toxic to consumers. Dioscorine is soluble in water and produce serious and distressing symptoms on ingestion. Another group of alkaloids are glycoalkaloids – solanine and chaconine, which is present in potato. The level of these glycoalkaloids in a healthy potato tuber is < 10 mg per 100 g. if the concentration is higher, gastrointestinal disturbances and neurological disorders occurs 8-12 hours after intake. The level of occurrence of this glycoalkaloids will vary with potato variety. This is usually seen in outer layers of potato (30-80 %), therefore, peeling is an effective way to remove this alkaloid.

Tannins

Another important antinutritional factor present in yams is tannins. These are polyphenolic compounds which can impede digestion and metabolism and also interfere with protein digestion and iron uptake. It reduces the nutritive value of yam tubers by forming complex with protein. Greater yam contains 0.21 per cent tannin content. Lesser quantity of tannin in yams helps them by acting as a repellent.

Oxalate Crystals

The chief antinutritional factor that prevents the consumption of aroids, mostly wild types is calcium oxalate crystals. Elephant foot yam also contains this compound. These are responsible for the acridity and are called acrid plants. Acridity increases with increase in calcium oxalate crystals in corms / cormels. In wild aroids, oxalic acid may be settled in the plant tissues in the form of calcium oxalate crystals. If aroids with excess amount of crystals ingested, it causes burning sensations/irritation on mouth, tongue and throat. Clusters of these crystals which are insoluble in nature are called raphides. Calcium oxalate content on taro / colocasia leaves and corms are 400 mg/100g of leaves and 43 mg/100g of corms, respectively. The two types of poisoning caused by oxalates are 1) hypocalcaemia after intake of corms (acute poisoning) which leads to low calcium level in the blood and 2) deposition of crystals in the kidneys (chronic poisoning).

Saponins

Saponins are secondary plant compounds which are glycosides of steroids, alkaloids and terpenes. Diosgenin is the steroidal sapogenin seen in yams, which gives a bitter taste to tubers. Besides its antinutrient property, it also has benefits of anti-inflammatory activities.

Other antinutritional factors like raffinose, terpenes etc are also seen in some tubers. Sweet potato contains raffinose which causes flatulence. It means accumulation of gas which leads to abdominal discomfort. Aerial/potato yam contains diosbulbin, which is a furanoid norditerpene, which will lead to paralysis. Rotenone is another antinutrient, which is present in the roots and seeds of yambean.

Methods to Remove Antinutritional Factors

There are several techniques to detoxify these compounds before consumption. Peeling of the outer skin and boiling/cooking are the important methods use to remove these antinutritional factors. HCN content in the centre of the roots is less than peripheral part of root parenchyma and cortex part in cassava root. Therefore, peeling and proper processing is required. Crushing, sun drying and made into flour will remove > 90 per cent of cyanogenic content. It can also be removed by boiling and draining of water (tuber :water = 1:5). Fermentation of grated cassava roots is also used to reduce cyanogenic concentration.

Cooking/boiling is enough for the removal/inactivation of trypsin inhibitors from sweet potato because, it is destroyed by heat. Microwave baking (180 seconds), boiling, oven drying and converted to flour is also effective to reduce TIA.

The major proportion of alkaloids in potato is seen in first 1 mm from the outer surface and reduce towards inside. Peeling of the outer skin (3-4 mm) before cooking will help to remove a major share from potato. Because, solanine needs a higher temperature for decomposition. Also, its content begins to rise when sprouting. Therefore, avoid consumption of sprouted potatoes.

The tubers are peeled, sliced and soaked in water for up to seven days for the detoxification of yam from dioscorine. The quantity of tannins in yams can also be removed by thermal treatments like soaking, blanching and cooking because of its high reactive nature.

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For the removal of calcium oxalate from aroids, peeling of outer skin from corms and blanching in boiling water or soaking, boiling and cooking can be done. Fermentation can also be done during processing.

Conclusion

Tuber crops are important food source among worldwide, especially in developing countries. The presence of antinutritional factors hinders them from consumption. Proper knowledge about these factors and removing techniques should be essential for the uptake of tubers. There are varieties which contain less level of these factors; therefore, cultivation and commercialisation of these varieties help to reduce toxicity or disorders due to these factors. Adoption of biotechnological approaches also used to lower the effect. These factors are present in lower doses in tubers; if the level goes beyond limit only it will become a problem. Therefore, adoption of proper cultivation practices, varieties and use of standard processing technologies can be used to reduce this element from tuber crops.

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Agro-Ecosystem Analysis (AESA) Based Integrated Pest Management

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Introduction

Agriculture being the backbone of our country contributes tremendously towards national food security. India is producing more than 284 Million tons of food grains every year achieving tremendous success over the year. The increased production and productivity are mainly because of use of improved crop varieties, proper management of nutrients, and good crop management. Though the country achieved self-sufficiency in food grain production, we are still importing some of the commodities like pulses and oilseed crops to meet nation's requirement. Over the years, the changes in climate (increased Temperature, Rainfall, CO_2) have raised concerns on agriculture production. Apart from this, agriculture also facing a number of biotic and abiotic constraints (Jena et al., 2018). Among them, biotic stress caused by insect pests and disease-causing pathogens stands out as important problems that every crop is facing. This ultimately leads to reduction in production and productivity. Insect pests are the important obstacles causing more than 30% of yield loss every year. There are various management options starting with use of resistant varieties, cultural management, biological control and finally use of fungicides. All these measures are employed under the umbrella of integrated pest management (IPM) to keep the pest level bellow economic threshold level.

The integrated pest management (IPM) has been evolving over the decades to address the deleterious impacts of synthetic chemical pesticides on environment ultimately affecting the interests of the farmers. The basis of IPM was Economic threshold level (ETL) which is being followed for several decades. But, in modern IPM, a new concept called Agro ecosystem analysis (AESA) is being introduced where farmers make decisions based on larger range of field observations in his/her field. The plant's health is determined by its environment which includes physical factors like soil, rain, sunshine hours, wind etc, and biological factors like pests, diseases and weeds play crucial role in ana ecosystem. Understanding the intricate interactions in the ecosystem play a critical role in pest management.

Steps in Agro Ecosystem Analysis (AESA)

Critically, AESA involves three steps, A. Observation, B. Analysis, C. Decision making.

1. Observation: Enter the field at least 5 ft away from the bund. Select a site with a dimension of 1 sq. mt. visual observations are recorded on flying insects (both pests and defender), pests and defenders which remain on plants, pests like stem borer that remain under soil. Disease incidence, insect damage, types of weeds, their size and population density in relation to crop plant, soil conditions are also recorded. Rodent live burrows are observed and climatic. Factors viz. sunny, partially sunny cloudy, rainy etc. for the preceding week are also recorded.

2. Analysis: When participants of IPM training learn to do an agro-ecosystem analysis (AESA) they will make a drawing on a large piece of paper, in which they include all their observations. The advantage of using a drawing is that it forces the participants to observe closely and intensively. It is a focal point for the analysis and for the discussions that follow, and the drawing can be kept as a record. Draw pest and defenders on the chart. Indicate the soil condition, weed population, rodent damage etc. draw healthy plants with green colour, and diseased plants with yellow colour. Pests and defenders are drawn at appropriate part or the plant where they are seen at the time of observation.

3. Decision making: Decision making in pest management requires a thorough analysis of the agro-ecosystem. Farmer has to learn how to observe the crop, how to analyse the field situation and how to make proper decisions for their crop management. AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse the field situations with regards to pests, defenders, soil conditions, plant health and the influence of climatic factors and their relationship for growing a healthy crop.

Principles of AESA Based IPM

Grow a healthy crop:

1. Select a variety of resistant/tolerant to major pests.
2. Grow certified seeds.
3. Treat the seed with recommended pesticides especially biopesticides.
4. Follow proper spacing.
5. Soil health improvement (mulching and green manuring).
6. Nutrient management especially organic manures and biofertilizers based on the soil test results. If the dosage of nitrogenous fertilizers is too high the crop becomes too succulent and therefore susceptible to insects and diseases. If the dosage is too low, the crop growth is retarded. So, the farmers should apply an adequate for best results. The phosphatic fertilizers should not be applied each and every season as the residual phosphate of the previous season will be available for the current season also.
7. Proper irrigation.
8. Crop rotation.

Components of Agro-Ecosystem Analysis (AESA)

Agronomic data (Weekly)	Plant Protection data (Weekly)	General Data (Weekly)
Plant Height	Counting insect pests	Variety
Number of leaves/plants	Counting natural enemies	Days after planting
Number of flowers/plants	Disease incidence	Weather conditions
Number of fruits/plants		Soil conditions
Weight of the harvested product		

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Economic Importance and Production Technology of Okra

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Introduction

Okra:

Scientific name: *Abelmoschus esculentus* L.

Family: Malvaceae.

Chromosome number : 2n=72, 108,130.

Origin: Asiatic region / Etthiopea/ Africa.

Common names: Bhendi, Lady's Finger.

Economic Importance and Uses

Okra has nutritional as well as medicinal value. The green tender pod contains oxalic acid, thiamine, riboflavin, nicotinic acid and also vitamin A, B and C. Calcium content is very high as compared to other vegetables, which is about 66 mg per 100 g. The okra pod is excellent source of iodine which is necessary for the resistant against throat disease like Goitre. It is good for the people suffering from heart weakness (Yawalkar, 1969). Its ripe seeds are roasted, ground and used as a substitute for coffee in some countries. Mature pods and stems containing crude fibre are used in the paper industry. Recently an attention has been given to the use of okra seeds as a source of proteins (about 20 per cent of dry matter) and vegetable oil (about 14 per cent of dry matter). The greenish yellow edible oil has a pleasant taste and odour, and is high in monounsaturated fatty acids (oleic) and palmitic acid (Martin and Rhodes, 1983) and high lysine level (Al-Wondawi, 1983).

Area and Production

Globally India ranks first in okra production having area of 509 thousand hectares with an annual production of 6094.9 thousand tons and productivity of 12 million tonnes/ha. The crop is grown throughout India, Gujarat is the leading okra producing state which has production of around 921.72 thousand tons from an area of 75.27 thousand ha, with a productivity of 12.25 tonnes/ha.

It is followed by West Bengal (914.86 thousand tonnes from 77.5 thousand ha with 11.5 tonnes/ha productivity. In Uttar Pradesh having area (22.93 ha), production (307.29 tonnes) and productivity (13.40 metric tonnes/ha) of okra.(NHB 2018-19).

Popular Varieties

Pusa Makhmali, Pusa Sawani, Arka Anamika (Selection 10), Arka Abhay, Punjab Padmini, Punjab -7, Parbhani Kranti, Varsha Uphar (HRB 9-2), Gujarat Bhendi-1.

Climate

1. It is basically adapted to tropical climate and vigorous warm humid weather for best growth and production.
2. Seed germination optimum soil moisture and a temperature range between 25 and 35°C. fast germination observed at 35°C.
3. Seeds fail to germinate below 17°C and temperature above 42°C flower buds in most of the cultivars may desiccate and drop causing yield losses.
4. The optimum temperature range for growth is 20- 30°C.

Soil

It can be grown in all kinds of soils ranging from sandy loam to clay. However, high yields can be obtained in loose friable, well manured loamy soils having better drainage. The soil optimum pH for okra ranges from 6-6.8.

Seasons

Sowing in plains is done in June-July for kharif and February-March for spring summer crop. The best time is from May 25th to June 25th. In hilly region, the crop is sown from April to July.

Seed Sowing

Seed is sown directly in the soil by seed drill, hand dibbling or behind the plough.

Seed Rate

The recommended seed rate per ha is 18-22 kg for spring summer crop and 8-10 kg for kharif crop.

Spacing

Plant distance of 60 X 30 cm accommodating 5000 plants/ha is recommended for branching types. 45 X 30 cm accommodating 66,000 plants/ha for non-branching type. spring summer season with less plant growth these spacing is kept at 45 x 20 cm or Less. The seed should be sown at a depth of 2.5cm.

Manures and Fertilizer

The quantity of manures and fertilizers depends upon the type of soil, but in normal condition 25 tonnes of FYM should be added at the time of last harrowing. In addition to this, 125kg N, 75kg P and 63 kg K/ha will be required in medium type of soils.

Irrigation

During kharif, irrigate the crop as and when required. In summer season the crop should be irrigated at an interval of 5-6 days. Flooding of plants should be avoided.

Weed Control

Fluchloralin @1.5kg a.i/ha as pre sowing soil incorporation and alachlor @ 2kg a.i/ha as post sowing gives control of weeds.

Use of Chemicals and Growth Regulators

The highest average fruit yield was obtained with cycocel at 400 ppm as foliar spray (Shaik Moulana et al. 2020). The highest average fruit set and yield were obtained with cycocel at 400 ppm as seed soaking for 24hrs on seed treatment by GA (400 ppm), IAA (200 ppm) or NAA (20 ppm) enhanced germination, ethephon (100-500ppm) reduced vegetative growth and weakened apical dominanc.

Physiological Disorder

Poor seed germination: Seed germinate poorly when soil temperature remains at or below 200C. The problem occurs during early spring summer cultivation when seed are to be sown at low temperature condition.

Control:

a. Soaking the seeds in water for 24 hours.
b. Soaking the seeds in hot water at 450C for 1 ½ hours.
c. Seed treatment with alcohol for half an hour.

Harvesting

The pods should be harvested when they are immature and green and have attained edible size. In general, harvesting every alternate day is advisable. Field is divided into blocks to ease harvesting at one or two intervals. The best length at which the pods should be harvested is 8 to 10 cm. For distant market harvesting in the late evening and transporting the produce during coolness of night is practiced.

Yield

An average yield of 8 tonnes green fruits per hectare during spring-summer and 12.5 tonnes during rainy season.

Storage

Fruits could be stored at 7-90C temperature and 70- 75% RH for a couple of days without much loss in colour, texture of weight. The pods can be stored at room temperature for 2-3 days if water is sprinkled on the pods during day and once in night to keep them cool and fresh.

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Doubling Farmers Income through Adoption of High-Density Plantation of Apple Under Kashmir Conditions

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India being endowed with varying climatic conditions provides ample opportunity for the development of horticulture. With a production of 153 million MT, India has emerged a major global player in horticulture. Horticulture is expected to have accelerated growth rate above 7 per cent for achieving overall growth of agriculture to the tune of 4 per cent. In the task of achieving the higher growth rate, hi-tech interventions like precision farming in horticulture is essentially required, as horticultural crops, whether it be a fruit, vegetable, flower, spice, medicinal and aromatic plant or plantation crop, respond to technologies like micro-propagation, micro-irrigation, fertigation etc. In order to optimize the use of resources and improve the returns to the farmers, these technologies have to be adopted Despite impressive research achievements and support to developmental activities by the Government of India, temperate fruit production is dogged by several constraints that need to be addressed effectively like, low productivity, depleting land resource, post-harvest losses and value addition, climate change, and inadequate market linkage etc. These challenges need to be tackled appropriately bearing in mind the fragile natural resources, coupled with expected climatic aberrations for long-term sustainable farming technologies. Presently the continuing decline in the availability of cultivable land, rising energy and land costs together with the mounting demand of horticultural produce, has given thrust to the concept of high-density planting of horticultural crops. No doubt there has been manifold increase in the area, production and productivity of temperate horticultural crops since independence, but the increase has neither been concomitant with the increase in population, nor the imports have been curtailed. Moreover, the productivity has not kept pace with the international level because the indigenous genetic sources have remained untapped and unexploited and the exotic genetic resources have not been made use of.

Horticultural industry in Jammu and Kashmir State has made rapid strides during the last few decades. Compared to 1954-55, the area under fruits in the state increased by 16 times and the production has shoot up to 60 times. Among the temperate fruits, apple ranks first covering 43.30 per cent area and 80.18 per cent production. Yield of apple has shown an increase from 4.12 to 10.87 MT/ha (1975-2019). Though it appears to be highest among the apple producing states in the country, yet it is far below the level achieved by advanced countries where productivity is of 50-60 MT/ha.

Our Productivity vs World Highest Productivity

Fruits	State Productivity (MT/Ha)	Highest Productivity in the world MT/Ha)	Country
Apple	10.87	70.89	Austria
Walnut	1.29	25.66	Slovenia
Almond	0.46	5.00	USA
Pear	5.52	37.00	Belgium
Cherry	4.30	10.00	Romania

In the state of J&K, the low quality of apple is mostly linked with mono-culture of a few old cultivars like Red Delicious, Royal Delicious, Maharaji, American Apirouge, Golden Delicious, Benoni and Irish Peach etc and their degeneration over the years. Among these cultivars, Red and Royal Delicious are the pre-dominant variety constituting more than 70% of the total production of apples. More-over these varieties have developed strong tendency of alternate bearing which accounts for low production during the off-years. Serious problems of pollination, apple scab disease and outbreak of premature leaf fall and infestation of red spider mite are causing great concern.

In advance countries of the world, the productivity is increasing manifold but in India it is still static. Continuous decline in land availability and natural resources coupled with increasing demand of fruits for increasing population has compelled scientific community to develop an efficient technique of high-density planting coupled with use of clonal rootstocks to boost production. This high-density planting system is a very intensive form of production system which has significant relevance to food and nutritional security to meet the demand of populous country like India. For getting higher production of high-density planting is one such technology which is defined as planting at density in excess of that which suffices to give maximum crop yield at maturity if individual tree grows to its full natural size. This is one of the improved production technologies. Yield and quality of the produce are two essential components of the productivity. High density planting aim to achieve the twin requisites and reproductive load without impairing the plant health. High density planting technique was first established in apple in Europe during sixties and now majority of apple orchards in Europe, America, Australia and New Zealand are grown under this technique. In high density planting, four planting densities are recognized viz. Low HDP (<250 trees/ha), moderate HDP (250-500 trees/ha), high HDP (500 to 1250 trees/ha) and ultra-high HDP (>1250 trees/ha). Recently super high-density planting system has been also established in apple orchards with a plant population of 20,000 trees/ha which is often referred as 'meadow orchards', (Anderson et al., 1977).

High density orchards require trees propagated on dwarfing rootstocks. Presently, only three commercially available rootstock groups or types can be recommended to develop a high-density orchard system. Having small trees is not enough; the trees must bear fruit early in the life of the orchard. The rootstocks that are commercially available to fit this niche are M.9, M9-T337,M9-T339,MM-106 and M.26. No perfect rootstock exists, and the limitations and strengths of each rootstock must be evaluated to select the rootstock that performs best in a specific situation. Table 1 lists the major advantages and disadvantages of different rootstocks. Trees propagated on these rootstocks for high density systems need to be supported and irrigation is strongly encouraged. Although only a few rootstocks are available for high density planting systems at present, several promising selections are under evaluation. Many different training systems are being promoted for high density orchard management. Fig 2 illustrates the four major systems currently in use, including the central leader, vertical axis, Hybrid Tree Cone (HYTEC), and the slender spindle, (Fant et al., 1992).

The training system does not significantly affect productivity in the first three years if the trees are not pruned heavily. Tree density, or more accurately light interception, is the factor that affects early production. The training system is a greater factor later in the life of the orchard when the system may affect light distribution within the tree canopy. Mature orchard systems that have at least 70% light interception have greater yields than systems that intercept less light. Light interception in trees is frequently reduced by allowing branches in the top of the tree to shade lower branches. This shading results from a lack of limb removal, or improper limb placement or orientation.

All lateral branches with wide crotch angles should be maintained for the first 3-5 years to maximize early fruit production. A lower whorl of scaffolds should be identified as permanent and others should be removed as shading becomes a problem. There may also be a second semi-permanent whorl approximately 12 inches above the first that should also be identified and removed as shading becomes a problem. Permanent whorls are maintained in the lower portion of the tree as there is some concern about a lack of vigour and light in that area of the tree. The permanent whorls should be spread out to approximately 85° from vertical to encourage lateral branching and floral initiation. Above the second whorl of scaffolds all branches should be renewed every 3-4 years. These lateral branches will be cropped for several years. As the diameter of the lateral approaches 50% of the leader's diameter, the lateral is removed by a cut at a downward angle, referred to as a Dutch cut This cut allows latent buds on the bottom of the stub to grow, giving rise to lateral limbs with wide crotch angles.

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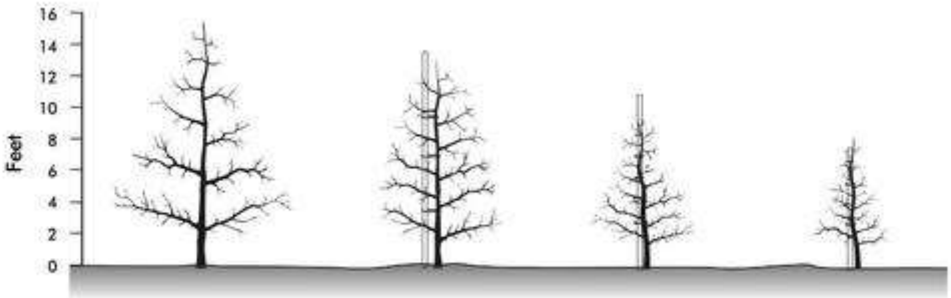
It is also imperative to maintain the conical shape of the tree to allow optimal light distribution within the canopy. However, in the first 3-4 years there should be minimal pruning done, using tree training techniques such as bending, spreading, etc. approximately every six weeks during the growing season.



Characteristic	Freestanding Central Leader	Vertical Axis	HYTEC (Hybrid Tree Cone)	Slender Spindle
Tree height (feet)	12-14	10-14	9-11	7-8
Tree spread at the base (feet)	9-11	5-7	5-7	3-5
In-row spacing (feet)	10-15	5-6	5-6	4-5
Between-row spacing (feet)	15-22	13-15	11-14	10-12
Density (trees/acre)	132-290	500-700	500-900	700-1,000
Rootstocks	M.7, MM.106, MM.111	M.9, M.26, M.7	M.9, M.26	M.9
Support system required	no	yes	yes	yes
Yield expectations, years 2-4	low	medium to high	high	high
Yield expectations, years 5-10	medium	high	high	high
Central leader pruning	headed annually	no pruning	remove to a weaker lateral; may head or snake depending on tree vigor	remove to a weaker lateral

* Note: Table adapted from *Intensive Orchard Management*, by Bruce H. Barritt, Good Fruit Grower, Yakima, Wash., 1992.

Fig: 2

The underlying principle of high-density planting is to make the best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and resources. For success of high density planting, several factors are involved, however among different factors which are responsible for high density, the use of right clonal rootstock is of utmost importance in terms of tree vigour control, inducing precocity, uniformity, improving the quality and yield, providing resistance against the drought and excess moisture and tolerance to insects like woolly aphids and diseases like root rot and collar rot. The exact limits of plant density vary with the region, variety, rootstock, cost of planting material, labour and the likely return from the orchard and agro-techniques adopted for a particular crop. So high density plantation not only helps in increasing the yield manifold but higher returns and better premium price will eventually improve the economic status of the farmer as well as shift from old traditional orchard system to high density orchards.

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Capsule Rice Cultivation

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Summary

In recent times ,the agriculture is affected by climate change, insufficient water and labour needs. We have the compulsion to adapt the new agricultural practices as we need. To decrease the water usage, labour cost capsule method is recommended.

Introduction

Rice is the seed of the grass species *Oryza glaberrima* (African rice) or Oryza sativa(Asian rice). It is a monocot, normally grown as an annual plant. It is grown under an extremely broad range of solar radiation ranging from 25% of potential during the main rice , season in portion of Myanmar, Thailand and India's Assam state to approximately 95% of potential in Egypt and Sundan.

In India as well as world ,the staple food grain is rice. Vietnam is the rice bowl of world and Andhra is the rice bowl of India. In India ,the production of rice is 281.37 million tonnes in 2018-2019. In Tamil Nadu, the production is up to 7.98 million tonnes in 2.04 million hectares. The capsule method not only suitable for rice but also suitable for vegetables, grains, millets etc.

Preparation of Capsule

1. The capsule is made up of thin layer of gelatin or starch.
2. It weights up to 750 mg to 1 g and its praise is Rs. 2 each.
3. Sixty thousand capsule is requiring per acre of land.
4. The seed is selected according to germinated test after feeding capsule with pre germination paddy seeds at the ratio of 1:1.

5. The seed requirement for one-acre land is 30 kg.
6. The capsule is filled with two seeds , humic acid, micro nutrients and neem powder.
7. The filled capsule is sow at the depth of 2-3 cm in the prepared land.
8. The capsule is sow at the space of 25 cm×25cm.
9. It germinates one week to fifteen days when the field gets irrigate.

The Needs for Preparing Capsules

Needs	Required for one acre	Amount (the praise is based on company)
Seeds	30 kg	Rs.60/kg
Capsule	60,000	Rs.2/capsule
Humic acid	10 kg	Rs.200/kg
Neem seed powder	10 kg	Rs.100/kg

Advantage

1. It reduces water consumption.
2. The diseases caused by pests and pathogens are reduced.
3. The root disease and weeds are reduced.
4. Tillers is increased from 60 to 80 tillers/hill.
5. Germination of seed is 99%.
6. The fertilizer and labour cost is reduced.

Disadvantage

1. The capsules may be getting damage by birds and rats.
2. The capsule get melts above 37° C, so it is not suitable for cold region.

Difference Between Normal Cultivation and Capsule Cultivation

Normal cultivation	Capsule cultivation
Seed requirement is high.(40 kg/acre)	Seed requirement is low.(30kg/acre)

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Nursery preparation is required (Rs.1000/acre)	Nursery preparation is not required
Labour cost is high.(transplant labour cost Rs.2500/acre)	Labour cost is low.
Water requirement is high.	Water requirement is low.
Root borne diseases are caused in nursery bed.	The seeds are protecting from root borne diseases.

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Impact of Lockdown During COVID-19 - A Way Forward for Opportunities in Agriculture

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Summary

The Indian agriculture has taken an enormous hit from the coronavirus pandemic and resultant lockdowns which has put new challenges in front of a sector that is already under threat, Telangana was not an exception to it. The nationwide lockdown came at an unfortunate time for farmers, because it was the harvest season for the rabi crop. Hence, it is important to understand the challenges faced, opportunities provided and strategies for doubling farmers income in times of pandemic. Lockdown created both a shortage of labour and equipment. Consequently, farmers have not been able to harvest their bumper crops of cereals like paddy, maize, oilseed crop like sesame and fruit crops like mango, watermelon and vegetables. Due to this, the crops have been abandoned with limited and more expense labour. The government economic package contains both long-term as well as short term measures to the agricultural sector which will play a key role in bringing the economy back on track post-Covid-19 with strategies like Farmer Producer Organizations (FPOs), digital marketing, mechanization and supply chain strengthening.

Introduction

The COVID-19 pandemic in India is part of the worldwide pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first case of COVID-19 in India, which originated from China, was reported on 30 January 2020. On 22 March, India observed a 14-hour voluntary public curfew at the instance of the prime minister Narendra Modi. It was followed by mandatory lockdowns in COVID-19 hotspots and all major cities. Further, on 24th March, the Prime Minister ordered a nationwide lockdown for 21 days, affecting the entire 1.3 billion population of India. On 14th April, the PM extended the nationwide lockdown till 3rd May which was followed by two-week extensions starting 3rd to 17th May with substantial relaxations. The farmers faced difficulty during this lockdown period.

Main Body

It was observed that, Paddy, Maize, Turmeric, Sesame, mango and vegetable growing farmers were mostly affected in the state of Telangana in general and northern part of Telangana in particular during lock down period. shortage of labour and increased labour wages for harvesting of rabi crops was observed to be the major constraints. Whereas, lack of marketing facilities was the major problem for Turmeric, sesame growing farmers. Lack of remunerative price was observed as the major constraint for fruit and vegetable growing farmers. In addition to this, the farmers faced problems due to inadequate supply of inputs for the next kharif season viz., lack of supply of vermicompost and seeds etc. as the major problems faced during the lock down.

The below strategies were formulated for the sustainable agriculture.

Major Challenges, Opportunities and Strategies

1. Labour Shortage hits harvest of rabi Crops and revealed scope for mechanisation: Due to this lockdown reverse migration of labour took place. The nationwide lockdown has triggered the labour shortage. Harvesting of rabi crops, especially Paddy, sesame, mango and vegetables. Especially mango farmers faced a severe labour scarcity phenomenon. The major source of labour is from Maharashtra. Most of the labour has returned to their home after lockdown before 24th March due to fear from COVID-19 and has to faced wage disruptions. Even though government offered procurement of paddy and maize at MSP, marketing practices like loading, unloading and weighing are mostly operated through the migrant workers. Lockdown results in the shortage of migrant labours, which creates challenging situations in front of the farmers and traders which resulted in increased labour wages.

Hence, a way towards seed to seed mechanisation may solve the problem of labour shortage. Hence, government as well as farming community has to take initiative measures towards mechanisation.

2. Lower availability of agricultural equipment's and scope for strengthening custom hiring centres, imparting skills to the unemployed rural people: The primary aim of the lockdown is to stop the spread of coronavirus. But lockdown has a negative effect on the demand for agricultural equipment and tractors. Labour scarcity has prompted the mechanisation activity. In India, around 95 per cent tractors are purchased on credit basis and most of the machinery was on hired basis which are coming from neighbouring states which requires skills.
Hence, in addition to strengthening government policies towards establishment of custom hiring centres, trainings may be provided for rural youth regarding technical skills required in agricultural operations and migrant labour may utilize this opportunity as a source of self-employment.

3. Drop in the prices of perishable Commodities and scope for Farmer Producer Organisations & digital marketing: Most of the farmers are marginal and small farmers and they are in distress sale. Due to lockdown, they are forcibly selling their farm produce at lower market price and facing economic challenges. As bulk demand from hotels and restaurants has dropped and there is uncertainty over exports, the prices of agricultural commodities such as perishable vegetables, mangoes and watermelon fallen 15-20 per cent. The price for mangoes was fallen from Rs. 50 to 20 per kg.

This problem may be overcome by creating online marketing facilities for the farmers which was beneficial for both producers as well as consumers for realizing better prices. In addition to digital marketing, strengthening the FPOs may also helpful to conquer the situation as the FPOs are expected to enhance incomes, reduce costs of input purchases along with transaction costs, create opportunities for involvement in value-addition including processing, distribution and marketing, retail marketing, women empowerment, enhance bargaining power and provide access to formal credit. Existing facilities like e-NAM (electronic National Agricultural Marketing) may be utilized by the farming community where cold storage facilities are also available which results in elimination of middlemen, dependency on private money lenders, colluded traders and unorganized marketing practices.

4. Drops in dairy products demand and improved scope for storage facilities & value addition: As livestock is an integrated activity to most of the farmers, the closure of hotels, restaurants created huge losses to the farming community as these are the bulk consumers of dairy products. Due to lockdown, these are shuttered down, and also there is a ban on inter-state trade. Therefore, demand, as well as sales of dairy products, drastically reduced. There is a demand for dairy products in metros and other regions, but manufacturers are not able to transport due to restrictions.

Hence, government may take initiative measures for improving storage facilities and start-ups may be encouraged at village and district levels with public-private partnerships to make value added products to improve the shelf life of the same. Whereas farming community has to utilize the existing opportunities to move towards growing needs of people.

5. Lockdown hits poultry farmers and scope for role creating awareness about food & nutritional security: Some of the farmers engaged in poultry farming as it is the additional and continuous income generating enterprise. But due to lockdown poultry industry was affected tremendously. First, the spread of rumours about linking chicken consumption with coronavirus pandemic in social media. After those misconceptions allayed due to awareness campaign and circular from the Department of Animal Husbandry & Dairying, the poultry farmers are facing the lockdown situation. Therefore, the poultry industry has faced a double whammy problem. The result of this rumour and lockdown is decreasing in chicken demand and the price was dropped from Rs. 150 to 40 per kg. after few days, the prices were hiked to a level of 250 per kg. which resulted in benefits to the same.

Hence, farming community has to create awareness on marketing aspects and has to practice allied activities in addition to the agriculture which results in additional income in times of uncertain situations like Covid-19.

6. Difficulty in meeting export specifications and scope for social media role in agriculture: APMCs (Agricultural Produce Market Committees) are the bulk suppliers of fruits, vegetables, flowers and grains in each district. To prevent the overcrowding and facilitate the implementation of lockdown, most of the APMCs are closed in the beginning. After the initiation of procurement process, the farmers faced difficulty in meeting the export standards with reference to moisture content, shrivelled grains etc.

Hence, Covid-19 expelled the scope for awareness creation to the farming community regarding the quality specifications for the export of commodities and mass or social media usage by the agriculture department may be strengthened which is the need of hour. The farmers have to realize their strengths and utilize the existing opportunity in decision making and move forward towards realizing better prices.

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Organic Farming – Overview

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Introduction

Organic farming, extensively considered to be a more productive and sustainable approach has also won much accolade for its diversified applications, techniques and above all its eco-friendly aspect. This system that categorically casts away the use of chemical fertilizers, growth regulators, soil and feed additives, pesticides and other similar synthesized products, substantially encourages the employment of conventional and benign modern agricultural techniques like crop rotation and bio-fertilizers. This in turn boosts the soil's health and productivity and also helps to effectively counter the onslaught of pests and weeds. Succinctly, organic farming will yield in healthy, natural and reliable produce.

Organic food, but bears upon the consumer additional costs effecting from the various processes and procedures it passes through, including organic certification, especially if they are to be exported, in order to ensure quality. The Government of India makes it mandatory for the organic produce to be inspected and certified if to be exported.

Organic Farming Includes

1. Crop rotation: The method of seasonally cultivating various crops in the same farmland in order to effectively combat weeds, pests and also to replenish the soil nutrients.

2. Compost: The use of composted organic waste as fertilizer and soil amendment not only results in an economic benefit to the small- scale farmer but it also reduces pollution due to reduced nutrient run-off, and N leaching (Nyamangara, 2003).

3. Green manure: Organic growers are increasingly utilizing legume cover crops as green manures in rotations to meet Nitrogen needs of crops.

4. Biological pest control: The method employs the use of bugs like ladybugs, big-eyed bugs, minute pirate bugs etc. that are advantageous to the crops aided with natural permitted insecticides.

Four Pillars of Organic Farming

The four pillars of Organic farming (Roychowdhury et al., 2013) are:
1. Organic standards.
2. Certification/Regulatory mechanism.
3. Technology packages.
4. Market network.

Organic Farm Products

Organic farm produce in India enlists spices, fruits, vegetables, oil seeds, rice, tea. coffee etc.

Table 1. Major Organic farm products in India.

Type	Products
Commodity	Tea, Coffee, Rice, Wheat

Spices	Cardamom, Black pepper, white pepper, ginger, turmeric, vanilla, mustard, tamarind, clove, cinnamon, nutmeg, mace chilly.
Pulses	Red Gram, Black Gram.
Fruits	Mango, Banana, Pineapple, Grape, passion fruit, Orange, Cashew nut, walnut.
Vegetables	Okra, Brinjal, Garlic, Onion, Tomato, Potato.
Oilseeds	Sesame, castor, sunflower.

(Source: Salvador and Katke, 2003).

Advantages of Organic Farming

1. Healthy poison-free food.
2. Reduced growing cost.
3. Ensures soil nourishment.
4. Reduced water pollution.
5. Environment-friendly practices.

Disadvantages of Organic Farming

1. Lower productivity.
2. Requires skill.
3. Comparatively labour intensive.
4. Expensive.
5. Require certification.

Organic Certification

Organic food and agricultural products have to pass many levels and types of certification to be legally graded as organic produce. These are some of them:

Certification Process

1. Study the organic standards.
2. Compliance.
3. Documentation.
4. Planning.
5. Inspection.
6. Fee.

7. Record-keeping.

The Government of India has issued a public notice according to which no organic products may be exported unless they are certified by an inspection and certifying agency duly accredited by the accreditation agencies designated by the Government of India' (Salvador and Katke, 2003).

Limitations of Certification

1. The quality of the inspection process is not sufficient.
2. High certification cost.

Challenges

The major challenges that thwarts the acceptance of organic farming among farmers are the questions and uncertainties on the production methods, competition markets, market access, market value, distribution channels, certification process etc.

Conclusion

Organic farming is a safe and environment friendly technique of using eco-friendly substances and methods in farming that has the capacity to produce healthy and toxin free edible and non-edible products. This method retains and consistently helps boost the soil's fertility, organic content and microbial presence by using conventional as well as modern practices like organic manuring, crop rotation, compost fertilizers and pest repellents, multiple produce from the same farm land.

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Dioxins and their Effects on Human Health

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Introduction

Dioxins are a group of chemically-related compounds that are persistent environmental pollutants. They have the dubious distinction of belonging to the “dirty dozen” - a group of dangerous chemicals known as persistent organic pollutants. Dioxins are of concern because of their highly toxic potential. Experiments have shown they affect a number of organs and systems. Once dioxins have entered the body, they endure a long time because of their chemical stability and their ability to be absorbed by fatty tissue, where they are then stored in the body. Their half-life in the body is estimated to be seven to eleven years. In the environment, dioxins tend to accumulate in the food chain.

The chemical name for dioxin is: 2,3,7,8- *tetrachlorodibenzo para dioxin* (TCDD). The name "dioxins" is often used for the family of structurally and chemically related *polychlorinated dibenzo para dioxins* (PCDDs) and *polychlorinated dibenzofurans* (PCDFs). Certain dioxin-like polychlorinated biphenyls (PCBs) with similar toxic properties are also included under the term “dioxins”.

Sources of Dioxin Contamination

Dioxins are mainly by products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. They also can be produced during bleaching of paper pulp and the manufacture of certain chlorinated chemicals like polychlorinated biphenyls (PCBs), chlorinated phenols, chlorinated benzene and the manufacturing of some herbicides and pesticides. Exhaust from vehicles, forest fires, and burning wood also releases dioxins into the air. Very small amounts of dioxins, that are not considered harmful, are present in bleached paper products including facial or toilet tissue, paper towels, and disposable diapers.

In terms of dioxin release into the environment, uncontrolled waste incinerators (solid waste and hospital waste) are often the worst culprits, due to incomplete burning. Dioxins are found throughout the world in the environment. The highest levels of these compounds are found in some soils, sediments and food, especially dairy products, meat, fish and shellfish. Very low levels are found in plants, water and air. Surface water bodies can become contaminated when rainwater carries soil containing dioxins into surface water and when some industries discharge their dioxin-contaminated waste directly into surface water. Dioxins do not easily dissolve in water, so they tend to settle to the bottom and cling to the sediment. Dioxins last for a very long time in the environment before breaking down. In surface waters and sediments, dioxins can pass into aquatic organisms and eventually find their way into the food chain. Dioxins are easily absorbed by animals and are stored in fatty tissue.

Exposure of Dioxin

Most people are exposed to dioxins by eating meat, dairy products, fish and other seafood. Dairy products and meat from grazing animals have lower dioxin levels than fish or other seafood. Fruits and other fresh produce can have dioxins in small amounts on their outer surfaces from pesticide sprays or contaminated dust. Freshwater fish such as carp, catfish or buffalo fish that feed on microscopic plants and animals could ingest dioxins present in the sediment. They are often eaten by larger animals, and the dioxins get into their body fat. People are generally not exposed to dioxins in surface water unless they contact contaminated sediments.

Dioxins also can enter your body through the air you breathe or by skin contact. Agricultural workers using pesticides or solvents may be exposed to dioxins. Industrial accidents have been responsible for most cases of dioxin poisoning in humans. Firefighters and clean-up crews responding to electrical system fires and hazardous waste accidents also may be exposed to dioxins.

Effects of Dioxins on Human Health

Dioxins are absorbed into the human body through the digestive and respiratory tracts or through skin contact. They are then distributed throughout the body. Dioxin exposure can cause a severe skin condition called chloracne, which results in small, pale yellow skin lesions that may last from weeks to years. Dioxins can cause short-term liver effects without any visible symptoms. A large historical study suggested workers exposed to dioxins for many years had increased cancer rates. However, other environmental factors may be related to the cancer. Studies have shown that reproductive, immune and nervous systems of the developing fetus and children are more susceptible to dioxins. The developing foetus is most sensitive to dioxin exposure. The new-born, with rapidly developing organ systems, may also be more vulnerable to certain effects. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions.

In animal studies, dioxins have caused nerve damage, birth defects, increased rates of miscarriages and changes to the immune system. Although the U.S. Environmental Protection Agency has classified dioxins as a probable human carcinogen (cancer causing chemical), there is not sufficient evidence to prove that dioxins cause cancer from exposure to the low levels normally found in the environment. One dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), is listed as a known human carcinogen and all the others as probable human carcinogens.

Test for Dioxin Level

Tests are available to measure dioxins in the blood, body fat and breast milk. A blood test is the best method for measuring exposure to large amounts of dioxins. Although measuring dioxins in the body is possible, the analysis is expensive, time-consuming and not generally recommended because results do not predict whether one might develop harmful health effects.

Prevention and Control of Dioxin Exposure

Proper incineration of contaminated material is the best available method of preventing and controlling exposure to dioxins. It can also destroy PCB-based waste oils. The incineration process requires high temperatures, over 850°C. Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of dioxins as much as possible. This is the responsibility of national governments, but in recognition of the importance of this approach, the Codex Alimentarius Commission adopted in 2001 a Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001), and in 2006 a Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Food and Feeds (CAC/RCP 62-2006).

More than 90% of human exposure to dioxins is through the food supply, mainly meat and dairy products, fish and shellfish. Secondary contamination of the food supply needs to be avoided throughout the food-chain. Good controls and practices during primary production, processing, distribution and sale are all essential to the production of safe food.

Food contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded. The exposed population should be examined in terms of exposure (e.g. measuring the contaminants in blood or human milk) and effects (e.g. clinical surveillance to detect signs of ill health).

Dioxins accumulate in fish fat, so removing skin and trimming the fat before cooking will help reduce dioxin intake. Barbecuing, broiling or baking fish on an elevated rack to allow fat to drip away helps further reduce exposure to dioxins. Another way to reduce exposure to dioxins is to thoroughly wash fruits and vegetables to rid them of any leftover pesticide or herbicide before eating. Persons who burn household, municipal or industrial waste should minimize their exposure to the smoke and ash. Also, a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source.

Role of WHO Related to Dioxins

Reducing dioxin exposure is an important public health goal for disease reduction, also with respect to sustainable development. In the latest of such expert meetings held in 2001, the Joint FAO/WHO Expert Committee on Food Additives performed an updated comprehensive risk assessment of PCDDs, PCDFs, and "dioxin-like" PCBs. The experts established a provisional tolerable monthly intake of dioxine is 70picogram/kg/month. World Health Organisation is now working with the United Nations Environmental Programme (UNEP) on the implementation of the 'Stockholm Convention', an international agreement to reduce emissions of certain persistent organic pollutants, including dioxins. A number of actions are being considered internationally to reduce the production of dioxins during incineration and manufacturing processes.

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An Easy Way of Vermicomposting

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Introduction

Vermicomposting is the process of turning organic debris into worm castings. The worm castings are very important to the fertility of the soil. The castings contain high amounts of nitrogen, potassium, phosphorus, calcium, and magnesium. Castings contain 5 times the available nitrogen, 7 times the available potash, and 1½ times more calcium than found in good top soil. Several researchers have demonstrated that earthworm castings have excellent aeration, porosity, structure, drainage and moisture-holding capacity. The content of the earthworm castings, along with the natural tillage by the worms burrowing action, enhances the permeability of water in the soil. Worm castings can hold close to nine times their weight in water. Using earthworms to convert waste into soil additives has been done on a relatively small scale for some time.

Vermicompost and its Utilization

Vermicompost is nothing but the excreta of earthworms, which is rich in humus and nutrients. Rear earthworms artificially in a brick tank or near the stem / trunk of trees (especially horticultural trees). By feeding these earthworms with biomass and watching properly the food (bio-mass) of earthworms, the required quantities of vermicompost can be produced.

Materials for Preparation of Vermicompost

Any types of biodegradable wastes like, crop residues, weed biomass, vegetable waste, leaf litter, hotel refuse, waste from agro-industries and biodegradable portion of urban and rural wastes.

Vermicomposting

Stage I	Processing involving collection of wastes, shredding, mechanical separation of the metal, glass and ceramics and storage of organic wastes.
Stage II	Pre digestion of organic waste for twenty days by heaping the material along with cattle dung slurry. This process partially digests the material and fit for earthworm consumption. Cattle dung and biogas slurry may be used after drying. Wet dung should not be used for vermicompost production.
Stage III	Preparation of earthworm bed. A concrete base is required to put the waste for vermicompost preparation. Loose soil will allow the worms to go into soil and also while watering, all the dissolvable nutrients go into the soil along with water.
Stage IV	Collection of earthworms after vermicompost collection. Sieving the composted material to separate fully composted material. The partially composted material will be again put into vermicompost bed.
Stage V	Storing the vermicompost in proper place to maintain moisture and allow the beneficial microorganisms to grow.

Earth worms need five basic things: a hospitable living environment, usually called bedding, a food source, adequate moisture, adequate aeration and protection from temperature extremes.

Vermicompost Production Methodology

1. Selection of suitable earthworm: For vermicompost production, the surface-dwelling earthworm alone should be used. The earthworm, which lives below the soil, is not suitable for vermicompost production. The

African earthworm (*Eudrillus engenial),* Red worms (*Eisenia foetida)* and composting worm (*Peronyx excavatus)* are promising worms used for vermicompost production. All the three worms can be mixed together for vermicompost production. The African worm (*Eudrillus eugenial)* is preferred over other two types, because it produces higher production of vermicompost in short period of time and more young ones in the composting period.

2. Selection of site for vermicompost production: Vermicompost can be produced in any place with shade, high humidity and cool. Abandoned cattle shed or poultry shed or unused buildings can be used. If it is to be produced in open area, shady place is selected. A thatched roof may be provided to protect the process from direct sunlight and rain. The waste heaped for vermicompost production should be covered with moist gunny bags.

3. Containers for vermicompost production: A cement tub may be constructed to a height of 2½ feet and a breadth of 3 feet. The length may be fixed to any level depending upon the size of the room. The bottom of the tub is made to slope like structure to drain the excess water from vermicompost unit. A small sump is necessary to collect the drain water.

In another option over the hand floor, hollow blocks / bricks may be arranged in compartment to a height of one foot, breadth of 3 feet and length to a desired level to have quick harvest. In this method, moisture assessment will be very easy. No excess water will be drained. Vermicompost can also be prepared in wooden boxes, plastic buckets or in any containers with a drain hole at the bottom.

4. Vermiculture bed: A vermiculture bed or worm bed (3 cm) can be prepared by placing after saw dust or husk or coir waste or sugarcane trash in the bottom of tub / container. A layer of fine sand (3 cm) should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened with water.

In general, selection of bedding materials is a key to successful vermiculture or vermicomposting. Worms can be enormously productive (and reproductive) if conditions are good; however, their efficiency drops off rapidly when their basic needs are not met. Good bedding mixtures are an essential element in meeting those needs. They provide protection from extremes in temperature, the necessary levels and consistency of moisture, and an adequate supply of oxygen.

5. Worm food: Compost worms are big eaters. Under ideal conditions, they are able to consume in excess of their body weight each day, although the general thumb rule is ½ of their body weight per day. They will eat almost anything organic (that is, of plant or animal origin), but they definitely prefer some foods to others. Manures are the most commonly used worm feedstock.

6. Selection for vermicompost production: Cattle dung (except pig, poultry and goat), farm wastes, crop residues, vegetable market waste, flower market waste, agro industrial waste, fruit market waste and all other bio degradable waste are suitable for vermicompost production. The cattle dung should be dried in open sunlight before used for vermicompost production. All other waste should be pre-digested with cow dung for twenty days before put into vermined for composting.

7. Putting the waste in the container: The pre-digested waste material should be mud with 30% cattle dung either by weight or volume. The mixed waste is placed into the tub / container up to brim. The moisture level should be maintained at 60%. Over this material, the selected earthworm is placed uniformly. For one-meter length, one-meter breadth and 0.5-meter height, 1 kg of worm (1000 Nos.) is required. There is no necessity that earthworm should be put inside the waste. Earthworm will move inside on its own.

8. Watering the vermined: Daily watering is not required for vermined. But 60% moisture should be maintained throughout the period. If necessity arises, water should be sprinkled over the bed rather than pouring the water. Watering should be stopped before the harvest of vermicompost.

9. Harvesting vermicompost: In the tub method of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in a week. With hand the casting will be scooped out and put in a shady place as heap like structure. The harvesting of casting should be limited up to earthworm presence on top layer. This periodical harvesting is necessary for free flow and retain the compost quality. Otherwise the finished compost gets compacted when watering is done.

In small bed type of vermicomposting method, periodical harvesting is not required. Since the height of the waste material heaped is around 1 foot, the produced vermicompost will be harvested after the process is over.

10. Harvesting earthworm: After the vermicompost production, the earthworm present in the tub / small bed may be harvested by trapping method. In the vermined, before harvesting the compost, small, fresh cow dung ball is made and inserted inside the bed in five or six places. After 24 hours, the cow dung ball is removed. All the worms will be adhered into the ball. Putting the cow dung ball in a bucket of water will separate this adhered worm. The collected worms will be used for next batch of composting.

11. Nutritive value of vermicompost: The nutrients content in vermicompost vary depending on the waste materials that are being used for compost preparation. If the waste materials are heterogeneous one, there will be wide range of nutrients available in the compost. If the waste materials are homogenous one, there will be only certain nutrients are available. The common available nutrients in vermicompost is as follows

Advantages of Vermicompost

1. Vermicompost is rich in all essential plant nutrients.
2. Provides excellent effect on overall plant growth, encourages the growth of new shoots / leaves and improves the quality and shelf life of the produce.
3. Vermicompost is free flowing, easy to apply, handle and store and does not have bad odour.
4. It improves soil structure, texture, aeration, and water holding capacity and prevents soil erosion.
5. Vermicompost is rich in beneficial micro flora such as a fixer, P- solubilizers, cellulose decomposing micro-flora in addition to improve soil environment.
6. Vermicompost contains earthworm cocoons and increases the population and activity of earthworm in the soil.
7. It neutralizes the soil protection.
8. It prevents nutrient losses and increases the use efficiency of chemical fertilizers.
9. Vermicompost is free from pathogens, toxic elements, weed seeds
10. It enhances the decomposition of organic matter in soil.
11. It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.

Value of Vermicompost

Vermicompost, like conventional compost, provides many benefits to agricultural soil, including increased ability to retain moisture, better nutrient-holding capacity, better soil structure, and higher levels of microbial activity.

Application of Vermicompost

For one hectare of land 5 ton of vermicompost recommended for field application. Some experts even opine that 20-30 % recommended dose of chemical fertilizers be substituted with vermicompost. In horticultural plants vermicompost application is preferred and is applied by mixing equal quantity of cow dung manure. Application rate depends upon the age and size of plant. Method involves preparation of a ring around plant base of ½ to 1 feet depth and 1 to 2 feet wide. In this ring mixture of vermicompost and farmyard manure or cow dung manure is filled. Over this thin layer of soil is put and finally covered with organic matter comprising dry leaves, weeds, husk and coir. This process completes important step of mulching and then watering should be done.

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Crop Residue Management in India

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Crop residues are those parts of the plants left in the field after the harvestable parts of the crops (grain, tubers, roots, etc.) have been removed. Farmers didn't take care about the crop residues in the earlier times as they thought it is a waste material but there is an increase in awareness about the uses of crop residues in the last few years. Now crop residues are regarded as natural sources of minerals as well as microbial population. Retention of crop residues after harvesting is considered to be an effective anti-erosion measure. According to the Indian Ministry of New and Renewable Energy (MNRE), India generates on an average 500 Million tons (Mt here after) of crop residue per year (Bhuvaneshwari et al., 2019).

Agricultural crop residues are broadly divided into two types (Ramprasad, 2016):

1. Field residues: Materials left in agricultural land or plantation areas after harvesting the crop are known as field residues. Stalks, stems, seed pods, and leaves comes under field residues. The residues can be cultivated directly into the ground, or burned first. With proper management of these residues' efficiency of irrigation and control of erosion can be accomplished effectively.

2. Process residues: Materials or by products formed or released after processing useful materials are called as process residues. Bagasse, husks, seeds, roots, and molasses comes are the examples of process residues. These residues can be utilized as animal fodder and fertilizers for soil improvement.

Crop residues are sources of nutrients and organic matter. If incorporated in to soil, they enhance the microbial population of soil and improve the soil physical as well as chemical environment. Although crop residue recycling has so many advantages, farmers are burning the crop residues in the field itself in order to avoid the late sowing of next crop. Recently Delhi pollution has become national issue which was mainly due to the burning of rice residues of farmers of Punjab, Haryana and Uttar Pradesh in order to avoid the late sowing of wheat crop in rabi season. These residues produce huge amount of carbon dioxide during its burning in the field and hence accelerate in global warming. The PM emitted from burning of crop residues in Delhi is 17 times that from all other sources such as vehicle emissions, garbage burning and industries (Jitendra et al., 2018). Crop burning increases the PM in the atmosphere and contributes significantly to climate change. One contributor to global climate change is the release of fine black and also brown carbon (primary and secondary) that contributes to the change in light absorption (Gadde et al., 2000). Farmers generally believes that burning of crop residues improve the soil nutrient content which is not true. In fact, if we burn the crop residues in the field it increases the soil surface temperature to several times which kills the beneficial bacteria. If crop residue burning continued for several years, microbial population will be reduced to maximum extent which ultimately reduces the soil productivity.

The crop residues generated due to agricultural activities are being utilized by several countries in different ways. They are exploited in processed or unprocessed form, based on the end use. They can be used as animal feed, composting material and for production of bio fuels. They can be utilized in mushroom production also. According to Lohan et al. (2018), many countries such as China, Indonesia, Nepal, Thailand, Malaysia, Japan and Philippines utilize their crop residues to generate bio energy and compost. Crop residues can improve soil structure, increase organic matter content in the soil and preserves the moisture content in soil. They play a vital role in carbon sequestration which helps to mitigate the climate change. Good residue management practices on agricultural lands have many positive impacts on soil quality. Besides, crop residues can be used in bio fuel production. Waste crop residues have been recognized as a potential cellulosic feedstock and the largest source of biomass (Ali et al., 2019).

Biochar is a fine-grained carbon rich porous product obtained from the thermo-chemical conversion called the pyrolysis at low temperatures in an oxygen free environment (Amonette and Joseph, 2009). It is a mix of carbon, hydrogen, oxygen, nitrogen, sulphur and ash in different proportions. Biochar can be used as amendment to soil and helps in improving the water holding capacity of soil. Many researchers have reported an increase in pH, increase in earthworm population and decreased fertilizer usage (Gaunt and Cowie, 2009). Biochar can be used in various applications such as the water treatment, construction industry, food industry, cosmetic industry, metallurgy, treatment of waste water and many other chemical applications.

The major agricultural crops grown in the world maize, wheat, rice and sugarcane, respectively, account for most of the lignocellulosic biomass. Lignocellulosic biomass composed of cellulose, hemicellulose, and lignin, are increasingly identified as a valuable commodity, due to its abundant availability as a raw material for the production of biofuels. The idea of using biomass for liquid fuels, or bio fuels for sustainable energy production has got much attention from researchers, policy makers and investors, in the hope of providing solution to the energy crisis and to the need to reduce greenhouse gas emission. Clean energy produced from locally harvested biomass can increase these energy shortages and provide alternative economic source for farm community. Converting biomass to methanol and substituting it for fossil-fuel-based energy production is one viable option in locations that generate high biomass waste supplies (Vogt et al., 2005). Bio fuels are also believed to offer a new source of income to farmers and generate employment opportunities in rural areas, both in developed and developing countries.

Conclusion

Crop residue incorporation improves physical, chemical and biological properties of soil. In long-term incorporation of crop residue increases the productivity of soil. Retention or incorporation of crop residues to the soil improves the N economy of the cropping systems and improves crop productivity through the additional N and other soil benefits. Farmers, who burn the crop residues in the field or treat crop residues as waste material, will require demonstration of the relative benefits of residues return to soil for sustainable crop productivity. Creating awareness about crop residue management to the farming community and other related stake holders is crucially important to bring them out of generational thinking that they are used to that the waste management is not their responsibility. It is very important to empower them with technical as well as socioeconomic assistance. They should be educated about the advantage of reduced agrochemical cost due to the utilization of compost and the extra revenue they can receive through other type of recovery programs such as energy production.

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Indirect Impact of COVID-19 on Water Bodies and Wildlife

Article ID: 32121

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Abstract

The coronavirus (SARS-CoV2) has affected almost every country on this planet earth. This pandemic has caused much devastation in such a small period of time. It has caused not only loss to millions of lives but also severely affected the world's economy. It is ironic that positive indirect effects of this pandemic have been observed on water bodies and wildlife. Lockdown period as a preventive measure for deadly pandemic across the world has played a role of life saving ventilator for degraded mother nature.

Keywords: Coronavirus; Pandemic; Water bodies; Wildlife; Lockdown period.

Impact on Water Bodies and Wildlife

Increased industrialization and anthropogenic activities from the last decade have polluted all the spheres viz. atmosphere, hydrosphere, biosphere. Natural resources have been over-exploited by social animal because of his selfish nature. Today, a life-threatening coronavirus disease has spread to almost every corner of the world. To prevent the spread of this deadly infection, social distancing has imposed to prevent the people from leaving their home frequently. Normal life has halted across the globe for some period of time. Due to Covid-19 pandemic, many industrial and human activities have suddenly ceased for about two or more months worldwide which may has resulted in improved water quality as well as positive effects on wildlife. The key sources of water pollution which affect aquatic ecosystems such as industrial wastewater disposal, crude oil, heavy metals, and plastics have halted during lockdown period almost in all parts of the world (Hader et al. 2020). As a result, the level of pollution especially in water bodies is expected to be reduced. For example, Mani, (2020) reported that a holy river in India, the Ganges which is severely polluted has turned cleaner during the nationwide lockdown period (Table 1; Fig. 1, 2). Moreover, Yamuna, another very polluted river in India, the concentrations of pH, electrical conductivity, dissolved oxygen, biological oxygen demand and chemical oxygen demand have been measured which indicated a reduction of 1-10%, 33-66%, 51%, 45-90%, and 33-82% respectively, during the lockdown phase in comparison to the pre-lockdown phase. A study conducted on surface water quality in terms of suspended particulate matter (SPM) in Vembanad lake, a longest freshwater lake in India revealed that SPM concentration has been decreased by 15.9 % during the lockdown period in comparison to pre-lockdown period (Yunus et. al., 2020). Another evidence is of Grand Canal in Italy which has turned cleaner and reappearances of many aquatic species has been observed (Clifford, 2020). Lockdown period has provided wildlife a never seen freedom as human has been forced to stay at their homes. By using an app ' Lockdown Wildlife Tracker', Wildlife Institute of India has revealed real time data on comfortable movement of wild animals in human restricted zones and keeps track on them. There are some evidences of the use of human dominated zones by wild animals during lockdown period such as spotting of coyotes on Golden Gate Bridge in USA, deer were grazing near Washington house, peacocks were flouncing through Bangor etc. (Loring, 2020). During the lockdown period, trucks and other vehicles movement has almost restricted following the social distancing measures and halted industrial activities which provide protection to wild animals against road accidents. For example, the annual hit and run cases of approximately one lakh hedgehogs, nearly thirty thousand deer, about fifty thousand badgers, one lakh foxes have predicted to lower down (Newburger and Jeffrey, 2020). Spotting of majestic whales in parts of Vancouver fjord for the very first time in the last few decades has been reported by local people. Small herds of rarely seen glorious insects has been found wandering over flowers and plants in UK (Child, 2020). Muhammad et. al., 2020 found beneficial effect of

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lockdown period on breeding success of aerial insectivorous Afro-Palearctic migratory bird *Apus apus* at a breeding site in Northern Italy and reported larger clutch size as well as higher percentage of 4-egg clutches i.e. 45 % during 2020 as compared to 15%-27% in 2017–2019 as like many other locked down areas, northern Italy has also experienced a big reduction of several air pollutants including nitrogen dioxide and benzene in March–April 2020. A few species which were rarely observed since several years such as the crested grebe *Podiceps cristatus* and the little grebe *Tachybaptus ruficollis* were found to breed in the area during April 2020 (Grattini and Nigrelli, 2019). Earth is regarded as a very big ecosystem which belongs to every living organism but it is dominated by humans and makes it unsafe for other organisms to live freely. Due to the absence of human activities during the lockdown period, animals other than humans has started flourishing again. In positive sense, we could say covid-19 is nurturing the mother nature which has been degraded from last few decades.

Table 1. Water quality parameters of the Ganges river

Quality parameter	Pre-lockdown	lockdown
DO1 (mg/L)	8.3	10
BOD2 (mg/L)	3.8	2.8
FCC3 (cfu/100 ml)	2200	1400

[1]Dissolved Oxygen, [2]Biological Oxygen Demand, [3]Fecal Coliform Count.

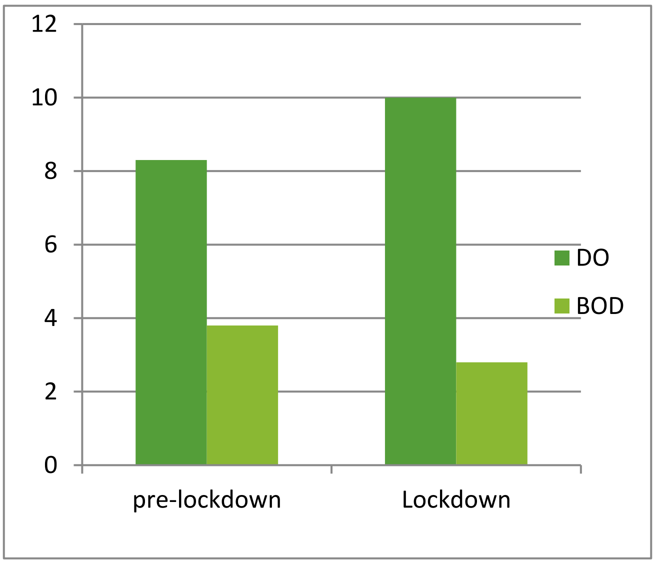

Fig.1 Dissolved Oxygen and Biological Oxygen Demand level in the Ganges River

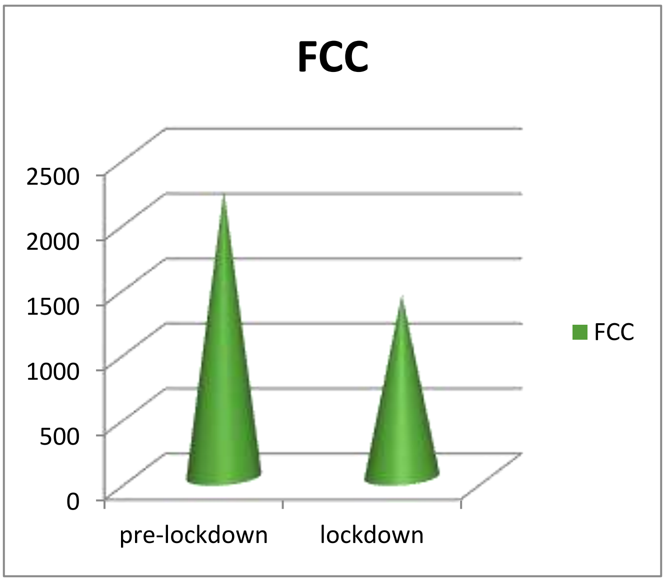

Fig. 2 Fecal Coliform Count in the Ganges River

Plate 1. Yamuna River has become Cleaner since Lockdown was enforced.

Plate 2. Yamuna River before Lockdown phase

Conclusion

Coronavirus has resulted in number of irredeemable losses across the world. However, the preventive measures taken against this pandemic has resulted in some unimaginable benefits to water resources as well as to wildlife. There is a possibility that post-corona period would pollute the environment again, so there is a need of implementation of some governmental policies to protect our mother nature.

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Advanced Cultivation Practices of Periwinkle

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Introduction

Periwinkle is a perennial ornamental herb found throughout India on waste lands and sandy tracts. It has medicinal importance owing to the presence of indole alkaloids raubasin (ajmalicine) and serpentine in its root which has anti-fibrillic and hypertensive properties. The leaves contain two alkaloids viz vinblastine and vincristine which form the constituents of patented cancer drugs and vincristine alkaloids are distributed in different parts of the plant but the roots contain the maximum (0.75-1.20 %), followed by the leaf (0.60-0.65%).

USA imports about 1000 tonnes of leaves while West Germany, Italy, Netherlands and UK import about 1000 tonnes of roots. There is ample scope for this crop if the raw materials are used in the manufacture of drug in India itself as there is a decline in the demand for the raw materials outside India. Farmers may also prefer this crop because of its wide adaptability, ability to grow in marginal lands and drought hardiness.

It is a perennial herb, often grows in garden for its pink and white flowers which bloom throughout the year. It bears flexible long branches with simple opposite leaves. Flowers 2-3 in cymes, axillary and terminal clusters. Fruit is a cylindrical follicle with many black seeds.

Varieties

There are no recognized varieties but their local types based on the colour of the flowers viz alba with white flowers, roseus with pink rose coloured flowers and ocillata with flowers having rose-purple spot in the centre are recognized.

1. Nirmal: White flowered variety developed from CIMAP, Lucknow. It yields about 1200 kg of dried leaves and 80 kg of roots/ha, resistant to collar rot and root rot.

2. Dhawal: A mutant bred by chemical mutagen treatment of the seeds of variety Nirmal developed by CIMAP, Lucknow. It consists of light green to greyish pubescent leaves with distinctly undulating leaf margin, green stem, white flower, leaf yield of 1352 to 2557 kg/ha, alkaloids yield 0.89 to 1.40 % (in leaves), 1.60 to 2.22 % (in roots), and resistant to die-back disease.

3. Prabhat: It is developed at HAU, Haryana. Duration is 8-10 months, dry root yield is 15-18 q/ha, dry leaves yield is 20-25 q/ha. It is purple stemmed, shining leaves and pods with dark pink flowers.

Climate and Soil

The cosmopolitan distribution of the plant shows that it has no specific climatic requirements. Its natural environments are, however, tropical and subtropical areas. A well distributed rainfall of 100 cm or more is considered ideal for raising it as a commercial crop under rainfed conditions.

Similarly, it grows on any type of soil except those which are highly alkaline or water logged. It grows wild in coastal area. Light sandy soils rich in humus are preferred for scale cultivation of the plant.

Propagation

The plant is propagated from seeds. Fresh seeds are preferable as they lose viability on long storage. Seeds can be sown directly in the field or the plants raised in the nursery and transplanted later on.

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Direct sowing is to be done for plantation of a large area, as it reduces the cost of sowing. About 2 to 3 kg seed are required for raising one hectare. The seeds are mixed with sand about 10 times its weight for even distribution and are sown during beginning of monsoon in rows 45 cm apart. When the plants grow up, they are thinned out, leaving a distance of 25-30 cm between the plants.

For nursery sowing and transplanting about 500 g of seed sown in 200 m2 bed is required for producing seedlings for one hectare. The seeds are sown in well prepared beds during March/April in rows about 1.5 cm deep, covered with light soil and leaf mould mixture and are watered to keep the bed moist. In about 10 days' time the seeds germinate and in 2 months' time (height 6-7 cm) they become ready for transplanting. In the field, the seedlings are transplanted at a spacing of 45 cm × 30 cm or 45 cm × 45 cm.

After Cultivation

The crop requires two weeding, the first one about 60 days after sowing/transplanting and the second one in another 60 days.

The plants do not require much as they have drought resistant capacity, in areas, where rainfall is evenly distributed throughout the year, no irrigation is required but in areas where monsoon is restricted, 4 to 5 irrigations are required during the life of the plant to get good yield.

They are not generally manured, however, for getting a good yield of both leaves and roots, farmyard manure at about 15 tonnes per ha should be applied and a fertilizer mixture of N (50 kg), P_20_5 (75 kg) and K_20 (75 kg) per hectare is applied as a basal dose.

Harvesting

The crop become ready for harvest of roots after one year. But two leaf stripping can be taken, the first one after 6 months and the second after 9 months of sowing. Third stripping of leaves can also be taken when the whole plant is harvested after one year. For seed collection, matured fruits are handpicked and dried in shade and threshed lightly. This method ensures mature seeds with even germination. But the usual practice is to uproot the plants, dry them in shade and thereafter thresh lightly for seeds. The seeds obtained by this method are not uniform and their germination is poor.

For harvesting of roots, the crop is cut about 7.5 cm above the ground and dried for stems, leaves and seeds and then the whole field is copiously irrigated and ploughed and the roots are collected. The roots are washed well and dried in shade and later made in to bundles for marketing.

Yield

Under rainfed conditions about 0.75 tonne of roots, 1.0 tonne of stems and 2 tonnes of leaves (all dry basis) may be obtained from one hectare. But under irrigated conditions, 1.5 tonnes each of roots and stems and 3 tonnes of leaves per ha can be obtained.

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Biochar: A Potential Tool for Future Agriculture

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Introduction

Soil is the most significant source and an important habitation of several nutrients and microflora that strongly influence crop growth and productivity. But due to rapid industrialization and urbanization, exhaustion of agricultural land holdings and depletion of soil quality by the means of burgeoning population pressure and an extravagant application of chemical fertilizers are exploring a exonerate awareness to maintain sustainable approaches in crop production. Furthermore, the gigantic utilization of inorganic chemicals into our resource base leads to environmental degradation resulting infinite problems including deterioration of nutrient composition and biological diversity in soil; decline in soil heath or fertility status; impairment in air, water and crop quality as well as detriment to ecological sustainability in the long run which are causing basic evils for agricultural production. Therefore, from a remedial point of view, the application of various organic amendments directly can reenergize the soil by the improvement of soil health and hence can be used as a powerful tool for sustainable agriculture, rendering agro-ecosystems more stress-free. Nevertheless, the employment of Biochar has been accepted as an endurable technique and a promising way to improve soil quality and remove heavy metal pollutants from the soil (Lahori et al., 2017). Notwithstanding the approach of biochar application is premeditated as a more recent strategy for carbon sequestration, the practice of adding charred biomass to improve soil quality is not new, however, the conception of biochar is rooted in an ancient Amazonian practice. This process is modelled after a 2,000-year-old practice in the Amazonian basin, where indigenous people created areas of rich, fertile soils called terra preta or dark earth. The positive influence of biochar on plant growth and soil quality suggests that it is a good way to overcome nutrient deficiency, making it an appropriate technology to improve farm scale nutrient cycles. Therefore, a consummate concentration should be imposed on the exploration of beneficial impacts of biochar amendment on soil stability and plant growth promotion.

What is Biochar?

Biochar is a charcoal like organic substance which is made by burning organic material from agricultural/forestry wastes or biomass or by combustion under a controlled process called pyrolysis with low or no oxygen conditions and high temperature (300°C to 700°C) resulting in a recalcitrant, high carbon rich material specifically for use as a soil amendment. According to the International Biochar Initiative, biochar is defined as 'The solid material obtained from the thermo-chemical conversion of biomass in an oxygen limited environment'. Pyrolysis basically involves heating of biomass such as wood, manure, or leaves etc. in complete or almost complete absence of oxygen, with oil and gas as co-products. Moreover, the quality of biochar depends on several factors, viz., the type of soil, metal, and the raw materials used for carbonization, the pyrolysis conditions, and the amount of biochar applied to the soil (Debela et al., 2012). Several uses and positive effects of biochar amendment have currently been considered as an effective method to reclaim the contaminated soil (Placek et al., 2016) and to achieve high crop yields without harming the natural environment.

Applications of Biochar in Agriculture: Direct and Indirect Benefits

1. Soil amendment: Biochar may ameliorate soil quality by improving soil structure and aggregation, porosity, electrical conductivity, pH, water, agrochemicals and nutrients retention due to its extremely porous nature and high specific surface area; reducing soil acidity and nitrous oxide emissions; regulating nitrogen leaching and also enhancing microbial properties. It brings agricultural benefits by boosting soil fertility and the ability to withstand drought or flooding; and also eliminating heavy metals and other pollutants from soil. Besides, biochar is reported to induce plant systemic responses to diseases caused by soil borne pathogens and foliar fungi.

2. Suitable for composting: It is found to be beneficial for composting as it reduces greenhouse gas emissions and prevents the loss of nutrients from the compost materials. The promotion of soil biological diversity also accelerates the composting process which in turn helps to reduce ammonia losses, bulk density and foul odour.

3. Biochar is an environmental solution: Biochar can solve a variety of global problems simultaneously by its considerable role in sequestering carbon and mitigating climate change. Adding biochar to 10% of global crop land can sequester the equivalent of 29 billion tons of CO_2 annually and hold it in the soil for thousands of years, where it is most advantageous. This technology contributes to food security by increasing crop yields and retaining water in drought prone areas involving decreased groundwater pollution, declined cost of water filtration, and reduced amounts of waste and higher profitability for farmers. Clean and renewable energy is produced as a by-product that can be used as an alternative to burning fossil fuels, hence, biochar production is a carbon negative process, it actually reduces CO_2 in the atmosphere. In the process of making biochar, the unstable carbon in decaying plant material is converted into a stable form of carbon that is stored in the biochar. The feed stocks used for making biochar would release higher amounts of carbon dioxide to the atmosphere if they were left to decompose naturally but by heating the feed stocks and transforming their carbon content into a stable structure that doesn't react to oxygen; this method ultimately reduces CO_2 in the atmosphere.

4. Carbon sink: Researchers have estimated that the sustainable use of biochar could reduce the global net emissions of carbon dioxide, methane, nitrous oxide etc. without endangering food security, habitats, or soil conservation. When biochar is applied in soil, the effect is to remove carbon from the atmosphere and store it underground, where it does not contribute to global warming.

5. Use as stock fodder: The application of biochar mixed with molasses has been explored by several scientists as improved stock fodder for ruminants because it can assist digestion and reduce methane production in animals.

Properties of Biochar

Biochar is made up of elements such as carbon, hydrogen, sulphur, oxygen, and nitrogen as well as minerals in the ash fraction and it is produced through pyrolysis, a thermal decomposition of biomass in an oxygen limited environment. Biochar is black, highly porous, and finely grained, with light weight, large surface area and pH, all of which have a positive effect on its application to soil. It is stabilized biomass, which may be mixed into soil with intentional changes in the properties of the soil's atmosphere to increase crop productivity and to mitigate pollution. Biochar can be extensively produced from raw materials like grasses; manures; wood chips; cassava rhizome; crop residues; forests and agricultural wastes such as bark, straw, husks, seeds, peels, sawdust, nutshells, wood shavings, animal beds, corn cobs and corn stalks; industrial wastes viz. bagasse, distillers' grain, etc.; urban/municipal wastes; mill waste; chicken litter; dairy manure; sewage sludge and paper sludge etc. The biomass used for the production of biochar is mainly composed of cellulose, hemicelluloses, and lignin polymers.

Conclusion

The problem of the massive depletion of agricultural land as a result of ever-increasing population pressure has necessitated the sustainable crop production. Hence, it was suggested that returning biochar into the soil rather than removing it all for energy production reduces the need for chemical fertilizers, thereby reducing cost and emissions from fertilizer production and transport. Besides, it can improve soil fertility and water quality; contribute to mitigation of climate change; stimulate plant growth and productivity; reduce GHGs emission, nutrient leaching, soil acidity, irrigation and fertilizer requirements; provide protection against some foliar and soil borne diseases; serve as remedy for contaminated soil; sequester carbon in soil for hundreds to thousands of years which make 'Biochar' a promising tool for regenerative agriculture. This 2,000-year-old practice converts agricultural waste into a soil enhancer that can hold carbon, boost food security, and increase soil biodiversity, and discourage deforestation. The surge of interest in climate-smart agriculture has sparked curiosity in using biochar as a tool to fight climate change while also improving soil fertility. Biochar systems are particularly relevant in developing country contexts and could be leveraged to address global challenges associated with food production and climate change. Today, we are rediscovering the value of biochar as the world staggers under climate change, environmental degradation and human poverty. The positive effects of biochar on the interactions between soil-plant-water caused better photosynthetic performance and improved nitrogen and water use efficiency. Hence, it can be concluded that biochar has the potential to improve the properties of soil, microbial abundance, biological nitrogen fixation, and plant growth. Therefore, it is recommended to use biochar as a soil amendment for long-term carbon sink restoration.

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Zinc Enhancement for Plant System by Zinc Solubilizing Bacteria (ZSB)

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Introduction

Nutrient enhancement by solubilization is become considerable important since soils in most parts of the world exhibit Zn deficiency (Alloway, 2001). Fifty percent of Indian soils are zinc deficient (Ramesh et al., 2014) and globally Zn deficiency in crop is due to low solubility of Zn, rather than low Zn availability in soil (Iqbal et al., 2010). First time, essentiality of Zn as a micronutrient for higher plants was established by Sommer in 1926. Among the micro nutrients, zinc plays a vital role in various metabolic processes in plants, and its deficiency adversely affects the growth and development of crop plants (Cakmak, 2008). Microbes are potential alternate that could provide required zinc to the plant by solubilising the complex zinc in soil. Microbes solubilize the metal forms by protons, chelated ligands, and oxido reductive systems present on the cell surface and membranes (Wakatsuki, 1995). Solubilization of Zn near the root zones can alleviate Zn deficiency and help maintain the critical level of Zn (2 mg/kg of soil) necessary for crop nutrition.

Zinc Solubilizing Bacteria (ZSB)

A term called zinc solubilizing bacteria (ZSB) was coined for those bacteria that are capable of solubilizing the insoluble zinc compounds / minerals in agar plate as well as in soil (Saravanan, 2007). ZSBs are known for their effectiveness to solubilize zinc through their association with plant roots due to the production of root exudates that act as a chemo attractant (Shakeel *et al*., 2015). ZSB have multiple beneficial characteristics that help plant growth (Othman *et al*., 2017). Several genera of rhizobacteria belonging *Pseudomonas*, *Bacillus*, *Gluconacetobacter*, *Burkholderia*, *Acinetobacter*, *Serratia*, *Flavobacter* and *Enterobacter* (Vidyashree *et al*., 2016) *Thiobacillus thioxidans*, *Thiobacillus ferroxidans* and facultative thermophilic (Saravanan *et al*., 2007) have been reported as zinc solubilizers.

Benefits of ZSB as Plant Inoculants Over Chemical Fertilizers

When Zn deficiency symptoms are observed in the field, inorganic fertilizers such as Zn-sulfates, Zn-ammonia complexes, Zn-nitrate, Zn-oxide, Zn-oxysulfate, Zn-carbonate, and Zn-chloride are usually applied on the soil surface. In addition, most Zn fertilizers dissolve relatively slowly in soil, sometimes at a rate which is not adequate to supply sufficient amounts of Zn as required for the plant growth (Rengel and Graham, 1996).

Extensive use of chemicals fertilizers by farmers to improve plant health and crop productivity and soil fertility has disturbed the ecological balance of soil, has often negatively affected the complex biogeochemical cycles, adverse effects on human health and the environment and has led to the depletion of native nutrients and severe environmental problems especially contamination of underground water due to leaching and pollution of atmosphere through gaseous emissions.

This resulted in the hidden hunger of micronutrients leading to crop failure and reduced micronutrient content in plant parts (Khanghahi et al., 2018). On the other hand, high cost associated with the application of Zn fertilizers in order to correct Zn deficiency places considerable burden on resource poor farmers (Wissuwa et al., 2006). Zn solubilization by soil microorganisms has better perspectives in comparison to chemical fertilizers. There are several reports on the utilization of rhizospheric microorganisms to enhance the acquisition of micronutrients (Sharma et al., 2012).

Conclusion

Plant growth promoting rhizobacteria (PGPR) as bio-inoculants which has the potential to transform various unavailable forms of zinc to available forms to crop assimilation and may offer a valuable alternative to chemical fertilizers to achieve the objective of low-input and sustainable agriculture. Therefore, it can be concluded that beneficial biofertilizers applied in combination are a better choice for farmers to reduce the use of chemical fertilizers for sustainable crop production. The application of different microbial technologies in agriculture is presently growing very rapidly and popularly with the recognition of novel bacterial strains, which are additionally effective in plant growth and yield. PGPR having multiple growth promoting abilities prove to be an effective biofertilizer. Various new interventions and technologies are needed to ultimately transfer soil and region specific ZSB to the farmers' fields in a relatively short time. There is a search for new efficient strains of ZSB as biofertilizers for development of microbial diversity for any region. Furthermore, scientists need to address that how to synergistically make zinc biofertilizer and improve the efficacy and how to get most benefits from these solubilizers.

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Nenopesticide: Its Role in Pest Management

Article ID: 32125

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Introduction

Food security in the world is challenging due to the limited available resources for the rising population. Various efforts are being practiced by governments, organisations and researchers to mitigate the demand and supply gap in human food chain. Agriculture took the roots of growth prior to industrial revolution, in around 90 countries. Though nanotechnology has already found industrial applications, the use of nanotechnology in agriculture is much more recent. Here we review nanotechnology applications in agriculture such as plant production, protection and detection of pathogen (Dubey and Mailapalli, 2016).

What is a Nanopesticide?

"A nanoparticide is a plant protection product that contains components in the nanometer size range (up to 1000 nm) and has new properties that are related to the small size of their components". Size-based definition is not enough for nanopesticides, unlike other nanomaterials. Generally, pesticides always consist of several substances. Similar to a drug, the actual active ingredient is mixed with other accompanying compounds. Those allow the active ingredient to be easy to apply to the plant, to evenly distribute and to remain stable after use. In most of the proposed applications for nanopesticides, the nanomaterial itself is not the active agent, but acts as an auxillary compound to stabilize the active agent or enhance its controlled release (e.g. as a nanocapsule). Nano-copper and nano-silver are examples of nanomaterials as active agents (Steinbach, 2020).

Formulations of Nano-Pesticides

The research in nanotechnology has led to the development of different nanoformulation which can be applied in crop protection viz., nanoinsecticides, nanoherbicides, nanofungicides and nanonematicide. Nanopesticides are formulated according to their intended purpose as formulations improving solubility, slow release of active ingredients, prevent degradation etc. For achieving these purposes, modifications in the chemical nature carrier molecule have been modified and classified as organic polymer-based formulations, lipid-based formulations, nanosized metals and metal oxides, clay-based nanomaterials etc. Some foremost nano-formulations are mentioned in this article.

1. Nano-emulsions: Generally, an oil-in-water (O/W) emulsion is more common as a nano-emulsion where, active ingredient of the chemical is dispersed as nanosized droplets in water, with surfactant molecules confined at the pesticide-water interface. Nano-emulsions get further classified based on the quantity and type of surfactants, as thermodynamically stable and kinetically stable. If the pesticide is partially soluble in the aqueous phase and spontaneous formation of a stable emulsion happens when surfactant, pesticide and water components are brought together, that is a thermodynamically stable nano-emulsion. The insolubility of the active ingredient makes the pesticide and surfactant to initially form a two-phase system and thus, a continuous shearing make them to mix together and pesticides droplets in the nano-emulsion will remain dispersed for an extended period of time and so are considered to be kinetically stable. Eg: Oil in water nanoemulsion of neem oil has been developed for insect management using Tween 20 as the surfactant.

2. Nano-suspension: Nano-suspensions, also termed as nano-dispersions, are formulated by dispersing the pesticide as solid nanosized particles in aqueous media. In nanodispersions, the surfactant molecules get confined at the particle surface where polar portions extending into the aqueous solution and the non-polar portions associating with the solid pesticide. Eg: Aqueous dispersions of nano-permethin, novaluron and βcypermethrin have been developed by researchers.

3. Polymer based nano-particles: Polymer-based pesticide nanocarriers are majorly deployed in the slow and controlled release of active ingredients to the target site. Moreover, they can serve to improve dispersion in aqueous media and also as a protective reservoir. Nano-encapsulation, nano-spheres, nano-gels, nano-fibers, etc are some of them falling in this category.

4. Nano-encapsulation: Nano-capsules or nano-encapsulation are heterogeneous reservoir type structure containing an inner central cavity which confines the hydrophobic or hydrophilic active ingredient, surrounded by a polymer coating or membrane. The active ingredient in neem-azadiractin formulation can be protected through this formulation. Eg: Controlled-release nano-formulation of the neonicotinoid insecticide i.e., acetamipirid and imidacloprid have been developed.

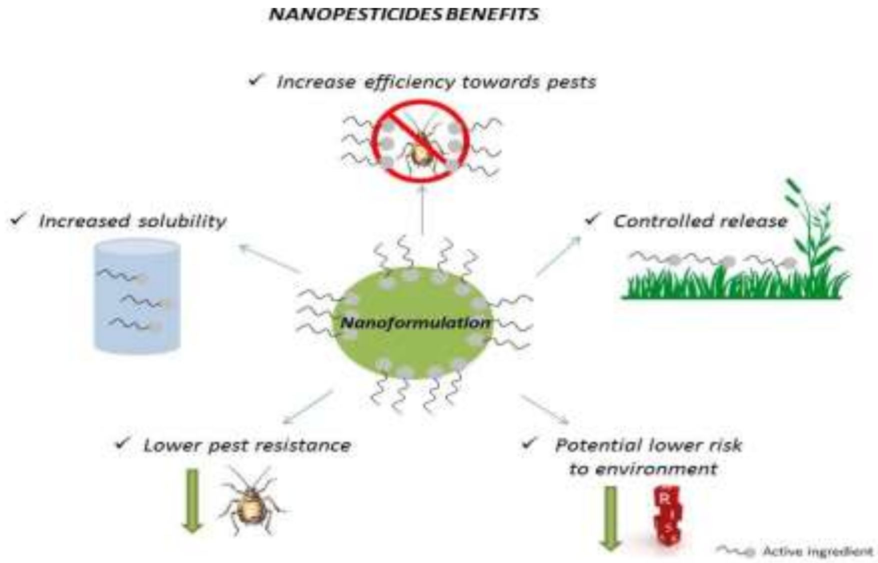
5. Nanospheres: These are homogeneous vesicular structures, in which the bioactive ingredient is uniformly dispersed throughout the polymer matrix. Eg: Polymer stabilized bifenthrin nanoparticles are developed as nanospheres. Nanogels: These are also known also hydrogel nanopartciles. These are formulated by cross linking of polymeric particles having hydrophilic groups, thus absorb higher quantities of water. Chitosan nanogel is an example for this.

6. Nano-fibres: Nano-fibres are developed through electrospinning, thermal induced phase separation. Researchers have developed electospun nano-fibers loaded with the chemical, (Z)-9-dodecenyl acetate, an ingredient of pheromone which get embedded in the polymer matrix for the management of many lepidopteran insect pests (Rajna et al., 2019).

Advantages of Use of Nano-Pesticides Over Conventional Pesticides

1. Nanotechnology offers a tool for developing novel formulations of eco-friendly pesticides as majority of nano-pesticide formulations are highly target specific.

2. Generally, targeted delivery and controlled release of nano-pesticides can improve pesticide utilization and reduce residue and pollution. For example, Nano-microcapsule formulations have slow release and protection performance because they have been prepared using light-sensitive, thermo-sensitive, humidity-sensitive, enzyme-sensitive and soil pH-sensitive high polymer materials to deliver pesticides.



3. Nano-pesticide formulations improve adhesion of droplets on plant surface (reduces drift losses) which intern improves the dispersion and bio-activity of active ingredient (a.i.) of pesticide molecules. Therefore, Nano-pesticides will have high efficacy compared to the conventional pesticide formulations (i.e., D-Dust, G-Granule, P-Pellet, EC-Emulsifiable Concentrate, WP-Wettable Powder, WDG-Water Dispersible Granule, etc.) and due to

their small size, improvable pesticide droplet ductility, wettability and target adsorption when sprayed in fields has made these nano-pesticides provide efficient and environmental friendly advantages

4. Nano-pesticides are extraordinary means for setting up an eco-friendly and sustainable agriculture system because it reduces the overall chemical usage, decreases the toxic residues and enhances the overall crop protection.

5. Silver, copper and gold nanoparticles are used as bionanosensors and electrical-nanosensors to detect a potential pathogen problem in plant and postharvest foods.

6. The metal oxide-based nanomaterials such as ZnO, TiO_2, Cu and SiO_2 are increasingly used in pesticides and fungicides to protect crops from bacterial disease and control microbial activity.

Limitations in the Usage of Nano-Pesticides

1. The risk that nano-particles (nano-pesticides) may pose to human and environment health is not yet fully understood.

2. Nano-pesticides may also create new kinds of contamination of soils and waterways since nano-pesticides are apparently much more persistent and have higher degrees of toxicity when compared to their traditional counterparts.

3. Nanoparticles of size lower than 50 nm usually adversely affect human health and the potential routing could be through inhalation, ingestion and dermal exposure.

4. The level of nanotoxicity in soil, plant and water mainly depend on the composition, size and concentration of the nanoparticles.

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Intercropping of Onion in Guava Based Cropping System –An INM Approach

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India is the second largest onion growing country in the world. Indian onions are famous for their pungency and are available round the year. Indian onions have two crop cycles, first harvesting starts in November to January and the second harvesting from January to May.

The onion is a hardy cool-season biennial but usually grown as annual crop. The onion has narrow, hollow leaves and a base which enlarges to form a bulb. The bulb can be white, yellow, or red and require 80 to 150 days to reach harvest stage.

Mostly onion is cultivated by using inorganic fertilizers along with meagre use of organic manures (FYM, urban compost) but without use of biofertilizers causing unsustainable soil productivity by reducing microbial activity which affects soil physical and chemical conditions.

The application of organic manures, bio fertilizers along with inorganic fertilizers not only improves productivity of the soil but also good soil health. By reducing the consumption of chemical fertilizers, following organic farming which plays a vital role in sustainable agriculture.

Inter Cropping of Onion in Guava Orchard

Material and methods: Onion is cultivated as inter crop in guava orchard (9 years old). The experimental details were presented as follows.

Raising of Nursery and Transplanting

Onion seed @ 8-10 kg of seed is required for one ha. The seeds were sown on well prepared raised nursery beds with a row spacing of 10 cm and the necessary plant protection measures were taken while the raising of nursery for the control of common insect pests and diseases. The seedlings are transplanted with 15 cm x 10 cm spacing and the gap filling was done.

Fertilization

The application of fertilizers such as phosphorous @ 60 kg ha^{-1} in the form of single super phosphate as basal dose, potassium (murate of potash) was applied @ 80 kg ha-1 in two splits, half as basal dose and the remaining half at 60th DAT. Nitrogen was applied in the form of urea in three splits viz., one third as basal dose along with P and K and the remaining two doses were applied at 30 DAT and at 60 DAT along with second dose of potash.

Application of Biofertilizers

The biofertilizers such as Azotobacter, PSB *(Bacillus megaterium)* and K-Mobilizer *(Bacillus circulans)* each @2 kg ha^{-1} were applied to the main field one week after transplanting by mixing with fine FYM for uniform and easy application and the field was irrigated.

Irrigation

The irrigation was given at 10-15 days interval regularly to maintain uniform soil moisture at transplanting and vegetative phase and 5-7 days interval from bulb initiation stage to complete bulb maturity. Irrigation was stopped 15 days before harvesting.

Intercultural Operations and After Care

Cultural operations such as weeding and earthling up were carried out for all the treatments wherever necessary during crop growth period. Necessary plant protection measures were adopted as per the recommendations at appropriate time for the control of common insect pests and diseases of onion crop during the experimental period.

Results

The data recorded on leaf dry matter production (kg/ha) at monthly interval of crop growth as affected by the application of different doses of chemical fertilizers, biofertilizers and neem cake in onion under guava-based cropping system is given in table1. The data revealed that the treatment (T8) i.e. application of 100% RDF of NPK, azatobacter, PSB, potassium mobilizer and neem cake has recorded highest leaf dry matter production followed by T5 i.e. application of 100% RDF of NPK, azatobacter, PSB, potassium mobilizer.

Table 1: Effect of INM on onion leaf dry matter production (kg/ha):

Treatments	Leaf dry matter production (kg ha-1)			
	30 DAT	60 DAT	90 DAT	At harvest
T1: Control (120:60:80 kg NPK ha-1)	528.83	758.60	977.69	1221.45
T2: 100% RDF + A+PSB	551.05	784.25	1028.27	1244.48
T3: 75% RDF + A+PSB	453.28	610.94	826.92	1114.55
T4: 50% RDF + A+PSB	364.40	507.16	656.60	1000.84
T5: 100% RDF + A+PSB+KM	577.71	818.92	1120.55	1256.47
T6: 75% RDF + A+PSB+KM	488.83	647.26	840.69	1127.88
T7: 50% RDF + A+PSB +KM	386.62	532.60	694.60	1024.55
T8: 100% RDF + A+PSB +KM+NC	608.82	848.59	1200.55	1301.21
T9: 75% RDF + A+PSB +KM+NC	519.94	732.26	908.57	1193.21
T10: 50% RDF + A+PSB +KM+NC	413.28	558.93	741.93	1091.88
Mean	**489.28**	**680.00**	**900.00**	**1158.00**
S.Ed	**NS**	**8.87**	**8.31**	**9.43**
CD at 5%	**NS**	**18.64**	**17.47**	**19.81**

The data recorded on yield and yield attributes as affected by the application of different doses of chemical fertilizers, biofertilizers and neem cake in onion under guava-based cropping system is given in table2. The data revealed that highest bulb yield was recorded in T8 i.e application of 100% RDF of NPK, azatobacter, PSB, potassium mobilizer and neem cake followed by T5 i.e application of 100% RDF of NPK, azatobacter, PSB, potassium mobilizer and same trend was observed with regard to TSS of onion bulb. The benefit cost ratio was found non-significant.

Table 2: Effect of INM on onion bulb yield and yield attributes:

Treatments	Bulb length (cm)	Bulb diameter (cm)	Bulb weight (g)	Bulb yield (t ha-1)	Harvest index (%)	TSS (%)	Benefit cost ratio (B:C)
T1: Control (120:60:80 kg NPK ha-1)	4.81	5.08	68.73	17.53	62.82	11.43	3.05
T2: 100% RDF + A+PSB	4.87	5.25	70.66	18.65	62.99	11.61	3.14
T3: 75% RDF + A+PSB	4.71	5.02	60.10	17.54	63.14	10.94	3.13
T4: 50% RDF + A+PSB	4.50	4.81	51.36	15.09	63.97	10.21	2.89
T5: 100% RDF + A+PSB+KM	4.91	5.30	73.30	19.01	63.55	11.90	3.15
T6: 75% RDF + A+PSB+KM	4.71	5.02	62.03	17.78	63.31	11.12	3.14
T7: 50% RDF + A+PSB +KM	4.50	4.84	54.46	15.29	63.73	10.65	2.90
T8: 100% RDF + A+PSB +KM+NC	5.05	5.35	78.43	19.52	63.85	12.13	2.07

T9: 75% RDF + A+PSB +KM+NC	4.73	5.04	64.53	18.02	62.70	11.19	2.22
T10: 50% RDF + A+PSB +KM+NC	4.58	4.88	58.93	16.87	63.92	10.83	2.46
Mean	**4.73**	**5.06**	**70.10**	**17.53**	**63.40**	**11.20**	**2.82**
S.Ed	**0.15**	**NS**	**2.35**	**0.13**	**NS**	**0.15**	**NS**
CD at 5%	**0.33**	**NS**	**4.95**	**0.30**	**NS**	**0.33**	**NS**

Conclusion

The growth characters are registered higher value with the application of nitrogenous, phosphatic and potash biofertilizers along with the application of chemical fertilizers and neem cake in integrated nutrient management system under guava-based cropping system. The application of 100 per cent RDF along with Azatobacter, PSB and K-mobilizer recorded highest yield with high TSS in bulb with improved quality. The application of neem cake along with biofertilizers and chemical fertilizers was found to be beneficial for improving bulb yield and quality of the produce in the following season. As per the results application of N,P,K and biofertilizers along with chemical fertilizers with or without application of neem cake can be recommended for optimum yield and gross return from onion in red sandy loam soils under guava-based cropping system.

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Tips for Savvy Purchase of Fruits and Vegetable

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Fruit and vegetable are integral part of diet. These supplement minerals and vitamins required for our physique. According to food expert, per ca requirement is 300-gram vegetable and 100 grams minimally fruits . There was a time when fruits and vegetables were beyond reach of every family, but these days' prices of vegetables and fruits are sky rocketing that why vegetable consumption is becoming beyond reach for every man. In addition, the fruits and vegetables are succumbed to summer season. Some tips given below can be helpful in rational purchase and upkeep of fruits and vegetables:

1. Avoid purchase of off-season vegetables and fruits. Being high rated venerable chemicals are sprayed on them.

2. Always purchase fully ripened vegetables and fruits. Leafy vegetables should stay green and fresh. Leaves should not be feeble and yellow.

3. While purchasing radish carrot, potato ensures that these are hard. brinjal of high quality have uniform colour. Brinjal having brown colour patches is the criteria for rotten brinjal. Beans should be crunchy and soft. Legumes on folding easily break up.

4. These days to bring shine on vegetables, these are washed through synthetic solutions. Apart from these synthetic tips are put into implementation to increase the yield of fruits and vegetables. Avoid purchase of fruits and vegetables having extra ordinary colour, flavour and larger size.

5. Keep a vigil while getting the weight of vegetables and fruits because the vegetables hawkers down weigh the fruits and vegetables.

6. ''Apni Mandi'' are arranged in every at one instance to be used for whole week. Many a times vegetables brought out in lumpsum mode turns stale and decayed. Instead using, the vegetables and fruits are thrown out. Do not purchase more than need of the family members.

Tips for Upkeep of Vegetables are Given Below

1. To ensure the long-lasting freshness of vegetables, before dipping the vegetables in cold water, pour in one teaspoon of vinegar. Take it out for fresh air, after drying, keep it into refrigerator.
2. Okra (Bhindi) instantly wither, for prolonged freshness, clean it after applying mustard oil. Keep these into refrigerator.
3. Green coriander, green chilli: stay fresh, if placed in refrigerator after wrapping these in a paper envelop.

4. All these vegetables supposed to be placed in plastic packs separately. Do not forget to punch the paper envelop at 2-4 sites. If some vegetables are not to be covered for more days, then open the envelop and check as if envelop from inner side is wet, then inner side should be reversed. Wipe out envelop dry it and re-keep it. By doing so vegetables does not perish. Store the lemon and garlic packed in glass box into refrigerator.
5. Keep onions and potato in porus basket. Potatoes don't sprout if placed along garlic and do not sprouts if placed along garlic and don't fall victim to insects – pests.

6. For prolonged freshness of flowers, place them into refrigerator only after packing them in flat vessel instead of plastic bag.
7. Avoid placement of new banana in fridge. By doing so, banana turn black externally. Banana do not turn black if wrapped up in a paper.
8. Similarly for prolonged upkeep of papaya, wrap it up with newspaper.
9. By implementation, on the above suggestions one can undertake savvy purchase of fruits and vegetables. In order to save them from being perished, we can sustain the freshness to larger extent.

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Foot Print of Post Covid-19 on Indian Economy

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Introduction

The farm economy has reflected negative implications of Covid-19 with the continuous restrictions on movements of people at the beginning phase of this sector. The panic among the stakeholders of wheat, gram, lentil, mustard, and paddy in some irrigated belt were almost at harvest stage. There was severe disruption to the supply chain of perishable fruits and vegetables, dairy products, fish, etc. having mobilized to meet the increasing demand from a bulging middle class as well as urban and rural consumers which may scup up irreparable damage to all players in the supply chain. India's agricultural sector depends on migrant labourers for several operations. Now, an estimated 50 million migrant labourers (of India's 140 million) are expected to have returned to their native places from cities following the nationwide lockdown from March 25. They account for about 11% of the non-self-employed labour force. Many migrant labourers, mainly from eastern states, are working in agricultural fields in the country's west and north. The governmental policies towards the agricultural sector have enlightened with the vision of ministry of agriculture and farmers welfare significantly.

The Indian Council of Agricultural Research (ICAR) has issued state-wise guidelines for farmers to be followed during the lockdown period. The advisory mentions specific practices during harvest and threshing of various Rabi (winter sown) crops as well as post-harvest, storage and marketing of the farm produce. The technologies which supported to effective utilization of resources were delayed little bit due to this lockdown. The follow up in the protocol made a drastic hurdle in the accessing various point of services. Both central and state government made regulations to ensure the operation and establishment of agri business across country. However, agricultural activities, being interconnected in neighbouring regions, agri-sops or benefits must not distort the market scenario.

Industry	April-June (Q1)				
	2018-19	2019-20	2020-21	Percentage Change Over Previous Year	
				2019-20	2020-21
1. Agriculture, Forestry & Fishing	4,27,177	4,39,843	4,54,658	3.0	3.4
2. Mining & Quarrying	88,634	92,807	71,209	4.7	-23.3
3. Manufacturing	5,61,875	5,78,936	3,51,396	3.0	-39.3
4. Electricity, Gas, Water Supply & Other Utility Services	74,998	81,628	75,877	8.8	-7.0
5. Construction	2,49,913	2,62,828	1,30,750	5.2	-50.3
6. Trade, Hotels, Transport, Communication & Services related to Broadcasting	6,09,330	6,30,860	3,34,284	3.5	-47.0
7. Financial, Real Estate & Professional Services	7,57,850	8,03,322	7,60,491	6.0	-5.3
8. Public Administration, Defence & Other Services	3,87,589	4,17,483	3,74,656	7.7	-10.3
GVA at Basic Prices	31,57,366	33,07,707	25,53,320	4.8	-22.8

Source: Ministry of statistics and programme Implementation

Waiver of farm loans, evidences suggest, have not fully benefitted the majority of small and marginal farmers. Rather, it affects the future credit behaviour of the borrowers and thus negatively impacts the agricultural credit culture altogether. Institutional lending of crop loans should be expanded and facilitated for smooth (and sufficient) flow of credit to borrowing farmers. Agri-inputs – seeds, fertilizers, agro-chemicals, etc. have to be pre-positioned for easy availability. Private sector must play a significant role with necessary policy support.

It was a parallel coincidence with lockdown and rabi harvest season besides supply chain response were not hindered during pandemic which made agricultural sector to a smooth functioning. Distribution of the commodities to vulnerable population, while maintaining prescribed guidelines and protocol, particularly of social distancing, must be effectively monitored. The only sector which possesses a positive growth is agriculture of 3.4 per cent. It was achieved by the regulatory mechanism taken the central government towards agricultural domain. The effective utilization of curative measures for the uplifting cultivation made this figure a positive approach. The construction sector shows a huge decline of about -50.3 per cent the migrant of labour influenced. Construction companies face challenges in arranging transportation and accommodation for labour, maintaining social distancing at construction sites, obtaining clearances from district officials for intra- and inter-district projects, and ensuring raw material availability. But the manufacturing sector faced a great crisis during this lockdown due to high demand and non-availability of labours which is clearly indicated by -39.3 per cent. This recovery phase will take few more months to stabilize to meet out the normal operations.

Conclusion

Investment in key logistics must be enhanced to sustain the market forces of agricultural commodities. Various start-ups need to be encouraged. Importance on e-commerce and e-market should be focused at larger scale. Small and Medium enterprises should be streamlined with suitable policies and incentives. Special attention needs to be given towards the rural economy. Creation of Farmer Producer Organizations for various agricultural and horticultural commodities. To eliminate the immediate concerns of scarcity of farm labour, policies must facilitate easy availability of machinery through state entities through custom hiring centres.

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Vertical Farming for Urban Households: A Revolutionary Modern Farming Technique for Future

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The concept of vertical farming involves growing of crops in vertically inclined surfaces and was first invented by an American geologist Gilbert Ellis Bailey in 1990. Vertical farming mainly focused to resolve the challenges arise due to decreasing percentage of arable lands, which is a major challenge faced by agricultural sector worldwide (Horvath, 2018).

Vertical Farming

Vertical farming refers to growing of edible green in stacked rows under a controlled environment. Physical layout, lighting, growing medium, and sustainability feature are the important aspects of environmental modification. In order to reduce the area requirement, plants are stacked in tower like statures. A perfect combination of natural and artificial light should be maintained for the proper growth and development of the crop. Aeroponic, hydroponic and aquaponic systems can be used for growing crops (Arya, 2020).

Profitable Crops

Crops with short life span which perform well under high density planting and low light intensity may be the better choice under the system. Height of the plants should be 30 cm or less than that because the distance between tiers is approximately 40 cm so that maximum space can be utilized. The best examples of crops were lettuce, kale, and mint (Reddy, 2019).

Types of Vertical Farming

1. Hydroponics: The most common growing system used in vertical farming is hydroponics. In this method, plants are grown in nutrient solutions which are free of soil. Roots of the plants will be dipped in the nutrient solution it will be monitored in specific interval to ensure the correct chemical composition (Reddy, 2019).

2. Aeroponics: Technology developed by NASA (The National Aeronautical and Space Administration) is an efficient way to grow plants in space without soil and less water. Use of aeroponics systems in vertical farming are under validation, but the social acceptance is high. Aeroponics the most efficient growing system as it saves 90 per cent of water when compared to hydroponics (Reddy, 2019).

3. Aquaponics: Next level of hydroponic system where plants and fish are combined together in the same ecosystem. Fish are grown in indoor tanks, producing nutrient-rich waste that is used as a feed source for the plants in the vertical farm. The plants, in turn, filter and purify the wastewater, which is recycled to the fish ponds. Although aquaponics is used in smaller-scale vertical farming systems, most commercial vertical farm systems focus on producing only a few fast-growing vegetable crops and don’t include an aquaponics component. This simplifies the economics and production issues and maximizes efficiency. However, new standardized aquaponic systems may help make this closed-cycle system more popular (Reddy, 2019).

Vertical farming systems can be further classified by the type of structure that houses the system.

Building-Based Vertical Farms

Mainly developed for discarded buildings in cities. For example “The plant” is vertical farm constructed in an old pork packing plant in Chicago.

Shipping-Container Vertical Farms

The containers of 40-foot which are used for carrying goods around the world are converted to vertical farms. These containers are modified by installing LED lights, drip irrigation systems and vertically stacked shelves and converted into vertical farms for growing variety of crops. Each unit will have computer-controlled growth management systems that allow users to monitor all systems remotely from a smart phone or computer.

Cropping Density

Vertical farming can accommodate 20 times a greater number of lettuce plants per occupied area compared to horizontal hydroponics systems (Touliatos et al., 2016).

Productivity

Touliatos et al. (2016) reported that vertical farming recorded 13.8 times more lettuce yield per occupied area compared to horizontal hydroponics systems. Wheat grown in a hectare of land in a 10-layer indoor vertical facility could yield from 700 ± 40 t/ha (measured) to a maximum of 1,940 ± 230 t/ha (estimated) of grain annually at optimal temperature, intensive artificial light, high CO2 levels, and a maximum attainable harvest index.

Such yields will be 220 to 600 times the current world average annual wheat yield of 3.2 t/ha. Independent of climate, season, and region, indoor wheat farming could be environmentally superior, as less land area is needed along with the reuse of most water, limited use of pesticides and herbicides, and no loss of nutrients (Assenga et al., 2020).

Advantages

1. Allow the farmers to grow plants in the indoor setting.
2. Ensures year around crop production.
3. More plants in lesser area.
4. Less water requirement that avoids crop failure due to insufficient rain.
5. Organic farming.
6. Eliminates agricultural runoff.
7. Significantly reduces use of fossil fuels (Elimination of ploughing, planting and harvesting with machinery and transport of crops).
8. Makes use of abandoned or unused properties.
9. No weather-related crop failures.
10. Offers the possibility of sustainability for urban centres.
11. Reduced crop loss and spoilage.
12. Less disruptive to the environment.
13. Limited land use leads to conservation of local flora and fauna.
14. Reduced fuel requirement and carbon emission.
15. Protect natural resources.

Disadvantages

1. High initial investments.
2. Economic feasibility should be studied.
3. Require technical skill.
4. Problems with natural pollination due to lack of insects in controlled environment.
5. Too much dependency on various technologies.

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Importance and Cultivation Practices for Isabgol

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Common names: Blond psyllium, Spogel seeds, sand plantain, flea seed, desert Indian wheat.

Botany

The scientific name of Isabgol is Plantago ovata, belongs to family Plantaginaceae. It was originated in Mediterranean region and Persia. It is a cool season crop and requires dry sunny weather during maturity season, propagated by seeds only.

The plant is 30-40cm tall stem less annual herb and having alternate leaf phyllotaxy. Flower is white in colour and the inflorescence is spike. Seeds are present in Capsule. The economic part is odourless and tasteless husk. It is mucilagenous in nature due to presence of Xylose, Arabinose, Galacturonic acid. Maturity indices is the spike turns brown. Husk to seed ratio is 25: 75.

Varieties

Gujarat Isabgol 1, Gujrat Isabgol 2, Gujrat Isabgol 3, Jawahar Isabgol 4, Haryana Isabgol 5, Niharika (mutant variety), TS-1-10, EC-124345.

Medicinal Uses

1.In India isabgol is being used in Ayurveda System of Medicine.
2. The seeds are sweet, astringent, refrigerant, emollient, mucilaginous.
3. The seeds are having cooling and demulcent effects and hence used to treat inflammation of mucous membrane of gastro-intestinal membranes.
4. Seeds also used as coolant, diuretic, laxative, expectorant, refrigerant, aphrodiasiac, roborant and tonic.
5. It is used as an anti-diahhoeal drug of amoebic and bacillary origin.
6. Useful for treating constipation and other intestinal disorders.
7. Used in dyeing and calico printing.
8. The mucilaginous material helps to stabilize ice creams and candy.
9. It helps in reducing body weight.
10. It also relieves acidity, cures piles and fissures, tridosa, burning sensation, strangury.
11. It reduces the risk of cardiovascular diseases, lowers blood pressure and cholesterol, and controls diabetes.

Marketing of Isabgol

Internationally the main buyers are Procter & Gamble (USA), Dr. Morepen (USA) and Al Parigo (USA). India exports isabgol seeds and husk worth more than `35 million annually. Out of total production, 75% from Gujarat and about 90% from Rajasthan is exported.

There are around 70 organisations all over the country undertaking export of isabgol husk and seed. Most of the leading exporters/processors are based in Sindhpur in Mehsana district and in Palanpur in Banaskantha district of Gujarat.

India dominates the world market in the production and export of isabgol (80% share). Isabgol husks and industrial powders are exported to the countries like; U.S.A., U.K., France, Germany, Japan, Indonesia, Canada, Mexico, Sweden, Spain, Norway, Italy, Australia, Denmark, Korea, Pakistan, Gulf countries and some other small countries.

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Crop Calendar

Cultural activities	Months	Description
Soil preparation	First fortnight of October	Field should be prepared till a fine tilth is obtained, FYM @10-15t/ha is added.
Sowing	Second fort night of October to second fortnight of November	Seed rate: 4 kg/ha. spacing: 30 × 10 cm spacing. After sowing the seeds swept with a broom and a light irrigation is given
Irrigation	November-February	6-7 irrigations are needed in light soil.
Intercultural operations and weeding	December-January	Two hand weeding, first at 20-25 days and second at 60-70 DAS.
Spraying	January-February	Spray neem-based bio-pesticides or Metalaxyl and Mancozeb together at 10- 12 days interval to control downy mildew and two spray of 0.025% Oxydemeton methyl to control Aphid.
Harvesting	March	When plants are completely dried and seeds turn dark brown. Harvest the crop by cutting at ground level.
Post-harvest operations	March-April	Harvested plants are Sun dried for 3-4 days and then threshed. Separate of husk from seed through grinding and sieving

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Crop Regulation and Propagation Techniques in Pomegranate (*Punica granatum* L.)

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Summary
Pomegranate (*Punica granatum* L.) is one of the ancient known edible fruit crops and it is capable to grow in different agro-climatic conditions ranging from the tropical to subtropical. Pomegranate flowers continuously throughout the year under tropical climate. In subtropical central and western India, there are three distinct seasons for flowering but yield and quality is not so well in all crop harvest. It is very vital to identify the flowering and fruiting behaviours of crops and which bahar will give good crop with considering all the factors related with a particular bahar.

Introduction
Pomegranate (*Punica granatum* L.) belongs to *Punicaceae* family is a favourite table fruit in tropical and sub-tropical regions of the world. Though, it is native of Iran but it is cultivated extensively in Mediterranean and central Asian countries. It is highly suitable for growing under arid and semiarid regions due to its versatile adaptability, hardy nature, low cost maintenance and high returns. India is the largest producer of pomegranate in the world with production of around 2.79 MT from the area of 0.25 million hectare (Anonymous, 2018-19). The pomegranate is a neat, rounded shrub or small tree that can grow to 20 or 30 ft., but more typically to 12 to 16 ft. in height. It is rich source of nutrients and phytochemical compounds. The seeds and arils are the edible parts of the fruit. Pomegranates are mainly consumed as fresh and processed products like juice, beverages, jam, jelly etc. Due to its multipurpose medicinal uses, it is also known as “Dadima” in Ayurveda and as “Super fruit” in the global functional food industry.

Need of Crop Regulation and Flowering in Pomegranate
The pomegranate plants flower and provide fruits throughout the year in central and southern India. However, it needs to be thrown into rest period so as to enable prolific harvest at a given time. The pomegranate starts fruiting about 4 years after planting and continues for about 25 to 30 years. Pomegranate has three main flowering seasons i.e. February-March (Ambe Bahar), June-July (Mrig Bahar) and October-November (Hasta Bahar) with the corresponding harvest period during rainy (June-July), winter (November-December) and spring season (February-March), respectively. The plants under such conditions may continue bearing flowers and bear small crop irregularly at different period of the year, which may not be desirable commercially. For commercial production only one crop is desirable in a year. Selection of bahar depends upon location and some prevailing production constraints like availability of the irrigation water, fruit quality, market prices and occurrence and infestations of the diseases and pests. Water availability is vast concern in arid and semi-arid regions during summer season for pomegranate grower. They always avoid taking ambe bahar crop and regulate this crop into mrig bahar with the onset of monsoon and crop is harvested during winter. Some farmers prefer hasta bahar with less availability of water.

Principles of Flower Regulation
The basic principle of crop regulation is to manipulate the natural flowering of the pomegranate plant in desired season that contributes to increased fruit yield, quality and profitability. Pomegranate produces blossoms irregularly from February to October in the arid and semi-arid regions. To avoid this, crop regulation is done at specific times in pomegranate by a series of systems. In country, all commercially grown varieties are very

sensitive to diseases and pests, especially Bacterial Leaf Blight, Scorching, Nematode, Termite and Mite etc. Therefore, availability of irrigation water, climate, pest and disease infestation and market demand are the major issues for flower regulation in pomegranate.

Methods of Crop Regulation in Pomegranate

Flowering is mostly affected by the many factors i.e. withholding of irrigation(lack of moisture), defoliants, plant growth hormones, nutrients status and canopy management (training and pruning) etc. Withholding of irrigation is done one to two months before taking desired bahar in pomegranate. Subsequently, light pruning and then foliar spraying of ethrels defoliant are practiced to shed off leaves. The top soil around the tree equal to the leaf canopy was dug up to 30 cm depth. The manure and fertilizers are applied into the soil which is then levelled. Light irrigation is done after application of recommended dose of manure and fertilizers. The better flowering, good floral sex ratio, higher fruit setting and ultimately higher quality yield of fruits may be taken in year at a desired season by these treatments. There must be good growth and development of pomegranate plants up to first two years. Bahar treatment must be started from third year onwards for taking better quality fruit production. Bahar treatment is done in the following ways in pomegranate.

1. Flowering due to the stress of water scarcity: The main principle of withholding of irrigation is to provide rest to the plant. It results in increasing of number of flowers and accumulates large amounts of food to increase growth in the coming season. Withholding of irrigation is done for one month in light sandy soils and for one and half month in loamy soils. The ideal condition for crop regulations practiced when pomegranate plants get the desired leaf fall (50 to 70 %).

2. Use of chemicals for flowering: In recent times, the foliar spray of ethrel (1-2 ml per litre) is extensively practiced for crop regulation in pomegranate crop. This is considered good for achieving more flowering, good sex ratio and high yield.

3. Flower regulation by cultural practices: Canopy management practices viz. training, pruning and nutrients management (carbon nitrogen ratio) are best for achieving higher flowering percent and quality fruit production in pomegranate. Pomegranate may be trained as multi-stemmed tree or single stemmed tree. At initial years, pomegranate plants are generally trained by open centre system. Light pruning is done after withholding of irrigation and 15-20 days before starting of new bahar. Use of 10 per cent Bordeaux paste is done on pruned parts of plants to avoid fungal attack.

Propagation Techniques in Pomegranate

Pomegranate could be propagated either sexually by seeds or vegetatively using stem cuttings. Layering and grafting of pomegranate trees is rarely done, because many different types of grafts have not been successful enough for use in commercial production.

Sexual Propagation

There is little significance of sexual propagation in pomegranate culture as seedlings raised from seeds show variability in morphological and yield attributes. The resulting tree will not be a true copy of the parent, and the fruit produced will be unpredictable in size, colour, sweetness and juiciness. In general, seed germination in pomegranate depends on seed hardiness, variety and sowing season. The germination percentage varied between 7% in varieties with the hardest seeds to 98% in soft-seeded ones. In general, 60-75% seed germination has been observed in most cultivated varieties.

Vegetative Propagation

Vegetative propagation by cuttings (softwood and hardwood) and micropropagation can be used to grow new pomegranate trees which produce fruit identical to the parental tree. Air layering and Stool layering may also be practiced in some varieties.

Cuttings

Pomegranates can be propagated using both softwood or hardwood cuttings, but hardwood cuttings are most commonly used commercially. Softwood cuttings are taken from wood late in the season and require mist and greenhouse conditions for rooting to occur. In contrast, hardwood cuttings are taken from one-year old wood or suckers, trimmed, and placed directly onto the nursery floor, where they grow for one year prior to being transplanted with bare roots. Cuttings are the easiest method for pomegranate propagation with 12-20 cm in length and pencil size in diameter and use of hardwood or semi-hardwood rooting hormone is possible. The rooting capability of cuttings varies from cultivar to cultivar, location to location, season to season and age of the branch. The success percent of pomegranate cuttings depends on many factors such as conditions of the mother plant, part of the tree from where the cuttings are made, time of operation, rainfall, temperature fluctuation, aftercare etc. Besides, different environmental conditions growth regulators also play an important role in rooting and growth of pomegranate cutting. It was found that the number of sprouts per cutting was highest when hardwood cuttings of pomegranate cv. Ganesh were treated with 4000 ppm IBA and planted in a mixture of soil, sand and leaf mould. Auxin either applied natural or artificially, is a requirement for initiation of adventitious root on stem cuttings.

Air Layering

In major pomegranate-growing areas of the Deccan Plateau of India, air-layered plants are used for culture. IBA @ 250-1000 mg/l induces rooting in air-layers of pomegranate. However, preparation of air-layers from ringed and etiolated shoots after treating with ethrel (1000 mg/l) + NAA (5000 mg/l) produced most and longest roots per layer.

Stool Layering

Ground layering is also an option for multiplication of pomegranate planting material. No efforts were made to propagate this crop by stool layering. Recently, stool layering in pomegranate cv. ‘Bhagawa’ was initiated in India.

Micropropagation

Micropropagation could be a beneficial approach to mass produce cultivars with ideal characteristics, including insect and disease resistance. The most efficient way to micropropagate pomegranate is by enhancing axillary bud branching. Various factors such as genotype (‘Ganesh’ and ‘Mridula’), explant type (axillary bud, cotyledon, shoot tip, etc.), season, media (MS and WPM) and PGRs (BA, IAA, IBA, NAA, kinetin, etc.) influence the micropropagation of pomegranate. However, more research is needed to refine micropropagation methods.

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Applications of Genotyping-by-Sequencing

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Introduction

A Widely used method for detecting SNPs through high-throughput sequencing techniques called as genotyping-by-sequencing (GBS) (Poland and Rife, 2012). Rob Elshire first coined GBS as a simple highly multiplexed system for constructing reduced representation libraries for the Illumina NGS platform. He inspired by the whole genome sequence effort in rice and builds upon the protocol of restriction site-associated DNA (RAD) tags. Elshire's system employed the Illumina platform and was equipped with a bioinformatics pipeline for SNP discovery and genotyping.

Characteristics of GBS

1. A cost-effective approach.
2. Feasible for high diversity and large genome species.
3. It can perform high-resolution genomic analysis of entire populations in different species.
4. Reduced sample handling and the system is easy to scale up.
5. GBS greatly reduces complexity by using restriction enzymes.

Steps Involving in GBS

1. Sample preparation.
2. Library assembly.
3. Sequencing.
4. SNP calling.
5. Diversity analysis.

Sample Preparation

Total genomic DNA extracted from young leaf tissue and quantified. Restriction enzymes PstI and MspI used to digest DNA and the resulting fragments directly ligated to a pair of enzyme-specific adapters consisting of a partially sequence-divergent MspI-specific "Adapter1" and a fully complementary PstI-specific "Adapter2". The resulting population of fragments consists of the Adapter1/Adapter2 fragments along with the undesirable Adapter1/Adapter1 and Adapter2/Adapter2 fragments. Following ligation, the fragments are PCR amplified with primers that are specific to each adapter and consist of an Illumina index sequence and flow cell annealing (FCA) complementary sequences. The combination of the ligated adapters and the PCR primer sequences forms the "full-length adapter" sequences required by the MiSeq instrument. Adapter1/Adapter1 and Adapter 2/Adapter 2 fragments sequenced inefficiently and did not affect the overall sequence yield.

Library Assembly

Library assembly begins with the pooling of up to four amplicons with similar concentrations. The Pippin Prep (Sage Science, Beverly, MA, USA) electrophoresis instrument used for the fractionation selection of amplicons between 400 bp and 600 bp, which consist of 260 bp to 460 bp of original gDNA and 140 bp of Illumina-specific sequences in the full-length adapters. Size-selected pooled fragments are quantified, and concentrations are adjusted preferentially to 4 nM and combined to form the sample library. Immediately prior to the sequencing run, the sample library denatured and diluted to 8 pM according to the Illumina MiSeq protocol. To create the final library, a final volume of 5% denatured PhiX Control Library (Illumina, San Diego, CA, USA) is added to the sample library as a spiked-in control and to increase sample diversity to avoid phasing read errors.

Sequencing on MiSeq

The freshly denatured and diluted library containing PhiX is loaded onto a MiSeq Reagent Kit v3 600-cycle cartridge. A MiSeq run typically lasts up to 48 h, and the run data, including the FASTQ files, downloaded. Each sample has two FASTQ files representing the forward and reverse sequencing reads labelled with the respective terms “R1” and “R2”.

SNP Calling

A computational pipeline, npGeno, specifically developed for SNP discovery and genotyping from FASTQ files. The script npGeno.sh consists of four shell scripts that automate freely available software and custom Perl scripts. The first constructs contigs from sequence reads from all samples, and the second calls SNPs using the constructed contigs as a reference. The third filters resulting SNPs, and the fourth formats data outputs. To construct contigs, fastx collapser, part of FASTX tools, is used to collapse all identical reads down to single unique sequences. Minia software used to construct the de novo reference contigs for calling SNPs. Bowtie 2 employed to map the reads from each sample against the reference contigs. SAMtools is used to create a pile-up file summary of the aligned reads relative to the contigs, and BCFtools calls SNPs in a variant call format (VCF) file. Custom Perl scripts developed to create tab-delimited genotype and haplotype data from VCF files, to remove duplicates and missing data and to re-format output data required for various diversity analyses. The pipeline takes FASTQ input, along with three other input files, and outputs seven data files. It developed for use on a Linux operating system, as it is dependent on a number of freely available programs. These programs need to install in Linux, including setting their proper execution paths, following their respective documented installation instructions.

Conventional Genetic Diversity Analysis

Output data files generated from the pipeline can use for a genetic diversity analysis and its corresponding haplotype data. Using the cleaned data, one could perform a conventional genetic diversity analysis of assayed samples to estimate heterozygosity, infer genetic relationships and structure, or quantify genetic distance and differentiation, using commonly applied population genetic analysis tools, such as GenAlEx, AMOVA, STRUCTURE or R packages, according to the study objectives.

GBS Data Analysis Platforms

1. Tassel-GBS: It is use to assign SNP genotypes from GBS data in a time- and storage-efficient manner.

2. Stacks: Stacks is a software package developed for RAD sequencing that identifies SNPs and calculates population statistics from any restriction enzyme-based, reduced-representation sequence data.

3. IBIS Genotyping by Sequencing Tools (IGST): It processes GBS data by implementing several popular genomic software tools connected by Perl and Python scripts.

4. Fast-GBS: Fast-GBS follows a strategy similar to IGST but employs a different alignment algorithm, a different variant caller, and a bash script that runs each software program (Torkamaneh et al. 2017).

Application of GBS in Crop Improvement

1. Genetic/linkage mapping: Genotyping-by-sequencing is an ideal platform for studies ranging from single gene markers to whole genome profiling (Poland and Rife, 2012). Many important crops have investigated using GBS to aid breeding endeavors, for example chickpea, canola, maize, potato, rice, sorghum and wheat (Scheben et al. 2017). The GBS method was originally tested with 276 RILs from a maize mapping population, which led to the identification of 200 000 markers (Elshire et al. 2011).

2. Association studies and GWAS: A larger scale Association Mapping, the genome-wide association study (GWAS), exploits the natural diversity generated by ancestral recombination events in a population. Many crops, including maize, wheat, barley, rice, potato, cassava, soybean, and potato have successfully improved by GBS methods (Poland and Rife, 2012).

3. Genomic selection (GS): GS is a novel form of traditional MAS, in which molecular markers covering the whole genome utilized with pedigree data so that the accuracy of breeding and genetic studies increased without the need to collect phenotypic data. The advantage of implementing GBS for GS is the development of genome-wide marker coverage with a high density at a lower cost (Jannink et al. 2010).

4. Polyploid studies: Polyploids are the result of past interspecific hybridization events (allopolyploids) and/or genome doubling (autopolyploids). Genotyping using GBS is more challenging in polyploids than in diploids, with problems in assembling duplicated regions and difficulties in distinguishing between inter- and intra-genomic polymorphisms, though these issues occur in polyploids with all genotyping methods. These genotyping errors can solve by increasing the read coverage by reducing genomic representation. However, this causes a reduction in genomic coverage. Thus, in order to satisfy both read and genomic coverage at a high level, reduced genomic representation can use to increase read coverage and different enzyme combinations can use to increase genomic coverage. The data sets from multiple libraries can merge for genetic analysis.

5. Genetic diversity and phylogeny studies: GBS is an excellent tool for genomic diversity studies. With an appropriate restriction enzyme(s), lower copy regions can target more efficiently by avoiding repetitive regions of genomes, which simplifies computational challenges like alignment problems in species with high levels of genetic diversity. Using GBS, Fu and Peterson (2011) confirmed a key geographical distribution in the cultivated barley gene pool. Lu et al. (2013) developed a network-based SNP discovery protocol to enhance the analysis of diversity in switchgrass to reveal genetic patterns.

Drawbacks

Missing data results in a decreased ability to detect regions of LD and a concomitant reduction in the power to detect haplotype associations.

Genotyping error is another issue for GBS, which mainly caused by sequencing errors or low coverage NGS reads. This problem can be resolved by increasing the sequencing depth by using rare cutters, by reducing the number of multiplexed samples in a library, or by sequencing a library with a higher capacity.

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Liquid Microbial Consortium for Sustainable Farming

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Introduction

Fertilizers are compounds added directly into the soil to increase the fertility. There is another alternative to help the soil to naturally gain productivity by the introduction of microbes that can help in solubilizing phosphorus or fixing atmospheric nitrogen or help in the synthesis of growth promoting substances etc. Microorganisms having the potential to oxidize Sulphur, solubilize phosphorus, fix nitrogen and decompose matter, when creatively incorporated into farming in order to contribute to the fertility of the soil are collectively termed as biofertilizers. These are introduced into the soil or applied to the seed or the plant surfaces enabling it to form colonies in the rhizosphere or seep into the plant to help the plant grow faster or to increase the availability and absorption of primary nutrients to the plant. This is an eco-friendly and inexpensive method to aid in farming. The past couple of decades have seen an increased reliance on carrier based biofertilizers, where carriers like rice bran, lignite powder, talc, rock phosphate, paddy straw compost, vermiculite, fly ash, peat may be used individually or mixed to productive proportions. But this system does not guarantee the survival of the microbe for more than a few months, in order to remedy the major hurdles associated with the shelf life of the average carrier based biofertilizers, liquid biofertilizers have been developed to function as a cost effective sustainable agricultural bypass. The liquid Biofertilizer technology giving authentic causes for their necessity, specificity and emphasizes that the use of agriculturally relevant microorganisms, is an effective tool for Sustainable farming.

Differences Liquid Biofertilizer v/s Carrier Based Biofertilizers

Liquid biofertilizer formulation is an encouraging and upgraded technology of the traditional carrier-based production technology which, despite several benefits over the agrochemicals, left a considerable conflict among the farmer community in terms of many grounds. The major one being the viability of the organism.

1. Shelf life: Only up to 3 months of shelf life contributes to its inability to survive throughout the crop cycle whereas, LBF bypasses this to ensure the long survival of the organism by facilitating the proper medium which is adequate for the entire crop cycle.

2. Temperature tolerance: Carrier based bio fertilizers are sensitive to high temperature while liquid bio fertilizers work and sustain at all temperature.

3. Control over contamination threat: In case of carrier-based bio fertilizers the chances of contamination are very high due to bulk sterilization. However, in the case of liquid biofertilizers the contamination can be controlled by proper sterilization technique.

4. Enhanced viability: Moisture retaining capacity of the CBBF is very low which restrict the viability of organism for longer period while the LBF provides the means for enhanced viability of the organism.

Additives Used to Formulate Liquid Biofertilizer

Liquid inoculants are not the common broth culture, as often perceived to be. It is a unique liquid formulation containing not only the preferred microorganisms and their nutrients, but also contains unique cell protectant and supplements to enhance cell survival before and after application. Several liquid media comprising carbon, nitrogen and vitamins sources, which enhance the growth of bacteria are being used to culture bacteria. The

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report by Tittabutr et al. (2007) states that the additives used in liquid inoculants upgrade the quality of inoculants by enhancing the population density and improved shelf life. For the preparation of liquid inoculants, the additives have been selected on the basis of their ability to safeguard bacterial cell in package and on seeds at harsh conditions such as high temperature, desiccation and toxic condition of seeds and seed chemicals. Most of the additives are having high molecular weight polymers with good water solubility, non – toxicity and complex chemical nature and are able to limit heat transfer, possess good rheological properties and high-water activities Deaker et al. (2004). For the preparation of liquid inoculants, the polymers which are presently used are glycerol, trehalose, polyethylene glycol, polyvinylpyrrolidone (PVP), gum arabica, cassava starch etc.

Influencing Factors

1. Temperature: Temperature can affect microbial activity both before and after application. The rise and fall in temperature directly affect the growth and effectiveness of the microbes. Temperature rise above 35°C leads to the rapid decline of organisms in solid carrier biofertilizer. On the contrary, in liquid formulation, they grow at 37°C and can tolerate temperatures up to 45°C to 2 years or more.

2. Moisture content: Moisture content helps regulate the stability and activity of microorganism. Carrier based inoculums tend to put strain on the organism during transport and storage owing to its dryness. Liquid formulations tend to aid the bacteria's need for moisture as they contain humectants (Mahdi et al. (2010).

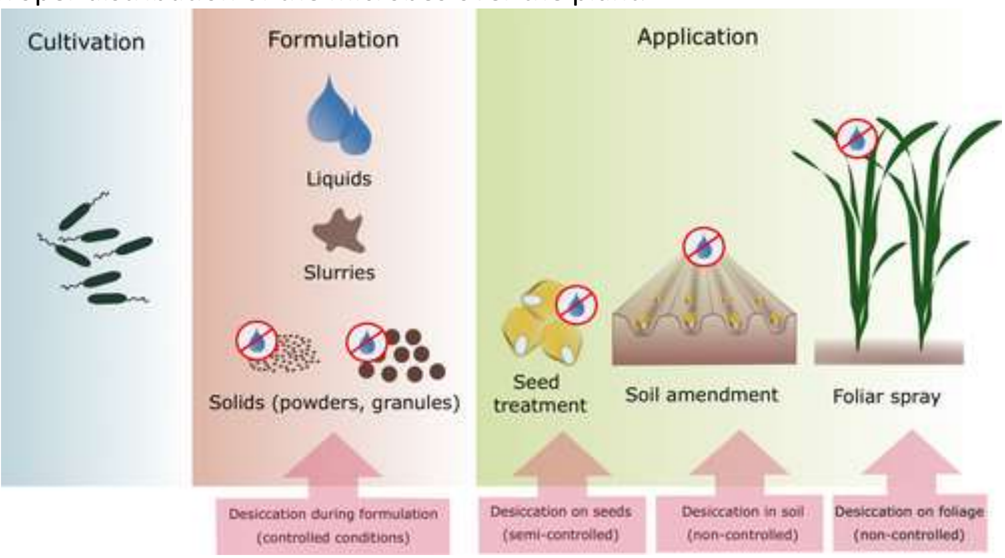
3. Intensity of Sunlight: Microbes are sensitive to the UVB (280-320 nm) and UVA (320-400 nm) rays on the Earth's surface. Sunscreens in the formulation counters the harmful effects of these rays by scattering, reflecting or absorbing the rays or converting them to wave-lengths outside this range, which is not a provision the solid base carrier can provide.

4. Effect of pH: Liquid inoculum enables the uniform maintenance of pH level throughout the culture enabling it to ensure a buffer to stabilize ranges thereby leading to improved shelf life.

5. Stabilization: Improving stability is achieved by the addition of additives into the liquid formulations helping in proper storage conditions.

Liquid Inoculums - Handling & Application

Liquid Inoculums offer worry-free transport and storage capabilities and the addition of thickeners, suspenders etc helps in the proper distribution of the microbes over the plant.



Methods for Application

1. Seed treatment.
2. Soil application.

3. Foliar spray.

Conclusion

To combat the threat of global food crises the alternative technologies in the agriculture like liquid biofertilizers are obligatory. Along with added advantages of improved shelf life and ensured survival and productivity due to the altered inoculum, they also tend to be more cost effective in comparison to the earlier relied on carrier based biofertilizers.

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High-throughput Phenotyping for Crop Improvement

Article ID: 32134

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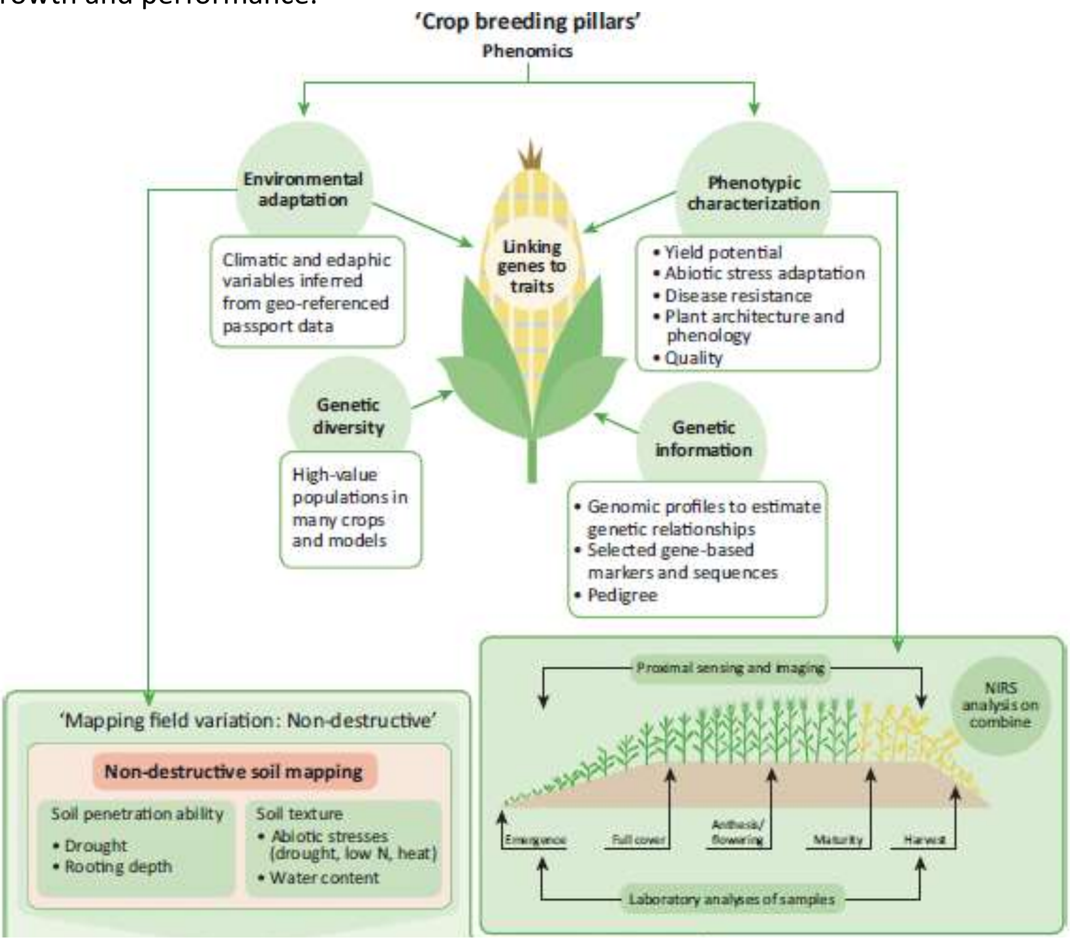
Introduction

Breeding is essentially a numbers game i.e., the more crosses and environments used for selection, the greater the probability of identifying diverse and superior variation. Researchers wish to screen large numbers of lines/progenies rapidly and accurately identify the best progeny. Highly accurate non-destructive phenotyping techniques have attracted the interest of scientists. In recent years, there has been increased interest in high-throughput phenotyping platforms (HTPPs). Most HTPPs, run by the big transnational seed companies and the most advanced public plant research institutions around the world relies on 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 Field Phenotyping

Although HTPPs enable detailed, non-invasive information to be captured throughout the life cycle of plants in a carefully controlled environment, quantitative trait loci and candidate genes identified within controlled environments have generally not been translated into gains in grain yield in the field. Field conditions are notoriously heterogeneous and the inability to control environmental factors makes results difficult to interpret. However, results from controlled environments are far removed from the situation plants will experience in the field and, therefore, are difficult to extrapolate to the field. They can be summarized into three categories:

1. Proximal (remote) sensing and imaging.
2. Laboratory analyses of samples.
3. Near-infrared reflectance spectroscopy (NIRS) analysis in the harvestable part of the crop.

Phenotyping for Abiotic Stress Tolerance

Two major abiotic stresses are drought and salinity that cause major losses to crop plants worldwide. In many aspects, these stresses produce quite similar phenotypic effects and the phenomics approaches used for screening show a high degree of crossover. One of the first effects of exposing a crop to salinity (hours to days) is stomatal closure, induced, at least in part, by the deleterious osmotic effect of solutes on the ability of roots to take up water from the soil. This osmotic stress, which is similar in nature to drought stress and salinity stress, has been termed 'chemical drought'. The effect of stomatal closure is a reduction in photosynthesis, but screening based on photosynthetic parameters or stomatal conductance measurements are generally slow and often have low reproducibility. As is the case with many plant phenomics tools, a surrogate measurement can be used to screen for stomatal or photosynthetic responses under osmotic stress. One of the best examples of using a phenomics approach with a 'surrogate' measurement is the carbon isotope discrimination (termed CID in plant breeding), a reproducible indicator of transpiration efficiency in crop physiology and plant breeding. This technique enables plants discriminate against the heavy isotope of carbon (13C) naturally present in atmospheric CO_2, both in the process of CO_2 diffusion into the leaf and in the metabolic processes of photosynthesis. This isotopic discrimination is reflected in the isotopic signature of plant dry matter and in C_3 crops, CID values are strongly related to stomatal conductance and transpiration efficiency for a given photosynthetic capacity. Infrared thermography or even simple automated spot canopy temperature measurements also have great potential for low-cost, high-throughput field phenotyping. It has been successfully used at the young seedling stage in wheat and barley to select genotypes capable of maintaining stomatal conductance under osmotic stress. In this case, salt was used to induce osmotic stress, but this technique is also applicable to high-throughput seedling screening for drought tolerance in the vegetative stages of crop development. Such screens early in plant development allow many thousands of lines to be assessed rapidly and at low cost relative to techniques requiring measurements across the whole lifecycle.

Chlorophyll fluorescence analysis has also been used as a surrogate measurement for maintenance of photosynthetic function under stresses such as drought. The most easily measured, and hence the most commonly used, fluorescence parameter in stress studies is dark-adapted Fv/Fm (a measure of the intrinsic photochemical efficiency of light harvesting in photosystem II.

Digital growth analysis is one of the least complicated and useful methods for quantitatively determining stress tolerance. Simple analysis of projected leaf area in model plants have proven to be useful and the availability of commercial systems for carrying out quasi '3-D' digital growth analysis on crop species have meant that, such approaches are becoming more popular for in situ crop phenotyping in controlled environment facilities. This technique uses multiple viewing angles (usually two side views and a top view) to extract a mathematical relationship between these three digital images and biomass or leaf area. Digital imaging of growth over a period of plant development allows assessment of the sum of stress response mechanisms and offers the opportunity to tease apart many of these responses.

Phenotyping for Biotic Stress Tolerance

Non-destructive techniques such as digital imaging in the visible spectrum and imaging of chlorophyll fluorescence have been used to monitor the progress of disease symptoms in leaves for some years. Digital imaging in just the visible region offers no advantage in sensitivity over the detection of symptoms by eye, but it provides a high-throughput technique to quantify lesions or chlorate areas on leaves. Using a combination of careful image capture, image analysis and colour classification, it is possible to follow the progression of lesions over time quantitatively. However, this approach has not commonly been used to date toin screens for pathogen resistance in crop plants. The adult plant resistance genes represent greater phenotypic challenges in scoring for disease symptoms owing to the need to examine plants at multiple time points during the progression of symptoms, in addition to genotypic challenges, because these traits are quantitative and can be non-race-specific rather than 'gene-for-gene'. Non-destructive imaging using fluorescence and hyperspectral reflectance offers great promise in quantitative scoring of such adult plant resistance phenotypes.

Conclusions

In this scheme, phenomics features at a number of levels. 'Forward' phenomics can be used to identify phenotypic, and thus genetic, variation in particular traits of interest for traits indicated as important and validated to be important by physiological studies ('reverse phenomics') of plants with differing drought tolerance. This genetic approach can take the form of a large genotype screen using a bi-parental or multi-parent population, or by direct analysis of a 'diversity panel' of lines for analysis by association genetics. As discussed above, accurate, cost-effective, high-throughput phenotyping is pivotal for fine mapping of traits, regardless of the genetic approach for producing allelic recombination or assessing variation by resequencing technologies. Phenomics is also essential for good quality reverse genetic studies, to test hypotheses regarding the role of particular genes in the function of a plant, and to test the effects of altering patterns, levels or alleles of target genes on the traits of germplasm and the drought tolerance of the resultant crop. Reverse phenomics allows the dissection of a trait to elucidate mechanisms and inform the process of identifying gene candidates through a hypothesis-driven rather than a high-throughput screening approach.

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Mapping Populations for Genomics and Crop Breeding

Article ID: 32135

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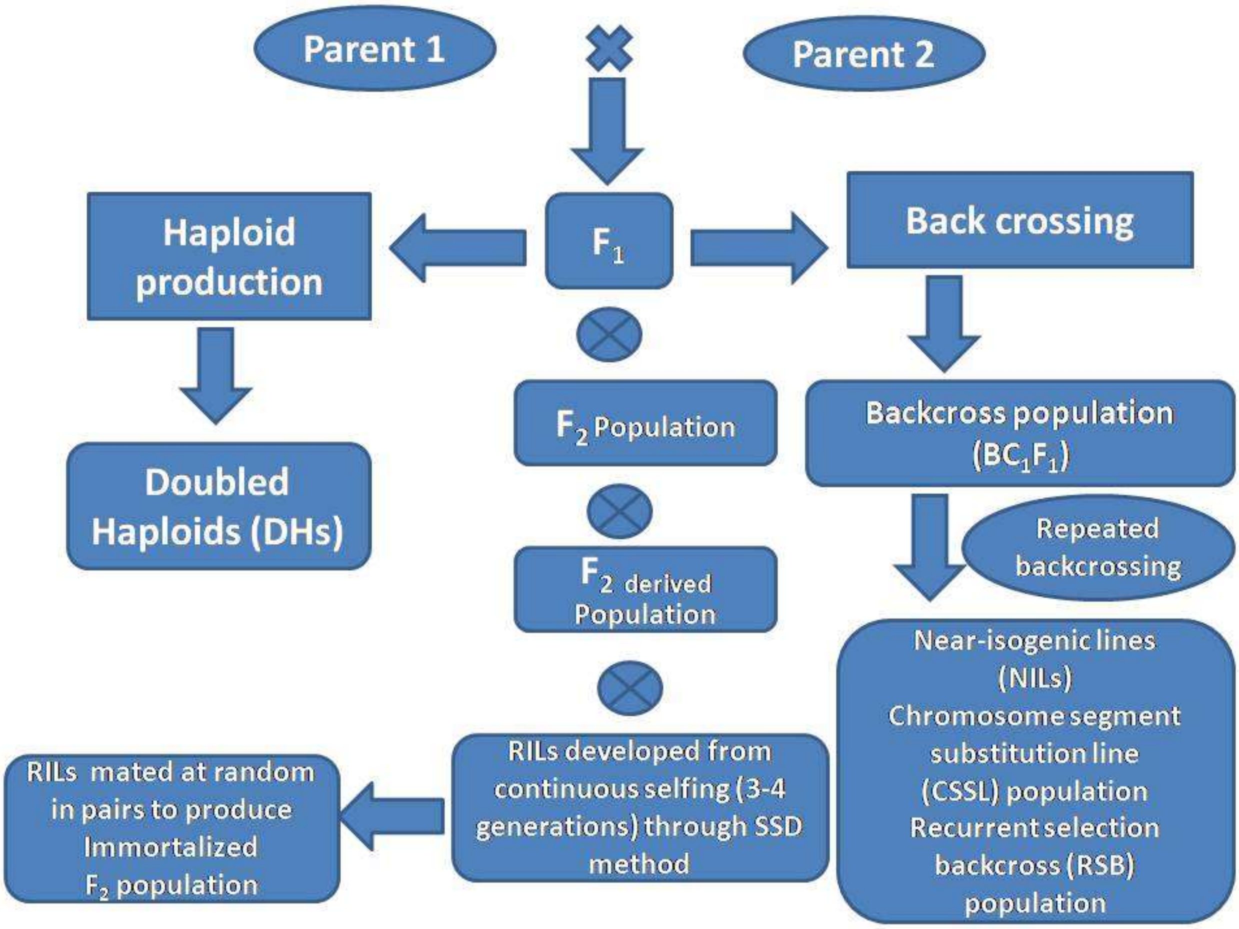
Introduction

A population that is suitable for linkage mapping of genetic markers is known as mapping population. Mapping populations are generally obtained from controlled crosses between two or more diverse parents. Parent's selection and mating design used for the development of a mapping population depend mainly on the objectives and traits to be mapped. Parents must have sufficient variation for the traits of interest at both the DNA sequence and the phenotype level. The more is the extent of DNA sequence variation, the greater is the chance of finding polymorphic markers. When the objective is to search for genes controlling a particular trait, genetic variation for the target trait among the selected parents is important.



A schematic representation of the various biparental mapping populations

Mapping Populations can be Classified into Two Types

1. Tentative or temporary or ephemeral or mortal populations: Individuals in a population, such as F_2, F_3, BC_1, BC_2, etc., have different genotypes and their genetic constitution will change with recombination resulting from selfing or inbreeding. These types of population are difficult to maintain and, in most cases, the same genetic constitution can be only used once that is difficult to replicate.

2. Permanent or immortalized or eternal or perpetual populations: This type of populations consists of a set of pure-breeding lines derived from two parents or a common set of parents. Individuals within a line have identical genotypes, while individuals from different lines have different genotypes. Each line can serve as a segregation unit from the parental population. Further, population structure and genetic constitution can be maintained consistently generation after generation through selfing or inbreeding processes. Examples are Double haploids (DHs), Recombinant Inbred Lines (RILs), Near isogenic lines (NILs), Chromosomal Segment Substitution Lines (CSSLs) and immortalized mapping populations.

Doubled Haploids (DHs)

Cells or plants that contain a single complete set of chromosomes are called haploid. Diploids produced from chromosome doubling of haploids are called doubled or double haploid (DH). The DH approach has several advantages that make it useful in genetics and plant breeding. DHs can be produced via in vivo and in vitro systems. The population is easy to generate in less time. DHls are mainly generated from F1, therefore undergo single round of recombination unlike RILs (multiple cycles of meiosis), resulting in half of recombination and resolution than RILs. Further, DHLs production are species specific and largely depend on culture responses.

Recombinant Inbred Lines (RILs)

RILs are the products of successive inbreeding. Based on reproduction systems and the degree of inbreeding, there are several types of procedures for developing RILs. Full-sib mating: for outbreeding organisms, the most severe inbreeding is full-sib mating, i.e. mating between the offspring of the same parents. Selfing: for self-pollinated plants, cultivars are genetically homozygous so they can be used to produce hybrids directly, followed by successive selfing. There are two different procedures for the management of the progenies, bulking and single seed descent (SSD) method. RILs have been the main choice, owing to the advantages derived from its homozygosity, increased effective recombination, can be propagated indefinitely, need of genotyping for segregating markers only once and efficient mapping of QTLs.

Near-Isogenic Lines (NILs)

Near-isogenic lines (NILs) derived from inbreeding are in most cases the product of successive backcrossing. Backcrossing is a hybridization method by which the F1 hybrid is crossed back to one of its parental lines. Backcrossing has been widely used in plant breeding to improve one or a few major traits (target traits) that are agronomically or genetically important but are lacking in a current commercial or elite cultivar. In this case, the commercial cultivar is crossed with the germplasm (the donor) that provides the target trait and then a backcross programme starts by backcrossing the hybrid to the commercial cultivar. The commercial cultivar used recurrently in this process is called the recurrent parent (RP), while the germplasm as the donor of the target trait is called the donor parent (DP).

Application of NILs in gene tagging:

1. Backcrossing significantly reduces the linkage drag around the target region.
2. The more backcrosses that are carried out, the smaller the linkage drag fragment in backcross progeny and the less frequently will false positives will be found between the NILs.
3. Molecular markers can be used to improve the efficiency of backcrossing by significantly reducing the linkage drag and increasing the RP genome ratio.
4. Linkage drag has significant influence on the recovery of the RP genome around the target region, indicating its important impact on backcross breeding programmes.
5. Using multiple NILs significantly reduces the probability of reporting false positives for linked loci.

Backcross Inbred Lines (BIL)

The final product of continuous backcrossing with recurrent parent would leads to development of backcross inbred line (BIL) with an almost identical genome to the RP except for the target trait/ locus. The final BILs are produced by one or more generations of selfing following the final backcross with recurrent parent.

Chromosome Segment Substitution Lines (CSSLs) or Introgression line libraries (IL libraries)

Such kind of mapping population could be generated by repeated backcrossing and MAS with the whole genome covered by the contigs of the introgressed segments from the DP. ILs has a high percentage of the RP genome and a low percentage of the DP genome.

They offer several advantages over conventional populations:
1. They provide useful stocks for highly efficient QTL or gene identification and fine mapping.
2. They can contribute to the detection of epistatic interactions between QTL.
3. They can be used to map new regions specific DNA markers.

Immortalized F_2 Population

This population can be developed by paired crossing of the randomly chosen RILs derived from a cross in all possible combinations excluding reciprocals. The set of RILs used for crossing along with the F1s produced, provide true representation of all possible genotypes' combinations (including the heterozygotes) expected in the F_2 of the cross from which the RILs are derived. The RILs can be maintained by selfing and required quantity of F_1 seeds can be produced by fresh hybridization. This population provides an opportunity to map heterotic QTLs and interaction effects from multiplication data. MAGIC populations are perpetual, lack population structure, can be used for both linkage and association analyses, and can be developed at an appropriate stage during the intermating process to afford the desired mapping resolution.

The Multiparent Advanced Generation Intercross (MAGIC) Populations

MAGIC populations are a collection of RILs produced from a complex cross/outbred population involving several parental lines. The parental lines may be inbred lines, clones, or individuals selected on the basis of their origin or use. A simple approach to generate a MAGIC population is to produce a complex cross involving multiple, typically eight, parental lines and to isolate RILs from this cross. The eight parental lines are crossed in pairs to produce four different single crosses, and these single crosses are crossed in pairs to generate two double crosses. Finally, the two double crosses are mated together to produce an eight-parent complex cross. This complex cross is handled as per the SSD procedure to develop the required number of RILs, which together constitute the MAGIC population.

Nested Association Mapping Population (NAM)

In order to combine the advantages of both linkage mapping and association mapping strategies, a structured population generated by crossing a set of diverse founder parents to one or two common parents. Each selected founder is crossed to one or few common parents (nested parents) and a set of 250 RILs from each of these crosses is generated using the SSD method. The nested association mapping strategy enables efficient utilization of genetic and genomic resources for genetic dissection of complex traits.

Conclusions

The short-term mapping populations, such as F_2, backcross, or the conceptual near-isogenic lines developed following the bulk segregant analysis (BSA) approach can be a good starting point in molecular mapping. However, long-term mapping populations like RILs, DHs, NILs, and CSSLs, or immortalized F_2, MAGIC, or NAM could be developed for precision phenotyping of the traits of importance and for sharing of the populations among different research workers. Since RILs, DHs, NILs, and CSSLs are homozygous, they are not suitable for studying dominance and interaction effects, except for additive x additive interaction effects. In contrast, immortalized F_2 populations combine the benefits of perpetual mapping populations and the opportunity for studying dominance and all interaction effects estimable from F_2 populations.

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Double Haploids Production Methods and their Application in Genomics and Plant Breeding

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Introduction

1. Doubled Haploids (DHs): Cells or plants that contain a single complete set of chromosomes are called haploids. Haploids derived from diploids are called monoploid, while haploids derived from polyploids are called poly-haploid. Diploids produced from chromosome doubling of haploids are called doubled or double haploid (DH). The DH approach has several advantages that make it useful in genetics and plant breeding. DHs can be produced via in vivo and in vitro systems. Haploid embryos are produced in vivo by parthenogenesis, pseudogamy or chromosome elimination after extensive crossing. The haploid embryo is rescued, cultured and chromosome-doubling produces DHs. The in vitro methods include gynogenesis (ovary and flower culture) and androgenesis (anther and microspore culture).

2. Haploid production: There are several approaches to haploid production. Naturally occurring haploids have been reported in a number of species including tobacco, rice and maize. In barley, the hap initiator gene was reported to control haploidy and spontaneous haploids were recovered at high frequency, with up to 8% haploid offspring being recovered when a cultivar that was homozygous for the hap allele was used as the female parent to cross with other cultivars, but none were produced from the reciprocal cross. In maize, the indeterminate gametophyte gene (ig) results in a monoploid embryo either from the sperm cell or the egg cell. Although DHs can be recovered from such spontaneous haploids, their frequencies are usually too low for genetics and breeding purposes. There are now several methods generally applicable to the production of haploids in plants with frequencies that are useful for genetics and breeding programmes.

- **a. Gynogenesis:** Cultured unfertilized isolated ovules and ovaries of flower buds develop embryos from cells of the embryo sac.
- **b. Androgenesis:** Cultured anthers or isolated microspores undergo embryogenesis or organogensis directly or through intermediate callus.
- **c. Parthenogenesis:** Development of an embryo by pseudogamy, semigamy or apogamy.
- **d. Inducer-based approach:** Haploid-inducing lines are used to produce haploids.

Haploid Production through Chromosome or Genome Elimination

Haploid embryos can be produced in plants after pollination by distantly related species. Chromosome or genome preferential or uniparental elimination arises as a result of certain crosses; fertilization occurs but soon afterwards the genome of one parent is preferentially eliminated.

Haploids can be produced by interspecific hybridization followed by chromosome elimination. In barley, this technique, called the bulbosum method, has been extensively utilized for the production of haploids in barley. Haploids can also be produced in hexaploidy wheat (var. Chinese Spring) by chromosome elimination following hybridization of wheat with *H. bulbosum*.

Haplod Production through the Anther Culture or Androgenesis

Another culture or androgenesis is a process by which a haploid individual develops from a pollen grain. Another culture is often the method of choice for DH production in crop plants.

Haplod Production through the Semigamy

Semigamy is a form of parthenogenesis and occurs when the nucleus of the egg cell and the generative nucleus of the germinated pollen grain divide independently, resulting in a haploid chimera (a plant whose tissues are of two different genotypes). Semigamy is a type of facultative apomixis in which the male sperm nucleus does not fuse with the egg nucleus after penetrating the egg in the embryo sac. Subsequent development can give rise to an embryo containing haploid chimaeral tissues of paternal and maternal origins. In cotton, the semigametic phenomenon was first reported by Turcotte and Feaster (1963), who developed the Pima line 57-4 that produced haploid seeds at a high frequency. There are many examples of DH lines developed from cultivars and intra- and interspecific hybrids between upland cotton (*Gossypium hirsutum* L.) and American Pima cotton (*Gossypium barbadense* L.) using semigamy.

Haplod Production through the Inducer-Based Approach

Haploid inducing lines have been used in maize to produce haploids by development of the unfertilized egg cells. A haploid induction rate of up to 2.3% was detected in crosses with the inbred line Stock 6. Inducer lines are now available with haploid seed induction rates of 8-12% in temperate maize germplasm.

Diploidization of Haploid Plants

Haploid plants may grow normally under in vitro or greenhouse conditions up to the flowering stage, but viable gametes are not formed due to the absence of one set of homologous chromosomes and consequently, there is no seed set. The only mechanism for perpetuating the haploids is by duplicating the chromosome complement in order to obtain homozygous diploids. In pollen-derived plants duplication of chromosomes may occur spontaneously in cultures. However, the spontaneous chromosome doubling rate of haploids is usually low. Thus, artificial chromosome doubling (diploidization) is necessary for the efficient large-scale use of haploid plants. Chromosome doubling is thought to occur by one or more of four mechanisms, namely endomitosis, endoreduplication, C-mitosis or nuclear fusion. Endomitosis is described as chromosome multiplication and separation but failure of the spindle leads to one restitution nucleus with the chromosome number doubled. It has also been called ‘nuclear restitution’. Endoreduplication is duplication of the chromatids without their separation and leads to diplo-chromosomes or to polytene chromosomes if many replications occur. Endoreplication is a common feature in specialized plant cells where cells become differentiated or enlarged in cells that are very active in metabolite production. C-mitosis is a specific form of endomitosis where, under the influence of colchicine, the centromeres do not initially separate during metaphase while chromosome arms or chromatids do separate. Nuclear fusion occurs when two or more nuclei divide synchronously and develop a common spindle.

Applications of DH Populations in Genomics

As DHs represent homozygous, immortal and true breeding lines, they can be repeatedly phenotype and genotyped so phenotypic and genotypic information can be accumulated over years and across laboratories. In genomics, DHs are therefore ideal for studying complex traits that are quantitatively inherited which may require replicated trials over many years and locations for accurate phenotyping. DH populations are desirable genetic materials for genetic mapping including the construction of genetic linkage maps and gene tagging using genetic markers. QTL analysis is facilitated by using DH mapping populations and the homozygosity of DHs enables accurate phenotyping by replicate trials at multiple sites.

Application of DHs in Plant Breeding

1. Providing the quickest possible route to complete homozygosity.
2. Giving an immediate product of stable recombinants from species crosses.
3. No masking effects because of the high homogeneity attained in the first generation of DH populations.

4. Increased performance per se due to selection pressure in the haploid phase and/or during the first generation of DHs.
5. Complete genetic variance accessible from the very beginning of the selection process.
6. Easy integration of line/hybrid development with recurrent selection.
7. Reduced efforts in the nursery after the first multiplication of DH lines compared to a conventional breeding nursery.
8. Maximum genetic variance in line per se and testcross trials.
9. High reproducibility of early-selection results.
10. High efficiency in stacking specific targeted genes in homozygous lines.
11. Simplified logistics for seed exchange between main and off-season programmes.

Conclusions

DHs have a significant impact on plant-breeding programs especially in decreasing time, labour, and cost. This technology is saving millions of dollars and allows less technical programs with limited resources to achieve extraordinary results. It was well known that DH barley cultivars had higher yields, grain quality, and resistance to stripe rust than conventional lines. Other benefits include increased genetic gain and improved parents and hybrids. DHs also have fewer crossovers and contain larger chromosomal blocks compared to conventional breeding, which results in a higher standard deviation around the mean and a greater chance of inheriting favourable traits. DHs become even more valuable when considering genotype by environment (G × E) because the environment has such a large effect on quantitative traits.

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Smart Practices and Technologies for Climate Resilient Agriculture

Article ID: 32137

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Introduction

Agricultural systems are extremely vulnerable to climate change including variations in temperature, precipitation and occurrence of natural events and disasters such as drought and flood. Meanwhile, emissions from agricultural activities contribute considerably to global warming. This cause and effect relationship between agriculture and climate change is rendered more complex by its impact on the economy, food security and development. The sensitivity is exacerbated by existing conditions of poverty, malnutrition and increasing populations which put intense pressure on limited natural resources, especially land, water and energy – all of which are integral to agricultural systems. About 20% variation in monsoon rainfall, more and more retreating of the glacier, increasing soil salinity, and heat stress and flood havoc simultaneously across regions, are all causing a web of vulnerability affecting the future of Indian agriculture and the questions of food security, employment and income scenarios (Hans, 2012). In this context, it becomes imperative to adopt Climate Resilient Agriculture which can be defined as the crop production practices that reduce poverty and hunger in the face of climate change, improving the resources it depends on for future generations and want to transform the current systems, and have a wider perspective than increased production only. It supports food production systems at local, regional and global level that are socially, economically and environmentally sustainable. Enhancing the resilience of Indian agriculture to cope with the climatic instability is mandatory to maintain livelihood security of millions of small and marginal farmers in our country. Devising appropriate adaptation strategies will enable farmers to confront with various risks, promote efficient use of natural resources to bring sustainability to farm production and stability to their incomes. Hence, the Indian Council of Agricultural Research (ICAR) has responded to this challenge of climate change on Indian agriculture by launching National Initiative on Climate Resilient Agriculture (NICRA) in 2011.

Pillars of Climate Resilient Agriculture

1. Community paddy nursery is taken as a contingency measure for delayed planting to combat the problems experienced by the farmers during deficit rainfall in lowlands.

2. Large number of community tanks/ponds with substantial water storage capacity is essential as a means of augmentation and management of village level water resources for storing and using properly the surplus rainfall or runoff during kharif season.

3. Crop diversification encourages livelihood security and resilience to climate variability to overcome the constraints of low yields or even crop failure due to erratic monsoon rainfall and skewed distribution associated with the practice of sole cropping.

4. Intercropping is a feasible and more profitable option to minimize risk in crop production, ensure reasonable returns, improve soil fertility with a legume intercrop and also it is a key drought coping strategy.

5. Direct seeded rice is vital for promoting water use efficiency in unpuddled field to cope with water shortages.

6. Drought tolerant paddy cultivars such as Sahbhagi dhan, Naveen, Anjali, Birsa Vikas Dhan 109, Abhishek etc. should be promoted to tackle deficit rainfall situations.

7. Drum seeding of rice needs to be encouraged for water saving and timeliness in planting to overcome the challenges of water shortages because of deficit rainfall, declining groundwater table due to insufficient

recharge, late and limited release of irrigation water from canals or poor inflows into tanks associated with the transplanted rice in irrigated and rainfed areas.

8. Flood tolerant high yielding rice varieties viz. Swarna Sub 1, MTU-1010, MTU-1001, MTU-1140 etc. impart resilience to farmers in flood prone areas.

9. Rejuvenation of farming in cyclone and flood prone coastal agro-ecosystems through land shaping should be come into practice for rainwater harvesting, utilization and integration of farm enterprises.

10. Check dams are established for ex-situ storage of excess runoff water in seasonal streams at suitable sites in different rainfall zones for direct use or for improving the ground water availability.

11. Short duration crop varieties of pulse and oilseed crops are predominantly suitable for late sowing under rainfed conditions.

12. Enhancing resilience through improvement in conveyance efficiency as one of the reasons for gap between potential created and utilized under canal irrigation systems is the lack of maintenance of conveyance channels which became silted up.

13. Rainwater harvesting and recycling was demonstrated by the construction of temporary check dams to help in ground water recharge and rising water table in the area, for life saving irrigation in rabi and summer crops, improvement of crop stand (70-75%), time saving (25-30%) in irrigation (1.5 hr/ha/irrigation), water saving (25-30%), higher yield (10-15%), lesser seed rate (20-25%) etc.

14. Recharging of tube wells to improve shallow aquifers was taken up as a major intervention because farmers were not aware of in-situ soil and moisture conservation techniques, hence, 35-40% of total rainfall was being lost as runoff and the rabi crops often suffered due to moisture stress affecting productivity.

15. Adequate supply of fodder, either green or dry, is crucial to the livelihoods of farmers involved in animal husbandry to tackle fodder scarcity. E.g. Sorghum (Pusa Chari Hybrid-106, CSH 14, CSH 23, CSV 17); Bajra (CO 8, TNSC 1, APFB 2, Avika Bajra Chari); Maize (African tall, APFM 8); Berseem (Wardan, UPB 110); Lucerne (CO 1, LLC 3, RL 88); Perennial fodders like APBN-1, CO-3 and CO-4 etc.

16. Improving the resilience of poor farmers by reclaiming cultivable wastelands or land improvement through levelling and bunding in undulated upland areas to arrest the unabated land degradation.

17. Small scale water harvesting structures like farm ponds at individual farm level enable the farmers to reuse the harvested water during critical growth stages; provide pre-sowing irrigation to rabi crops for improving livelihoods of small farmers; increase irrigated area in the villages, crop productivity and ground water level; take up at least two assured crops in a year and also shift to vegetable cultivation.

18. Direct rainwater harvesting and its judicious use for crop production through water catch ponds/pits i.e. Jalkund (a low cost rainwater harvesting structure) can be highly beneficial to the farmers for providing protective irrigation to the crops for successful cultivation during moisture scarcity conditions during dry seasons; for animal husbandry activities like piggery, poultry and duckery; taking up fish rearing in the harvested water; and cultivating high value vegetable crops such as brinjal, chilli, tomato, radish, amaranthus, coriander, cowpea etc.

19. Small farm mechanization through Custom hiring centres (CHCs) for farm implements such as rotavator, zero till drill, drum seeder, multi-crop planter, power weeder, chaff cutter etc. can successfully empower farmers to tide over the shortage of labour and improve efficiency of agricultural operations. Mechanization provides access to small and marginal farmers to costly farm machinery, facilitates timeliness and precision in agricultural operations and efficient use of resources and applied inputs, promotes adoption of climate resilient practices and technologies by the farmers because of availability of appropriate machines at reasonable hiring charges, reduces drudgery, promotes increase in cropping intensity wherever feasible, facilitates crop residue recycling and greater field coverage over a short period, prevents burning of residues, reduces in cost of

cultivation, provides work opportunities to skilled labour and small artisans, conserves available soil moisture under stress conditions and provides adequate drainage of excess rain and floodwaters.

20. Identification of suitable varieties of main and alternate crops is needed so that participatory seed production of short duration, drought and flood tolerant varieties of rice, soybean, groundnut, green gram, finger millet, foxtail millet, pigeonpea etc. can be taken up well in advance and kept in the village level seed banks for use in contingency situations at the local level to combat seed shortages.

21. Zero till drill wheat not only escapes terminal heat stress but also saves irrigation water up to 10-15% during first irrigation; facilitates two days early and uniform germination, better plant stand than traditional method and no crust formation after rains; improves crop yield, soil structure and fertility and causes no lodging of crops at the time of maturity in case of heavy rains.

22. There is a need for improved planting methods like broad bed and furrow (BBF), furrow irrigated raised bed (FIRB) and ridge and furrow method for in-situ soil and water conservation and proper drainage technology in deep black soils; for enhancing water use efficiency and crop productivity (5-10%); facilitates less moisture stress during non-rainy days, 20-25% lower seed rate, better weed management; saves time (25-30%) and water (25-30%) in irrigation as well as reduces crop lodging and compaction of soil.

23. In situ incorporation of biomass and crop residues is mandatory for improving soil health

24. Integrated Farming System modules with a combination of small enterprises such as crop, livestock, poultry, piggery, fish and duck rearing are demonstrated to minimize risk from a single enterprise in the face of natural calamities and diversified enterprises bring in the much-needed year-round income to farmers in monocropped paddy growing areas and improve their livelihoods and resilience to extreme weather events.

Conclusion

Climate change and climatic variability are likely to affect sustainability of agricultural production thereby affecting national food security. Adoption of climate resilient technologies can help in coping up with the challenge of climate change. Some climate resilient technologies like growing heat/drought tolerant crop varieties, changes in crop management practices, adoption of water management technologies, increasing nutrient use efficiency, development of improved farm machineries, adoption of resource conserving technologies and better pest management, access to weather forecasts, introduction of crop insurance products and harnessing of indigenous knowledge can help in agricultural adaptation to the changing climate. Exchanging information and providing technical advice on improving efficiency, productivity and resilience of agriculture at regional and national scales should be considered. Besides, capacity building and awareness on multiple advantages of climate smart, sustainable agricultural technologies should be promoted. Farmers should be ensured with better support price of agricultural produce to enable them to cope with higher adaptation cost of cultivation under changing climatic scenarios.

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Quantitative Trait Loci Mapping through Association Mapping: A Novel Tool for Crop Improvement

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Introduction

A QTL is defined as “a region of the genome that is associated with an effect on a quantitative trait.” So a QTL can be a single gene, or it may be a cluster of linked genes that affect the traits. A quantitative trait locus (QTL) is a region in DNA that correlates with variation in a phenotype of the quantitative trait. Usually the QTL is linked to, or contains, the gene or cluster of genes that control the phenotype. QTLs are mapped by identifying molecular markers correlated with an observed trait.

Qualitative Versus Quantitative Traits

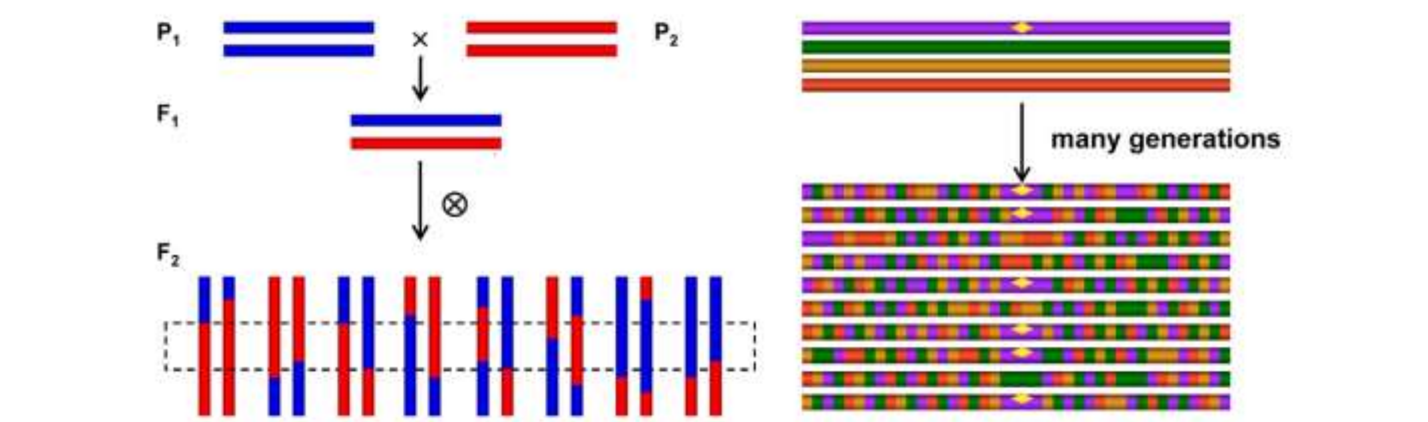
Particulars	Qualitative Traits	Quantitative traits
Phenotypic differences among individuals	Discrete	Continuous
Observation of phenotypes	Visual	Statistical parameters
No. of phenotypic classes	Few	Range of phenotypes
No. of genes involved	Few but major genes	Many but minor genes
Effect of individual gene on phenotype	Large	Small
Effect of environment on phenotype	No effect or very small effect	Large effect

Approaches of QTLs Mapping

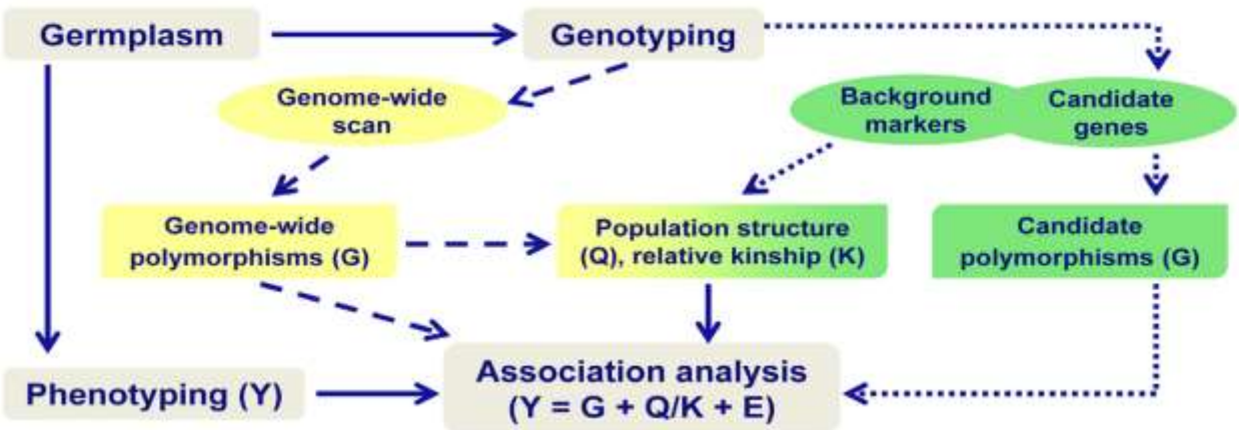
1. Biparental Mapping / Linkage mapping.
2. Association mapping / Linkage disequilibrium mapping.

The phenotypic variations in many complex traits of agricultural or evolutionary importance are governed by multiple quantitative trait loci (QTLs), their interaction, the environment, and the interaction between QTL and environment. Linkage analysis and association mapping are the two most commonly used tools for dissecting complex traits.

Association Mapping Over Linkage Mapping



Linkage mapping	Association Mapping



Association Analysis Method

Linkage analysis in plants typically localizes QTLs to 10 to 20 cM intervals because of the limited number of recombination events that occur during the construction of mapping populations and the cost of propagating and evaluating a large number of lines. Association mapping, also known as linkage disequilibrium (LD) mapping, has emerged as a tool to resolve complex trait variation down to the sequence level by exploiting historical and evolutionary recombination events at the population level. As a new alternative to traditional linkage analysis, association mapping offers three advantages:

1. Increased mapping resolution.
2. Reduced research time.
3. Greater allele number.

Types of Association Mapping

Based on the scale and focus of a particular study, association mapping generally falls into two broad categories:

1. Candidate-gene association mapping, which relates polymorphisms in selected candidate genes that have known roles in controlling phenotypic variation for specific traits.
2. Genome-wide association mapping, or genome scan, which surveys genetic variation in the whole genome to find signals of associations for complex traits.

Steps of Association Mapping

1. Species and Germplasm: Before initiating association mapping, researchers should carefully consider all genetic aspects of the species and the associated germplasm available. Choice of germplasm is critical to the success of association analysis. Genetic diversity, extent of genome-wide LD, and relatedness within the population determine the mapping resolution, marker density, statistical methods, and mapping power. Generally, plant populations amenable for association studies can be classifiable into one of five groups:

a. Ideal sample with subtle population structure and familial relatedness.
b. Multi-family sample.
c. Sample with population structure.
d. Sample with both population structure and familial relationships.
e. Sample with severe population structure and familial relationships.

2. Linkage Disequilibrium: Linkage disequilibrium, or gametic phase disequilibrium, measures the degree of non-random association between alleles at different loci. The difference between observed haplotype frequency and expected based on allele frequencies is defined as D.

$$D = p_{AB} - p_A\, p_B$$

Where, p_{AB} is the frequency of gamete AB; p_A and p_B are the frequency of the allele A and B, respectively. Alternative measures of D;

$$D' = \frac{|D|}{D_{\max}}$$

$$where \quad D_{\max} = \min(p_A p_b, p_a p_B) \; if \; D > 0;$$

$$D_{\max} = \min(p_A p_B, p_a p_b) \; if \; D < 0$$

$$r^2 = \frac{D^2}{p_A p_a p_B p_b}$$

3. Background Markers: In association studies, a set of unlinked, selectively neutral background markers used to achieve genome-wide coverage are employed to broadly characterize the genetic composition of individuals. Further, co-dominant microsatellites, or simple sequence repeats (SSRs), and SNPs are more revealing (i.e., no allelic ambiguity) than their dominant counterparts and, therefore, are more powerful in estimating population structure (Q) and the relative kinship matrix (K).

4. Candidate Gene association mapping: Candidate-gene association mapping is a hypothesis driven approach to complex trait dissection, with biologically relevant candidates selected and ranked based on the evaluation of available results from genetic, biochemical, or physiology studies in model and non-model plant species Candidate-gene association mapping requires the identification of SNPs between lines and within specific genes.

5. Whole-Genome Scan: If whole-genome association scans are to be conducted in crops, an important first step is to use high-capacity DNA sequencing instruments or high-density oligonucleotide (oligo) arrays to efficiently identify SNPs at a density that accurately reflects genome-wide LD structure and haplotype diversity.

6. Statistical Analysis: The basic statistics for association analysis, under an ideal situation, would be linear regression, analysis of variance (ANOVA), t test or chi-square test.

7. Software: A variety of software packages are available for data analysis in association mapping. TASSEL is the most commonly used software for association mapping in plants and is frequently updated as new methods are developed. STRUCTURE software typically is used to estimate Q (Pritchard et al., 2000). The Q is an n × p matrix, where n is the number of individuals and p is the number of defined subpopulations. SPAGeDi software is used to estimate K among individuals.

Uses of QTL Information in Genetics and Breeding

1. Selecting plants or families on the basis of their marker genotypes, a procedure known as marker-assisted selection. In theory, the technique should be useful for traits that are expensive or logistically difficult to measure directly or that need to be measured on mature plants. Marker data can be obtained on very young seedlings, resulting in a significant time savings in some cases.

2. Understanding trait “architecture” i.e., the number of genes, size of their effects, and type of gene action governing a trait. This information is potentially valuable to breeders in helping them decide appropriate breeding methods and population’s sizes.

3. Providing insights into genetic relationships among traits, the physiological mechanisms or biochemical pathways that contribute to a trait, and environmental effects on QTL expression.

Limitations of QTLs Analysis

1. Information on QTL locations and effects is specific to a particular population and cannot be readily transferred to another population. This is because QTLs can be detected only when the loci influencing a trait are polymorphic, and each population is likely to be polymorphic at different sets of loci.

2. QTL analysis (including population development, marker genotyping, trait evaluation, and statistical analysis) is expensive in time and materials. Therefore, it can only be used in a very limited number of populations.

3. QTL analysis detects chromosome regions, not genes that influence traits. Moreover, QTL locations have large confidence intervals, often greater than 30 cM. Such large regions encompass many candidate genes, so it is difficult to deduce which specific gene might be influencing the trait. Therefore, in most cases little information is provided on the mechanisms or pathways involved in trait expression.

4. It is difficult to distinguish two closely linked QTLs, those that are less than 20 cM apart.

5. When two QTLs are linked "in repulsion", i.e., alleles at loci on the same parental chromosome have opposite effects on the trait, it may not be possible to detect the QTL, because the effects of the associated alleles cancel each other out.

Conclusion

QTL mapping identifies markers flanking the QTL regions; these markers can be used for Marker assisted selection (MAS). The analysis is able to detect and estimates the QTL x QTL and QTL x environment interactions. QTL validation is prime importance for the successful introgression of identified QTLs into the elite genotypes for the trait's improvement. Advanced backcross QTL (AB-QTLs) analysis was proposed as a method of combining QTL analysis with variety development. It is tailored for the discovery and transfer of valuable QTL alleles from unadopted donor lines (e.g., land races, wild species) into established elite inbred lines. Comparison of linkage analysis and association mapping for QTL detection revealed that linkage mapping is more useful for genome-wide scan for QTLs, while association mapping gives more precise location of an individual QTL. Therefore, linkage analysis may be preferred for preliminary location of QTLs and then use association mapping for more precise location.

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Potential Roles of Calcium and Boron in Apple Production

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Abstract
Nutrients are an integral part of apple development. Apple is one of the biggest export business that significantly contribute to the country economy. Apple needs incredible attention for healthy and high-quality production. Calcium and boron are the key nutrient in apple plant nutrition. Calcium affects the apple quality after harvest. Calcium concentration in plants affects the firmness of the flesh, acids and fruit colour, while boron is an important trace element needed for pollen germination, successful fruit setting and optimal growth and development of apple plants.

Keywords: Apple, Nutrient, Calcium, Boron.

Introduction
Apple is a worldwide essential and widely grown temperate fruit crop that belongs to the family Rosaceae. Apple is the world's finest table fruit full of dietary fibres, pectin and antioxidants. India ranks 4th in the world's apple production and occupies an area of 301,000 hectares with 2327,000 metric tonnes of output (Anonymous, 2018). Nutrient plays a crucial part in the production of apple. Calcium and boron play an important role in the production of quality fruit among different nutrients. The deficiency results in deformed form and fruits of poor quality which lower their market value.

Calcium in Plants
Calcium is the most important compound in plants which is immobile. The root system takes calcium from the soil solution, and translocate it to the shoot through xylem. Transport of calcium to the xylem is confined to the extreme root tips and regions where lateral roots are initiated (Clarkson, 1993; White, 2001). It is needed both in the cell wall and in the cell membrane for various structural roles. It serves as a counter cation for inorganic and organic anions in the vacuole, and the concentration of cytosolic Ca2+ is an obligate intracellular messenger coordinating responses to various signs of growth and environmental threats (White and Broadley, 2001).

Metabolic Functions of Calcium
1. Calcium content of the tissue affects the rate of leaf senescence and various parameters of senescence such as respiration, protein and chlorophyll content can be altered by increasing calcium levels. It also helps in retaining of buds, blossoms and formation of new cells.
2. Calcium helps in delaying degradation of cell wall polymers which further delays softening of apples (Conway and Sams, 1984). It enhances stomatal function and engaged in heat shock protein induction that helps in protecting the plant against heat stress.
3. Calcium plays a special role in preserving the cell wall structure in fruits and other storage organs by communicating with the pectic acid in the cell wall to form calcium pectate.
4. Calcium plays a significant role in maintaining fruits quality. It helps in retaining fruit firmness (Shear, 1975) and decreasing browning in apples (Hopfinger et. al., 1984).

Deficiency of Calcium
1. Low concentration of calcium causes cork spot and bitter pit shown by depressed, often dark areas on the surface of the apple and small brown corky areas within the flesh. Calcium deficiency can be confused with

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boron deficiency, but boron deficiency causes early fruit development symptoms while calcium deficiency causes symptoms a few weeks before harvest.
2. The reduced height, fewer nodes and less leaf area are associated with Ca deficiency (Chen et. al., 2018).
3. Symptoms of calcium deficiency initially occur as localized tissue necrosis leads to stunted growth of plants, necrotic leaf margins on young leaves and eventual death of terminal buds and root tips.

Application of technical grade of calcium chloride @ 2.0 to 2.7 pounds per 100 gallons dilutes until mid-July and after mid-July, it should be applied @ 2.7 to 3.3 pounds per 100 gallons dilute is recommended for correcting calcium deficiency. 2/3 ounce of vinegar (5%) should be added per pound of $CaCl_2$ as $CaCl_2$ increases the pH of the spray solution (Autio and bramlage, 1914).

Fig. 1

Fig. 2

Fig.1: Bitter pit and Fig.2: Corky spot caused by Ca and B deficiency

Boron in Plants

Apples require a sufficient supply of boron during flower formation and fruit set. Boron deficiency in crops is greater than any other micronutrient deficiency (Gupta, 1993). The distribution of boron between plant organs, the symptoms of boron deficiency and toxicity indicates that boron has restricted mobility. Nonetheless, boron is present in the phloem and re-translocated in the phloem, mostly in adequate quantities to meet the demands of emerging sink regions that do not transpire readily. Boron has minimal mobility in many plant species, and is readily mobile in others, making it unique among the essential nutrients of plants. No other element is known to vary so greatly in mobility (Brown and Shelp, 1997).

Metabolic Functions of Boron

1. Boron helps to improve the structure of the cell wall and increases flowering, pollination and fruit set. Boron plays a very important role in the germination of pollen and the growth of the pollen tube which helps in the setting of fruit.
2. Application of boron can result in a good fruit set, thus greater yield. Pre-bloom boron application improves both fruit set as well as yield. Applying boron to soil also increases yield though to a lesser degree.
3. Application of boron decreases fruit drop and it may be due to the role of boron in auxin metabolism and transport (Zude et. al., 1997). Boron helps in reduction of bitter pit spot.

Deficiency of Boron

1. Boron deficiency results in apple chlorosis and terminal buds die off. The youngest leaves first turn somewhat chlorotic and the edge becomes scorched and rolls inward.
2. Boron deficiency can also result in cork pit, darkening of internal tissue and corked spots appear on bark of lateral shoot and may be more prone to russeting.
3. The fruits are small showing corky areas, deformed and necrotic and have a sunken area that gives a dimpled look. Strong symptoms of boron deficiency can be confused with apple scab.

Annual foliar spray of boron @ 250gms/200 liter of water at pink bud, pea stage and 20 days before leaf fall is effective in preventing boron deficiency. Boron application four weeks after petal fall, enhances boron concentration of the fruits (Zude et. al., 1997).

Conclusion

Calcium and boron are highly useful in enhancing the physio-chemical consistency of the fruit. A sufficient supply of calcium and boron contributes to increase in shoots growth, leaf area, pollen tube germination, fruit quality and firmness and reduces the risk of physiological disorders. Foliar spray of recommended dose of technical grade calcium chloride during the month of July and boron at pink bud, pea stage and 20 days prior to leaf fall is effective to avoid calcium and boron deficiency.

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Indian Economy in Corona Time: Agriculture Only Bright Spot

Article ID: 32140

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Abstract

The outbreak of the novel corona virus in India - as part of global pandemic - shut down offices and factories. But crops standing in fields kept growing, and farmers continued to tend them. Covid-19 has essentially and largely remained an urban outbreak in India till now. Now, economy indicators show what is already known: Production has contracted in factories and services have suffered losses. The seasonally adjusted market of India Manufacturing Purchasing Managers' Index (PMI) fell to 27.4 in April, 2020. This is the lowest reading of PMI in 15 years, that is, since it started recording data. A PMI of below 50 indicates contraction in manufacturing. It was 51.8 in March, 2020.

Introduction

Cases of the novel corona virus started surging in India in the first week of March. The national lockdown was announced from March. India remained locked down through April. The manufacturing units have started opening in green and orange zones (areas either free from corona virus or less impacted by Covid-19). It is expected that PMI will rise in coming months. But how long the economy will remain in revival mode is a difficult question to answer. The Indian economy was already in an extended slowdown before the corona virus outbreak applied brakes. As the novel corona virus shows ebbing signs in Asia, Europe and America, there is a fresh round of trade war between the US and China. This has dampened the mood of revival. Stock exchanges including those in India have reflected the soggy sentiments. In a Confederation of Indian Industry (CII) survey, about 45 per cent of CEOs in India said they don't see economic normalcy returning before a year. Another 36 per cent were more optimistic but said it would take 6-12 months for economy to function with normalcy. Simply put, over 80 per cent of CEOs in India think normalcy is not going to return before six months. So, before the end of October, the Indian economy of industry and services sectors (agriculture fields don't have CEOs) is to reel under the impact of corona virus. The Indian economy is left with agriculture, only agriculture to depend upon. And, the good news is India is expecting record food-grain production at almost 300 million tonnes - 298.32 million tonnes to be precise (149.92 MT kharif + 148.4 MT rabi). The government now has to ensure that all food-grains that farmers want to sell in the market are picked up. This is particularly necessary because with seemingly less significant contribution to the GDP at around 16 per cent, agriculture provides employment to about 55 per cent of workforce in India. Add to this tally those migrants who are returning home in Shramik Special trains and are likely to return to their villages when lockdown is lifted as the regular public transport resumes. A healthier and growing agriculture could not have happened at a better time. Niti Aayog member Ramesh Chand has pointed to this silver lining in the dark clouds hovering over Indian economy. In media reports, Chand has been quoted as saying, "The farm sector will grow by 3 per cent this year despite adverse conditions and it would add at least 0.5 per cent to India's GDP growth in 2020-21." This 0.5 per cent additional contribution by agriculture may actually prevent Indian economy from contracting this fiscal. This includes production of non-food crops such as oilseeds. To top it up, the Indian Meteorological Department (IMD) has predicted a normal monsoon in 2020.

There is no concrete study yet but corona virus outbreak has put pressure on ground water resources everywhere. Sanitization of body, hospitals, vehicles and public places requires a lot of water. Water consumption has increased in every household. With factories opening, water consumption will only increase as India eyes up scaling the fight against corona virus. The Indian Meteorological Department (IMD) predicted that if it turns out accurate, will ensure that taps, wells and fields don't dry up when summer hits its peak.

Conclusion

While Indian economy is facing headwinds of corona virus, the agricultural sector is an outlier, with the growth in the sector also helping spur rural demand. In fact, several sectors whose sales heavily depend on rural India have already started to exhibit a demand revival. “The agricultural sector has emerged as a bright spot; developments have had a salutary effect on rural demand as reflected in fertilizer production and sales of tractors, motorcycles and fast-moving consumer goods. Owing to good progress of monsoon in July, the sowing in the season has been higher by 5.9% as of 31st July 2020 as compared to last five-year average. The live storage in major reservoirs in the country also bodes well for the rabi season. Going ahead as well, rural India is expected to report robust recovery, buoyed by the progress in kharif sowing. Inflation is expected to rise in the food items on the account of supply chain disruptions due to coronavirus and several other reasons. For one, “the relatively moderate increases in minimum support prices (MSP) for the kharif crops and monsoon are also supportive of benign inflation prospects,” RBI said in the statement. Pressure is also high on protein-based food items due to tight demand-supply balance in the case of pulses. With more production and more workforces, agriculture requires proper management by the government. If 100 per cent procurement happens, it will revive private consumption demand, which was originally responsible for the economic slowdown in India. This brings us back to the opening sentence that India is still an agricultural country.

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Really Interesting New Gene (RING): DNA Insecticides

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Introduction

Since the late 1970s, a wealth of scientific research from different disciplines shed light on the off-farm human health and the environmental jeopardies of pesticide use, concluding that an indiscriminate use of chemical inputs in the agricultural production system cannot be environmentally or socially sustainable in the long run. The cause behind all these adverse effects which are reflecting on the environment and human health is that less than 0.1% of pesticides applied for pest control reach their target pests.

Thus, more than 99.9% of pesticides used move into the environment where they unfavourably affect human health, beneficial biota, contaminate soil, water, and the atmosphere of the ecosystem and development of insecticide resistance due to the exhaustive use of insecticides. Apart from that, biopesticides like baculoviral preparations have been well studied to control the insect pests although there are some limiting factors inhibiting the activity of the baculoviral preparations such as gut pH, peritrophic membrane, enzymes and apoptosis.

Among all, apoptosis is an important factor limiting the secondary spread of the virus owing to the death of cells adjacent to the site of infection. As the approaches used to develop preparations to protect plants from insect degradation have evolved, a pivotal moment has arrived: the beginning of the end of the supremacy held by chemical insecticides as they are replaced by better, more efficient preparations based on nucleic acids. Though biological preparations are selective, they are slow acting and relatively costly to produce. DNA insecticides and RNA preparations are fundamentally chemical insecticides made of natural polymers that, due to the principle of complementarity, act in a highly selective manner.

Thus, DNA insecticides and RNA preparations are able to unite the best features of the other types of modern insecticides, without the shortcomings, and can be synthesized in enormous quantities on automatic equipment. In the present scenario, entirely new approaches are being arisen to control insect pests. One of them is the creation of insecticides based on nucleic acids. In precise, these are the DNA insecticides based on short single-stranded fragments of anti-apoptotic (IAP) genes of nuclear polyhedrosis viruses (Oberemok et al., 2013), and formulations based on long double-stranded RNA fragments (Wang et al., 2011). The idea of the development and application of such preparations is similar to the means of blocking the expression of genes important for life using the mechanisms of RNA interference, DNA interference and application of anti-sense technologies.

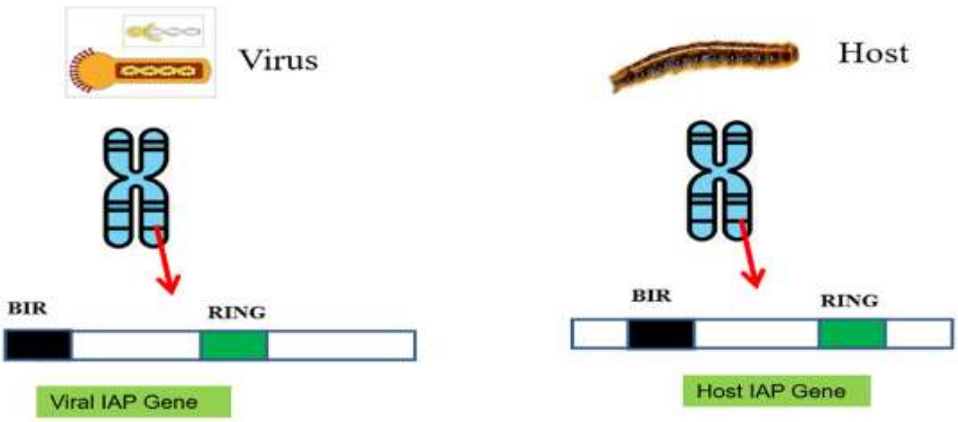
Special attention is paid to the view of creating preparations based on nucleic acids, in particular DNA insecticides. The use of insect-specific, short single-stranded DNA fragments as DNA insecticides, is paving the way in the arena of "intellectual" insecticides that "think" before they act. It is worth noticing, though, that in the near future, the quantity of produced insecticides will increase due to the challenges associated with food production for a fast-growing population.

Really Interesting New Gene (RING)

Really Interesting New Gene (RING) finger domain is a protein structural domain of zinc finger type which comprises a C3HC4 amino acid motif which binds two zinc cations (seven cysteines and one histidine arranged non-consecutively) (Borden et al., 1996). This protein domain contains around 40 to 60 amino acids. Many proteins containing a RING finger which plays a key role in the ubiquitination pathway. Scientists have focussed on the RING domain of the IAP gene since the RING domain is highly conserved than BIR domain. They designed an antisense strand of 18-20 nucleotides and named as OligoRING (DNA insecticides) from the baculoviral IAP gene of the *Lymantria dispar* Multi nucleocapsid polyhedrosis virus (LdMNPV). The oligoRING (5'-CGACGTGGTGGCACGGCG-3'), acting as an antisense RNase H-dependent oligonucleotide, induces the degradation of target mRNA for the host IAP-Z gene (very homologous to LdMNPV IAP-3 gene) and as a consequence, there is downregulated expression of the target protein.

Idea of DNA Insecticides

In this regard, a group of scientists have unravelled the outstanding evolutionary adaptation of baculovirus with many arthropods including insects. Because of this co-evolution, baculoviruses attained the capability to block apoptosis caused by the insect host employing anti-apoptotic genes that are generally called IAP (inhibitors of apoptosis) belonging to viral IAP (vIAP) and host (hIAP). These domains are in charge for blocking the activity of caspase enzymes which inhibit the process of apoptosis. Phylogenetic analysis of baculoviral IAP genes showed their host origin. The capture of these genes from insect genome likely happened at least twice in the course of evolution. In spite of the evolutionary relatedness of vIAP proteins and hIAP proteins, there is an important structural distinction between them. In contrast to the hIAPs, which possess a specific N-terminal domain and are negatively regulated by signal-induced N-terminal degrons upon virus infection, the vIAPs do not have an equivalent N-terminal domain. This makes vIAPs more stable and active as apoptosis inhibitors controlling host cell fate (Cerio et al., 2010). If we explore the function of the IAPs, the conservative part of IAPs contains BIR (baculovirus IAP repeat) domain and RING (really interesting new gene) domain. BIRs interact with processed N-terminus of apoptosis inducer Hid (head involution defective) protein. In sequence, RING domain functions as a module that confers ubiquitin protein ligase (E3) activity and, in conjunction with a ubiquitin activity enzyme (E1) and a ubiquitin conjugating enzyme (E2), catalyze the transfer of ubiquitin to target apoptosis proteins. The knowledge of DNA insecticides is unique in topical application, small size of oligonucleotides, pico molar concentrations of ssDNA (3 to 30 Pico molar), it could lead to the creation of selective host, low risk for agro-ecosystem and food webs, DNA insecticides are affordable and relatively fast acting for the control of lepidopteran pests.



Apoptosis (Programmed Cell Death, PCD)

The word "apoptosis" originates from Greek language means trees shedding their leaves in autumn. Due to apoptosis lots of morphological changes happening on the cell like chromatin condensation, membrane blebbing and apoptotic body formation that leads to the apoptosis of the cell. Some key proteins associated in the procession of the apoptosis have been deciphered such as Bcl-2 family protein, caspases (aspartic acid specific cysteine protease), Bid, Bax etc.

There are ample of components present inside the cell which are regulating the apoptosis. Regulation of apoptosis is done by caspases which play vital role. There are two pathways; extrinsic pathway, where a cell receives a signal to start apoptosis from other cells in the organism. Intrinsic Pathway, wherein a cell receives a signal to destroy itself from one of its own genes or proteins due to detection of DNA damage. There are three types of apoptosis viz., type I is called as caspase-dependent apoptosis pathway. Type II is called as caspase-independent pathway. It is basically involved in morphological variation. Type III is called as RIP-kinase-dependent necrosis or necroptosis.

Process of Apoptosis

1. Apoptosis Signal Pathway: Apoptosis is triggered by multi-signal pathways and regulated by multi-complicated extrinsic and intrinsic ligands. This phenomenon is controlled by diversity cell signals pathway and involved in regulation of cell fate death or survival. There are two major apoptosis pathways distinguished according to whether caspases are involved or not. The mitochondria, as the cross-talk organelles, can connect the different apoptosis pathways. Mainly two types of cells are involved in apoptosis; one is called as signalling cell and second is called as target cell.

2. Caspase Dependent Pathway: Caspase-dependent apoptosis is the classic programmed cell death pathway, the capase-8, caspase-9, caspase-12, caspase-7 and caspase-3 cascade are usually participated in this type of apoptosis pathway. Variety of receptors such as the TNF-alpha receptor, FasL receptor, TLR and Death receptor will be taking part in this kind of apoptotic pathway.

Some iron channels may also be involved in apoptosis pathway. The classic iron channel is the calcium channel, since calcium's concentration in the cytosol plays an important role in the signal transduction regulation and participates in the cell proliferation and cell death; the cell fate can be controlled by the calcium channel opening or closing. This process starts from the stress, when cells feel that something is going to stop the activities or modulate the cell.

The signalling cell or infected cell transmits a signal to target cell in the form of a protein called as first apoptotic ligand (Fas L) to the target cell. The Fas ligand is going to bind with the Fas receptor which is present on the plasma membrane of the target cell and one Fas receptor receive the ligand it activates another domain called as death domain (DD) and the death domain activate first apoptotic death domain (FADD) and later tumour apoptotic death domain (TRADD) after activation of all the apoptotic domain it results into formation of death inducing signalling complex (DISC).

This DISC stimulates the pro-caspase 9 to active form caspase 9 (Initiator caspase) and the caspase 9 trigger the executioner caspase, pro-caspase 3 to active form caspase 3 and which is going to act on the inhibitors of the nuclease. Once the inhibitors get inhibit it, the nuclease is becoming active and nuclease is going inside the nucleus and responsible to degrade nucleic acid inside the nucleus. Ultimately this leads to the death of the cell. When the cell feel that the stress factor has gone, they suddenly activate the anti-apoptotic genes and block the activity of apoptosis to stop further degradation of the cells. The anti-apoptotic genes are acting on the different caspase by the process of the ubiquitination.

Conclusion

As we all know that the population of the world will continue to grow over the next 50 years and may reach nine billion people. This would cause an increased global demand for food. More intensive food production is associated with more intensive use of pesticides.

It is assumed that in 2050, the use of pesticides will be 2.7 times higher than in 2000, which will put people and the environment in an extremely dangerous situation. In this circumstance, an agreeable interaction of scientists and the manufacturers of insecticides will lead to the selection of the most optimal solutions for the control of insect pests.

The use of insect-specific, short single-stranded DNA fragments as DNA insecticides, paves the way for the creation of “intellectual” insecticides that “think” before they act. It is important to show that DNA insecticides will be safer to the environment. Additionally, diverse studies need to be conducted to identify its specific mode of action and application across insect orders. Proper DNA application methods need to be developed. Studies need to be conducted to enhance the stability of DNA in insect tissues and gut.

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COVID-19 Impacts on Air Quality

Article ID: 32142

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Abstract
The COVID-19 has affected almost every country of the world and causes a great threat to humankind. It has generated an unprecedented impact on the world. The WHO estimates that 90 percent of people worldwide breathe polluted air, with the bulk of pollution affecting lower-income countries. The COVID-19 pandemic has many indirect effects on the environment which has resulted in improved air quality. It is ironic that this life-threatening virus has caused reduction in air pollution.

Keywords: Air, Quality, Pollution.

Impact on Air Quality
Air quality is important for health and survival of everyone living on the planet. The COVID-19 pandemic has brought about an improvement in air quality worldwide. After the lockdown was put in place in many countries, there were fewer people moving, whether by their own cars or by trains and planes. Also, the factories were shut down and not permitted to work. This in turn led to a substantial drop in air pollution, as nitrous oxide emissions decreased markedly. The amount of pollution around the countries decreased dramatically in just a few days, due to the imposed restrictions. According to WHO (2016), nearly about 91 per cent of the world population lives in the places where poor air quality exceeds the permissible limit and results in almost 8 per cent of the total deaths of the world. NO_2 is one of the six major air pollutants. Natural sources of NO_2 accounts very less for total NO_2 levels whereas human activities are mainly responsible for NO_2 emissions. To control the expansion of SARS-CoV$_2$, many countries have implemented public policy of social distancing. In a country like India, the nationwide lockdown has dramatically reduced the levels of NO_2 in many metropolitan cities. In Delhi, NO_2 levels from March 25 to May 2 (lockdown period) have averaged 90 µmol/m2 compared to 162 µmol/m2 from March 1 to March 24 (before lockdown). In Greater Mumbai and Navi Mumbai, a similar pattern has been observed as NO2 levels from March 25 to May 2 averaged 77µmol/m2 compared to 117 µmol/m2 from March 1 to March 24. In 2019, NO_2 levels from March 25 to May 2 averaged 122 µmol/m2 (Poetzscher, 2020).

	**Before lockdown in New Delhi**
	**During lockdown in New Delhi**

Strict traffic restrictions and self-quarantine measures to control the spread of SARS-CoV$_2$ have resulted in reduction of air pollution in China. NO_2 levels have been reduced by 22.8 µg m-3 in Wuhan and 12.9 µg m-3 in China. Particulate matter of diameter less than 2.5µm (PM 2.5) is also one of the constituents of the air pollution. PM 2.5 decreased by 1.4 µg m-3 in Wuhan and by 18.9 µg m-3 in many other cities. According to Copernicus Atmosphere Monitoring Service (2020), on comparing the difference between monthly average for February, 2020 and the mean of the monthly averages for February 2017, 2018 and 2019, a drop of approximately 20-30 per cent of PM 2.5 is reported in many parts of China. According to Global Carbon Project (2020), climate experts have predicted that greenhouse gas (GHGs) emissions could drop to proportions never before seen since World War II. In Europe, to prevent the spread of COVID-19 government has ordered people to stay at home and as a result, air pollution has dramatically reduced due to the reduction in usage of motor vehicles which has resulted in decrease in GHGs emissions (Monserrate et. al., 2020). To make the current drops in air pollution levels permanent, serious changes in policy needs to be enacted.

Conclusion

Combining the findings, it is concluded that pandemic COVID-19 increases the air quality. Limited population enclosure, reduction in road traffic and economic activity contributed to a decline in levels in CO and NO_2. The study reported that the COVID-19 lockdown has proven a blessing for the world's air quality.

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Contingency Planning to Tackle Climate Change Impacts

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Introduction

Climate change refers to any significant change in measures of climate (such as temperature, precipitation or wind) lasting for an extended period. Impact of climate change on agriculture like drought, flood, heat wave, cold wave, frost and cyclones. Contingency cropping is growing of crops in aberrant weather situations like drought and floods. (Joshi, et al. 2009). Aberrations in rainfall behaviour include late onset of monsoon, dry spell during crop period, early withdrawal of monsoon and extended monsoon and inadequate. Contingency crop planning includes selection of crop/variety and change in sowing time, inter cropping & crop row management, in season heat stress/drought management, nutrient management, water management and moisture conservation and alternate land use system etc. (Srinivasarao (2010)).

Climate Change

Climate change is any change in climate over time that is attributed directly or indirectly to human activity that alters the composition of global atmosphere in addition to natural climate variability observed over comparable time period.

Impact of Climate Change on Agriculture

1. Heat wave: The normal maximum temperature is more than 40°C, if the day temperature exceeds 3°C above normal for 5 days it is defined as heat wave. The rise in temperature beyond a threshold level for a period of time sufficient to cause irreversible damage to plant growth and development.

2. Cold wave: In regions where, normal minimum temperature remains 10°C or above, if the minimum temperature remain 5°C lower than normal continuously for 3 days or more it is defined as cold wave. The adverse effect observed are on growth, flowering, fruiting, delay in ripening and mortality of young plants.

3. Frost: The temperature of earth surface and earthbound objects fall below zero degree (freezing). Frost is experienced in the month of January. Suggested measures include frost resistant varieties, change in planting time, adopting shelterbelts, shade trees and use of mulches.

4. Cyclone: Cyclone starts as a tropical low-pressure depression, created by oceanic temperature rising above 26°C and usually occurs between April- May and also between Oct- Dec in the country. The entire costal area is affected by cyclones with varying frequency and intensity. Cyclone causes extensive uprooting leading to total crop loss and physical damage. Table - 1 Expected changes in temperature and rainfall in India due to climate change:

Year	Season	Temperature change (°C)		Rainfall change (%)	
		Lowest	Highest	Lowest	Highest
2020s	Annual	1.00	1.41	2.16	5.97
2050s	Annual	2.23	2.87	5.36	9.34
2080s	Annual	3.53	5.55	7.48	9.90

Strategies for Adaptation to Climate Change

1. Altered agronomy of crops & Crop-management strategies.
2. Diversified farming.
3. Increase income from agricultural enterprises.
4. Policy tools for resource management on a sustainable basis.

5. Improved risk management through early warning and crop insurance.

Contingency cropping is growing of crops in aberrant weather situations like drought and floods. It aims at partial mitigation of misery by producing some food, feed and fodder to encounter emergency conditions.

Aberrations in Rainfall Behaviour

1. Late onset of monsoon.
2. Dry spell during crop period.
3. Early withdrawal of monsoon.
4. Extended monsoon.

Late Onset of Monsoon

1. Transplantation.
2. Alternatives crops.
3. Alternate varieties.

Dry Spell During Crop Period

Common phenomenon in dry land agriculture:

1. Ratooning / Thinning: Pigeon pea, Sorghum.
2. Urea spray: Castor, Groundnut.
3. Mulching: Stubble mulch, soil mulch (dust mulching).
4. Weed control.
5. Water harvesting and protective irrigation.

Early Withdrawal of Monsoon

This situation is equally or more dangerous than late onset of monsoon. Rainy season crops will be subjected to terminal stress leading to poor yield.

Remedies Measures

1. If irrigation facilities/ harvested water in ponds are available, give supplementary irrigation to the crop.
2. Light interculture to avoid soil crack thereby reduction of evaporation losses from soil.
3. Removal of weeds to minimize the losses of water from soil.
4. Harvest the crop at physiological maturity.
5. Mulching should be used.
6. Thinning should be followed in wider spaced crops.

Extended Monsoon

Extended monsoon is seldom a less problem in agriculture. It benefits long duration Kharif crops taken as a component crops in inter-cropping and relay cropping system.

Remedies Measures

1. Ratooning of crop like hybrid jowar.
2. Second crop of safflower, gram, sunflower, mustard and fodder jowar immediately after early harvest of kharif crops.
3. Relay cropping.

Contingency Crop Planning

Contingency crop planning includes selection of crop/variety and change in sowing time, inter cropping & crop row management, in season heat stress / drought management, nutrient management, water management and moisture conservation, efficient energy use and management and alternate land use system etc.

1. Selection of crop/variety and change in sowing time.
2. Inter cropping & crop row management.
3. In season heat stress/drought management.
4. Nutrient Management.
5. Water management and moisture conservation.
6. Alternate land use system.

Conclusion

Climate change is a major constraint in agricultural production system. Adoption of conservation furrow, foliar spray of nutrients, In- situ, ex- situ water harvesting and thinning we can sustain the production with minimum losses due to climate change. Growing of drought and flood resistant crop/ varieties are more profitable and resilient under climate change scenario. Agronomic interventions like altering time of sowing, appropriate irrigation & nutrient management can play a vital role in reducing the ill effect of climate change.

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Integrated Pest Management Strategies in Okra

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Okra, *Abelmoschus esculentus*, is an herbaceous annual plant in the family Malvaceae which is grown for its edible seed pods. It is one of the most common and extensively grown vegetable crops in India, and occupies an important place in the food basket of Indian consumers. It is also noted for its rich iron content and nutritive value.

Though okra is cultivated in an area of about 0.43 m ha in the country, its productivity is very low. One of the major constraints identified in their production is the increasing incidence of insect pests, diseases and nematodes, thereby resulting in substantial yield losses. Due to their tender and supple nature, and their cultivation under high moisture and input regimes, okra is more prone to pest attack and this often leads to an estimated yield loss of about 35-40 percent.

To mitigate such losses, a huge quantity of pesticides is often used in okra. It is not unusual for the okra growers to give around 10-12 pesticidal sprays in a season and thus the fruits, which are harvested at short intervals, are likely to retain unavoidably high level of pesticide residues which are highly hazardous to consumers. With a view to minimize all these problems and to create awareness among the farmers, Integrated Pest Management strategies for okra has been discussed below

Major Disease and Insect Pests Infesting Okra

1. Fusarium wilt: Wilting of cotyledons and seedling leaves; cotyledons become chlorotic at the edges and then necrotic; older plants exhibit symptoms of wilting and leaf chlorosis; wilting is usually gradual but may be pronounced after heavy summer rain; if infection is severe, plants become stunted and may be killed; vascular system of infected plants becomes discoloured and can be seen by cutting the stem.

2. Charcoal rot: Discoloration of stem at soil line; cankers on stem may spread upwards; leaves may wilt and drop from plant; numerous small black sclerota (fungal fruiting bodies) develop in affected tissues and can be used to diagnose the disease.

3. Yellow vein mosaic (YVM): Interwoven network of yellow veins encompassing with islands of green tissues on leaves. Later, entire leaves turn yellow. It is a viral disease, transmitted by whitefly. In case of severe infestation of whitefly, premature defoliation also takes place.

4. Shoot and fruit borer: When the crop is young, larva bore into tender shoots and tunnel downwards which wither, drop down and growing points are killed. Later, the larvae bore inside fruits and feed on inner tissues, thereby making them deformed in shape, with reduced or no market value.

5. Leaf hopper: Nymphs and adults of leaf hopper are pale green and suck sap from foliage. The affected leaves turn yellowish and curl. In case of heavy infestation, the leaves turn brick red and crumble.

6. Red spider mite: Nymphs and adults suck cell sap and whitish grey patches appear on leaves. Affected leaves become mottled, turn brown and fall. Under severe infestation the top canopy of the plant is covered by webbing of mites. The mite infested plants can be identified from the distance by the characteristic mottling symptom produced on the upper surface of the leaf. Infestation of mites is mostly observed during warm and dry periods of the crop season.

7. Root knot nematode: Microscopic, soil borne, vermiform pests. They feed vigorously on roots and cause galling of roots. Affected plants are weak, stunted with yellow leaves.

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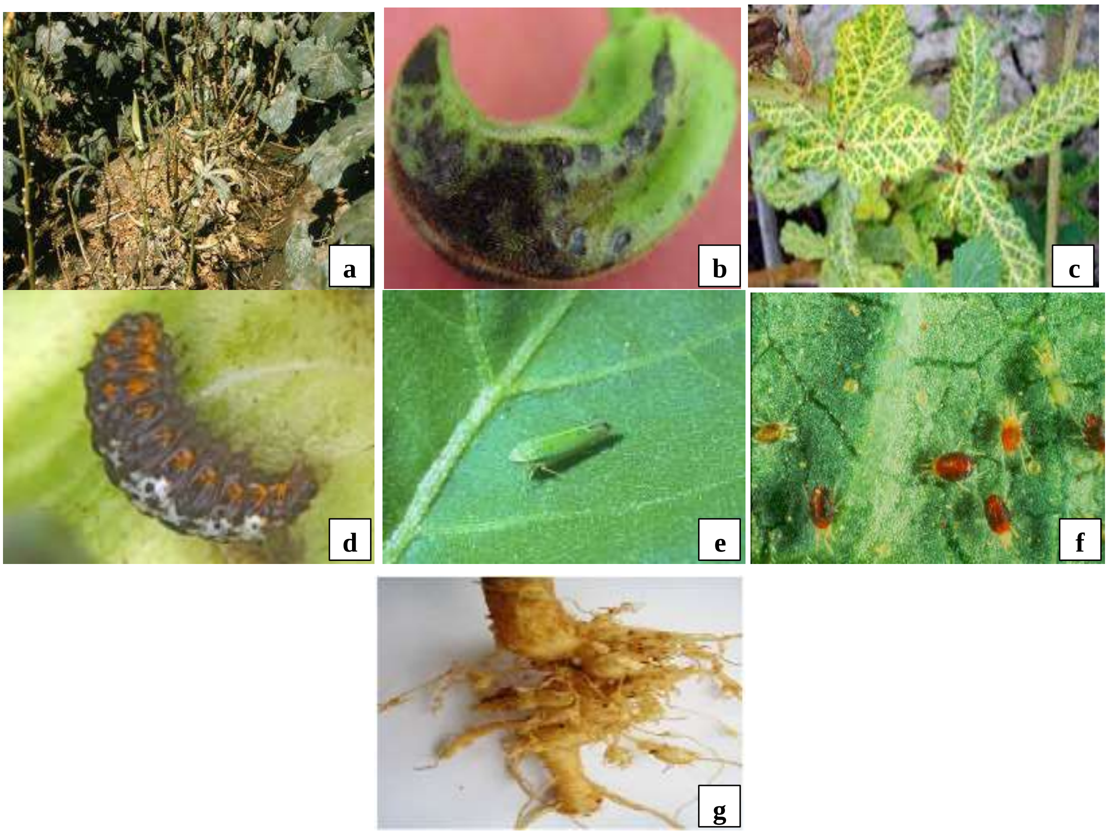
Integrated Pest Management Strategies

1. Sowing of YVM resistant hybrids like Makhmali, Tulsi, Anupama-1 and Sun-40, should be adopted, especially during *kharif* season.

2. For diseases any one uses of biopesticides namely, Achook (5ml), Spictaf (4.5 ml), Neem-Azal (3 ml), Neem gold (10 ml) Nimbicidine (5ml), Wanis (5 ml) and tulsi leaf extract (10 ml) and biocontrol agents like *P. fluorescens* (Bioshield-5ml), *Gliocladium virens* (Soilgard-5g)and *Trichoderma harzianum* (Bioderma-5g), *Trichoderma viride* (Ecoderma-5g)as seed treatment per kg and foliar sprays per liter thrice at 15 days interval most effective in reducing the disease incidence.

3. Uses of any one fungicide i.e. thiophanate-methyl (Neotopsin 70WP)@ 0.5g/l, difenconazole (Score 25 EC) @ 1.0g/l, hexaconazole (Contaf 25 EC) @ 1.0g/L, propiconazole (Tilt 25 EC) @ 1.0g/L have the potential to be used as highly effective against diseases.



Major pests associated with okra, a: Fusarium wilt, b: Charcoal rot, c: Yellow vein mosaic disease, d: Shoot and fruit borer, e: Leaf hopper, f: Red spider mite, g: Root knot nematode

4. Seed treatment with carbendazim @ 2.5g/kg seed + spraying of tricyclazole @ 0.06% + second spray of tricyclazole @ 0.06% after 7 days of first spray.

5. Grow maize/sorghum on borders to restrict the entry of shoot and fruit borer adults.

6. Removal and destruction of infected volunteer plants and collateral hosts in the vicinity of the field in early stage of infection.

7. Set up yellow sticky and delta traps for white fly etc.

8. Erection of bird perches @ 10/acre in the field for facilitating bird predation.

9. Give two to three sprays of NSKE @ 5% alternating with sprays of pesticides, if needed, for leaf hopper, white fly, mites and aphids etc. Leaf hopper, if crosses ETL (5 hoppers/plant), spray imidacloprid 17.8 SL @ 150 ml/ha.
10. This will be effective in controlling other sucking pests as well.

11. Install pheromone traps @ 2/ acre for monitoring of Earias vittella moth emergence. Replace the lures after every 15- 20-day interval.

12. Release egg parasitoid *Trichogramma chilonis* @ 1-1.5 lakh/ ha starting from 30-35 days after sowing, 4-5 times at weekly interval for shoot & fruit borer.

13. Shoot & fruit borer, if crosses ETL (5.3 % infestation), spray cypermethrin 25 EC @ 200 g a.i/ha.

14. Rogue out the YVM virus affected plants, if any, from time to time.

15. Periodically remove and destroy the borer affected shoots and fruits.

16. Need based application of chemical pesticides *viz.* imidacloprid 17.8 SL @ 150 ml/ha, cypermethrin 25 EC @ 200 g a.i/ha (0.005%), or Propargite 57 EC @ 0.1 % for control of leaf hoppers, aphids, white flies, borers and mites.

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Advance Tools for Increasing Nitrogen Use Efficiency in Rice

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Introduction

Cereals are the major source of food and rice (*Oryza sativa* L.), is the staple food for nearly half of the world's population. Global production of rice is more than 740 million tons and world's 90% of rice produced and consumed in Asia. India is the second largest producer of rice after China. India placed third in production and second in consumption of chemical fertilizers in the world. The total nitrogen (N) production, import and consumption in India was 13.43, 3.43 and 16.96 million tons respectively. Fertilizer is one of the major factors for the continuous increase in rice production and more than 20% of nitrogenous fertilizer produced in worldwide is used in the rice fields of Asia. Nitrogen Use Efficiency of rice production is only 30-40% due to various N loss mechanisms. Irrigated and rain-fed lowland area account 92% of total rice production and 20–25% of total cost of cultivation spend on fertilizers. Low nitrogen use efficiency of rice, due to rapid loss through volatilization and leaching and it contributes to different environmental impact like eutrophication of surface water bodies, acidification of agricultural soils and increased concentration of nitrous oxides in atmosphere contributing to global warming.

Now, need to reduce loss of nitrogen and increase of nitrogen use efficiency which can be achieved by using advance tools for nitrogen management in rice. Following advance tools available for nitrogen management in rice:

1. Leaf colour chart for nitrogen management: Leaf Colour Chart (LCC) is cheaper method used for determining timing and amount of N fertilizer application in rice crops. LCC has four strips and colour of strips ranging from yellow green to dark green, green colour indicate sufficient N content and yellow colour indicate deficient in N. Farmers can easily use the LCC to qualitatively assessing foliar N status of rice crop and adjust N application accordingly, for large area. LCC offer to manage N need in real time for their efficient use. Farmers apply N fertilizers in splits but the number of splits, amount of N and the time of application varies, so LCC is more useful, simple and cheaper method for Indian farmers for N management in rice. By using LCC farmer can save 25 kg nitrogen per hectare without any reduction in yield. Based on LCC N application save 40 percent of N as compared to blanket recommendation.

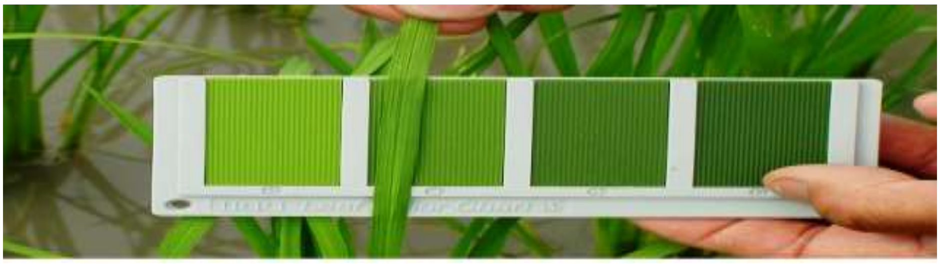

Fig1: Leaf colour chart

2. Site-specific nutrient management for nitrogen management: The site-specific nutrient management (SSNM) approach emphasizes on feeding of nutrients to crops when needed with optimum amount. The SSNM approach not based on reduce or increase of fertilizer use, instead, it aims to apply nutrients at optimal rates and time to achieve high efficiency of nutrient and yield. SSNM dynamically use of fertilizer to fill the deficit between the nutrient needs of the crop and nutrient supply from naturally occurring sources.

SSNM save 10% N, increases 25% yield and more uniform N application in Rice-Wheat cropping sequence as compared to Farmers fertilizer practices.

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3. Chlorophyll meter for nitrogen management: The chlorophyll meter or SPAD meter (Soil Plant Analysis Development) is a simple, faster and portable diagnostic tool than tissue testing for N needs of plant that measures the greenness or relative chlorophyll content of leaves. The chlorophyll meter allows "fine tuning" of N management to field condition. The Chlorophyll Meter would also helpful for farmers those are not highly trained to make N recommendations. The linear relationship between N and SPAD value used for N management in rice crop. SPAD readings indicate that plant nitrogen by the physiological nitrogen status of crops at different growth stages. It is a quick and non-destructive and in situ tool for measuring relative chlorophyll content in rice leaf that is directly proportional to N content. Higher the SPAD value indicates optimum N concentration in plant and decrease in the SPAD value indicates a decrease in the nitrogen concentration.

Chlorophyll meter-based N application in rice increase agronomic efficiency of N and save N, 6.97 % and 25 % respectively as compared to fixed time N application.

4. Crop canopy sensor for nitrogen management: Crop canopy sensors can be used to estimate crop growth and nutrient status more efficiently and for large scale applications. Two type of crop canopy sensors are:

a. Green seeker sensor: Green seeker is emerging as a potential tool for efficient nitrogen management through monitoring crop growth with remotely sensed indices like NDVI (Normalized difference vegetation index). The Green Seeker sensor measures NDVI by using active sensor light source in the red (660 ± 10 nm) and near infrared (780 ± 15 nm). The Green Seeker calculates NDVI using the following formula:

$$NDVI = \frac{pNIR - pred}{pNIR + pred}$$

Where, pNIR represents the fraction of emitted near infrared radiation returned from the sensed area (reflectance) and, pred represents the fraction of emitted red radiation from the sensed area (reflectance). Gupta, (2006) reported that use of green seeker saves 68 kg N ha^{-1} compare to farmer's fertilizer practices, without reduction of grain yield rice.

b. Crop canopy sensors: The crop canopy sensor works on the same principle as that of the green seeker sensor, however the visible light produced by this sensor is called yellow but has also been referred to as the amber. Therefore, this sensor is referred to amber sensor and the index calculated is referred to as amber index. It is used for determining the time and amount of N application in rice crop based on amber index.

5. Crop simulation model: Crop simulation models are quantitative tools based on scientific knowledge that can assess the effects of climate, edaphic, hydrological and agronomic factors on crop.

Crop simulation model predict the time of application of nitrogenous fertilizer, it also predicts how much amount to be required by crop. It thus avoids the excessive use of nitrogenous fertilizers and also improve nitrogen use efficiency.

Crop simulation model used for nitrogen management in rice are:

a. SSAT models
b. CERES models
c. WOFOST models etc.

6. Smart fertilizer: Low fertilizer use efficiency of water-soluble N fertilizers such as urea, ammonium sulphate and ammonium carbonate in rice is the mismatch between the time and intensity of fertilizer and crop requirements. Nitrification inhibitors, urease inhibitor, slow and control release fertilizers increase N use efficiency, productivity and yield and reduce N losses through better coordination of N availability with plant demand.

a. Control release fertilizer: Control release fertilizers (CRF) are coated or encapsulated with organic or inorganic materials which control plant nutrient release pattern, rate and duration. The CRFs release rate is optimized to meet the changing crop nutrient requirements in a designed pattern. The CRFs provide the plant nutrients that are usable for a longer duration than normal fertilizers like urea.

b. Slow release fertilizer: Slow release fertilizers (SRF) consist of compounds that are typically having low water solubility and reduce urease or other biological catalysts on enzymatic hydrolysis. SRFs mean a slower nutrient release rate than traditional water-soluble fertilizers and CRFs.

The release rate, pattern, and duration are not regulated because they rely on microbial organisms whose efficacy depends on temperature and humidity. These significantly extend their bioavailability longer than normal N fertilizers such as ammonium nitrate and urea. Using SRF and CRF to achieve high fertilizer N use efficiency along with high grain yield of rice in a large number of studies from all over the world.

c. Nitrification inhibitors: Nitrification inhibitors inhibit bacterial oxidation of the ammonium ion by reducing the activity of Nitrosomonas bacteria in soil over a certain period of time (4-10 weeks). Nitrification inhibitors are designed to prevent nitrate loss by leaching or producing nitrous oxide by denitrification from the top soil by holding N in the ammonium form longer and thus increasing the NUE.

Delaying the conversion of ammonium to nitrate-avoiding unwanted high levels of nitrate in plants used for human and animal nutrition. Nitrification inhibitors favour the partial ammonium nutrition of plants because plant needs less energy to incorporate ammonium into amino acids; nitrate has to be reduced first to ammonium and this requires energy. Nitrification inhibitors are based on the ability to tie-up copper-a vital metal used by bacteria for nitrification.

The important Nitrification inhibitors include: N-Serve, nitrapyrin (2-chloro-6{trichloromethyl}pyridine), DCD (dicyandiamide), 4-amino-1,2,4- 6-triazole-HCL (ATC), 3,4-dimethylpyrazole phosphate (DMPP), carbon disulphide (CS2) and ammonium thiosulphate.

d. Urease inhibitors: A chemical called urease inhibitor that prevents hydrolytic action on urea by inhibiting enzyme urease. It delays the conversion of urea into ammonium and nitrate, depending on the soil and climatic conditions they can inhibit urea hydrolysis for 2 weeks or more. Theoretically, inhibition of urease activity is due to a tie-up of soil nickel-a critical metal constituent of urease enzyme. The key benefits of urease inhibitors are a major reduction in ammonia volatilization losses resulting in an increase in the soil N availability to plants, an improvement in the performance of N-use from urea and urea- based fertilizers and decrease in the toxicity of nitrate and decrease in the release of N oxides and nitrous oxides. Most commonly used urease inhibitor is NBPT (N-(n-butyl1) thiophosphoric triamide).

7. Deep placement of N fertilizers: Best management practices for fertilizers based on the principles of nutrient stewardship consist essentially of the right source of nutrients for application at right rate, at right time and at right place. Placement of fertilizer nutrients, particularly deep placing in the soil, is crucial for increasing rice yield because it affects potential N losses. Urea supergranules is a big sized granule approximately one gram is used for deep placement, it performs better when applied by deep placement method.
Incorporation of N into the soil minimizes N losses and broadcasting of urea to soil or floodwater can increase N losses, particularly NH3 volatilization losses (Mikkelsen et al., 1978; De Datta et al., 1989).

8. Split application: Split application of N is well known for increasing NUE. When large quantities of N are applied at a time as a basal dose N, lowest efficiency of N. Nitrogen should be added to suit the crop requirement for N, two split doses are recommended for varieties of short and medium duration, whereas three split doses are recommended for long-duration varieties. Less number of splits recommended for heavy soil and more for sandy soils.

Conclusion

According to our discussion, LCC, an ideal eco-friendly tool for optimizing NUE irrespective of N applied but some time it does not work on all rice varieties so they need to develop area or variety or group of LCC based varieties. Need-based and real-time management of N fertilizer are probably most effective tools for improving N use efficiency in rice. For increasing N use efficiency in rice use of simple and affordable gadgets such as LCCs and costly gadgets such as chlorophyll meters and optical sensors. Improvements in agricultural practices such as split application, depth of nitrogen use, time and application rate are also free of cost tools for improving N use efficiency in rice. Some changes in the input source with small changes in cultivation costs such as slow release and control release fertilizers, urease and nitrification inhibitor fertilizer give better results compared to increase in cost of cultivation. There is also a need for improvement in technology that is cost-effective and can use at field-level and need to research in need-based and real-time nutrient management in rice. Increasing awareness in agriculture about soil health, new technologies and sustainability for increasing N use efficiency in rice.

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Agrobacterium: Soil Bacterium and Natural Genetic Engineer

Article ID: 32146

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Introduction

Agrobacterium tumefaciens is a gram negative, motile, rod shaped bacterium which is non sporing, and is closely related to the N fixing rhizobium bacteria which form root nodules on leguminous plants. The bacterium is surrounded by a small number of peritrichous flagella. This is a single-celled microbe that lives in the soil and act as plant pathogenic bacterium.

Crown Galls first appear as small, white, soft protrusions, initially found at the base of the plant stem. As the tumours enlarge, the surface takes on a mottled dark brown appearance due to the death and decay of the peripheral cells. When infected with the bacterium, plants may also become stunted, produce small chlorotic leaves, and are more susceptible to extreme environmental conditions.

A. tumefaciens is most well-known for its ability to integrate a small part of the Ti plasmid into the host plant genome, which causes the plant cells to become cancer cells and produce specific compounds called Opines, which the bacterium utilizes as a carbon source. The bacterium redirects the metabolic activities of the plant to produce compounds specific to the bacterium. It is this process which gives A. tumefaciens its potential to be used as a tool for plant transformation.

Why called Nature's Genetic Engineer?

A. tumefaciens has the ability to find a wide range of different plants by moving toward chemicals that are released from naturally occurring plant wounds. *Agrobacterium* can swim through water films in the soil to reach plants, using structures called flagella, which beat like tails. This bacterium having a number of specialized proteins that identify plant chemicals. These proteins allow *Agrobacterium* to move in the right direction, toward the plant.

Agrobacterium is well versed in communicating with plants, using chemicals. When the microbe contacts a plant, it releases several different chemicals, which allows *Agrobacterium* to attach to the plant and prepare to invade. Virulent bacteria contain one or more large plasmids, one of which carries the genes for tumour induction and is known as the Ti (tumour inducing) plasmid.

The Ti plasmid also contains the genes that determine the host range and the symptoms, which the infection will produce. Without this Ti plasmid, the bacterium is described as being non-virulent and will not be able to cause disease on the plant.

Agrobacterium Transfers DNA into the Plant

Agrobacterium has a special circular type of DNA, called a plasmid. The small section of DNA that *Agrobacterium* wants to transfer into the plant genome (called T-DNA, for transfer DNA), is found within the plasmid. One of the Vir genes that is activated when the microbe sticks to the outside of the plant makes a protein called VirD2. VirD2 functions like biological scissors, cutting the T-DNA out of the circular DNA plasmid.

VirD2 then attaches to one end of the T-DNA, and drags it into the plant cell, toward the plant nucleus (like a little protein tugboat … which is also a pair of scissors). Before that can happen, *Agrobacterium* needs to break through the barrier of the plant cell wall. It does this by building a "syringe" with other virulence proteins, called VirB1 through VirB11, and VirD4. Using this protein syringe, Agrobacterium injects the T-DNA through the plant cell wall.

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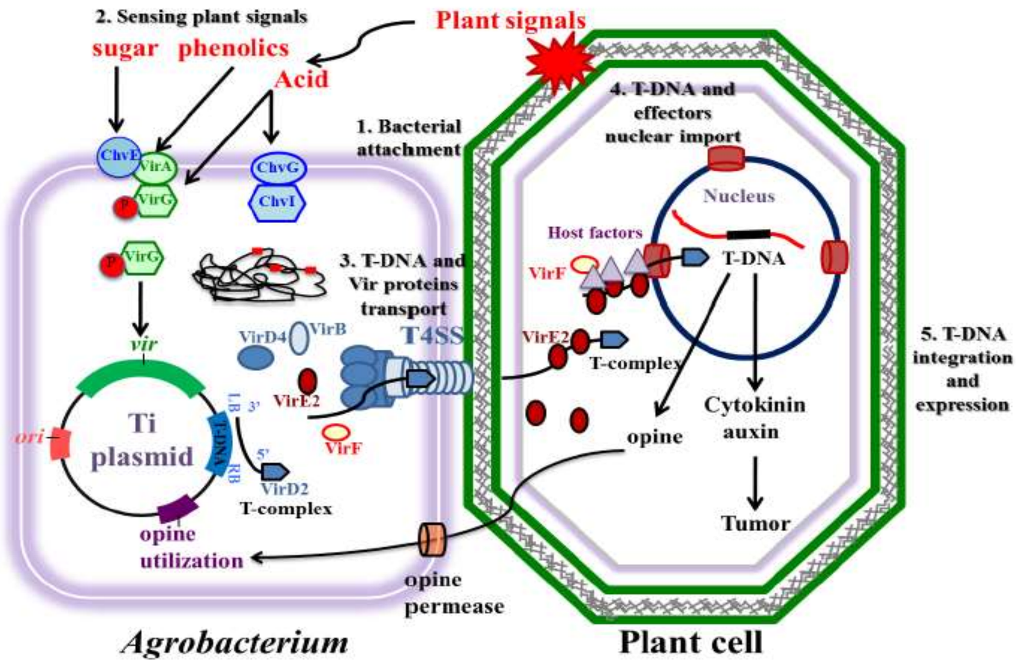

Schematic representation of Agrobacterium- mediated transformation

(1) Attachment of A. tumefaciens to the plant cells. (2) Sensing plant signals by A. tumefaciens and regulation of virulence genes in bacteria following transduction of the sensed signals. (3) Generation and transport of T-DNA and virulence proteins from bacterial cells into plant cells. (4) Nuclear import of T-DNA and effector proteins in the plant cells. (5) T-DNA integration and expression in the plant genome.

Plants have learned to protect themselves against this damage, though. When the plant finds that *Agrobacterium* is attacking, a defence of plant enzymes tries to cut up the *Agrobacterium* T-DNA before it can reach the plant cell nucleus.

However, *Agrobacterium* is one step ahead, having clothed the T-DNA in a protein armour made of another virulence protein, called VirE2, which prevents the plant enzymes from getting hold of the T-DNA. Once the T-DNA makes it to the plant cell nucleus, it looks for breaks in the DNA and inserts itself into the DNA as the plant cell repairs the DNA break (Williams and Yuan).

When this happens, the plant cell becomes genetically modified, as it now contains DNA instructions from another organism (the *Agrobacterium*) that will change how the plant behaves and works the plant is now a genetically modified organism (GMO).

Agrobacterium can Help Us to Improve Plants

Genetic engineering is a natural process that *Agrobacterium* uses to manipulate plants. There is good evidence that many different plants have kept parts of the T-DNA after *Agrobacterium* infection (Matveeva). According to (Vaeck *et al.,*) scientists can alter *Agrobacterium* T-DNA to remove all of the instructions that harm the plant, and replace them with new DNA instructions that will help the plant. Many successful plants have resulted from this process: crops that are resistant to insect pest. By using *Agrobacterium* to modify plant DNA, we are harnessing a natural process to develop crop plants that need fewer pesticides, are more nutritious, and that yield more food using less land. Using less land is a really important consideration because, if we want to avoid the destruction of natural ecosystems. We can able to understand development of different plant factors useful for humankinds.

Conclusion

Agrobacterium is a soil microbe, a plant pathogen, and a genetic engineer. Through understanding the biology of natural genetic modification, we can better understand the process used to develop genetically modified plants, or other kinds of GMOs. *Agrobacterium* allows us to make beneficial changes to the DNA of plants, which ultimately means we can grow more nutritious food using less land, which protects our environment.

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Major Foliar Diseases of Mulberry and their Management

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Introduction

Nutritive quality of mulberry leaves is the determinant factors of quantity and quality of silk produced. Among various limiting factors, diseases of mulberry are vital for quality leaf production per unit area (Pratheesh Kumar at al., 2005). Mulberry shoots are harvested five times in a year as a continuous crop. This favours survival, multiplication and inoculum built-up pathogens of various diseases. Diseases caused by fungi, bacteria, viruses and nematode affect mulberry. These diseases are either airborne or soil borne in nature and reduces leaf yield up to 20%, besides deterioration of leaf quality. Environmental factors such as temperature, humidity and rainfall play an important role in spread of mulberry diseases. Feeding of diseased leaves affects growth and development of silkworm, cocoon yield and in turn income. Hence, close watch, timely control measures and regular monitoring are essential for managing diseases (Biswas et al., 1993). Foliar diseases such as black or grey leaf spot, powdery mildew, black rust, red rust, fungal and leaf blight are prevalent throughout the country in mulberry growing areas causing substantial loss in leaf yield.

Black Leaf Spot

Pathogen and occurrence: The disease is caused by *Cercospora moricola*. The disease is prevalent in during rainy and winter seasons (July-Feb.). The disease starts progressing from 35-40 days after pruning and becomes severe thereafter (Pratheesh Kumar, et al., 2011).

Symptoms: Brownish necrotic, irregular tiny spots on the leaf surface. Small spots coalesce and form characteristic ‘shot hole’ due to shedding of dead tissues from middle part of the spots. Surrounded by each spot there will be yellow halo marks. In the later stages, leaves become yellow and wither off.

Predisposing factors: The disease spreads by means of conidia through rain droplets. Temperature of 24-26ºC and 70-80% relative humidity are congenial for disease development.

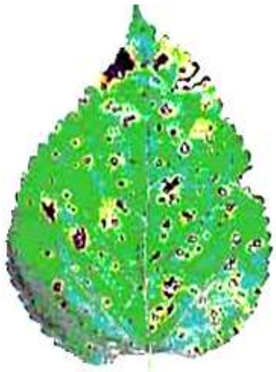

Fig.1: Black leaf spot

Management: Wider spacing of plantation with 90 × 90 cm spacing or paired row planting system [(90+ 150) × 60 cm] should be followed. Avoid sprinkle irrigation. Spray 0.2% Bavistin (Carbendazim 50% WP) solution. The leaves can be used for rearing seven days after the spray.

Powdery Mildew

Pathogen and occurrence: Powdery mildew is caused by the fungus *Phyllactinia corylea*. It is prevalent during winter and rainy seasons and starts progressing 40th day after pruning.

Symptoms: White powdery patches appear on lower surface of the leaves. The corresponding portions on the upper surface of leaves develop yellow chlorotic patches. On severity of the disease, these white powdery patches turn to brownish-black; the leaves become yellow and coarse.

Predisposing factors: The disease is air borne; it spreads by dumbbell shaped conidia primarily through wind current. Temperature of 24-28 ºC and high relative humidity (75-80%) are ideal for infection and development of the disease.

Management: Avoid growing mulberry in shaded places. Spray 0.2% Karathane (Dinocap 30% EC) or Sulfex (Wettable sulphur 80WP) on the lower surface of the leaves. The leaf can be used for rearing 15 days after the spray.

Fig. 2: Powdery mildew

Leaf Rust

1. Black rust:

Pathogen and occurrence: The pathogens are fungus *Cerotelium fici* (= *Peridiopsora mori*). The disease is prevalent during winter and rainy seasons. It is an obligate, micro cyclic parasite. The disease starts progressing 45-50 days after pruning. Mature leaves are more prone to the disease.

Symptoms: Circular pinhead sized brown eruptive lesions appear on lower side of the leaves. Later, the leaves become yellow and wither off.

Predisposing factors: The disease is air borne by dispersal of uredospore through wind current. Temperature of 22-26°C and relative humidity above 70% are ideal for development of the disease.

Management: Wider spacing in plantation with 90 × 90 cm or paired row planting system [(90+ 150) × 60 cm] should be followed. Avoid delay for harvesting the leaves and keeping older plants near the garden. Spray 0.2% Kavach (Chlorothalonil 75% WP) on the leaves the leaves can be used 14 days after spray for rearing.

2. Red rust:

Pathogen and occurrence: Red rust is caused by the fungus, Aecidium mori, commonly observed in Himachal Pradesh, Uttar Pradesh, West Bengal, North-Eastern region and to some extent in Karnataka. It appears during rainy and winter seasons.

Symptoms: The disease affects young buds, leaves, petioles and shoots. The affected buds become swollen and curl up in abnormal shapes with many protruded golden yellow spots. On both surface of the affected leaves, numerous small, round, shiny-yellow coloured protruded pustules appear in powdery form. If the shoot and petiole are affected, the fungus also spreads through vascular bundles.

Predisposing factors: As the disease is air borne, it disperses by aeciospores through water droplets and wind current. Temperature of 10-22ºC and 76-85% humidity is congenial for outbreak and spread of the disease.

Management: Mulberry plantation with paired row planting system [(90+ 150) × 60 cm] should be followed also, avoid delay in harvesting of the leaves to reduce the disease. Spray 0.2% Bavistin or Sulphur dust on the leaves. The leaves can be used 14 days after spray for silkworm rearing.


Fig. 3: Black rust


Fig. 4: Red rust

Leaf Blights

1. Fungal leaf blight:

Pathogen and occurrence: The disease is caused by *Alternaria alternata* and is prevalent during summer and rainy seasons (Gunasekher et al., 1992).

Symptoms: The disease appears as browning/ blackening of leaves starting either from the leaf tip or edges of the lamina. The preliminary symptoms appear in the form of isolated irregular brown discoloration along the edges or tip of the leaf. The entire leaf surface will be affected, and leaves fall off in the severe stage.

Predisposing factors: The disease is air borne, conidia disperse through water droplets and wind current, Temperature of 25-30ºC and 60-70% relative humidity are congenial for outbreak and spread of the disease.

Management: Deep digging and ploughing, wider spacing in mulberry plantation will reduc the disease severity. Spray 0.2% Dithane M-45 on the leaves. The sprayed leaves can be used 14 days after for silkworm rearing.

2. Bacterial leaf blight:

Pathogen and occurrence: The disease is caused by *Xanthomonas campestri* pv mori. the disease is more prevalent during rainy season.

Symptoms: Numerous black or brown, irregular, water-soaked patches appear on the leaves resulting in curling and rotting. The tender part of the shoots also shows black streaks.

Predisposing factors: Soil is the primary source of infection. Secondary infection takes place through irrigation and cultivation practices. Higher temperature (28-30ºC) and humidity above 80% are congenial for development and spread of the disease.

Management: Wider spacing reduces the disease. Spray of Streptomycin (0.02%), Agrimycin (0.01%) on the leaves. The leaves can be used for silkworm rearing 14 after spray.


Fig. 5: Fungal blight


Fig. 6: Bacterial blight

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Role of Molecular Markers in Agriculture

Article ID: 32148

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Molecular markers are distinguished between two classes viz. Molecular genetic markers (those derived from direct analysis of polymorphism in DNA sequences), and biochemical markers (those derived from study of the chemical products of gene expression).Molecular markers possess various features:

1. Molecular markers consist of specific molecules, which show easily detectable differences among different strains of a species or among different species.
2. Molecular markers analyse genes directly.
3. Molecular markers reveal neutral sites of variation at the DNA sequence level. These variations do not necessarily show themselves in the phenotypes.
4. Use of linked molecular markers would allow indirect selection for desirable traits in early segregating generations at the seedling stage and independent of environmental influences.
5. This, in turns will save time and other resources that are needed.
6. They have the big advantage that they are much more numerous than morphological markers.

Application of Molecular Markers in Agriculture

Markers used in QTL Analysis: Identification of qualitative traits loci for resistance to Black rot caused by *Xanthomonas campestris* pv. *Campestris* in cabbage (*Brassica oleracea* var. *capitata*).

January king Sel improved (resistant parent) and golden Acre (susceptible parent) were used to generate 200 plants of F2 mapping population. 80 RAPD and 120 SSR primers were used for polymorphism survey. The detected QTL will prove of great significance for marker assisted selection/breeding for selecting resistant genotypes at an early stage of growth and development which will save time, energy and resources.

Selection Mapping of Loci for Quantitative Disease Resistance in a Diverse Maize Population: The complex of maize population for improved primarily quantitative disease resistance to northern leaf blight (NLB) and secondarily for common rust resistance were studied. 151 simple sequence repeat (SSR) markers were employed in 90 individuals of the maize population. Study revealed that QTL for NLB resistance present on Chromosome number 8 Selection of QTL is done in early stage of development which will save the time.

QTL identification for tolerance to fruit set in tomato by fAFLP markers: Quantitative trait loci (QTL) was detected by fAFLP (Fluorescent Amplified Fragment Length Polymorphism) markers associated to the trait at high temperatures. A cross between line Jab-95 (heat-tolerant) and cultivar Caribe (heat-susceptible) was made. A total of 192 plants of the F2 generation were evaluated. Six trait-linked QTL were identified in the analysis of simple markers. These results could be highly useful in improvement programs, since heat-tolerant plants can be selected rapidly, which improves tomato fruit set.

2. Markers used in Genetic Variability: Data mining of ESTs to develop dbEST-SSRs for use in a polymorphism study of cauliflower (*Brassica oleracea var. botrytis*).

3364 EST sequences belonging to four varieties of *Brassica oleracea (botrytis*) (cauliflower), *capitata* (cabbage), i*talica* (broccoli), and *gemmifera* (brussels sprout) and to *Arabidopsis thaliana*, derived from the NCBI website , were screened for SSR motifs using two search programmes. 76 ESTs were found to contain tri-nucleotide or tetra-nucleotide repeat motifs, with AAC and ACAT being in greatest abundance. Eighteen genomic SSR primers were also used in this study, out of which 16 primer pairs amplified cauliflower DNA, eight primers being polymorphic. The new set of EST–SSR markers described in this study would be useful for further studies on genetic diversity and genome analysis in this major crop species.

Genetic Variability of *in vitro* raised plants of *Punica granatum* L. by RAPD: Genetic variability among *in vitro* raised plants of *Punica granatum.* 24 RAPD markers were used which show 38.8% polymorphism. As variation was detected at genotype level among the micropropagated plants, it could be concluded that somaclonal variations were present in *in vitro* raised plants.

Molecular characterization of Mutated plants of *Gerbera jamesonii* Hook: Genetic variation of regenerated plantlets treated with 8 doses of gamma rays (1.5,2,2.5,5,10,15,20,30 Gy) and 5 doses of EMS (0.1,0.2,0.5,0.8%) for two duration (10 & 20 min) were studied. 20 RAPD, 10 SSR were employed to study the genetic variation. This study clearly revealed the applicability of PCR based technique i.e. RAPD & SSR in differentiating the mutant plants.

3. Markers associated with Disease resistance: AFLP studies on downy-mildew-resistance and down-mildew–susceptible genotype of opium poppy.

Downy mildew (DM) caused by *Peronospora arbarescens*, is a serious disease in opium poppy (*Papaver somniferum*) which has a world-wide spread. Three opium poppy genotype PPs-1(DM resistance), Jawhar-16(DM susceptible) and H-9 (DM-Susceptible) were crossed and the F1 progeny along with the parents were subjected to AFLP analysis. They developed DM resistance opium poppy genotype specific AFLP markers. These AFLP markers could be used in future genetic studies for analysis of linkage to the downy mildew resistance trait.

Inheritance and development of EST-SSR marker associated with turnip mosaic virus resistance in Chinese cabbage: Turnip mosaic virus (TuMV) is one of the major pathogens infecting Brassica crops (including Chinese cabbage), and often causes serious reductions in yield and quality. The objective of this research was to determine the mode of inheritance and to develop molecular markers associated with TuMV resistance in Chinese cabbage. F1 and F2 populations were developed from the cross between 71-36-2 (susceptible) and 73 (resistant) lines and mechanically inoculated with TuMV-C4. A total of 132 EST-SSR primers were designed from EST sequences available in public databases. Seven primers detected polymorphism between parental genotypes. Marker HCC259 was associated with the TuMV resistance Ph-retr02. This was the first co-dominant marker linked to the TuMV resistance gene with a distance less than 3.8 cM in Chinese cabbage. This marker was suitable for TuMV-C4 resistance screening in progenies from the cross between lines 73 (resistant) and susceptible line, 71-36-2. The usefulness of this marker was validated in 21 additional resistant and susceptible lines. This marker has the potential to simplify and accelerate breeding of Chinese cabbage cultivars resistant to TuMV-C4.

4. Markers in Marker assisted selection: Introgression of *Striga Resistance Genes into a* Sudanese Sorghum Cultivar, Tabat, Using Marker Assisted Selection (MAS).

QTL associated with Striga resistance were identified in N13 variety. The witch-weed (*Striga spp.), is an obligate root parasite of various crops.* The parasite results in considerable crop damages. 11 SSR markers were used for selection. Progenies with two or more QTL showed high levels of *Striga* field resistance, confirming the effectiveness of marker assisted selection (MAS). Some of the variety produced by marker assisted selection : RP BIO 226 in Rice, Pusa 1460 in Rice, Vivek QPM variety in Maize, MAS 946-1 In Rice.

5. Marker free transgenic production: An efficient method for the production of marker-free transgenic plants of peanut (*Arachis hypogea* L.).

A marker-free transgenic plant is an efficient method for the production of peanut. *Agrobacterium tumefaciens was* used for peanut transformation. The putative transgenic events growing *in vitro* were initially identified by PCR and further confirmed for gene integration and expression by dot blot assays. This approach for generation of marker-free transgenic plants minimizes the risk of introducing unwanted genetic changes.

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Regulations for the Release of Transgenic Crop to Environment

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Release of Transgenic

Government of india has evolved a comprehensive regulatory mechanism of development and evaluation of GMOs and rDNA research work. The ministry of environment and forests (MoEF) is the nodal agency for release of GMOs in the country. The ministry has enacted Environment and Protection Act (EPA), 1986, rules 1989, to provide for protection and improvement of environment and related matter. The rules and regulations cover the areas of research as well as large scale application of GMOs and products made there from. The rules also cover the application of hazardous microorganism which may not be genetically modified. Department of Biotechnology (DBT) had formulated recombinant DNA Guidelines in 1990 which were revised in 1994. There are six competent authorities for the regulatory mechanism as described below:

1. Recombinant DNA Advisory Committee (RDAC): A committee constituted by DBT referred as RDAC, take note of developments in biotechnology at national and international levels and recommends safety regulations for research and applications.

2. Institutional Biosafety Committee (IBSC): It is the nodal point for interaction within the institution for implementation of guidelines. For this, institution carrying out research activities on genetic manipulation should constitute IBSC with one DBT nominee. The main activities are:

a. To note and to approve r-DNA work.
b. To ensure adherence of r-DNA safety guidelines of government.
c. To prepare emergency plan according to guidelines.
d. To recommend to RCGM about category III or above experiments and seek RCGM's approval.
e. To act as nodal point for interaction with statutory bodies.
f. To ensure experimentation at designated locations, taking into account approved protocols.

3. Review Committee on Genetic Manipulation (RCGM): DBT has next higher level of body known as RCGM which has the following functions:

a. To bring out manuals of guidelines specifying procedures for regulatory process on GMOs in research, use and applications including industry with a view to ensure environment safety
b. To review all the work going on r-DNA projects involving high risk category and controlled field experiments
c. To lay down procedures for restriction or prohibition, production, sale, import and use of GMOs both for research and applications
d. To permit experiments with category III risks and above with appropriate containment.
e. To authorize field experiments in 20 acres in multi-locations in one crop season with up to one acre at one site.
f. To generate relevant data on transgenic materials in appropriate systems.
g. To undertake visits sites of experimental facilities periodically where projects with biohazards potentials are being pursed and also at a time prior to the commencement of the activity to ensure that adequate safety measures are taken as per the guidelines.

4. Genetic Engineering Approval Committee (GEAC): it functions as a body under the MOEF and is responsible for approval of activities involving large scale use of hazardous microorganism and recombinant products in research and industrial production from the environment angle. It also has the following functions:

a. To permit the use of GMOs and products thereof for commercial applications.

b. To adopt procedures for restriction or prohibition, production, sale, import and use of GMOs both for research and applications under EPA, 1986.

c. To authorize large scale production and release of GMOs and products thereof into the environment.

d. To authorize agencies or persons to have powers to take punitive actions under the EPA.

5. State Biotechnology Coordination committee (SBCC): In each state there is a state Biotechnology Coordination committee (SBCC) headed by chief Secretary where research and applications of GMOs are contemplated.

6. District Level Committee (DLC): DLC is the district level committee headed by district collector as an authoritative unit to monitor safety regulations. Both SBCC and DLC work along with RCGM in the inspection and monitoring of the experiments at the field sites.

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Male Sterility and its Types

Article ID: 32150

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Male Sterility

Male sterility is defined as an absence or non-function of pollen grain in plant or incapability of plants to produce or release functional pollen grains. The use of male sterility in hybrid seed production has a great importance as it eliminates the process of mechanical emasculation.

Causes of Male Sterility

It can result from adverse growth conditions, from diseases, or from mutations. Naturally occurring genetically male sterile plants in hermaphrodite species generally maintain fully normal female functions.

Complete absence of male organs, the abortion of pollen at any step of its development, the absence of stamens dehiscence or the inability of mature pollen to germinate on compatible stigma also causes male sterility.

Genes Responsible for Male Sterility

Nuclear male sterility (nms) is generally caused by mutations which affect a huge number of functions. In maize for example, several hundred loci are involved. These mutations may affect for example proteins involved in male meiosis, the metabolism of plant hormones, the biosynthesis of complex lipid molecules or the synthesis of secondary metabolites.

Cytoplasmic male-sterility (cms) is usually defined as "maternally inherited deficiency in producing viable pollen" and the mitochondria and chloroplast are responsible for this trait.

This definition leads us to call cms any mitochondrial or chloroplast mutation which impairs the proper functioning of mitochondria and chloroplast, leading to male sterility. For example, in *Nicotiana sylvestris*, mitochondrial mutants were obtained from in vitro culture.

Types of Male Sterility: The Male Sterility is of Five Types

1. Genetic male sterility.
2. Cytoplasmic male sterility.
3. Cytoplasmic genetic male sterility.
4. Chemically induced male sterility.
5. Transgenic male sterility.

Genetic Male Sterility

1. The pollen sterility, which is caused by nuclear genes, is termed as genic or genetic male sterility.
2. It was first reported by Suneson in 1953 in barley.
3. It is usually governed by recessive gene 'nms' with monogenic inheritance, but dominant gene governing male sterility are also known e.g. in Safflower.
4. The male sterility alleles may rise spontaneously or it can be induced artificially and is found in several crops like Pigeon pea, castor, tomato, barley, cotton etc.

Cytoplasmic Male Sterility

1. The pollen sterility which is controlled by cytoplasmic genes is known as cytoplasmic male sterility (CMS).
2. CMS was first reported by Katsuo and Mizushima (1958) in rice.

3. Usually the cytoplasm of zygote comes primarily from the egg cells and due to this progeny of such male sterile plants would always be male sterile.
4. Cytoplasmic male sterility is not influenced by environmental factors and it resides in mitochondria and chloroplast and is maternally inherited.

Cytoplasmic Genetic Male Sterility

1. When pollen sterility is controlled by both cytoplasmic and nuclear genes is known as cytoplasmic genetic male sterility.
2. Jones and Davis first discovered this type of male sterility in 1944 in onion.
3. This is the case of cytoplasmic male sterility, where a nuclear gene restoring fertility in the male sterile line is known. The fertility restore gene 'R' is dominant and found in certain strains of the species.

Transgenic Male Sterility

1. When the male sterility is induced by the techniques of genetic engineering, it is called as Male sterility may have multiple causes: transgenic male sterility.
2. It is heritable and basically comes under genetic male sterility.
3. In this system, the two kinds of genes are involved.
4. One gene causes male sterility (integrated with genome of A line) while the other suppresses it (R gene).

Chemically Induced Male Sterility

1. The chemical which induces male sterility artificially is called as male gametocide.
2. It was first reported by Schuster in 1969 in sunflower using GA3.
3. It is rapid method but the sterility is non-heritable.
4. Some of the male gametocides used are gibberellins (rice, maize), Sodium Methyl Arsenate (rice) and Maleic hydrazide (wheat, onion).

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A Review on Transgenic Plant

Article ID: 32151

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Transgenic Plant

Is one that contains a gene or genes which have been introduced artificially into the plant's genetic makeup using a set of several biotechnology techniques. Contains a gene (s) which have been artificially inserted instead of the plant acquiring them through pollination. Inserted genes, called transgenes, when they are inserted into the new host plant, may come from another plant of the same or a different species, or a completely unrelated kind of organism like bacteria or animals. Eg. *Populus nigra*, with the *Bacillus thuringiensis* (Bt) genes, which are used to impart pest-resistance properties.

Target Genes Mainly Introduced for

1. Increased resistance to stress and growth rate.
2. Shortening the juvenile phase.
3. Developing for multipurpose characteristics such as feed, fibre, fuel and fruit etc.
4. Altered processing and storage qualities.
5. Improvement of rooting.
6. Enhanced photosynthetic metabolism and vegetative growth.
7. Increased nitrogen use efficiency and reserves.
8. Increase the amount of genetic variability.

Transgenic Plant Technology

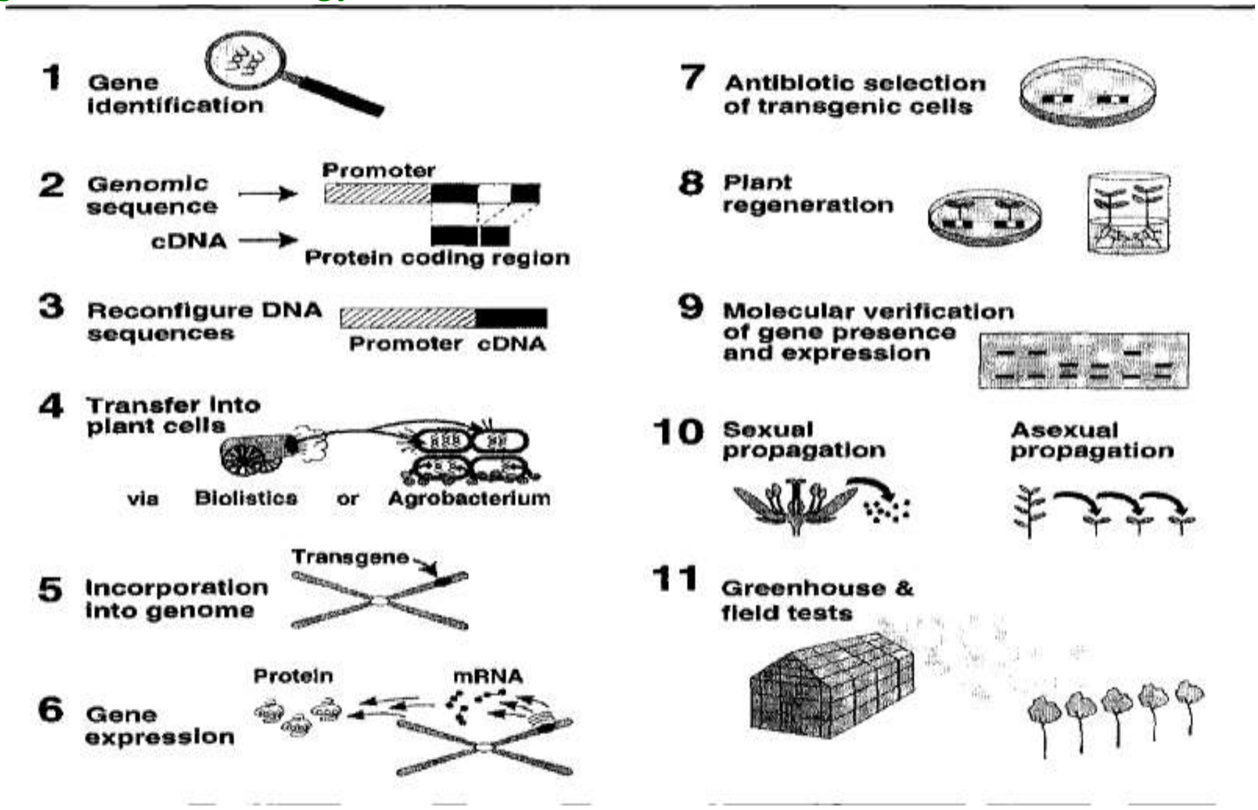

Figure 1: Summary of the steps required to produce transgenic plants

Step 1: Gene construction which include gene isolation, characterization & synthesis.

Step 2: Plant transformation which include introduce DNA construct into plant cells & transgenic cells selection and plant regeneration.
Step 3: Transgenic plant analysis which include test biological effects of transgene.

How Genetic Modification is Possible?

"Genetic code is universal" i.e. the DNA of all organisms is made up of same building blocks and is encoded in same way. Therefore, it is possible to transfer a copy of DNA sequence (or gene) that codes for particular characteristics into the cell of a different organism.

Genetic Modification Options

GM relates to asexual technologies for generating new genetic combinations. This may take mainly two forms:
1. Somatic hybrids produced by fusing cells containing different genomes (each containing n) and regenerating whole plants from such fusion events.
2. Production of 'cybrids' containing nucleus of one parent but cytoplasm from both the parents.

Why GM will be Required for Tree Domestication?

1. One cycle of conventional breeding takes a decade; GE takes 6 months.
2. Outcrossing mating system prevents recovery of recessive mutations; GE can create them easily.
3. Many vital tree functions are supported with duplicated genes; GE can 'knock out' all copies of a gene at once.
4. Using GE/GM, domestication could be compressed into a few decades instead of centuries of conventional breeding.
5. Using genetic modification within a breeding population is that if a transgene is known to show stable vertical transmission, without adverse side-effects, it can be used indefinitely without risks attendant upon re-creating the transformation.

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Insect Pests Common in Cashew and Mango (Anacardiaceae)

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Cashew (Anacardium occidentale L.) and mango (Mangifera indica) are two important commercial tree species belong to Anacardiaceae family. Several insect species have been recorded by different workers at various locations infesting mango and cashew trees. Information on pests of mango and cashew incidence, damage and new pest reports are available time to time. Cashew and mango share few pest species commonly during their phenological stages. In which, some pests are polyphagus in nature. In the changing pest scenario, the information on those common pest species is important, when host species are grown together or are available in the vicinity. This report attempts to document the common insect pests occurring on mango and cashew based on the available literature. The information will be helpful to keep a watch on occurrence and spread of the insect pests in the locations where both the plants are grown for commercial purpose.

Table1. Details of common insect pests occurring on cashew and mango

Sl. No.	Common name	Species	Family	Plant part infested
Hemiptera				
1	Tea mosquito bug	*Helopeltis antonii* Signoret	Miridae	Shoots, flowers, fruits, nuts (c)
2	Mirid bug	*Campylomma sp.*		Flowers
3	Two tailed mealy bugs	*Ferrisia virgata* Cockerell	Pseudococcidae	Shoots, flowers, fruits
4	Citrus mealy bug	*Planococcus citri* (Risso)		
5	Mango mealy bug	*Rastrococcus iceryoides* (Green)		leaf
6	Aphids	*Toxoptera odinae* van der Goot	Aphididae	Shoots, inflorescences, fruits
7	Coreid bug	*Pseudotheraptus wayi* Brown	Coreidae	Shoots and inflorescences
8	Pentatomid bug	*Nezara viridula* (Linnaeus)	Pentatomidae	Leaf, tender nuts (c), fruits
9	Scales	*Ceroplastes sp.*	Coccidae	Leaf, shoots
10	Black Stink bug	*Coptosoma sp.*	Plataspidae	Shoots, flowers, tender nuts
11	Lygaeid bug	*Graptostethus* spp.	Lygaeidae	Shoot, flower (c)
Coleoptera				
12	Leaf weevil	*Deporaus marginatus* Fst.	Attelabidae	Leaf
13	Chrysomelid beetles	*Monolepta* spp.	Chrysomelidae	Leaf, shoots
14	Mango tree borer	*Batocera rufomaculata* DeGeer	Cerambycidae	Stem
15	Cashew stem and root borer	*Plocaederus ferrugineus L.*		Stem and root (c)
16	Albizia Long horned beetle	*Coptops aedificator* (Fabricius)		Stem
17	Ash weevil	*Myllocerus* spp.	Curculionidae	leaf

18	Leaf twisting weevil	*Apoderus tranquebaricus Oliver*	Attelabidae	Leaf
19	White grubs	*Holotrichia* sp.	Scarabaeidae	Flowers
Lepidoptera				
20	Leaf miner	*Acrocercops syngramma* M.	Gracillariidae	Leaf
21	Tussock Hairy caterpillar	*Euproctis fraterna Moore*	Erebidae	Leaf, flowers
22	Yellow tail tussock moth	*Prothesia (Somena) scintillans* Walker		Leaf, flowers
23	Common Baron	*Euthalia garuda* Moore	Nymphalidae	Leaf
24	Slug caterpillar	*Parasa lepida* (Cramer)	Limacodidae	Leaf
25	Webber	*Gatesclarkeana* sp.	Tortricidae	Flowers, tender fruit (m)
26	Leaf webber	*Dudua aprobola* M.		Shoots, flowers, tender apples fruits
27	Webber	*Anarsia* sp.	Gelechiidae	Flowers
28	Fruit borer	*Citripests eutraphera* (Meyrick)	Pyralidae	Nursery pest in cashew, but flower and fruit pest in mango.
29	Webber	*Nanaguna* sp.	Nolidae	Flowers
30	Tea flush worm	*Cricula trifenestrata* Helfer	Saturniidae	Leaf
31	Hairy caterpillar	*Metanastria hyrtaca* Cramer	Lasiocampidae	Leaf
32	Bag worm	*Eumeta variegata* (Snellen)	Psychidae	Leaf
33	Snout moth	*Orthaga exvinacea* (Hampson)	Pyralidae	Shoots, inflorescences
34	Webber	*Lamida* sp.		Inflorescences
35	Mango shoot borer	*Penicillaria* (*Bombotelia*) *jocosatrix* Guenée	Noctuidae	Leaf, flowers
36	Bark eating caterpillar	*Inderbella* sp.	Cossidae	Bark
37	Fruit borer	*Hyalospila leuconeurella* (Ragonot)	Pyralidae	Fruits, nuts (c)
38	Hairy caterpillar	*Olene mendosa* Hubner	Lymantridae	Leaf, flowers
39	Semilooper	*Thalassodes spp.*	Geometridae	Leaf
40	Semilooper	*Perixera illepidaria* Guenée		Flowers
Diptera				
41	Oriental Fruit fly	*Bactrocera dorsalis* Hendel	Tephritidae	Fruits
-	Oriental latrine fly	*Chrysomya megacephala* F.	Calliphoridae	Flowers (visitor- (c) pollinator -m)
Thysanoptera				
42	Chilli thrips	*Scirtothrips dorsalis* Hood	Thripidae	Leaf, flowers, fruits, nuts (c)
43	**Grape Vine thrips**	*Rhipiphorothrips cruentatus* (Hood)		Leaf (c)

44	Red banded thrips	*Selenothrips rubrocinctus* (Giard)		Leaf (c)
45	Hawaiien flower thrips	*Thrips hawaiiensis* (Morgan)		Flowers
46	Common blossom thrips	*Frankliniella schultzei* Trybom		Flowers (c)
47	Thrips	*Haplothrips ganglbaueri* (Schmutz)	Phlaeothripidae	Flowers (c)
Orthoptera				
48	Variegated grasshopper	*Zonocerus variegatus* L.	Pyrgomorphidae	Leaf
49	Coffer grasshoppers	*Aularches miliaris* (Linnaeus)	Pyrgomorphidae	Leaf
Isoptera				
50	Fungus-growing termites,	*Odontotermes* spp.	Termitidae	Collar region, trunk

(c)- cashew, m- mango

Understanding the ecological, biological and dispersal factors of the important common insect pests is critical to evolve innovative management systems. The present list includes 50 insect pest species from 7 insect orders, in which lepidopteran species (20) are more. It is to be noted that this list can be extended, if few more literature survey is done. A few insects are very serious in both crops (eg. tea mosquito bug), some species are serious in either crop (*P. ferrugineus* – cashew, *B. rufomaculata* – mango) while, many are minor pests. Some species share different plant parts in both plants. Eg. *Citripestis* sp. damages seedlings in cashew, but fruits in mango. Hence, information about the nature and extent of pest damage is important to understand its pest status. In general, shift in pest status in crops can be related to changes in climate or anthropogenic activities including cropping systems, pesticide usage etc. Thus, surveillance of pests is essential to understand the changing pest scenario during different crop phonological stages and accordingly pest management efforts need to be planned.

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A Review of Molecular Markers in *Rubus ellipticus*

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Rubus is one of the most diverse genera of plant kingdom with over 500 species. The word '*Rubus*' is derived from latin word '*Ruber*' which means 'Red'. The main members of genus *Rubus* are raspberry, blackberry and dewberries which are together commonly known as brambles. Brambles is a collective term for various prickly shrubs sometimes classified as small bush or berry fruits. All brambles are species of *Rubus*, a taxonomically complex group that includes blackberries (European and American species) and raspberries.

Rubus ellipticus is a raspberry with yellow fruits, native to tropical and subtropical India, and Asia. It grows in abundance throughout the mid-hill region and is known as 'Yellow Himalayan Raspberry', 'Akhe' or 'Hinure' in Himachal Pradesh, 'Machao Kodi' in Odisha and 'Jotelupoka' in Assam. Its basic chromosome number is seven, however polyploidy also exists which varies from diploid (2n=14) to tetradecaploid (98). Classification of *Rubus ellipticus*:

Kingdom	Plantae
Order	Rosales
Family	Rosaceae
Subfamily	Rosoideae
Genus	*Rubus*
Species	*ellipticus*

It is medicinally important wild fruit. It contains anthocyanins, catechins, flavonols, flavones, ascorbic acid and tannins which are protective against variety of diseases, such as cardiovascular diseases and epithelial cancer. Routinely the fruits are used for the treatment of fever, cough and sore throat and have also been reported effective against treatment of diabetes.

Interest in improvement of this crop is increasing in the light of its nutraceutical value. Development of new cultivars can benefit from reliable markers linked to important traits, including disease resistance, flowering traits, fruit quality characteristics, and plant architecture. Recent advances in molecular biology have provided us with novel tools to establish evolutionary and genetic relationships among plants of our research interest, which was earlier a cumbersome job. It can be done by observing variations in DNA sequence using molecular markers with high accuracy and throughput which is often not visible at the phenotypic level. Molecular markers have numerous applications in plant breeding, including the analysis of genetic diversity, cultivar identification, gene tagging and QTL analysis. Very few simple sequence repeat (SSR) markers exist for *Rubus* in general and fewer are transferable between species .

Several genetic Linkage maps composed of various types of molecular markers are available for raspberry, and one is available for blackberry, however, not all marker types used to construct these maps are transferable between taxa. Only a limited number, to mention only seven EST-SSRs are available for *Rubus ellipticus.*

Many more molecular markers for *Rubus* and other genomic tools are needed to map important traits, facilitate cultivar development, maintain cultivar identity, and study basic genetic and genomic mechanisms. Molecular markers designed from simple sequence repeats (SSR), tandem repeats of 1–6 nucleotides, are known to be highly variable even within species, and are transferable across taxa to a varying extent. Variation in the number of repeat motifs is revealed by PCR using oligonucleotide primers specific to the unique DNA sequences flanking the SSR sequence. The high information content of SSR loci together with their co-dominant inheritance, distribution throughout the genome, multi-allelic variation, high reproducibility, high level of polymorphism and requirement of only a small amount of starting DNA make those as markers of choice in genetics. These markers often present high levels of inter- and intra-specific polymorphism, particularly when tandem repeats number ranges from 60-100. SSR markers are being frequently used for genetic diversity studies among different species and between populations.

Conventional SSR marker development is a costly and time-consuming process. SSR marker development has become easier and more cost-effective by *in silico* methods. Gene-based SSR loci derived from expressed sequence tag (EST-SSR) are significantly more transferable across large taxonomic distances compared with genomic SSRs, since they are mainly from exonic regions. Therefore EST-SSR markers have more conserved region in comparison to markers which are generated from genomic sequence. ESTs are a potential rich source of SSRs that reveal polymorphism not only within the source genus, but have been found informative in related genera as well. So, they show transferability between species.

However, EST resources available for the genus *Rubus* at the National Centre for Biotechnology Information (NCBI) GenBank are scarce. A main advantage of this research would be to generate a useful set of EST-SSR markers to enable further genetic research into the raspberry genome, and to increase the number of DNA sequences available for the Rosaceae research community and raspberry breeders who would like to use *Rubus ellipticus* as a breeding material.

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A Review on Gene Stacking / Pyramiding

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Gene Stacking / Pyramiding

Gene stacking or pyramiding is the expression or manipulation of multiple genes in transgenic plants:

1. The development of molecular genetics and associated technology like MAS has led to the emergence of a new field in plant breeding-Gene pyramiding.

2. Pyramiding entails stacking multiple genes leading to the simultaneous expression of more than one gene in a variety to develop durable resistance expression.

3. Gene pyramiding is gaining considerable importance as it would improve the efficiency of plant breeding leading to the development of genetic stocks and precise development of broad-spectrum resistance capabilities.

4. The success of gene pyramiding depends upon several critical factors, including the number of genes to be transferred, the distance between the target genes and flanking markers, the number of genotypes selected in each breeding generation, the nature of germplasm etc.

5. Innovative tools such as DNA chips, micro arrays, SNPs are making rapid strides, aiming towards assessing the gene functions through genome wide experimental approaches.
    a. The first-generation transgenic crops mainly addressed a single trait like disease resistance.
    b. The second-generation transgenic plants are geared towards high 'output trait' products such as enhanced nutritional value, ability to withstand environmental stress (abiotic and biotic) or other benefits to consumers.
    c. Gene stacking offers the potential for providing durable multitaxon resistance to particular pests or for engineering multiple resistance to different types of pathogen perhaps in crops that are also herbicide tolerant.

Methods of Gene Stacking: Three Main Approaches Used in Gene Pyramiding

1. Crossing transgenic lines: Two or more transgenes can be sequentially introduced into a plant by conventional iterative procedures, e.g. a plant containing one transgene is crossed with individuals harbouring other transgenes.
2. Re-transformation: Retransformation means to transform a new or back.
3. Co-transformation: Co-transformation is the simultaneous transformation of two or more genes.

Examples of Gene Stacking

1. Crossing plants: Expressing different Bacillus thuringiensis (Bt) toxins can provide an effective way of delaying the emergence of Bt-resistant pests.

2. Re-transformation: In potato, antisense inhibition of three starch synthase genes was achieved by retransforming plants, already altered in amylopectin synthesis.

3. Co- transformation: The methodology is based on:
    a. Direct gene transfer: When two plasmids with different genes are used.
    b. Agrobacterium transformation: When multiple transgenes, either harboured within different T-DNAs in a single Agrobacterium strain or harboured separately within different strains, are inoculated together on to plant tissues.

4. Gene pyramiding: Gene pyramiding holds greater prospects to attain durable resistance against biotic and abiotic stresses in crops. Different resistance genes often confer resistance to different isolates, races or biotypes. Combining their resistance broadens the number of races or isolates that a more than one character in a variety at the same time. In general, the development of pyramid lines is a long and costly affair in addition to the epistatic effect. However, MAS based gene pyramiding could facilitate in pyramiding of genes effectively into a single genetic background. When hybrids crops are the goal, additional options for pyramiding different resistance gene combinations into different parents also exist.

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Basics of Internal Combustion Engine (Diesel Engine)

Article ID: 32155

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Introduction

In India about 85 per cent households cultivate about 36 per cent of entire cultivatable land in the country. This average land holding of the small Indian farmer is very low. It is therefore quite difficult for the average Indian farmer to afford mechanized farming utilizing standards tractors of 20 hp and above ratings, which, in its turn, tells upon the productivity and per unit yield. There has been a tremendous demand for developing small, compact and easily manoeuvrable tractors of rating of 10 hp or less, which are deemed fittest for the small land holding farmers.

Heat Engine is a machine which converts heat energy into mechanical energy. This heat is supplied to working substances at high temperature. By the expansion of this substance in suitable machines, heat energy is converted into useful work. In the case of internal combustion engine, the combustion of fuel takes place inside the engine cylinder itself. Hence the name is given as Internal Combustion engine. There are two ways in which combustion takes place in the cylinder: By rapid explosion of air-fuel mixture within the cylinder, when it is ignited by a spark, is called constant volume combustion (C.V.C.) and Combustion takes place by slow burning when the fuel is injected into highly compressed heated air contained in the cylinder. This is called constant pressure combustion (C.P.C.).Compression ignition engine is an engine designed to convert chemical energy of heavier fuel oil into mechanical energy. The injected fuel is ignited by the heat of the air which is compressed by the piston within the cylinder head. In this engine, only air is sucked during suction stroke and only the liquid fuel is injected in the cylinder under high pressure. Spark ignition engine is an engine in which liquid fuel is atomised vaporized and mixed with air in correct proportion before being taken into the engine cylinder. The fuel is ignited in the cylinder by an electric spark. The unique features of this tractor are Minimum turning radius, Ground clearance is comparable with other high hp tractors, uncultivated land remaining is the least, as compared to other tractors, and same gear oil is used for hydraulic system. Design development of engine has been subjected to interest of many researchers, from the end of the nineteenth century.

Working

I.C. engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of connecting rod. The piston which reciprocates in the cylinder is very close fit in the cylinder. Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides of the piston. Mechanical cycle of internal combustion engine can be completed in two ways:

1. When the cycle is completed in two revolutions of the crankshaft, it is called four stroke cycle engines.
2. When the cycle is completed in one revolution of the crankshaft, it is called two stroke cycle engines.

Engine Components

1. Cylinder: The cylinder of an I.C. engine constitutes the basic and supporting portion of the engine power unit. Its major function is to provide space in which the piston can operate to draw in the fuel mixture. The cylinder is usually made of high-grade cast iron.

2. Cylinder block: It is the solid casting which includes the cylinder and water jackets.

3. Cylinder head: It is the detachable portion of an engine which covers the cylinder and includes the combustion chamber, spark plug and valves.

4. Cylinder liner: It is the cylindrical lining either wet or dry which is inserted in the cylinder block in which the piston slides. Cylinder liners are fitted in the cylinder bore and they are easily replaceable.

5. Piston: It is the cylindrical part closed at one end which maintains a close sliding fit in the engine cylinder. It is connected to the connecting rod by a piston pin.

6. Piston rings: It is a split expansion ring, placed in the groove of the piston. The primary function of the piston rings is to retain compression.

7. Connecting rod: This is the connection between the piston and crankshaft. The end connecting the piston is known as small end and the other end is known as big end.

8. Crankshaft: This is connected to the piston through the connecting rod and converts the linear motion of the piston into the rotational motion of the flywheel.

9. Camshaft: The valves are operated by the action of the camshaft which has separate cams for the inlet and exhaust valves.

10. Fuel injection: It the component which delivers finely atomised fuel under high pressure to the combustion chamber of the engine. Modern tractor engines use fuel injectors which have multiple holes. Main parts of injector are: nozzle body and needle valve.

The nozzle body and needle valve are fabricated from alloy steel. The needle valve is pressed against a conical seat in the nozzle body by a spring. The injection pressure is adjusted by adjusting the screw in operation; fuel from the fuel injection pump enters the nozzle body through high pressure pipe.

When the fuel pressure becomes so high that it exceeds the set spring pressure, the needle valve lifts off its seat. The fuel is forced out of the nozzle spray holes into the combustion chamber. The injection is installed in a brass tube or sleeve which is fitted in the cylinder head and is held in position by a special clam.

Lubrication System

I.C. engine is made of many moving parts. Due to continuous movement of two metallic surfaces over each other, there is wearing of moving parts, generation of heat and loss of power in the engine. Lubrication of moving parts is essential to prevent all these harmful effects. The oil layers act between a rotating shaft journal and a stationary bearing. It is seen that the journal takes an eccentric position in the bearing when in operation. This position is the result of the loading of journal and the direction of rotation. The oil film is maintained by wedging action.

Engine Lubricating System

The lubricating system of an engine is an arrangement of mechanism and devices which maintains supply of lubricating oil to the rubbing surface of an engine at correct pressure and temperature. There are three common systems of lubrication used on stationary engines, tractor engines and automobiles:

1. Splash system.
2. Pressure feed system.

Cooling System

The heat produced on the power stroke of a diesel engine can be as high as 1600º C and this is greater than the melting point of the engine parts that come in contact with the heat, thus it is essential to have an efficient cooling system. Assuming the heat value of the fuel used to be 100% then probably 30% is used to produce power, 40% is passed to the atmosphere via the exhaust and 30% is dissipated by the cooling system. Some heat is also removed by the oil employed by the lubrication system. Engines using water as cooling medium is called water cooled engine. The liquid is circulated around the cylinders to absorb heat from the cylinder walls. The heated water is conducted through a radiator which helps in cooling the water.

Ignition System

In the type of stationary engines under discussion the high-tension electric spark needed for ignition is often generated by a magneto. A novel device is used on most tractor magnetos to give the armature a quick flip when cranking the engine to get it started. Ordinarily, the armature is driven from the cranks haft or camshaft by suitable gearing and shafting. When the engine starts, centrifugal force causes the pawl to disengage the spring, and thereafter the magneto drive is direct in the usual fashion. The impulse starter also retards the spark for hand cranking, thus lessening the danger of a kick-back that might injure the operator. As soon as the engine starts, the device automatically advances the s park for normal operation. The distributor of the ignition system contains a revolving head that contacts in correct firing sequence, the high-tension wire leads extending to each of the spark plugs.

Exhaust System

The exhaust gases from each cylinder are usually conducted into a gathering manifold and piped away to a point where exhaust flames will not constitute a fire hazard. As already explained, the hot exhaust gases are often piped around a portion of the intake manifold to aid in vaporization of the fuel charge. A muffler may be used to quiet the sound of the exhaust but the type used must be such as not to cause undue back pressure in the exhaust system.

Governor

There are two main types of governor in tractor which prevent engine damage due to over-revolving and also help maintain close speed control for any particular machine the engine may be driving.

1. Mechanical governor which gives a very quick response to any load changes therefore maintaining reasonable constant revs of the engine.
2. Pneumatic governor which have been fitted in inline injector pumps but tend to respond slower causing considerable drop or gain in engine revolutions before Correcting and settling.

Brake Horse Power

Brake horsepower (BHP) is the measure of an engine's horsepower before the loss in power caused by the gearbox, alternator, differential, water pump, and other auxiliary components such as power steering pump, muffled exhaust system, etc. Brake refers to a device which was used to load an engine and hold it at a desired RPM.

Specific Fuel Consumption

The fuel consumption characteristics of an engine are generally expressed in terms of specific fuel consumption in kilogram of fuel per kilowatt-hour. It is an important parameter that reflects how good the engine performance is. It is inversely proportional to the thermal efficiency of the engine.

Brake Thermal Efficiency

Brake thermal efficiency is the ratio of brake power output to brake power input. In another words, brake thermal efficiency is defined as the ratio of energy in the brake power, to the input fuel energy in appropriate units.

Volumetric Efficiency

It is the ratio of actual weight of air introduced by the engine on the suction stroke to the theoretical weight of air that should have been introduced by filling the piston displacement volume with air at atmospheric pressure and temperature. Four stroke engines have distinct suction stroke and therefore the volumetric efficiency indicates the breathing ability of the engine. Volumetric efficiency is defined as the volume flow rate of air in to the intake system divided by the rate at which the volume is displaced by the system. The Volumetric Efficiency of the engine at different loads is 79 %.

Summary and Conclusion

We studied some basic information of the engine like fuel system, ignition system, lubrication system, cooling system, intake and exhaust system. In this article, the author tried to provide basic information of an internal combustion diesel engine and its principle.

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Cold Storage in India: Challenges and Prospects

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Agriculture sector in India has moved from traditional agriculture in the 1950s to a highly capital-intensive sector. This evolution has transformed Indian Agriculture from a food grain deficient economy to a food grain surplus economy. Further, agriculture in India, today is not just limited to food grains, it has expanded to diverse crops, like, horticulture, medicinal and other allied activities. This transformation is expected to grow as more Farmer Producer Organisations (FPO) are created and through impetus from Cooperatives or other collaborative farming practices, there is a likelihood that entire villages will collaborate as farmer groups and operate farms collectively in the shape of Village Producer Organisations (VPOs) (NABARD, 2015). Thus, the scale of production in meeting the growing demand is no longer a concern. The focus has now shifted to maximising returns to the farmers by improving resource use and input management and providing easy and affordable access to the large population.

Over the past decades, significant focus and resources have been allocated to increase food production. For example, 95% of the research investments during the past 30 years were reported to have focused on increasing productivity and only 5% directed towards reducing losses (Kader 2005). Efficient management in Post-harvest stage is critical for attaining the twin objective of maximising returns for farmers and ensuring food security.

Food and Agriculture Organization of U.N. predicts that about 1.3 billion tons of food are globally wasted or lost per year (Gustavasson, et al. 2011). Food losses at the post-harvest stage is not only a threat to human consumption and returns to the farmers, but it can also harm the environment in various ways. Food loss is estimated to be equivalent to 6- 10 percent of human-generated greenhouse gas emissions (Gustavasson, et al. 2011). A significant contributor of this problem is through methane gas generation in landfills where food waste decomposes anaerobically (Buzby and Hyman, 2012). On the basis of global food loss and waste (FLW), the equivalent in CO2 emissions is assessed at 4.4 billion tons per annum. This raises acute concern that food loss and waste have a major contribution to climate change from greenhouse gases (DFI Committee report, 2017).

In India, food grains surplus is captured by private sector (milling units) and through procurement by Food Corporation of India, National Agricultural Cooperative Marketing Federation (NAFED) and State government agencies. However, in case of perishable produce, such as fruits, vegetables and others with lower holding life, the surplus when not procured, tends to go waste. India witnesses nearly, 4.6 to 15.9% wastage in fruits and vegetables, 5.2% in inland fish, 10.5% in marine fish, 2.7% in meat and 6.7% in poultry meat (Wold Food India, 2017).

The primary development focus for agricultural post-production infrastructure, has been in the form of warehousing and cold stores, for holding inventory for extended durations. However, despite the growing focus on post-harvest management, the cold chain industry in India is still at a nascent stage. Reports on the postharvest sector and its contributions to economic development (Mrema & Rolle 2002; Kader 2006; Winrock 2009) emphasises the importance and cost effectiveness of cold chain, yet introducing a cold chain in a developing country requires the integration of a great many different elements and the continuing management of those elements.

In India, currently there are largely two different schemes to provide financial assistance to set up cold storage facilities in the country – one under the Mission for Integrated Development for Horticulture (MIDH) of the agriculture ministry and another called Pradhan Mantri Krishi Sampada Yojana (PMKSY) managed by the Ministry of Food Processing Industries. Since 2014-15, a total of 1104 cold storage facilities with a total capacity of 48.34 lakh MT was created under MIDH. About 208 cold chain and value addition infrastructure facilities with 5.3 lakh ton were built under PMKSY till 2019.

However, despite the growth, number of cold storages in India is still inadequate as compared to the, requirement. As per the estimates of National Centre for Cold Chain Development (NCCD), there is a shortfall of 126 lakh tons of cold storage capacity. Annual production of fruits and vegetables in the country is about 300 million tonnes. This accounts for 18% of our agricultural output. Due to diverse agro-climatic conditions and better availability of package of practices, horticulture production is gradually rising. Although, there is a vast scope for increasing the production, the lack of cold storage and cold chain facilities are becoming major bottlenecks in tapping the potential.

The cold storage facilities now available are mostly for a single commodity like potato, orange, apple, grapes, pomegranates, flowers, etc. which results in poor capacity utilization. Currently, there are about 7645 cold storages in the country with 68% of the capacity being used for potato while 38% is multi commodity cold storage capacity.

Progress of cold storage in the country has also been extremely skewed. Almost 33% of the cold storage in the country is in Uttar Pradesh and largely used for storing potato. In terms of requirement of cold storage, as per horticulture produce, Gujarat fares better than all states in the country. About 15% of the cold storage in the country is in Gujarat and holds a capacity of 6403 lakh tonne per horticulture produce. This is followed by Punjab, Telangana, Uttar Pradesh, Rajasthan, Haryana and Orisha where the cold storage capacity is at least more than 1 lakh tonne per horticulture produce of the state. However, states, like, Maharashtra, Karnataka with large amount of exportable produce do not have adequate cold storage capacity. Bihar, Chhattisgarh and West Bengal are the lowest in order in terms of cold storage as per horticulture produce.

Table 1: Statewise status of cold storage in India, 2019

States	% contribution to All India cold storage	Cold Storage Capacity per horticulture produce (lakh tonne)
Gujarat	15%	6,403
Punjab	8%	3,908
Telangana	2%	2,969
Uttar Pradesh	33%	2,392
Rajasthan	3%	2,290
Haryana	3%	1,946
Odisha	2%	1,833
Karnataka	3%	796
Maharashtra	7%	766
Andhra Pradesh	4%	701
Madhya Pradesh	3%	556
Tamil Nadu	2%	501
Bihar	3%	343
Chhattisgarh	1%	157
West Bengal	3%	132
Others	4%	200

Source: National Horticulture Board, Lok Sabha unstarred questions

Developing the cold chain in India involves a mix of awareness and technical capacity, investment, information and technology. transfer, and better governance mechanisms. Given the gap between export-oriented food chains and domestic traditional food handling, the focus should be on technologies that are economically accessible and long-term capacity development for the vast number of small- scale food producers and food chain SMEs. Currently, 95% of the cold storages are owned by the private sector, 3% by cooperatives and the remaining 2% by public sector undertakings (Crisil,2019). Although private sector actors are primary for developing and operating the cold chain in a vibrant agro-industry sector, governments can do much to facilitate private activity.

The long-term solution to increasing farm income lies in the growth of a viable food processing industry being fed by a robust network of cold storages and transport infrastructure. Based on the growing demand for processed, food, fresh fruits and vegetables, sea food and biopharmaceuticals in export market, cold storage industry in India is expected to grow by 13-15% in the next 5 years.

Some of the measures that need to be adopted for a robust growth in cold storage are the following:

1. Link farmers to value chain- Provision of safe, controlled pre-cooling phase in the production stage will help generate the volume needed to justify cold chain investment.

2. Create incentives for investment in technology for cold storage and process enhancement, thus lowering the economic barriers for investors and supporting return on investment:

3. Encourage the formation and operation of industry bodies for supply chain actors in the agro-food industry, logistics companies, technicians and engineering firms specialized in cold chain infrastructure. These bodies can serve to enable access to technologies/knowledge, finance and equipment, as well as facilitate the dialogue and coordination necessary for effective cold chain development.

4. Invest in research and development of proper small scale and affordable technologies (i.e. evaporative cooling, small scale mechanical precooling and refrigeration systems), post-harvest handling techniques, with particular attention to the needs of small-scale producers and SMEs.

5. Interventions should be adapted to the specific products and geographic and socio-economic conditions. Feasibility studies are essential before any investment or interventions and must take into account the conditions of the product supply chain, and its opportunities and weaknesses for development.

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An Underutilized Nutritious Medicinal Plant Athalakkai *(Momordica cymbalaria)*

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Introduction

In India, there are many medicinal plants, fruits and vegetables are underutilized, which have high medicinal and nutritious values. Among them *Momordica cymbalaria* also one of the underutilized medicinal plants (Kulkarni, 2003). It belongs to the family of Cucurbitaceae, originating in tropical regions of India and South East Asia. *M. cymbalaria* Hoof. is commonly known as Athalakkai (Tamil) or Karchikai (Kannada) or Kasarakayee (Andra Pradesh) and Kakrol (Hindi). Athalakkai has been used in various Asian traditional medicine systems for a long time. *Momordica cymbalaria* having rich source of Vitamin C, Fibre content, Beta carotene, Iron and Calcium. It is having medicinal properties like Antidiarrhoel, Hepatoprotective, Antidiabetic, Nephroprotective, Antiallergic, Antimicrobial *etc*. The plant parts are traditionally used for the treatment of various diseases of human being (Kirtikar and Basu 1991). Because of lack of awareness about the nutritional and medicinal aspects it is not commercially cultivated in India. Hence, it is considered as an underutilized medicinal plant.

Botanical Description

M. cymbalaria is a climbing annual or perennial herb with slender, branched, striate stem. The leaves are orbicular-reniform in outline, deeply cordate at the base, obtusely lobed with 5 - 7 lobes. The fruits are 20 - 25 mm long, pyriform with 8 sharp ridges, 24 mm x 15 mm attenuated at the apex and with the base narrowed into the curved peduncle, which is fleshy, dark green and robbed.

The seeds are 4.6 mm long, ovoid shaped, smooth and shiny. Flowers are unisexual; the male flower peduncle is 5-30 mm long, filiform, puberulaus, ebracteate with 2-5 flowers in racemes with a pale-yellow corolla and two stamens for each flower. The female flower is solitary on a peduncle of 28 mm length. The roots are woody in nature. A limited number of perennial tubers survive in soil and produce single plant in the next season.

	
Plant	**Fruit**

Propagation

The mode of propagation is through asexual method as it is generally propagated through tuberous roots. The tubers sprout after the onset of monsoon and undergo dormancy during summer dry periods. Seeds are not used for propagation because physical dormancy (due to hard seed coat) is the major constrains for seed germination. Hence, it is better to do mechanical scarification to break the seed dormancy (Rekha chittapur et al., 2015).

	
Tuber	**Seeds**

Uses

M. cymbalaria fruits were considered as tonic, stomachic, stimulant and laxative. It is useful in treating gout, rheumatism and sub-acute cases of the spleen and liver diseases. It has also been shown to have hypoglycaemic properties (antidiabetic) in animal as well as human studies. The fruit juice and leaf tea of *M. cymbalaria* is employed for treating diabetes, malaria, colic, measles, hepatitis, fever, sores and wounds, infections, worms and parasites. Fruit pulp, leaf juice and seeds possess antihelimintic activity. Root is astringent, abortifacient, aphrodisiac and also used to treat constipation, indigestion, diabetes, diarrhoea and rheumatism. This crop contained higher amounts of carbohydrate (3.72%), protein (3.26%) fat (1.61%), fiber (5.63%) and ash (1.25%). The beta-carotene content was 224.9 Ig/100 g and that of sponge gourd and ridge gourd have only 200 I.U/100 g and 55 I.U/100 g respectively. It contains higher amount of ascorbicacid160.77mg/100 g on a fresh weight basis. The iron and phosphorous content was also found to be higher in *M. cymbalaria*.

Conclusion

M. cymbalaria have high nutritionally rich and medicinal value, dormancy present in the both seeds and tubers it is not being cultivated commercially. In future, it needs more studies with respect to the seed dormancy and seed viability test methods. Hence, to promote commercial cultivation of *M. cymbalaria* awareness has to be created about the nutritional and medicinal aspects and standardize the advanced production techniques.

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Image Processing: A Non-Destructive Quality Detection Technique

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The developments in the technology, media and communication accompany the increasing awareness of consumers. Therefore, there are more expectations than ever. The situation forces the manufacturers to produce and present higher quality food and agricultural products to market. Moreover, these products have to satisfy sophisticated consumer desires.

Computer imaging system is one of the methods serving the assurance for high quality food products. Product quality is evaluated by a wide range of parameters including external, internal parameters. However, in some cases, sensory and safety scores gain higher importance than above ones. External quality parameters, such as surface colour, texture, presence of bruises and defects, are generally monitored and sorted manually by workers, whereas the internal quality parameters including firmness, pH value, soluble solid contents, and titratable acidity are evaluated using common techniques.

Sensory (e.g. sweetness, flavour) and food safety (e.g. pathogenic bacteria and faecal contamination, pesticide residues and other hazardous residues) characteristics influence general palatability of the products. However, the old fashion techniques are time consuming, destructive and unable to represent the whole batch. Unlike to traditional ones, computer imaging systems do not cause any damage on/in the product and they are rapid analysis techniques as well as being feasible for in-line process. Being another advantage, these systems in this extent can be easily implemented for any analysis of an individual object and/or a batch of food and agriculture products, like intact fruits, even as they are on the yards. Against the traditional techniques, intensity of the analysed feature in a bulk is possible to figure out by imaging systems. Moreover, these systems also provide opportunity to perform rapid, hygienic, automated and objective inspections (3).

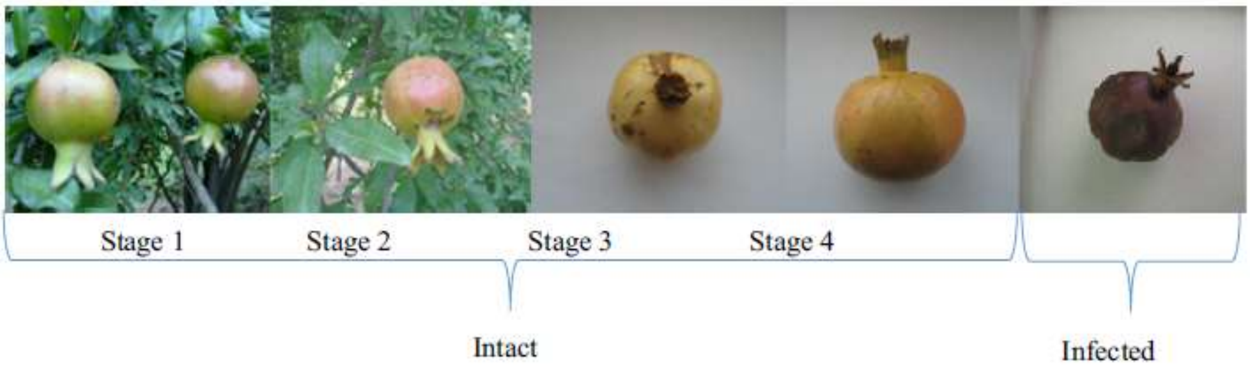

Fig: Image processing for detection of infection and maturity of pomegranate (Source:1)

Recently, there has been an increasing interest in non-destructive methods for internal quality evaluation techniques such as Nuclear magnetic resonance spectroscopy (NMR), Nuclear magnetic resonance imaging (MRI) optical, sonic, Near-infrared (NIR) spectroscopy and X-rays with some success (2).

Vis/NIR spectroscopy technique is very low-cost as compared to other techniques (NMR, X-ray CT system). It has been widely used for rapid internal quality and safety assessment and chemical compounds predication of both thin-rind and thick-rind fruits. It is rapid, safe, non-contaminant and can be used in processing lines. This technique can effectively use for detection of internal insect larvae or infestation in different fruits.

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Postharvest Diseases of Fresh Fruits and Vegetables

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Introduction

The diseases which develop on harvested parts of the plants like seeds, fruits and also on vegetables are the post harvested diseases. The harvested products may get infected on the way to storage or to market or even before their final consumption. The plant parts may get infected in the field, but expression of symptoms may take place later, at any stage before final consumption.

Classification of Postharvest (PH) Diseases:
1. Field pathogen.
2. Storage pathogen.

Field Pathogen

The field pathogens are those, which cause infection during development of plants or their products before harvest.

Storage Pathogen

The pathogens which cause infection during storage are the storage pathogen. Symptoms from infection caused by the field pathogens may be very inconspicuous to be noted at the time of harvest. In fleshy and/or juicy fruits and vegetables, infection by field pathogen continues to develop even after harvest. They may become infected during storage by the same field pathogens or by other pathogens. In seeds and grains, the disease caused by field pathogens ceases to develop further soon after harvest. But they may be infected further by the other pathogens during storage.

Types of Postharvest Diseases: The pathogenic storage diseases into two groups.
1. Diseases of dry, bulk materials, such as seeds and grains.
2. Diseases of fleshy storage organs, such as vegetables and fruits.

Observations of many investigators indicate that the real cause of the spoilage of vegetables and fleshy fruits in transit and also in storage are due to high moisture, high temperature, and injuries caused during marketing. Due to high moisture content and nutrient in harvested vegetables and fruits, they are vulnerable to attack by the pathogenic organisms. Injuries of fruits and vegetables may be caused during harvesting, packing and transposition they help the pathogen to enter the host and cause damage. But the seeds and grains can be stored for long time due to low moisture content (about 12-14%), where most of the pathogens cannot grow favourably (1).

Control of Postharvest Diseases

1. Fungicides / synthetic chemicals.
2. Physical treatments: Cold storage, Heat treatment, Hot Air treatments (HAT), Hot Water treatments (HWT), Radio frequency (RF) heating, Hypobaric and hyperbaric pressure, Ultraviolet-C light.

Fruits and vegetables are susceptible to many postharvest diseases caused by a large number of fungal pathogens. The current strategy to control these diseases is the use of synthetic fungicides, because are relatively inexpensive, easy to apply, and have both curative and preventive action against established and new infections, respectively.

Need to Replace Fungicides / Synthetic Chemicals

The use of fungicides is becoming more limited because the concerns of the consumers and the administration about human health and the release of fungicides in the environment. In addition, organic products becoming more popular, retailers ask for products with a very limited number of residues and the cost of developing and registering new fungicides is very high especially for a small market as postharvest. For all these reasons, the development of nonchemical techniques to control postharvest diseases is increasing in many research programs worldwide (2). We can use physical treatments as an alternative to Fungicides/synthetic chemicals but these techniques are not adopted much by farmers due to lack of awareness about these techniques and cost is also high.

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Millets and their Potential Health Benefits

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Nutrition is one of the major needs of the individuals, which provides energy to carry out various routine tasks in the daily life. Improper and insufficient amount of intake of food nutrients results in various disease, weakness and disabilities. Therefore, the dietary quality of the food has to be taken into account for maintaining good health and fitness, and also to overcome the deep-rooted malnutrition. Some of the foods were underutilized by the people, especially the urban society due to lack of awareness of the nutritive value of these foods. Millets are one such category that was ignored for decades. A shift to fast paced urban lifestyle, rising disposable amount and availability of ready to cook foods are some of the reasons that results in less usage of the millets.

Millets are group of small seeded grasses that are hardy and grown well in drought and rain-fed zones with minimal soil fertility and moisture (Himanshu *et al.,* 2018). Besides, millets are rich source of various proteins, carbohydrates, lipids, minerals (K, Ca, Mg, Fe, Zn, etc.,) and vitamins (B complex and vitamin E). In addition to its nutritive value, millets also confer several health benefits such as preventing cardiovascular diseases and cancer, lowering blood pressure, cholesterol and fat absorption rate, risk of heart diseases and delaying gastric emptying (Gupta et al., 2012). Due to these advantages, millets are gaining importance in the developing countries like India. The most widely grown are pearl millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*), while the secondary group of millets (minor millets) includes, finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), Kodo millet (*Paspalum scrobiculatum*), Proso millet (*Panicum miliaceum*) and Banyard millet (*Echinochloa esculenta*).

Nutritive Importance of Millets

The world is in the clinch of several nutritional disorders and chronicle diseases. According to Global nutrition report (2016), 44% of the world population is suffering from various levels of malnutrition, adult over weight and obesity. These factors lead to severe health complications, such as cardiovascular diseases and diabetes, which are much prominent in India. Therefore, for combating the deep-rooted malnutrition, a balanced dietary quality should be considered. Millets occupies a major role in providing a balance diet, with health benefits and nutritional values when compared to rice and wheat.

Macro Nutrients

Millets are rich in carbohydrates, proteins, dietary fibre and fats. The average carbohydrate content ranges from 60.8 to 78.2g/100g (Table 1). These carbohydrates are composed of free sugars, non- starchy polysaccharides and starch. Glucose, fructose and sucrose are prominent among the free sugars and cellulose, hemicellulose and pectinaecious substances are the non- starch polysaccharides (dietary fibres). The protein content in the millets are comparable. Protein fractions includes, globulins, albumins, prolamin, gluetin etc, However, they are rich in prolamine and glutin. Various amino acid such as lysine, methionine and valine are available in the millets. The fat content in the millets are comparable to rice and wheat. However, least fats are present in proso millet. These fat substances reside in the barn as well as in the endosperm. It is composed of more than 60% of unsaturated fatty acids, including linolenic acid. Millets are the richest source of fibres i.e. crude fibre and dietary fibre, and among the millets, finger millet and Pearl millet are having the highest quantity (11g/100g) of fibre. This fibre content is several higher in millets when compared to rice and wheat and hence millets are gaining importance as major food choice, since they are correlated with the reduction of blood cholesterol and sugars.

Table 1. Proximate Composition and Dietary Fibre (per 100 g)

Millet Type	Proteins	Ash	Fat	Fibre	Carbohydrates	Energy (KJ)
Rice (raw milled)	07.94 ±0.58	0.56±0.08	0.52±0.05	02.81±0.42	78.24±0.68	1491±15
Wheat (whole)	10.59±0.60	1.42±0.19	1.47±0.05	11.23±0.77	64.72±1.74	1347±23
Sorghum	9.97±0.43	1.39±0.34	1.73±0.31	10.22±0.49	67.68±1.03	1398 ±13
Pearl millet	10.96±0.26	1.37±0.17	5.43±0.64	11.49±0.62	61.78±0.85	1456 ±18
Kodo millet	08.92±1.09	1.72±0.27	2.55±0.13	06.39±0.60	66.19±1.19	1388±10
Finger millet	07.16 ±0.63	2.04±0.34	1.92±0.14	11.18 ±1.14	66.82±0.73	1342±10
Banyard millet	06.20	-	2.20	-	65.55	307
Proso millet	12.50	-	1.10	-	70.04	341
Foxtail millet	12.30	-	4.30	-	60.09	331

Micro Nutrients

Vitamins and minerals that are required in very minute quantity constitute the micronutrients. Millets are rich in minerals, such as calcium and magnesium and their quantity are very high when compared to rice and wheat. Among all the millets, finger millet is the richest source of calcium. Besides calcium, Iron is another mineral that plays an important role in combating anaemia and finger millet (4.62mg/100g), followed by Sorghum (3.95mg/100g) are iron rich (Table 2). Millets are also rich sources of Vitamin E and B complex (except B12) and, highest thiamine content is found in Foxtail millet (0.59mg/100g). The riboflavin content of millets is much higher than cereal grains and Proso millet (0.28mg/100g) has the highest quantity among the millets (Table 3). Therefore, inclusion of these millets that are rice sources of several micro and nutrients helps in maintaining sound health.

Phenolic Compounds

Phenolics are characterized by the presence of an aromatic ring consisting of one or more hydroxyl group. Phenolics are important source of anti- oxidants. The main polyphenols are phenolic acids and tannins, while flavonoids are present in small quantities. All millets have phenolic acids.

Flavonoids

Flavonoids are secondary metabolites with two phenyl rings and one hetero cycle rings. Flavonoids such as catechin, anthocyanin, quercetin and tannins are beneficial components. They generally act as radical scavengers.

Anti-Nutrients

Though, millets are superior in terms of nutrition they have certain anti- nutritional compounds like phytate, oxalates, polyphenols, tannins which limits the bio availability of nutrients such as calcium, zinc and iron by forming complexes with these elements. However, the negative action of these anti- nutritional factors can be overcome by using several house hold techniques, such as decortication, milling, and malting, soaking, fermentation, germination popping and cooking. These methods not only increase the bio availability but also reduces the content of anti -nutrients and improves the digestibility.

Millets and Health Benefits

1. Role of Millets in coronary risk factor: The modernization and the present life style has led to morbidity and mortality increase of chronic diseases, of which cardiovascular disease (CVD) is most prevalent. Millets plays an important role in minimizing the CVD and hypertension. Millets are good sources of Mg, which is known to reduce the effects of heart attack, tannins are known for lowering cholesterol. Millets acts as anti-oxidants and prevents the oxidation of LDL's (bad cholesterols), which might otherwise lead to development of atherosclerosis (leads to CVD and hypertension) on oxidation. In addition, millets also increase the levels of High-Density Lipoproteins (HDL), which is the good form of cholesterol. Millets are rich in dietary fibres, which improve the large bowel function and slows down the digestion and absorption process, thus reducing the risk of chronic diseases.

2. Role of millets in Cancer prevention: As millets are rich source of fibres, phenolic acids, phytates and tannins, they reduce the risk of breast cancer in women. According to several records, the tannins and polyphenols have anti-carcinogenic and anti- mutagenic properties.

3. Role of millets in Diabetes mellitus: Diabetes has become an increasingly prevalent diseases in the world, which is characterized by high blood glucose level (hyperglycaemia). This hyperglycaemia majorly results in atherosclerosis (hardens and narrows the blood vessels), and also other complications such as heart diseases, stroke, retinopathy and kidney failure. The Mg content present in millets increases the efficiency of insulin and glucose receptors and prevents the diabetes. The high fibre content reduces the starch digestibility and absorption, thus showing lower gylcemic response. According to Montonen et al., 2003, the Mg, Vit-E, fibres and tannins present in the millets reduces the risk of diabetes as they slow down the sudden increase of blood glucose and insulin levels. Among all the millets, Pearl millet is highly efficient in controlling diabetes due to high fibre content.

Table 2. Trace elements of millets and major cereals (mg/100g):

Millets and Cereals	Aluminium (mg)	Arsenic (mg)	Cadmium (mg)	Calcium (mg)	Chromium (mg)	Cobalt (mg)	Copper (mg)	Iron (mg)	Lead (mg)	Lithium (mg)
Rice	0.44 ± 0.30	-	0.002 ±0.002	7.49 ± 1.26	0.005 ± 0.003	0.003 ± 0.002	0.23 ± 0.06	0.002 ± 0.66	0.002 ± 0.66	0.002 ± 0.66
wheat	0.55 ± 0.23	-	0.002 ± 0.001	39.36 ± 5.65	0.006 ± 0.003	0.003 ± 0.002	0.49 ± 0.12	3.97 ± 0.78	-	0.005 ± 0.004
Sorghum	2.56 ± 0.59	1.53 ± 0.04	0.002 ± 0.002	27.60 ± 3.71	0.010 ± 0.003	0.012 ± 0.007	0.45 ± 0.11	3.95 ± 0.94	0.008 ± 0.003	0.001 ± 0.001
Finger Millet	3.64 ± 0.69	-	0.004 ± 0.004	364 ± 58	0.032 ± 0.019	0.022 ± 0.009	0.67± 0.22	4.62 ± 0.36	0.005 ± 0.002	0.003 ± 0.003
Pearl Millet	2.21 ± 0.78	0.97 ± 0.24	0.003 ± 0.001	27.35 ± 2.16	0.025 ± 0.006	0.030 ± 0.015	0.54 ± 0.11	6.42 ± 1.04	0.008 ± 0.002	0.003± 0.001
Little Millet	-	0.49 ± 0.15	0.001 ± 0.000	16.06 ± 154	0.016 ± 0.006	0.001 ± 0.00	0.34± 0.08	1.26 ± 0.44	-	-
Foxtail Millet	-	-	-	-	0.030	-	1.40	-	-	-
Banyard Millet	-	-	-	-	0.090	-	0.60	-	-	-
Proso Millet	-	-	-	-	0.020	-	1.60	-	-	-

Table 3: Water Soluble Vitamins profile of millets and major cereals:

Millets and Cereals	Thiamine – B1 (mg)	Riboflavin – B2 (mg)	Niacin- B3 (mg)	Pantothenic Acid – B5 (mg)	Total B6 (mg)	Biotin - B7 (µg)	Total Folates - B9 (µg)
Rice	0.05 ± 0.019	0.05± 0.006	1.69± 0.13	0.57 ± 0.05	0.12± 0.012	0.60 ± 0.12	9.32 ± 1.93
wheat	0.46± 0.067	0.15 ± 0.041	2.68 ± 0.19	1.08 ± 0.21	0.26 ± 0.036	1.03± 0.58	30.09 ±3.79
Sorghum	0.35 ± 0.039	0.14 ± 0.014	2.10 ± 0.09	0.27 ± 0.02	0.28 ± 0.023	0.70 ± 0.06	39.42 ± 3.13
Pearl Millet	0.25 ± 0.044	0.20 ± 0.038	0.86 ± 0.10	0.50 ± 0.05	0.27 ± 0.09	0.64 ± 0.05	36.11 ± 5.05
Finger Millet	0.37 ± 0.041	0.17 ± 0.008	1.34 ± 0.02	0.29 ± 0.19	0.05 ± 0.007	0.88 ± 0.05	34.66± 4.97
Little Millet	0.26 ± 0.042	0.05 ± 0.008	1.29 ± 0.02	0.60 ± 0.07	0.04 ± 0.005	6.03± 0.57	36.20 ± 7.04
Foxtail Millet	0.59	0.11	3.20	0.82	-	-	-
Banyard Millet	0.33	0.10	4.20	-	-	-	-
Proso Millet	0.41	0.28	4.50	1.20	-	-	-

4. Role of millets in Gastrointestinal Disorders: The high fibre content in millets eliminates disorders like excess gas formation, bloating, constipation and cramping.

5. Role of millets in Obesity: High dietary fibres in the millets reduces the risk of over eating due to its bulkiness.

6. Role of millets in aging: The pytates, phenols and tannins in the millets contribute to anti-oxidant activity that are important in health, aging and metabolic syndrome.

Conclusions

Millets are easily available and cheap. They are the major source of various nutrients like carbohydrate, fat, proteins and fibres etc. They also provide ample of vitamins and minerals. In developing countries, due to the changes in the lifestyle has led to malnutrition and various health related issues like diabetes, CVD, obesity, cancer, skin problems and celiac diseases. This is mainly due to the underutilization of these beneficial millets and also unawareness of people about the importance of them.

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Automatic Irrigation System

Article ID: 32161

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Introduction

In present scenario, population is increasing at faster rate and we have to produce food at limited available land. Technology is growing day by day to meet this demand in precise manner and decreasing misuse of resources. In country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. Irrigation has always been an ancient practice which has evolved through so many stages over the years. Our ancestral farmers in a bid to irrigate their farm sought for various methodologies. Manual irrigation using buckets and watering cans, flood irrigation, drip irrigation, sprinkler irrigation was and are still being used today. The existing system has several limitations; leaching off of soil nutrients, erosion due to flooding, loss of water from plant surfaces through evaporation, water wastage which can result to water scarcity in drought areas and production of unhealthy crops. This problem can be rectified if we use microcontroller based automated irrigation system in which sensors were used to irrigate were precise requirement of water.

Types of Automatic Irrigation System

1. Pneumatic system: A pneumatic system is a permanent system activated by a bay sensor located at the cut-off point. When water enters the sensor, it pressurises the air, which is piped to a mechanism that activates the opening and closing of irrigation structures.

2. Portable timer system: A portable timer system is a temporary system which uses electronic clocks to activate the opening and closing of the irrigation structures. Because of its portable nature, 4 or 5 units are usually purchased to move around the whole property.

3. Timer or sensor hybrid: This system is a hybrid of portable timer and sensor systems. Like a portable timer, it uses an electronic device to activate the opening and closing of the irrigation structures. This system has an additional feature of the irrigator being able to place a moveable sensor down the bay. When it comes in contact with water, transmits radio signals to the timer devices at the outlets to open or close the structures. It then sends a radio message to a receiver to let the landowner know water has reached the cut-off points down the bay.

Supervisory Control and Data Acquisition (SCADA)

Automation systems that use SCADA consist of a personal computer and software package to schedule and control irrigation via a radio link. Signals are sent from the computer to control modules in the paddock to open and close irrigation structures with linear actuators. Bays are opened and closed on a time basis. Some systems have the capacity to automatically alter the time a bay outlet is open, if the channel supply is inconsistent. SCADA based systems have the additional benefit of being able to start and stop irrigation pumps and motors.

Automatic of Channel Sections

In this system, the channel structures are automated allowing the channel level to be changed. The bay outlets do not have opening or closing structures rather each set of outlets is set at a specific level (such as a set of sills). This method of automation requires a larger amount of fall to be available in the channel system to allow for a change in water level between different areas. This change in water level is required to prevent water flowing onto bays previously irrigated, when another section is to be irrigated. On many farms this fall is not available, so this method of automation in many cases is not suitable.

Automation of Individual Bay Outlets

This method of automation involves control of the bay outlets to change the flow of water onto the areas being irrigated. This system of automation is the most frequently used in areas where there is insufficient fall to automate channel sections. The same type of automatic devices available can be set up to operate either automation of channel sections or automation of bay outlets.

Anti-Nutrients

Though, millets are superior in terms of nutrition they have certain anti- nutritional compounds like phytate, oxalates, polyphenols, tannins which limits the bio availability of nutrients such as calcium, zinc and iron by forming complexes with these elements. However, the negative action of these anti- nutritional factors can be overcome by using several house hold techniques, such as decortication, milling, and malting, soaking, fermentation, germination popping and cooking. These methods not only increase the bio availability but also reduces the content of anti -nutrients and improves the digestibility.

Pros of Automatic Irrigation System

1. Reduced labour.
2. Timely irrigation — plants being watered when needed.
3. Management of higher flow rates.
4. Accurate cut-off of water compared to manual checking.
5. Reduced runoff of water and nutrients.
6. Reduced costs for vehicles used to check irrigation.

Cons of Automatic Irrigation System

1. Costs for purchasing, installing and maintaining the equipment.
2. Reliability of irrigation system (due to human error when setting up).
3. Increased maintenance of channels and equipment to ensure it is working properly.

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Problems Faced by the Nursery Growers in Akola District

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Abstract

The study was conducted in Akola district. The sample constituted 50 of the nursery growers. Nursery growers face problems of more than three fourth (86.00 per cent) of the respondents were express financial constraints like high investment. Whereas the respondents expressed non availability of inputs like lack of quality plantings materials such as seed, seedling, rootstock etc. (58.00 per cent), high cost of chemical fertilizers (94.00 per cent), and Irregular supply of electricity (86.00 per cent). Major labour problems were faced by the respondents includes high cost of labour (90.00 per cent), Lack of skilled labour (68.00 per cent) and Unavailability of labour (32.00 per cent). A major problem of technical knowledge like lack of guidance for control of pest and disease were expressed by 58.00 per cent of the respondents. However, the respondents expressed marketing constraints like transportation problems (58.00 per cent), Low market price of planting material (68.00 per cent), Lack of market knowledge (92.00 per cent) and exploitation by middleman (62.00 per cent) are the major problems in the area of marketing.

Keywords: Constraints, Nursery growers.

Introduction

Nursery raising is one of the highly economic enterprise and commercial venture in horticulture sector. As the demand for high quality planting material is steadily increasing there is need of setting up plant nurseries by small and marginal farmers as well as by gardeners and farmhouse owners. Also, there is profound scope for starting the small nurseries, which will serve to augment the income of needy section of rural society. The history of civilization is rich with verses pertaining to agriculture. Almost all of them candidly connote the nature of agriculture as a food obtaining activity. The major constraints faced by the respondents were unavailability of finance, high cost of inputs and labours, lack of storage and transportation facility, lack of knowledge about export-oriented practices etc. Accordingly, respondents suggested to provide support for initial infrastructure development, training on use of plant protection chemicals, bonsai preparation, increase in subsidy, good quality and timely inputs, export-oriented market information. Further study can be concluded that nursery owners should form strong organization, more agriculture graduates should enter in this business and become successful entrepreneurs to address the problem of unemployment.

Methodology

As a greater number of nurseries are located around the Akola city, so this formed the research area for present study. As selected area fall under the Akola district . From the selected area 20 ,20 and 10 private nursery growers engaged in ornamental and floriculture nurseries from Akola district respectively were selected by using purposive sampling method. Data were collected with the help of well-structured and pretested interview schedule. All the selected respondents were personal interviewed with the help of pre tested interview method and data were collected. For obtaining results, frequency, percentage and correlation coefficient was worked out .Data were categorized by calculating mean and standard deviation.

Results

It can be observed that, more than three fourth (86.00 per cent) of the respondents were express financial constraints like high investment. Whereas the respondents expressed non availability of inputs like lack of quality plantings materials such as seed, seedling, rootstock etc. (58.00 per cent), high cost of chemical fertilizers (94.00 per cent), and Irregular supply of electricity (86.00 per cent). Major labour problems were faced by the respondents includes high cost of labour (90.00 per cent), Lack of skilled labour (68.00 per cent) and Unavailability of labour (32.00 per cent). A major problem of technical knowledge like lack of guidance for control of pest and disease were expressed by 58.00 per cent of the respondents. However, the respondents expressed marketing constraints like transportation problems (58.00 per cent), Low market price of planting material (68.00 per cent), Lack of market knowledge (92.00 per cent) and exploitation by middleman (62.00 per cent) are the major problems in the area of marketing. Some of the similar findings of above constraints have identified by Singh (2004) and Sadanshiv (2006) respectively.

Conclusion

We conclude that the problems faced by the nursery growers, there are need to conduct training programmes on plant protection measures and provide guidance regarding marketing aspects by the experts and scientist of SAUs. Also, there is a need to have strong association of all the nursery growers to address their problems and to develop good marketing network for marketing of their planting material.

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Major Insect Pest of Sugarcane

Article ID: 32163

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Early Shoot Borer

Biology:

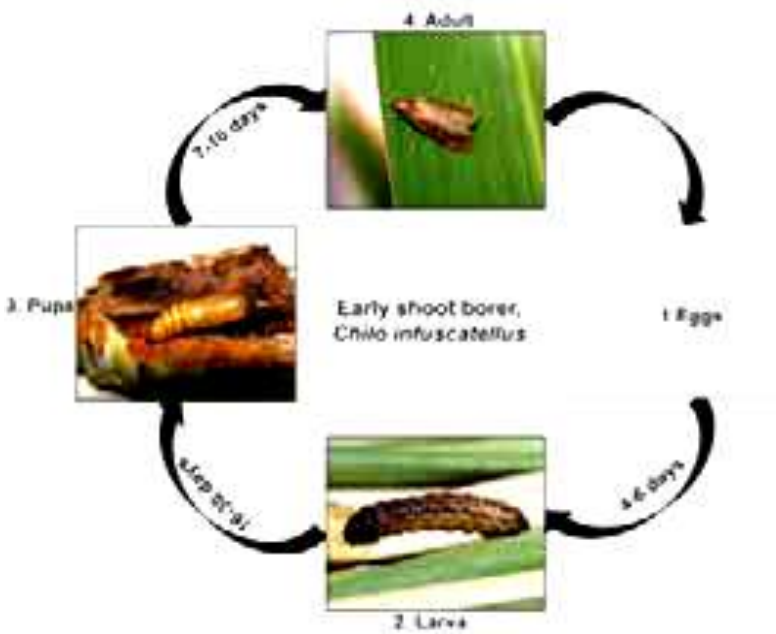
a. Egg: Flat – scale like eggs are laid in 3-5 rows on the lower surface of leaves in masses of 4-100. The masses are slightly overlapping like tiles. It hatches 4-6days.

b. Larva: Larva is dirty white with fi ve dark violet longitudinal stripes and dark brown head. Duration 16-30days.

c. Pupa: Pupation takes within the tunnel. Caterpillar before pupating makes a large exit hole in the stem and blocks the opening with silken discs.

d. Adult: Pale greyish brown moth with black dots near the coastal margin of the forewings and with white hind wings.

Life cycle:



Damage symptoms: Dead heart in 1-3-month-old crop, which can be easily pulled out, rotten portion of the straw-coloured dead – heart emits an off ensive odour. A number of bore holes at the base of the shoot just above the ground level.

Internode Borer

Biology:

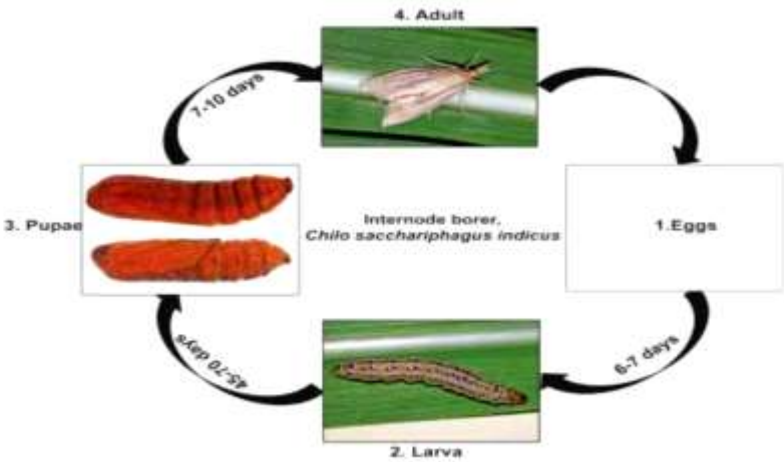
a. Egg: Scale – like oval, flat, shiny and waxy white eggs are laid by female moths in batches of 9-11, near the midribs, on leaf sheaths or on stem.

b. Larva: White larva with four violet longitudinal stripes and light brown head.

c. Pupa: Pupation takes place in semi – dried sheath. Pupal period 7 - 10 days.

d. Adult: Straw coloured with a dark spot on each of the forewings.

Life cycle:



Damage symptoms:

a. Internodes constricted and shortened with a number of bore holes and frass in the nodal region.
b. Affected tissues reddened.

Top Shoot Borer

Biology:

a. Egg: Eggs are laid on the lower surface of top leaves in clusters particularly near midribs. The clusters are covered with buff coloured hairs. : 10-80 eggs per egg mass
b. Larva: Smooth, white or cream coloured with a red coloured mid – dorsal line and yellow head.
c. Pupa: Pupation takes place within the larval tunnel in a chamber with an exit hole Constructed by the caterpillar. Pupal period 6 - 21 days
d. Adult: White Coloured moth (with a buff Coloured anal tuft in the abdominal tip of female)

Damage symptoms:

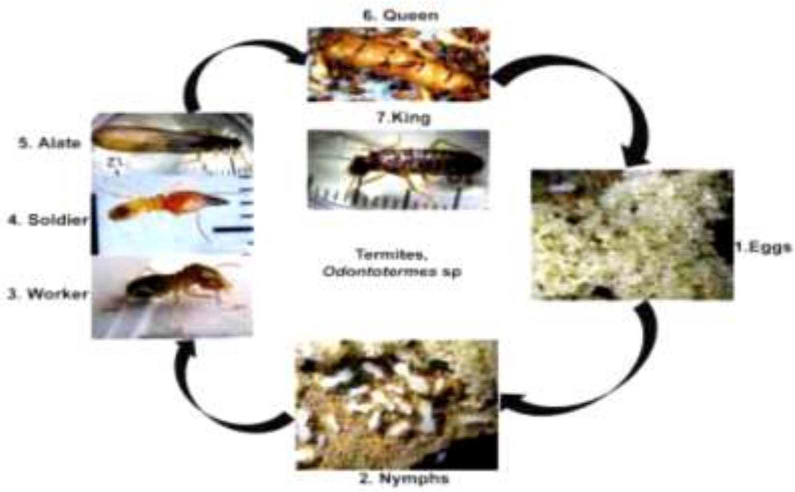
a. Dead heart arises on after sixth month grown up canes, which cannot be easily pulled.
b. Parallel row of shot holes in the emerging leaves.
c. Bore holes at the top of the shoot and shows bunchy top appearance.

Termites

Biology:

a. Egg: Dull, kidney shaped and hatches in 30-90 days.
b. Nymph: Moult 8-9 times and are full grown in 6-12 months.
c. Adult: Creamy coloured tiny insects resembling ants with dark coloured head.

Life cycle:



Damage symptoms:

a. Characteristic semi- circular feeding marks on the leaves in the standing crop.
b. Entire shoot dries up and can be pulled out easily.
c. Setts hollow inside and may be filled with soil.
d. Cane collapses if disturbed.
e. Rind filled with mud.

White Grub

Biology:

a. Egg: A female lays on an average of 27 eggs in the soil, which are pear like white enclosed in earthen cells.

b. Grub: Fleshy 'C' shaped, whitish yellow in colour found close to the base of the clump.

c. Pupa: Pupae are tan to brown, and occur deeper in the soil in earthen chambers.

d. Adult: Adult beetles are a rusty-red colour just after emerging from the pupal stage, but turn nearly black.

Life cycle:

Damage symptoms:

a. Yellowing and wilting of leaves.
b. Drying of entire crown.
c. Affected canes come off easily when pulled.
d. Cause extensive damage to roots and base of shoot.

Whitefly

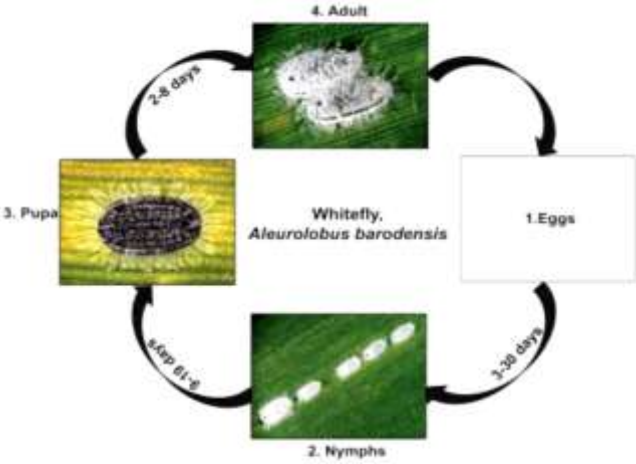
Biology:

a. Egg: Females lay eggs in a line near the midrib or anywhere on the lower surface of the leaves. Eggs are yellowish with a small curved stalk. Colour changes to black about two hours after the eggs are laid.

b. Nymph & Pupa: Neonate nymphs are pale yellow in colour, flat and oval in shape, later turn shiny black. Its body is surrounded by fringes of wax. The fourth instar being the pupal stage, is flat, oval, greyish in colour and slightly bigger than the nymph. There is a 'T' shaped white marking on the thorax, which splits at the time of adult emergence.

c. Adult: Pale yellow body with hyaline wings dusted with waxy bloom, exhibit brisk fluttering movements.

Life cycle:



Damage symptom:

a. Yellowing of leaves.
b. Leaf turns pinkish or purple and later gradually dry.
c. Infested leaves look white with black dots.

Mealybug

Biology:

a. Egg: Eggs are retained in the female reproductive organs until almost fully mature. Incubation period is short. The females may bring forth hundreds of young ones parthenogenetically. Egg is yellowish, smooth, cylindrical and rounded at both ends.
b. Nymph: Newly emerged nymphs are quite active with a pinkish transparent body.
c. Adult: White with mealy coating, sessile.

Damage symptoms: Pinkish oval insects beneath leaf sheath on the nodes, with whitish mealy coating, main cane stunned also attack roots. Sooty mould develops on the honey dew giving blackish appearance on canes.

Scale Insect

Biology:

a. Nymph: Females multiply ovo-viviparously. The nymphs that hatch out from the eggs within the female's body come out through the genital aperture. They are called 'crawlers.' They settle after selecting suitable site for feeding.
b. Adult: Greyish black or brown circular scales, they cover the nodal region forming a thick encrustation.

i. The leaves of infested canes show signs of tip drying and unhealthy pale green colour and with continued infestation these turn yellow.
ii. Desapping leads to non-opening of leaves also, which also turn yellow and finally dry up.
iii. Nodal region is more infested than intermodal region.
iv. Infested crop losses its vigour, canes shrivel, growth is stunted and the internodal length is reduced drastically.
v. Ultimately cane dries up. Such canes when slit open appear brownish red.

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Courtship Behaviour in Insect's Mating

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Introduction

Courtship can be defined as the behaviour used to have copulation with a new partner, or to sustain reproductive interactions with an existing partner. Generally, in all the insect's fertilization is internal. Reproduction through internal fertilization usually requires some behavioural changes that lead to mate finding and finally mating. To get this, insects have evolved some curious behaviours and unusual adaptations to make sure that they can find a suitable mate among and within the species and successfully reproduce with that mate.

Types of Courtship

1. Nuptial gifts.
2. Aphrodisiacs.
3. Visual displays.
4. Serenades (sound production).
5. Ritualized movements (dancing and foreplay).

Nuptial Gifts

Prior to mate finding, hangingfly males chase and capture arthropod prey. They then lure a female closer to him using a chemical signal and offer her that dead arthropod as a food gift. Then she scrutinizes the prey and if she likes that gift then only, she goes for mating. If she does not like that gift or she finds that gift insufficient, she refuses to accept his offer for mating.

Example: In the image shown here, Male scorpion fly is offering the female with a dead insect before mating. The gift provides her with additional nutrition which will be important for her while producing eggs.

(Image courtesy: https://www.amentsoc.org/)

Aphrodisiacs

The males of some insects produce aphrodisiac pheromones to convince females for mating, once the two sexes have come together. On the other hand, insects sometimes produce 'anti-aphrodisiacs' to repel other males. For instance, male mealworm beetles apply anti-aphrodisiac pheromones to their female partners after mating, so that they can look less attractive to other males. A male bumble bee uses pheromones to lure a female to a roost, where he can mate with her. The male flies use some chemicals released by them as perfume to attract females. Once he sets his "traps," he guards his territory waiting for an appropriate female to land on his roost. If he finds her compatible, then the go for mating.

Visual Displays

Some insects begin their search for a mating partner by giving visual cues or signals. Butterflies, flies, odonates, and fireflies generally use visual signals for mate finding. Fireflies are the most famous example of this type of courtship behaviour. They communicate visually through the dazzling process known as 'bioluminescence' in which, a chemical reaction take place in the flies' body to produce light.

Here, the female produces a signal to lure a male. She flashes her light in a specific pattern that notify the passing males about her species, her sex, and that she is interested in mating. Again, if any male will show interest in that female, then the male will reply with his own signal. Both male and female insects continue to blaze their lights until they have got each other.

Sometimes appearance of an adult male along with his behaviour can help to fascinate a female. For example, adult male rhinoceros beetles have exaggerated horns on the thorax and head that help to arrest the female's attention. Females then select the male with the largest horn because it acts as a symbol of his fitness and overall health. They use a lot of nutrients and energy to produce that horn, which act as an ornament to the male beetle.

Serenades

Some insects produce sound to attract their mate. The males of various orthopterans like Cicadas, grass hoppers, crickets, mole crickets etc and some coleopterans and hemipterans are good examples of insects that "sing" to announce their presence and attract the prospective female mates.

Examples: Male crickets generally rub their forewings together to produce a harsh and loud sound. Once he lures a female close to him, his loud song changes to a softer courtship call. Similarly, the mole crickets, which are ground dwellers, actually construct special type of tunnel shaped like megaphones, from which they amplify their calls for the mate. The best example is male cicadas which produce a cacophonic sound by congregating in an area after emerging. In the group of the cicadas, there are three different species which sound like a chorus song singing together. Remarkably, the females respond to the song and are able to identify the mates of the same species from the congregation.

Ritualized Movements (Dancing)

Some male insects and spiders dance, and even a sort of can-can with their long forelegs. Peacock jumping spiders are famous for their ballroom skills. They can perform a linear dance, a zigzag dance, and even a sort of can-can to attract the mate. All of these dances are performed by a male with the wish that the female will select him for mating. Certain male flies perform aerial dances around a female to draw her attention.

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Role of Nutrition in Growth and Development of Insects

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Subject: Entomology

Nutrition concerns the chemicals required by an organism for its growth, tissue maintenance, reproduction and the energy necessary to maintain these functions. Many of these chemicals are ingested with the food, but others are synthesized by the insect itself. Achieving optimal involves a complex interplay between feeding behaviour and post-invective processing of food. Insects need essential nutrients in exact quantities for maintenance of life style.

Deficiency of any nutrient leads to impairment of some vital functions. The nutritional requirements for growth, development and reproduction are now known in biochemical terms for many representative species, largely through the use of synthetic diets (Altman and Dittmer, 1968; Vanderzant, 1974). The substances thus shown to be necessary are as follows:

Water and mineral salts:

a. Substantial amounts of potassium, magnesium and phosphates are needed by all insects but much less sodium, calcium and chloride; traces of zinc, iron, manganese and copper are sometimes also required.
b. Meal worm survive and reproduce on essential dry food.
c. Housefly and honeybee require large amount of water.

Sources of energy:

These are normally taken as carbohydrates but fats and amino acids can also provide energy on oxidation and form the major source in Dipteran larvae.

Carbohydrates: most common source of chemical energy though carbohydrates are least essential for growth, many lepidopterans need for growth and development. Insect blood sugar is trehalose which is a disaccharide

Proteins or Amino Acids

1. The amino acids needed for tissue replacement and growth are normally obtained by digestion of the dietary proteins.
2. An external supply of the following is essential for most insects: arginine, histidine, iso-leucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine
3. In silkworm, three amino acids are present (GAS) Glycine, Alanine and Serine.

Water-Soluble Growth Factors

1. Seven B-complex vitamins are usually needed.
2. Quantitative and qualitative amino acids composition derivatives its nutritive value for normal insect growth: Tenebrionid beetles need carnitine (BT) while ribonucleic acids and ascorbic acid (vitamin C) are needed by some other species.

Lipogenic Factors

Dietary inositol and choline (water-soluble growth factors originally included in the B-complex but with special roles in lipid metabolism) are needed by many insects in larger quantities than the true vitamins.

Fatty Acids

Apart from their role as energy sources, the poly-unsaturated (di- and trienoic CIS) fatty acids are essential for the development of many Lepidoptera and Orthoptera, more particularly in connection with wing-expansion and successful emergence from the pupal cuticle.

Sterols

1. Insects need an external source of sterols (Clayton, 1964; Robbins et al., 1971) and this is probably the greatest nutritional distinction between them and the vertebrates.
2. Cholesterol as such seems essential for some carrion-feeding Dermestidae but many other insects can apparently transform metabolically the phytosterols that they ingest to produce cholesterol.
3. All dietary steroids like Cholesterol, phytosterols and ergosterol are essential for growth and development.

Lipids

1. Essential for formation of membranes and synthesis of hormone.
2. Lepidopteran larvae require linoleic acid for normal development.

Vitamins

1. Water-soluble Vitamin: B-complex and ascorbic acid.
2. Mosquito, Aedes aegypti, needs Vitamin A for normal functioning of compound eye.
3. Locust, *Schistocerca* sp needs pro –vitamin A for growth and development.
4. Few species need a-tocopherol (vitamin £) and carotenoids related to vitamin A.

Purines and Pyramidines

1. DNA and RNA are dietary nucleic acids that influence growth.
2. RNA positively influences growth of Dipteran maggots.

Symbionts

Yeast-like *Actinomyces rhodnii* which occurs in the gut of *Rhodnius prolixus* (Brecher and Wigglesworth, 1944) and the yeasts of *Stegobium paniceum* and *Lasioderma serricorne* which synthesize B-vitamins and a sterol (Pant and Fraenkel, 1950).
1. Adults require amionacids, purines and certain lipids.
2. Immature stages require large amounts of amionacids.

Quantitative Effect of Sucrose in Artificial Diet

1. Most insects so far examined require some carbohydrate in the diet, and grow better as the proportion is increased. *Schistocerca* for example, needs at least 20% of digestible carbohydrates in an artificial diet for good growth.
2. *Tenebrio* fails to develop unless carbohydrate constitutes at least 40% of the diet, and growth is optimal with 70% carbohydrate

Balance of Nutrients

1. The required balance of the major constituents, amino acids or proteins and carbohydrates, is generally adapted to the natural foods of the species.
2. Insects that feed on other animals have high amino acid requirement relative to carbohydrates,
3. Plant-feeding species generally require approximately equal amounts of amino acids and carbohydrates. This is true for Orthoptera, Coleoptera and Lepidoptera.

Microbes in Hindgut Helps Digestion

Crickets do not have enzymes capable of digesting these compounds (above diagram).

Digestion of carbohydrates by crickets, Acheta, with and without their normal hindgut bacterial flora. Digestive efficiency is measured as the quantity of maltose equivalents produced in one hour (after Kaufman & Klug,):
1. Digestion by homogenates of the midgut. The absence of hindgut bacteria has no effect.
2. Digestion by homogenates of the hindgut. In the presence of bacteria complex carbohydrates are digested, the germ-free insect is unable to digest these compounds.

Anautogenous

Some female mosquitoes do not lay eggs until they have had their first blood meal; they are said to be anautogenous.

Autogenous

Others are autogenous and can lay their first batch of eggs without a blood meal.

In anautogenous blowflies, such as *Phormia*, the intake of protein declines in the later stages of vitellogenesis and then rises again after oviposition. The intake of sugar may remain more or less constant, but sometimes varies inversely with protein intake (de Clerk & de Loof, 1983). Similar changes may occur in grasshoppers.

Amongst those holometabolous insects that do not feed as adults, sexual differences in diet selection may already be apparent in the larvae. Female gypsy moth larvae continue to select more of a high protein diet than males in the later stages of development, and also maintain a higher level of nitrogen utilization. Changes in consumption and utilization of protein in successive larval stages of the gypsy moth, *Lymantria*.

1. The percentage of the high protein diet eaten by each stage. Relatively less of this diet was eaten by the later stages. Insects were given a choice of two artificial diets. One contained high concentrations of both protein and lipid, the other contained a low protein concentration with high lipid. Females have six larval stages, males only five (data from Stockhoff, 1993).

2. The efficiency of utilization of ingested protein declines in the later stages (after Montgomery, 1982).

Nutritional Effects on Growth and Development

As food intake decreases, the duration of development is extended and the insect becomes smaller and lighter in weight. Effects of differing amounts of food on development of a grasshopper, Schistocerca americana. Insects received different amounts of seedling wheat, a highly nutritious food.
1. Duration of the final larval stage.
2. Weight of newly emerged males:

> a. The caterpillars of *Spodoptera exempta*, which feed on grasses, grow more slowly on *Panicum* and *Setaria* than they do on *Cynodon*.
>
> b. When feeding on the latter grass, the insects pupate at the end of the fifth stadium, but on the other two grasses they are still small and continue to develop through one or two additional stages. The sizes of the last stage larvae are similar irrespective of the food (Yarro, 1985).
>
> The adequacy of larval food is reflected in the quantity of nutrients stored for subsequent egg production, but more direct effects of nutrient levels occur in insects that feed as adults. In mosquitoes, for example, egg production is proportional to the amount of nitrogen ingested with the blood meal.

Nutrition Affects Coloration: Diet-Induced Polyphenism

1. Differences in nutrition may also produce profound differences in morphology coloration and features of phenotype. Caterpillars of the spring brood of *Nemoria arizonaria* resemble the oak catkins on which they feed. They are yellow with a rough cuticle, and have two rows of reddish spots along the midline.

2. Caterpillars of the summer brood resemble stems. They are green-grey and are without the rows of spots. They feed on leaves and have larger head capsules and mandibles than the spring brood. These differences

result entirely from differences in the quality of food eaten by the insects (Greene, 1989) i.e. Tannin content of catkin

3. In the honeybee, the quality of food given to larvae by the workers determines whether the larvae will become queens or workers, with the effect being mediated by a protein, royalactin. The quantities of protein and aminoacids ingested are important for growth and development

4. The propensity to store excess ingested carbohydrate as fat in caterpillars of diamond back moth, *Plutela xylostella*, changed with consecutive generations of rearing on diets of differing protein- carbohydrate ratios. High –carbohydrate low- protein resulted in caterpillars becoming less prone to depositing fat

5. Caterpillars maintained on a High- protein low-carbohydrate regime developed greater lipid stores when offered excess carbohydrate food.

6. Changes in the efficiency with which ingested carbohydrate was converted to fat in DBM.at generations 1,4 & 8 caterpillars were exposed for the final larval stadium to one of the five diets containing different proportions of protein and carbohydrate and body fat growth were measured.

Nutritional Balance Affects Reproductive Performance and Lifespan

1. The adult female Drosophila lived longest on a diet containing a 1:16 ratio of protein to carbohydrate.
2. It produced most eggs across their lifetime on a 1:4 protein to carbohydrate ratio.
3. Similar differences were observed in crickets, tephritid fruit flies, ants and bees.

Immune Response Affected by Dietary Nutrient Balance

1. *Spodoptera litura* caterpillars infected with either a bacterial or viral pathogen survived better as the ratio of protein to carbohydrate in the diet was increased.
2. Uninfected larvae, in contrast preformed best on an intermediate nutrient ratio.

Role of Nutrition in Pest Management

1. Silica induced plants –affects mandibles.
2. Transgenic plants in cotton and maize. early mortality of host larva is due to the poor quality of host insect.

Expression of Moulting Effects Can Be Modified by Nutrition

1. Beta –ecdysone affects promotes synthesis of epidermal cell proteins.
2. Triggers release of tyrosine.

Feeding Stimulants and Feeding Deterrents

1. Sucrose-important phagostimulant.
2. Aminoacids –weekly stimulating.
3. Ex: Spruce budworm.
4. Sucrose +L-proline (individually)-- weekly stimulants.
5. Sucrose +L-proline (mixture)- high stimulating.
6. Monophagous pests can be easily controlled compared to oligophagous and multiphagous.

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Evapotranspiration: Concept, Advantages and Factors Affecting of Evapotranspiration

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Introduction

Water absorbed more than 99 % by root system of plants and it is lost by evaporation and transpiration from soil surface and plant respectively in the form of vapour. Evapotranspiration is not the same as evaporation. The term, evapotranspiration denotes the water transpired by crops/ plants and the water evaporated from the soil or water surface in the crop field and the intercepted precipitation by crop aerial parts in any specified period. It is usually expressed as surface depth of water in millimetres or centimetres.

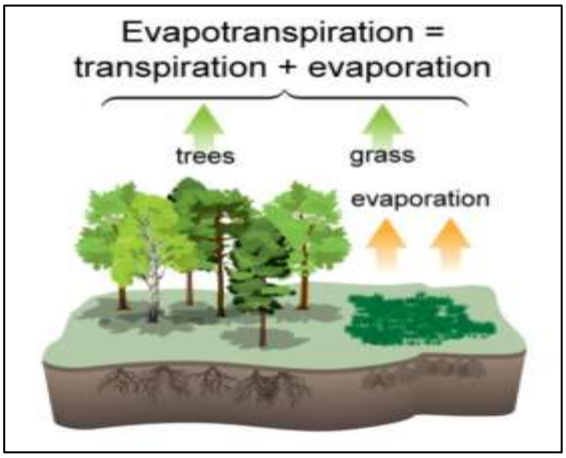
The term, consumptive use of water by crop refers to the evapotranspiration together with the water used for metabolic activities by the crop plants. Evapotranspiration is often used synonymously with the consumptive use since the amount of water metabolically used by crop plants is hardly one per cent of the evapotranspiration value. They may be expressed as follows:

Evapotranspiration = Evaporation from crop field (E) + Transpiration (T) + Intercepted precipitation by crop plants lost by evaporation (IP)

Consumptive Use (CU) = ET+ Water use by crop plants for metabolic activities (Wm).

Definition

"Evapotranspiration is a combination of two separate processes evaporation and transpiration. In evaporation, loss of water from the water bodies in form of vapour and in transpiration, loss of water from the living plant bodies, both adding up to give the total amount of water lost from the earth surface."



Difference Between Transpiration and Evaporation

Transpiration	Evaporation
It is a physiological process and occurs in plants	It is a physical process and occurs on any free surface
The water moves through cell epidermis with its cuticle, lenticle or stomata	Any liquid can evaporate but living tissues are not involved
Various forces such as vapour pressure, diffusion pressure, osmotic pressure are involved	Not such forces are involved at all

It keeps the surface of leaf and young stem cool and protects from over heating	It causes dryness of the surface
Water vapours are formed in the internal tissues of plants	Water vapours are formed at free surface of water
Transpiration depends largely upon absorption of water from soil	It continues as long as water is available on the surface
Transpiration is comparatively slow process	Evaporation is comparatively fast process

Significance of Evapotranspiration

1. It is an important process in water cycle as it responsible for 15% atmosphere water vapour.
2. It maintains soil and plant temperature.
3. It helps in movement of nutrients in plant.
4. Regulates rate of absorption of water.
5. Optimizes temperature of plant.
6. Maintenance of plant cell turgidity which provide a proper shape to plant.

Factors Affecting of Evapotranspiration

1. Environmental / Climatic factors.
2. Plant / Crop factors.
3. Soil factors.
4. Cultural / Management practices.

Environmental / Climatic Factors

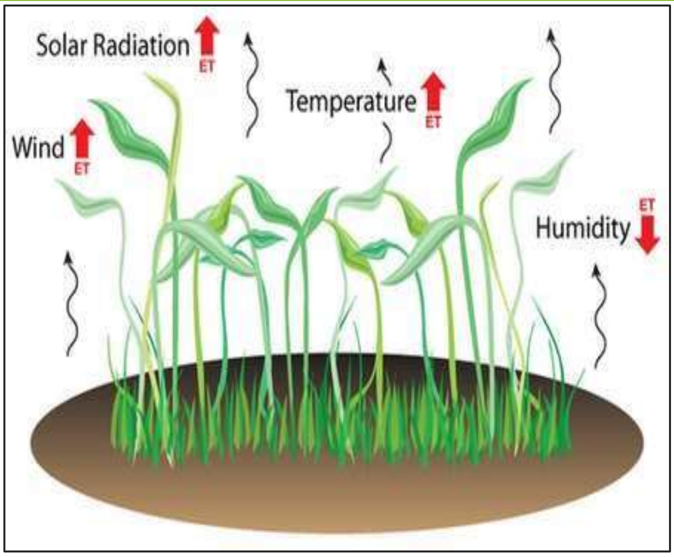
Solar radiations: More solar radiations, increase the rate of evapotranspiration. Solar radiation supplies the energy for the Evapotranspiration processes. With increasing day length or solar radiation, the energy received from the sun converts more of the water from liquid to vapour form. Evapotranspiration is more in summer months, because a greater amount of solar energy is received on the earth surface than in winter.

Air temperature: As temperature increase, evapotranspiration also goes up. The rate of evapotranspiration in any locality is probably influenced more by temperature than any other factor. Temperatures of plant body and soil rise because of more amount of radiant energy received which leads to more transpiration and evaporation. The CU may vary even in years of equal accumulated temperatures because of deviations from normal seasonal distribution. Unusually low or high temperatures may retard plant growth activities and consequently the transpiration process.

Atmospheric humidity: As the air becomes more and more saturated, less water is able to evaporate into that air. Rates of evaporation and transpiration are inversely related with the atmospheric humidity. Gradient of diffusion pressure deficit of water vapour from soil to atmosphere and from leaves to atmosphere becomes flatter with an increase in relative humidity of the atmospheric air. The evapotranspiration thus falls with increase in relative humidity that is usually observed during rainy days when the relative humidity remains normally very high. The CU increases with a fall in relative humidity in any growing season.

Movement of wind increases: Evaporation and transpiration does as well because moving air is less saturated than stagnant air. Evaporation from the soil surface and transpiration from plants occur at a higher rate on a windy day than under calm air conditions. The moist air in the immediate vicinity of a moist soil or leaf surface is swept away by wind and the dry air occupies the place. The dry air on coming in contact with the evaporating surfaces steepens the diffusion pressure deficit. This causes the evapotranspiration to occur at a higher rate. Hot dry winds and other unusual wind conditions during the growing season increase the consumptive use.

Moisture/water availability: If less water available means plants begin to transpire less water in an effort to survive. This in turn decreases evapotranspiration.



Plant / Crop Factors

Growth habit: Growth habit of crops influence the water use rate. Crops that have a faster rate of growth with quick development of foliage and roots have higher evapotranspiration rate than those growing slowly.
Canopy development a bigger canopy increases the transpiration loss, reduces the evaporation from the crop field & reflects back a greater amount of solar radiation. Reflectance is the only way that an incoming radiation is lost.

Stomata: Transpiration depends upon the number of stomata per unit area (i.e. distribution), position of the stomata (either it is distributed on upper surface, lower surface or both surfaces). Plants having stomata on both surfaces of leaf transpire more. Transpiration also depends on size of the stomatal pore along with periodicity of the stomatal opening. Rate of transpiration is minimum in scotoactive plants (Sinha RK, 2017).

Plant density: Plant density influences the evapotranspiration. Crop density influences the evapotranspiration in the same way as the crop cover influences the evapotranspiration. The degree of its influence depends on the extent of crop cover attained with a given crop density. The row spacing, seed rate and ultimate plant population decide the density of crop. Tanner et al., (1960) stated that the plant population and other crop management practices that affect the net radiation at the soil surface, change the evapotranspiration unless the soil surface and plants get constant water supply. With lower plant population, the evapotranspiration is low.

Root : Shoot ratio : High root: shoot ratio increases the rate of transpiration while low root/shoot ratio decreases the rate of transpiration. Small plants have high root/shoot ratio hence transpire more water per unit of leaf area as compared to large plants which have low root/shoot ratio (Sinha RK, 2017).

Soil Factors

Soil texture: Soil texture refers to the relative percentage of various types of soil particles (sand, silt, and clay). Coarse textured and well-aggregated soils retain less water and have low hydraulic conductivity at relatively higher tensions. As a result, they support less evapotranspiration compared to fine textured soils, unless too frequent irrigations are provided.

Soil colour: Soil colour is produced by the minerals present and by the organic matter content. Red or yellow soil indicates the presence of oxidized ferric iron oxides. Black or dark brown colour in soil indicates that the soil has a high organic matter content. Wet soil will appear darker than dry soil.

Soil surface: Soil surface rough surface of soil decrease the evapotranspiration by reflecting greater amount of radiant energy.

Cultural / Management Practices

Irrigation practice: Irrigation practice is the most important contributing factor to the amount of evapotranspiration. A wet soil contributes more to the evapotranspiration than a dry soil. Frequency, method and depth of irrigation influence the evapotranspiration to the degree of wetness of the soil surface and water availability attained. Frequent irrigations encourage water loss by evaporation as the surface soil remains wet for relatively longer periods and the soil water is maintained at relatively low suction. Irrigation methods such as sprinkler, border strip and check basin result to wetting of bigger surface area leading to higher evapotranspiration as compared to furrow, corrugation and drip methods (Majumdar DK, 2018).

Weed management: Weed management is necessary to reduce the water loss through transpiration by weeds. Mulches can reduce seed germination of many weed spp and reduce light, which stresses existing weeds. Coarse textured soils are more effective than fine textured ones in reducing weeds.

Fertilizer application: Fertilizer application increase the evapotranspiration and CU by producing greater biomass and developing a deeper and extensive root system. This is mainly due to increased transpiration by the biomass produced and exploration of a greater amount of soil water by the root system. However, the CU does not vary widely between well-fertilized and under-fertilized crops (Majumdar and Mandal, 1984).

Mulching: Mulching reduces the evapotranspiration by reducing the evaporation from the bare soil surface, reflecting the solar radiation and reducing the weed infestation. Peters and Russell (1959) stated that the evapotranspiration could be reduced by one-half using plastic mulch. Mulching has a greater effect in reducing the evapotranspiration when the crop cover is relatively small.

Conclusions

It is well known that more than 99% of water absorbed by plants is lost by transpiration and evaporation from the plant and soil surface, respectively. Thus, for all practical purposes, the water requirement of crops is equal to the evapotranspiration requirement, Crop evapotranspiration. Crop evapotranspiration is mainly determined by climatic factors and hence can be estimated with reasonable accuracy using meteorological data.

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Pigments from Commercial Flowers

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Introduction

Pigments are colourful compounds. Colour is the net effect of all the light reflected back – wide spectrum. Chemical compound that reflects certain wavelengths of visible lights. Substance produced by living organisms that have a colour resulting from selective colour absorption. Absorbs Electrons exist at lowest specific levels. If external energy comes in contact with electron to the next level – it absorbs and occupy higher level. Light provides too much energy or less energy which is reflected back.

Pigments in Plants

1. Chlorophyll: Chlorophyll is a green photosynthetic pigment found in plants, algae, and cyanobacteria. Chlorophyll absorbs mostly in the blue and to a lesser extent red portions of the electromagnetic spectrum, hence its intense green colour. Green substance in producers that traps light energy from the sun, which is then used to combine carbon dioxide and water into sugars in the process of photosynthesis Chlorophyll is vital for photosynthesis, which helps plants get energy from light. Chlorophyll molecules are specifically arranged in and around pigment protein complexes called photosystems, which are embedded in the thylakoid membranes of chloroplasts.

2. Carotenoids:

- a. Red, orange or yellow pigments.
- b. Eg: Carotene – Carrot.
  - i. Lutein – yellow pigment in fruits and vegetable.
  - ii. Lycopene – red pigment in tomatoes.
- c. Attract pollinator, seed dispersal.
- d. Antioxidant.
- e. Substrate for hormones.
- f. Absorbs excess light energy.

3. Xanthophyll: Xanthophylls are a class of oxygen-containing carotenoid pigments,4 responsible for the color of many of the yellow, orange, and red hues of flowers, fruits, vegetables (corn, pepper, etc.), egg yolks, and feathers, shells, or flesh of many animal species (flamingo, canary, shrimp, lobster, chicken, or salmonids).5 In plants, they are involved in photosynthesis with chlorophyll and are responsible for the red, yellow, and/or brown colours of autumn foliage as the chlorophyll levels decline.

4. Anthocyanins: Attract pollinators and seed dispersers. Repel predators, protect cells from damage by excess light. Improve plant tolerance to stress such as drought, U V-B improve night vision and other vision disorders, protect against heart disease.

5. Betalains: Red or yellow pigments. They are water soluble and Synthesized from tyrosine. Never co-occur in plants having anthocyanins.

Primary Functions of Pigments in Plants

1. Photosynthesis.
2. Helps capture light as much possible-chlorophyll.
3. Attract insects' pollination.

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Pigments in Flower Crops

Marigold:

a. Xanthophylls are the major carotenoid fraction in flower petals.
b. Lutein accounts for 80 – 90% of total Xanthophylls content.
c. Used for poultry feed to intensify the yellow colour of the egg yolk and broiler skin and also for fish.
d. Also used for colouring food stuffs.

Chrysanthemum: Chrysanthemum is a commercially valuable ornamental plant with bright yellow petals, mainly reflecting the accumulation of lutein.

Pot marigold – *Calendula officinalis:*

a. Petals and pollen contain carotenoids **flavoxanthin** and **auroxanthin** as antioxidants, & source of their yellow-orange coloration.
b. Petals used to add colour to salads , extract is common food additive to produce darker egg yolks.

Adonis gestivalis:

a. An ornamental plant native to Europe.
b. Petals of *Adonis aestivalis* and *A. annua* accumulate large amount of astaxanthin, resulting in their blood-red colour.
c. Astaxanthin is a keto-carotenoid that is produced in a number of bacteria, fungi and algae.
d. Only a few plant species are known to produce Astaxanthin.

Osmanthus fragrans:

a. Native to China.
b. Delicate fruity-floral apricot aroma.
c. Silver-white (*Osmanthus fragrans var. latifolius* Mak.).
d. Gold-orange (*Osmanthus fragrans* Lour. *var. thunbergii* Mak.).
e. Reddish (*Osmanthus fragrans var. aurantiacus* Mak.).
f. Various workers have examined different colored varieties and found that the gold-orange variety have more desirous notes and tend to be higher in carotenoid derived materials.
g. *Osmanthus* accumulate beta-Carotene in higher amounts.
h. Flowers are used to flavour jam, sauce and sweets.

Taraxacum officinale:

a. Flower heads are yellow to orange colour.
b. Analysis have detected the presence of beta- carotene, cryptoxanthin, flavoxanthin and lutein.
c. Mixed carotenoids can act as cancer preventing anti-oxidants.
d. Dandelion flowers - tea that helps muscles to relax.

Lilium candidum:

a. Asiatic hybrid lily (*Lilium* spp.) commercially valuable ornamental plant with flower colors ranging from red, orange and yellow (carotenoids).
b. Carotenoid profiling has shown that most of the carotenoids in yellow petals are antheraxanthin, violaxanthin and lutein.

List of Plant Sources

Plant name	Part used	Colour
Bougainvillea *(Bougainvillea glabra)*	Flower	Red, Brown
Golden rod *(Solidago grandis)*	Flower	Yellow
Marigold *(Tagetes species)*	Flower	Yellow
Parijatha *(Nyctanthes arbortristis)*	Flower	Yellow
Balsam (*Impatiens balsamina*)	Flower	Brown

Dahlia (*Dahlia* species)	Flower	Orange
Flame of forest *(Butea monosperma)*	Flower	Yellow
Butterfly creeper *(Clitoria ternatea)*	Flower	Blue
Fire flame bush *(Woodfordia fruticosa)*	Flower	Red
Holly hock (*Althea rosea)*	Flower	Red
Bajradantip *(Barleria pritonis)*	Flower	Yellow
Champaka *(Michelia champaca)*	Flower	Yellow
Corn poppy *(Papaver rhoeas)*	Flower	Red
Indian tulip *(Spathodea companulata)*	Flower	Red
Bottle brush *(Callistemon citrinus)*	Flower	Red
Cosmos *(Cosmos sulphureus)*	Flower	Yellow

Conclusions

These flowers contain pigments which can be extracted using different methods and these pigments may be used as food colourants and also acts as antioxidants. Also, they are used in Medicine, Cosmetics, Leather industry, Tanning industry, Dry flower industry, Paints, ink and paper and textile industries.

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Role of Plant Growth Regulators in Agricultural Crops

Article ID: 32168

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Introduction

Plant growth regulators or plant regulators are the synthetic organic compounds other than nutrients which modify or regulate or inhibit or promote plant physiological processes in an appreciable measure when used in small concentrations. The growth behaviour of many plants could be modified or controlled by applying small amount of plant growth regulators, either by seed soaking, root dipping or whole plant spray. Among several growth substances, gibberellins and auxins are very promising and these are being used on large scale in number of agriculture crops. PGRs are when applied at the time of flowering, it will increase number of flowers per plant and also reduced flower drop to some extent.

Different growth regulators like (auxins, gibberellins, cytokinins, maleic hydrazide), growth inhibitors like (Ethylene, Abscisic acid) growth retardant like (Cycocel) have been used in agriculture crops. Although the naturally occurring (endogenous) growth substances normally control plant growth, modification of growth can be produced by application of exogenous growth substances, some of which may produce beneficial effects (Weaver, 1972). Today various plant growth promoters, inhibitors and retardants are available in the market in synthetic forms and they act as natural hormones.

Plant Growth Promoters

1. Auxin: Auxin were the first of the major plant hormones to be discovered. Auxin is required for fruit growth and development and delays fruit senescence. Auxin plays also a minor role in the initiation of flowering and development of reproductive organs. In low concentrations, it can delay the senescence of flowers. A number of plant mutants have been described that affect flowering and have deficiencies in either auxin synthesis or transport.

2. Gibberellic acid: Gibberellic acid (GA3) is known to improve physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. It is also known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates, thereby increasing the productivity. Gibberellins have a number of effects on plant development. They can stimulate rapid stem and root growth, induce mitotic division in the leaves of some plants, and increase seed germination rates. Foliar application of GA3 enhances plant growth and development by encouraging cell elongation and division resulting in larger produce, extended shelf life, increased plant vigour and better pod set. Richards et al. (2001) reported that exogenous application of gibberellic acid induced flowering and affected flower morphology.

3. Cytokinins: Cytokinins are a class of plant growth substances (phytohormones) that promote cell division, or cytokinesis, in plant roots and shoots. They are involved primarily in cell growth and differentiation, but also affect apical dominance, axillary bud growth, and leaf senescence. Cytokinin promotes plant cell division and growth, produce farmers use it to increase crops. One study found that applying cytokinin to cotton seedlings led to a 5–10% yield increase under drought conditions. Cytokinins have recently been found to play a role in plant pathogenesis.

4. Maleic hydrazide: Maleic hydrazide is a plant growth regulator, used to suppress growth and to induce dormancy in some crops. It is mostly used to reduce sprouting in stored crops, such as potatoes, onions, shallots and garlic. It is used as a foliar treatment of potatoes to prevent volunteer formation and sprouting during storage. It can also be used pre-harvest to suppress sprout formation in onions. Maleic hydrazide has a mutagenic effect on the cells and prevents cell division in tubers as well as an inhibitory effect on biosynthetic activity. It is also used in combination with various herbicides (dicamba and MCPA) as well as fatty acids, to control unwanted vegetation in amenity turf and ornamental gardens.

5. NAA (Naphthyl Acetic Acid): NAA is a synthetic plant hormone in the auxin family. The use of NAA affects the growth and yield of a number of plants and also increase photosynthesis in different crops. (Ullah et al., 2007). Foliar application of NAA resulted an increased nitrogen content in stems and roots and also increase the number of pods. It is an ingredient in many commercial plants rooting horticultural products; it is a rooting agent and used for the vegetative propagation of plants from stem and leaf cuttings. It is also used for plant tissue culture. The hormone NAA does not occur naturally, and, like all auxins, is toxic to plants at high concentrations.

Plant Growth Inhibitors

1. Ethylene: Ethylene is regarded as a multifunctional phytohormone that regulates both growth and senescence. It promotes or inhibits growth and senescence processes depending on its concentration, timing of application, and the plant species. The application of ethephon, an ethylene releasing compound enhanced ethylene evolution and increased leaf area at a lower concentration, while inhibited at higher concentration. It acts as stimulating or regulating the ripening of fruit, the opening of flowers, the abscission (or shedding) of leaves. Ethylene shortens the shelf life of many fruits by hastening fruit ripening and floral senescence.

2. Abscisic acid (ABA): Abscisic acid (ABA) is a plant hormone. ABA functions in many plant developmental processes, including seed and bud dormancy, the control of organ size and stomatal closure. It is especially important for plants in the response to environmental stresses, including drought, soil salinity, cold tolerance, freezing tolerance, heat stress and heavy metal ion tolerance.

Plant Growth Retardant

Cycocel: Cycocel (2-chloroethyl-trimethyl-ammonium chloride) is a synthetic growth retardant. Cycocel (CCC) retard stem elongation by preventing cell division in sub-apical meristem, usually without similarly effecting the apical meristem. Cycocel influences very significantly the vegetative growth of plants, without effecting the flower bud initiation, number of leaves, number of flowers, duration of flowering, emergence of flower and increases the number of branches.

Conclusions

Plant growth regulators (PGRs) are chemicals used to modify plant growth such as increasing branching, suppressing shoot growth, increasing return bloom, removing excess fruit, or altering fruit maturity in different crops.

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Reflection of Bloom's Taxonomy in the Learning Outcomes of B.Ed. Syllabus of Agriculture Science in Jagannath University

Article ID: 32169

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Abstract

This study determines to seek out the reflection of Bloom's taxonomy on the course outcomes of B.Ed. info of Agriculture science in Jaga nath university. Its objectives were: to reason the learning outcomes of Agriculture science course in step with the Bloom's taxonomy and to investigation the reflection of Bloom's taxonomy on the course outcomes of Agriculture science info knowledge was collected by analysing course document victimization table of specification and interviewing course specialist's victimization interview schedule. in step with the findings of the study, uneven application of the domains indicated by Benjamin Bloom and lack of consistency of the info became apparent.

Keywords: Bloom's Taxonomy, Agriculture, Learning Outcomes.

Introduction

Many new efforts are made at the national and state level with the aim of providing quality education to the students studying in schools, all of which aim to develop educational quality and achieve good achievement level among the school students through the overall evaluation of the students They can be upgraded by making a definite plan of development, but mostly by thinking through observation. The opposite is seen in the picture, it is often seen that even 25% of what teachers are told and taught during training is not shared in their schools and they do not understand that traditional teaching style Along with strengthening the teaching quality and the pace of its development through various methods, the academic processes in a planned and systematic way will help the students in a fear-free and enjoyable environment. More opportunities to learn Is emphasized. This was considered from the point of view of nomination, stay and achievement. Apart from this, the desirable features of the learners, learning process, educational facilities, learning materials, subject material, administration and management and learning outcomes were also included.

Specific Objectives of the Study are as Follows

1. Classifying learning outcomes of agriculture sciences according to bloom's classification.
2. Analysing Bloom's Classification reflections on the learning outcomes of the agriculture sciences Syllabus.

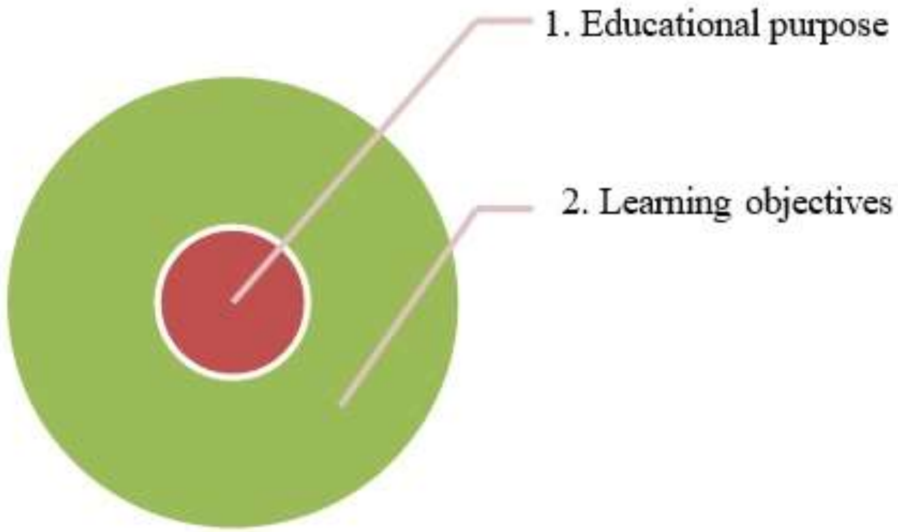
The educational system aims at all-round development of the student. In practice, it is almost impossible for a class teacher to practically achieve these goals if he does not analyse these goals. It is important for the teacher to know what are the characteristics of the objectives, how are they?

Purpose has Three Characteristics

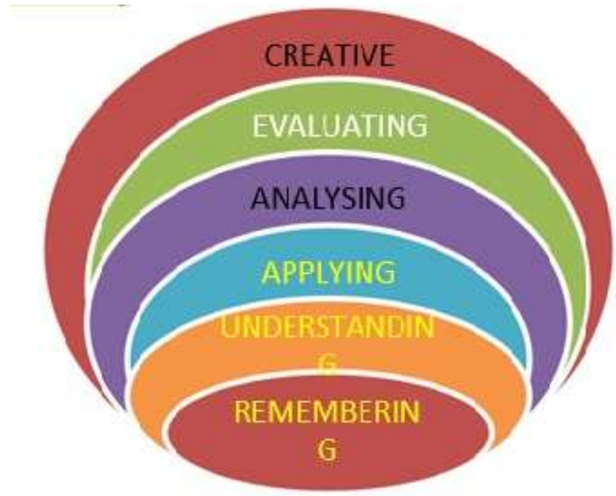
1. It gives direction to the action to be taken for any end goal.
2. The planned change is brought about by an action.
3. With their help the verbs are arranged.

There are Two Types of Objectives

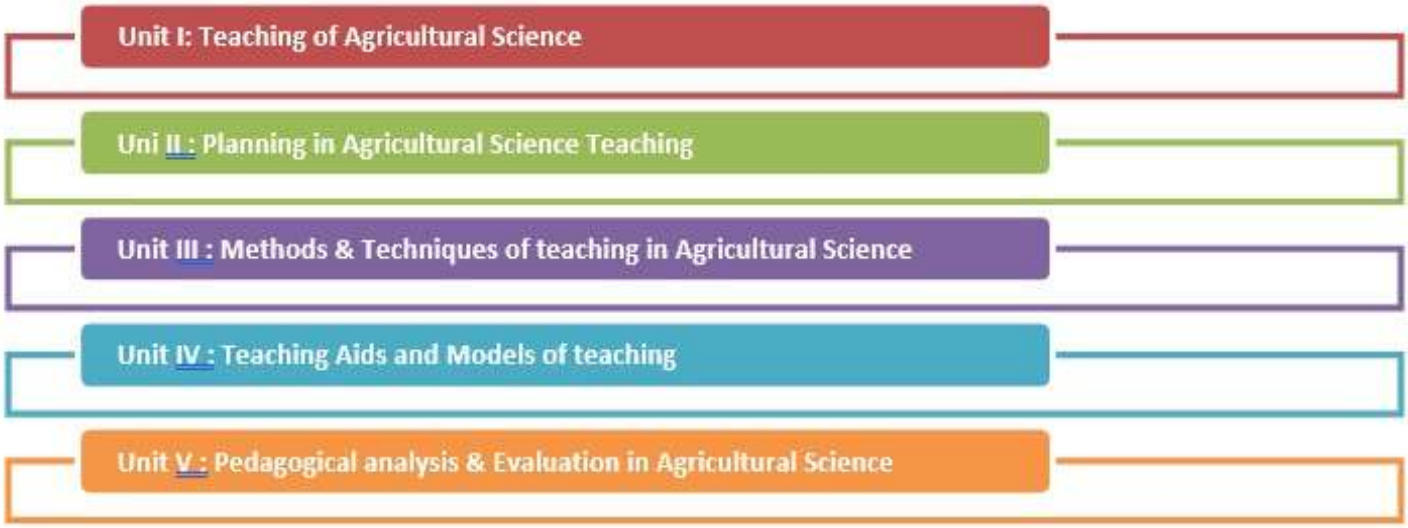
The educational objectives are broader, it gives a sense of the state of perfection that can be reached and possible. Conversely, teaching or learning objectives are narrow and specific. They are predetermined and are constructed in such a way that they can be easily achieved while completing the normal classroom teaching in a fixed time period of fixed duration. That is why it is called instructional purpose.



Blooms Texonomy



Course Content



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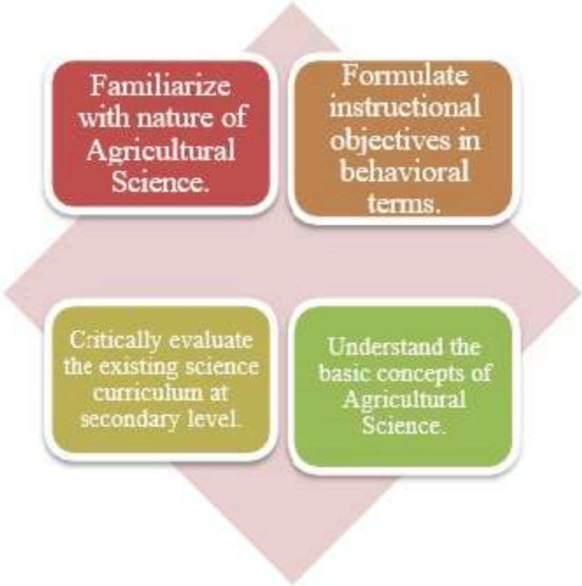
Objectives of the Course



Course Outcomes of Agriculture Science

After completion this course the student teacher will be able to:		
CO	**Statement**	**Bloom's Level**
CO1	Explain the nature, scope and objectives of teaching science at Secondary level.	L2
CO2	Develop competence in teaching different topics of Science effectively	L6
CO3	Compute the scientific temper & provide teaching in scientific method to their student	L3
CO4	Apply the various methods with appropriateness of content, level and classroom situations.	L3
CO5	Apply the instructional materials effectively in the teaching of Science.	L3
CO6	Organize the Co-curricular activities & practical work in Science.	L4

Conclusion

The data available in various types of educational surveys suggest that the achievement level of learning in the world-class level of children is not in line with the prescribed level, in which efforts have been made in this, in which teachers complete their syllabus based on the textbook but it It is not clear what kind of opportunities need to be given to the children in the subject matter, that is, what kind of content should be given to the child at the end of the year. It is defined as educative expectations. But all the educational system from the syllabus has been determined to achieve learning for the understanding of the last beneficiaries, such as the members of the foster school development committee, community people, teachers and children etc. It is considered as a market of perceived learning assessment of learning level of the assessment level. Learning to teach is a continuous process. Learning is seen in the pedagogical process of this process itself. Curriculum related expectations are given to the children of the whole country. The property of learning by keeping is accepted.

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Ohmic Accelerated Steam Distillation of Essential Oils

Article ID: 32170

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Essential oils are blends of low molecular weight (< 0.5 kDa) compounds and stored in plant's glands, trichomes, oil ducts, and resin ducts, and have been traditionally extracted by solvent extraction, hydro-distillation (HD), and steam distillation (SD) (5). Steam distillation is the preferred technique for commercial and large-scale extraction of essential oils from several aromatic plants.

The traditional extraction methods are more time consuming and energy intensive process (3) and the essential oil industry is seeking for alternative extraction techniques which can reduce the production time and cost. While several emerging techniques, such as ohmic-assisted hydrodistillation (OAHD), microwave-assisted hydro-distillation (MAHD), microwave-assisted steam distillation (MASD), and ultrasound assisted ohmic distillation, have been recently proposed, but none of them could take the place of large-scale steam distillation units due to their industrial limitations (1&4). Segregation of ohmic electrode and plant material might address the issues and develop a potential alternative to the conventional steam distillation process.

Ohmic Accelerated Steam Distillation (OASD) is a short time, energy efficient and volumetric heating technique, used to extract the essential oil from the aromatic plants. OASD isolated the essential oil from lavender inflorescences with similar physicochemical properties and yield to that of a conventional SD (2). Ohmic accelerated steam distillation addressed the drawbacks of the previously proposed ohmic-assisted hydro-distillation method including the possibility of electrochemical reactions between electrode and extraction medium, limited range of applied frequency, the necessity of using costly corrosion resistant electrodes (6).

Ohmic accelerated steam distillation is potentially applicable to SD which is the preferred industrial extraction technique for most of the essential oils. Prospective economic analysis, process optimization studies, and large-scale investigations can assess the applicability of OASD and result in its industrial adaptation.

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Plasma Sterilization

Article ID: 32171

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Plasma was named after an American physicist, Irving Langmuir. Plasma refers to a group of Positive ions and electrons with an electric charge created by an Electrical discharge, and plasma. Plasma is considered to be the fourth (4th) State of material and 99% of all the materials in space are Plasma. Plasma sterilization is known to have started in the year of 1968, when the use of a Pulsed RF (radio frequency) field to kill spores in time scales on the order of seconds rather than minutes. Electrical plasma, used in sterilization, can be classified into two Types broadly: volume and surface Plasma. Plasma is classified as volume plasma when it is generated by injecting a gas at a specific flow rate into a chamber fitted with electrodes and grounded sufficiently. When the circuit was closed, the gas inside the chamber would be subjected to an Electric field and hence ionized, Creating plasma. Surface plasma is usually when the electrodes (power and ground) are embedded into a dielectric and hence Plasma is generated on the surface of the dielectric itself.

Plasma sterilization has vast application in food industry such as: Cereals, Fruits and Vegetable, Dairy, Spices, Meat and Poultry Industry.

Advantages of Plasma Sterilization

1. Short Sterilization Cycle.
2. Low Temperature.
3. Low Humidity.
4. No Aeration Requirement.
5. No Toxic Chemical Residues.
6. No Environmental Impact.
7. Broad Compatibility with Materials.

Limitations

1. Increase in oxidation of lipids and decreases in firmness of fruits, etc
2. Increase in peroxide value of nuts at higher power and time of treatment (2).
3. Affects the colour properties of fruits.
4. Not possible to be used for inactivation of endogenous enzymes which are present intact in the whole fruits

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Strategy of Seed Production for Doubling Farmers Income - Success Story

Article ID: 32172

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Summary
Paddy is the important staple food for majority of the population in India. Seed production contributes to the economic empowerment of farmers and it was proved by young farmer of Gullapet village of Jagtial district. Paddy variety JGL-24423 was selected for seed production and it reaped good profits with net returns of Rs. 51522.64/A and benefit-cost ratio of 2.42.

Introduction
The seed is the fundamental constituent and difficult to urge input for cultivation. Seed is prime input for agriculture because it reflects production level and cost of cultivation. The usefulness of other inputs for increasing productivity and profitability of crops depend upon seed. Numerous farmers are running behind the varied government and non-government organizations every season in search of good quality seed.

However, in sight of huge gap between production and supply, some of the farmers are resorting to locally available poor-quality seed thus less productivity and income. Hence, adoption of seed production under the supervision of scientists through farmer participatory approach can improve farmers' income besides ensuring the availability of good quality seed. This article narrates how RARS, Jagtial helped the farmer to produce 65.44 q/ 2 acres of quality seed of JGL-24423 variety of paddy and doubled the farmer's income as compared to that of normal paddy cultivation.

In order to address the above issue, the scientists of Regional Agricultural Research Station (PJTSAU), Jagtial have been encouraging farmers to take up seed production in paddy varieties JGL-24423 released from Professor Jayashankar Telangana State Agricultural University (PJTSAU), Telangana state. One of the success stories has been narrated here under.

Sri Vinod, 26 years old Young farmer from Gullapet Village, Jagtial rural mandal of Jagtial district, Telangana State. He began to seed production of JGL-24423 variety with involvement of RARS Scientists and he reaped good profits as compared to normal paddy cultivation. The beneficiary farmer was extremely happy about the technical guidance provided from RARS, Jagtial, yield and returns obtained from paddy seed production.

Scientists Involvement
Following interventions were made by the scientists of RARS, Jagtial.
1. Pre-seasonal training programme organized on paddy seed production at RARS, Jagtial.
2. Good quality breeder seed of JGL-24423 from RARS, Jagtial was supplied to the beneficiary farmer on cost basis.
3. Isolation distance of 3.0 m was followed scrupulously.
4. Alleyways of 20 cm width at 2.0 m interval were for throughout 2.5 acres seed production field.
5. Rouging was done twice i.e., before flowering and after flowering in the presence of scientists to pull out of types and avoid contamination thus good quality seed.
6. Need based plant protection measures were taken up such as application of carbofuron granules 3G @ 25/ha and Plantamycine@ 0.2 ml/lit against stem borer and BLB, respectively. Though the incidence of pest and diseases was more in other rice growing belts, but, the same was very less in this seed production field due to

adoption of good agricultural practices (GAPs) and timely plant protection measures under the supervision of scientists of RARS, Jagtial since beginning.

7. Harvesting was done by mechanical paddy combiner to reduce harvesting/ threshing cost.

Table 1: Economics of Seed Production of JGL-24423 Paddy Variety

Sl. No.	Particulars	Rs. /A
A	**Variable costs**	
1	Value of seeds	1625
2	Seed treatment chemicals	130
3	Value of insecticides and pesticides	920
4	Value of weedicides	780
5	Value of manures	4200
6	Value of fertilizers	2700
7	Value of hired human labour	6000
8	Value of machine power (both hired and owned)	9600
9	Interest on working capital @12.5%	1622.19
	Sub total	**27577.2**
B	**Fixed cost**	
1	Land revenue	320
2	Rental value of owned land	7200
3	Depreciation (machinery and farm buildings)	1182.17
	Sub total	**8702.17**
C	**Total cost of cultivation (Rs. /A)**	**36279.35**
D	**Yield (q/A)**	**33.77**
E	**Market price (Rs/q)**	**2600**
F	**Gross returns (Rs. /A)**	**87802**
G	**Net returns (Rs. /A)**	**51522.64**
H	**Returns per rupee spent**	**2.42**

The total cost incurred for cost of cultivation of seed production was accounted to Rs. 36279.40/A and the yield was 33.77q/A. The market price was Rs. 2600/q as the farmer practiced all the seed production practices which resulted in best quality seed of paddy. Hence, the total gross returns were accounted to Rs. 87802.00/A. The net returns were accounted to Rs. 51522.64/A and returns per rupee spent was 2.42. This clearly indicates that farmer is benefitted with seed production of paddy variety JGL-24423 which may be encouraged to the farming community for doubling farmers income.

Conclusions

Seed production was beneficial to the farming community as the price of paddy was higher when compared to the normal paddy which was marketed at MSP (Minimum Support Price). Hence farmers are advised to practice seed production to increase the net returns.

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Post Flood Handling of Sugarcane Crop for Higher Productivity and Sugar Recovery

Article ID: 32173

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Introduction

Sugarcane (Saccharum spp. hybrid complex) is an important cash crop in India and sugar industry is one of the largest agro-based industries, next only to cotton textiles. It is cultivated in tropical and subtropical region of India. The productivity of sugarcane is lower in sub-tropical region as compared to tropical region. In Bihar, eastern Uttar Pradesh and West Bengal, lower cane productivity and sugar recovery is mainly governed by various biotic and abiotic stresses.

Among them waterlogging or excess moisture during grand growth period is one of them. If waterlogging occurs during July to September which is the grand growth period of crop, adverse effect is reported on growth, yield and quality of sugarcane (Kumar, 2009; Kumar et. al., 2013). The extent and severity of yield and quality deterioration depends upon variety, period of growth, depth and duration of waterlogging, aerial roots formation, soil condition etc.

Varieties are the most important factor that contributes to improve cane productivity. It is imperative to replace old varieties with newly recommended one. The realization of higher cane yield could be achieved with adoption of appropriate agro-technologies such as drainage, method of planting, irrigation and fertilization at appropriate crop stages.

Earlier studies showed positive response of sugarcane genotypes to planting method under waterlogged conditions (Kumar, 2018). In another studies, Kumar et. al., (2015) reported that water stagnation during grand growth phase (July- September) reduced plant height by 9.4%, cane diameter by 13.4%, millable canes by 13.8%, single cane weight by 15.7% over normal condition. Gilbert et. al., (2007) noticed 38% reduction in leaf weight and 4-15 times more adventitious root due to a continuous 3 months flood. Hasan et. al., (2003) reported lowest number of millable canes and cane yield under waterlogged condition. In this context, a brief description for post flood handling of sugarcane crop under waterlogged condition has been given in this paper.

Source of Excess Moisture / Water Logging

1. High rainfall.
2. Flood by river.
3. Deposition of rain water in low land from nearby uplands.
4. Excess irrigation.
5. High water table.
6. Hard pan/ crust formation below plough layer.
7. Lack of drainage facility.

Crop Management at the Time of Flooding

Waterlogging during grand growth stages of sugarcane in sub-tropical region adversely affects single cane weight and millable cane leading to the reduction in cane yield and quality.

Following practices should be adopted to reduce the losses from waterlogging:

1. Earthing up operation is also known as 'hilling up'. This practice is done in the second fortnight of June at maximum tillering stage. At this stage the remaining 25% dose of nitrogen along with carbofuron 3G (insecticide) @ 33 kg/ha are advisable. Earthing-up also helps in providing anchorage to plant and also provide sufficient drainage to excess water.

2. To prevent lodging of cane, propping should be done in the month of August-September by trash-twist method. In this method two adjacent rows of cane are brought together to form a sort of arch and the lowest leaves of cane were twisted in to the form of a rope.

3. Foliar application of urea @ 2% is advisable during waterlogging period. For which 20 kg urea should be dissolved in 1000 liter water and sprayed in one-hectare area.

4. If possible, drain the excess water from field.

5. Use insecticides and fungicides as and when required.

Table 1: Economics of Seed Production of JGL-24423 Paddy Variety

1. First of all, it is desirable to bring saturated soil to field capacity level as early as possible through drainage. The cheapest method of draining excess water is to dig to open channels deeper than the irrigation channels in the field to draw out excess water. These drains are closed at the time of irrigation.

2. Tying up and straight the lodged cane under moist condition. If possible, earthing up should be done.

3. Just after recedes of flood water, intensive care should be taken to destroy the red rot and wilt affected clumps.

4. Apply recommended insecticides for the region as waterlogged cane badly affected with many insects like white fly, top borer and stem borer etc.

5. Bud sprouting and emergence of aerial roots is the serious problem of waterlogging affected canes, care should be taken to harvest the water logging cane as early as possible to reduce sucrose inversion.

Conclusions

Waterlogging is a condition when either ponded water stands on the soil surface for a longer time or water table rises to an extent of the root zone. It causes changes in the soil physical, chemical and biological properties of soil. In waterlogged conditions structure of soil is destroyed as all pores are saturated with water. Under reduced condition, carbon dioxide is reduced to methane, nitrates to nitrites, ammonia to free nitrogen, sulphate to hydrogen sulphide, ferric to ferrous ion and trivalent manganese to divalent manganese. Thus nutrients present even in adequate amount, become largely unavailable to plants. Only management options may sustain productivity of these stress prone areas.

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Milk Production in Cattle in a Clean and Hygienic Way

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Introduction

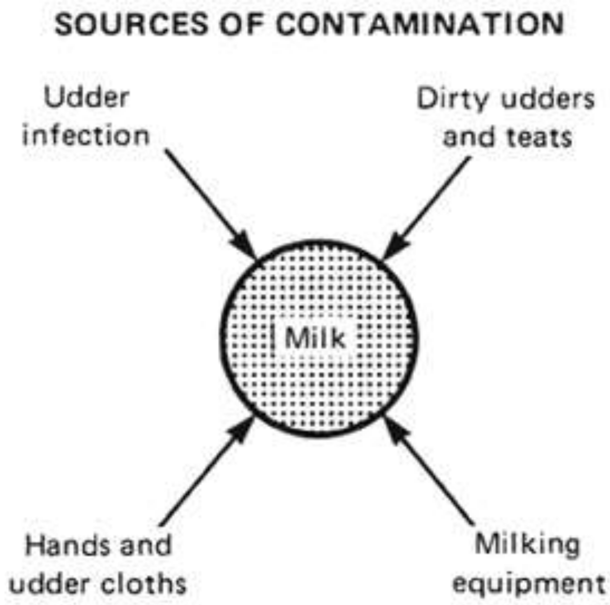
Milk is a whole, fresh, clean mammary gland secretion that is obtained from healthy milk animals after parturition complete milking of healthy milch animals excluding that obtained 15 days before or 5 days after calving and containing prescribed % of fat and SNF. Clean milk production is important as it is important for the health of young animals and also the consumers. Unclean milk has the chances of spread of diseases from animals to humans. Clean milk production improves the quality of milk.

What is Clean Milk?

Milk that is free from dust, dirt, bacteria and foreign particles is called as clean milk. When the milk gets contaminated with those foreign particles it is said to be contaminated milk. The raw milk not exceeding 2, 00,000 total plate count per ml of milk is graded as very good milk. Milk gets contaminated by different sources which includes the animal's body especially udder, external parasites, milking barns, milking equipment's, and milker.

How Milk Gets Contaminated?

The cow's body is an important source of milk contamination. The exterior of animal body contains flies, lice and ticks which get contaminated with milk during milking. Other contamination sources include milking equipment, milking man and place of milking.



What are the Essentials of Good Milking?

Milking is an art which requires experience and skill. Milking should be gently, quickly and completely. Cow in comfortable state produces milk than a roughly handled cow. The milking process should be completed with five to seven minutes.

Incomplete milking results in infection of udder leading to mastitis in cows. The following hygienic measures have to be followed for good milking.

1. Animal's hygiene.
2. Milker's hygiene.
3. Environmental hygiene.
4. Equipment hygiene.

Animal's Hygiene (Udder, Exterior of Cow's Body, Flies and Other Vermin)

Udder: Unsanitary conditions of milking barns and bedding of the animal causes bacterial growth. Such bacteria may enter into udder through teat canal, which causes infection of udder like mastitis resulting in contamination of milk. Hence, the animals to be milked should be washed before milking. The animal's udder should be washed with lukewarm water and disinfectant solution, cleaned and wiped with clean towel before milking. The fore milk may be discarded as it contains high bacterial count. Complete milking of the animal should be done. Incomplete milking may lead to udder infection.

Flies and other vermin: The animal's body should be free from external parasites like flies, lice and ticks to avoid their entry into the milk. They can be prevented by spraying the animal shed using insecticides. Breeding places for these parasites like stagnant water, moist atmosphere etc may be avoided.

Milker's Hygiene

Milker is directly responsible in producing good quality milk. So, the milk man should be clean and hygienic. Dirty hands and nails of milker may be source of contamination. The hands of milk man should be cleaned and dried. The nails of milk man should be trimmed which prevents scratching of the udder. Some bacterial diseases may be transmitted from milker to the consumer through milk.

Hence the persons suffering from diseases like tuberculosis, typhoid and diphtheria may not be employed for milking. Dirty habits like smoking and drinking should be avoided by the milker. Wet hand milking should be avoided to avoid high bacterial count in milk. The fore milk of the udder should be discarded to reduce high bacterial count. Complete milking of animal should be followed to prevent infection of udder.

Environmental Hygiene

Milking barns with good ventilation and neat flooring avoids contamination of milk from these sources. The milking parlour should be washed at least half an hour before milking. The milking barns should be good ventilated and should have neat flooring.

Dusty feeds like rice polish should not be fed to the animal before milking. The milking barns should be free from flies. The place where the animal is milked should be free from stagnant water. Flavour producing feeds should not be fed at the time of milking as the flavour will be absorbed in the milk.

Equipment Hygiene

Utensils are the containers or equipment's in which the milk is handled, processed, stored or transported. Clean sanitized, smooth copper free and dry utensils may be used for handling milk. The utensils in which the milk is collected, stored and transported should be cleaned and dried before milking.

The milking vessel should be round in shape. Heating of milk before milking improves the quality of milk. Milk should be closed with lid to prevent the entry of dust, dirt, hot or cold light, artificial light which in turn reduces the quality of milk. All the buckets, containers and utensils which are used for milking must be washed inside and outside before and after usage.

What should be Done After Milking?

1. The teats should be disinfected with potassium permanganate solution after milking which reduces the bacterial growth on the teats.

2. The animal should be prevented from lying down immediately after by giving feed or fodder to avoid teat contamination by sand or other foreign materials.

3. The towels that were used for cleaning and drying of the udder should be cleaned properly after each milking.

Conclusions

Clean milk production protects the health of calves. It also protects the health of consumers especially infants, growing children and aged people. The cleaner the milk, the longer it's keeping quality and flavour. Complete milking of animal with strict hygienic measures will reduce the chance of spread of diseases. Thus, complete milking of animal with strict hygienic measures lead to quality and clean milk production.

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Modified STR Dryer: A Low-Cost Drying Technology

Article ID: 32175

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Introduction

For small and marginal farmers, issues in grain drying have always been discussed at harvesting time. Constraints could be identified as (1) lack of compatible technologies;(2) lack of understanding of the mechanical drying process in both design and operation; and (3) lack of extension activities. In the other hands, we have to pay more attention to the current situation of smallholders in which field varies from 0.5 to1.0 hectare per farm, and almost farmers are poor so that they have not enough money to invest modern mechanical dryers. To meet the demand of these small-holders on post-harvest of production, studies on low cost dryers focused some key features as low capacity(one to two tons per batch), simple structure, easy fabrication, low cost investment, low energy consumption, short drying time and good quality of drying product. STR dryer is a low-cost batch dryer developed by Centre for Agricultural Energy and Machinery, Nong Lam University, Vietnam and Japan International Research Centre for Agricultural Sciences (JIRCAS).The design was based on the principle of low-temperature drying (a few degrees above ambient air), and aims to small-scale farmers cultivating less than 0.5 ha, but living in area with electricity available. The investment for this dryer was only 20,000 INR with the drying capacity of 0.5 ton in 8 hours. This dryer consists of two perforated concentric cylinders made of bamboo with grains inside the annular space. Air is passed from the inner cylinder through walls with bottom and top closed to dry the grains inside the annular space. An axial flow blower issued to suck the hot air from the stove (Chula) through steel pipe and force the air radially through perforated bins.

Fig 2: Pictorial view of modified STR dryer

The modified STR dryer improved the drying efficiency and ease in drying operation. Following modifications were made against the conventional STR dryer:

1. The two cylinders were made from metal sieves in order to ensure the durability of the dryer.
2. The dryers were constructed on an elevated platform using legs for easy discharge of grains.
3. An air shutters were provided at the outlet pipe of Chulha and above the inner cylinder in order to control the temperature of hot air by allowing the fresh air through the opened shutters.

4. The position of the motor was above the inlet of hot air in order to prevent it from getting heated by hot air from chulha.
5. The length of pipe conveying the hot air from chulha to dryer was reduced in order to prevent heat loss and material loss.
6. A high volumetric capacity centrifugal fan was installed to improve drying rate.

Performance of STR Dryer

The STR dryer was tested for wheat grain. It was observed that the grain close to inner cylinder had maximum moisture loss as compared to grain close to outer cylinder. It was clear from fig 4 that the initial moisture content of was 20.45 (% wb) and after drying the final moisture content (%wb) were10.19, 11.44 and 11.73 %for grains at three locations i.e. inner, middle and outer respectively. It was seen that moisture of 8.82 % (w.b.) was removed in 4 hours (Fig 4) i.e. around 2.21 % moisture content was removed per hour.

The STR dryer was also tested for maize grain. It was observed that the grain close to inner cylinder had maximum moisture loss as compared to grain close to outer cylinder. It is clear from fig 4 that the initial moisture content of was 22.45 (% wb) and after drying the final moisture content (%wb) was 10.93,10.89 and 10.84 % for grains at three locations i.e. inner, middle and outer respectively. It was seen that moisture of 10.03 % (w.b.) was removed in 4 hours (Fig 4) i.e. around 2.5 % moisture content was removed per hour.

How Milk Gets Contaminated?

The cow's body is an important source of milk contamination. The exterior of animal body contains flies, lice and ticks which get contaminated with milk during milking. Other contamination sources include milking equipment, milking man and place of milking.

Table 1. Dryer dimensions:

	Items	Specification
I	**Blower**	
	Diameter, cm	40.0± 0.10
	Height, cm	21.0 ± 0.10
	Motor size, HP	1.0
	Operating voltage, V	220-240
	Frequency, Hz	50
	RPM	2800
	Fan sweep, cm	12
II	**Inner bin**	
	Material	Wire mesh, stainless steel
	Diameter, cm	40
	Length, cm	100
III	**Outer bin**	
	Material	Wire mesh, stainless steel
	Diameter, cm	102± 0.10
	Length, cm	100
IV	**Stove (Chula)**	
	Diameter, cm	40
	Length, cm	37
	Placement of the iron rods for holding fuels, cm	20
	Opening for air flow at the bottom H×W, cm	8 × 11
	Stand height for chulha, cm	62.50
V	**Conveyance pipe**	

	Total length of pipe for hot air movement from chulha to Dryer, cm	217.50
	Diameter of conveyance pipe, cm	7.5
VI	**Metal Funnel at Chulha**	
	Height, cm	25.00
	Diameter, cm	46.00
VII	**Metal Funnel at Dryer**	
	Height, cm	25.00
	Diameter, cm	43.00
	Batch capacity (maximum), kg	500

Conclusion

Modified STR dryer offered good drying performance with drying rate of around 2.5 % per hour Investment cost was very less, can be operated on farm/biomass wastes and can be recommended for adoption by small and marginal farmers at times when rapid or fast drying is required or when the sun drying becomes ineffective.

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Black Soldier Fly: A Step Towards Animal Food Security

Article ID: 32177

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Introduction

With numerous aspects of utilizing insect predators for biological control of different pest species in agro-ecological systems (Cock et al., 2016 and Van Lenteren et al., 2018), the domain of applied entomology is flourishing its considerable influence on using insects for developing biologically exhilarated technologies in modern times (Gorb, 2011and Lenau et al., 2018), as an alternative protein source of animal feed and for recycling biowaste as renewable energy resource for future sustainability. The black soldier fly, *Hermetia illucens* (Diptera: Stratiomyidae) is one of the most efficacious options for bioconversion (Surendra et al., 2016). The larvae have a very ravenous hunger and can devour a wider array of natural wastes, including nourishment waste (Salomone et al., 2017), metropolitan natural waste (Kalova and Borkovcova, 2013), crop straw (Manurung et al., 2016) and creature excrement also. The larvae have acquired broad consideration because of having significant levels of lipids and proteins and likewise can be utilized as feed for poultry and fish, for biodiesel creation and antibacterial peptides. Therefore, research associated with the black soldier fly is getting multiplication in an exceedingly spurt manner. Nevertheless, majority of the explorations on bioconversion of organic wastes from *H. illucens* rely upon food wastes and manures. Their feed conversion ratios are known to be superior to both crickets and mealworms, and, compared to those two, BSFL survival rate and nitrogen and phosphorus compositions do not vary as highly with diet (Oonincx et al., 2015). All these benefits make BSFL practical to rear and a suitable tool to valorise wastes, plus possibly a sustainable animal feed or human food source.

Black Soldier Fly as Livestock Feed

Black soldier fly larval (BSFL) meal and oil are previously premeditated to have higher concentration of protein along with high lipid content even when they are fed plant-oriented waste streams. Hence, its inclusion as an animal grade substitute for fulfilling the requirement to feed carnivorous fish is commendable (Kroeckel et al., 2012). Fish meal and oil hold an influential position in aquaculture but the contention with the requirement of fish for the purpose of human consumption and the status of impoverished fishery section have fetched the contribution of fish meal and oil down in addition with the rising costs which have ultimately led to the exploration of different alternatives like vegetable oils (Li et al., 2016). BSFLs can agglomerate a considerable amount of lipid in their bodies when they are completely surviving upon an accurate lipid enriched diet and are usually more palatable to the fish than vegetable oils. The pre-pupae having an augmented status of Omega-3 fatty-acid are produced while the larval diet is supplemented with fish debris (St-Hilaire et al., 2007). These certain types of enriched pre-pupae are convenient to be used as fish foods which do not generate any substantial variability in fish growth and vision development when comparable with the normal fish meal for feeding the rainbow trout, *Oncorhynchus mykiss*. Sensory interpretation of trout fillets could not observe discrepancy among fish meal, BSFL, or high quality BSFL diets. From an experiment it was opined that rainbow trout approved defatted BSFL supplementation up to 40% in diet deprived of any deleterious impact on physiology of fishes or fillet physical quality but observed a decline in appreciable polyunsaturated fats (Sealey *et al*., 2011). Another trial indicated that juvenile Jian carp (*Cyprinus carpio* var. Jian) did not recognise any type of conflict between the effect of BSFL and soybean oil on growth performance except the descending carp lipid accumulation as the proportion of BSFL oil in diet has taken an increment (Li et al., 2016). Regarding the condition of turbot, *Psetta maxima*, the utilization of BSFL was nevertheless favoured as an attainable and fragmentary alternative of fish meal due to its behaviour of being reared upon local greenhouse wastes, notwithstanding BSFL meals had comparatively lesser palatability and nutritious value (Kroeckel *et al*., 2012). An experiment conducted with African catfish, *Clarias gariepinus* noticed that the entire BSFL supplementation of fish meal in diets in which it contained merely 25% had not contributed any significant effect on growth rate as well as nutrient utilization indices; therefore, BSFL were considered as an alternative because of their negligible cost (Aniebo *et al*., 2009). Eventually the capability of BSFL for effective production of protein embellished edible biomass from protein deficient organic wastes has compelled many researchers to terminate their decision with the acceptance that BSFL can bestow to sustainable development of aquaculture section consciously as a proportional or complete meal substitute, involving aquatic invertebrates like shrimp. BSFL has additionally been utilized in poultry feed as a partial substitute for maize or soy fed primarily because the species naturally colonises and breaks down poultry manure and poultry farms also retain it for waste management and pollution reduction purposes. In experiments with broiler quails, *Coturnix coturnix japonica*, no difference was found between control and two proportions of BSFL meal on productive performance, breast meat weight, and yield (Cuelure *et al*., 2016). BSFL supplementation had no impact on sensory aspects of breast meat and taste perceptions, oxidative status or cholesterol composition; and increased the meat's amino acid to boost nutritional value (Cuelure *et al*., 2017). Similar effects in the diet of broiler chickens, *Gallus gallus domesticus* were observed with BSFL supplementation, with the not that using defatted BSFL minimized the negative impact on fatty acid profiles. BSFL supplementation (50 percent) or complete replacement of soybean cake in laying hens' diets did not affect the health or efficiency of hens and had little to no effect on the eggs themselves (Maurer *et* al., 2016). BSFL are also highly palatable to poultry, with laying hens reported to seek out BSFL from feeders rather than continue to eat as libidum provisioned wheat–soy feeds (Ruhnke *et al*., 2017).

Conclusion

Therefore, Black Soldier Fly Larva is a possible partial replacement for poultry feed, providing additional protein with the bonus that BSFL can be reared on the manure of the same organism that eat it, valuing and recycling the waste at the same time. The prospects that BSFL holds for animal food security can be harnessed to the maximum extent if following recommendation can be adopted.

Recommendations

1. In order for insect meals to be a major part of the animal diets provided by the feed industry, these must be produced and stored in vast quantities and ideally be available year-round. There is a need to set up cost-effective, well-optimized mass insect rearing facilities using well-established substrates, delivering a defined range of insects or insect meals.

2. Consideration must be given to developing sanitation protocols for the safe use of bio-wastes and the management of pathogens, heavy metals and pesticides in order to obtain safe insect meals for use as feed.

3. The impact of feeding insect meals on the safety and quality of products from the point of view of human health and research on the human acceptance of animal products obtained from feeding insect meals should be carried out.

4. In order to make informed decisions on the environmental impact on using insects or insect meals vis-à - vis other traditional feed supplies, sound data must be produced on the feed conversion efficiency of different insects and the use of water and substrates per unit of insect biomass and production of insect protein.

Future Prospects

1. Future examination should zero in on the reasonableness of a variety of waste streams that adequately uphold the development of the fly hatchlings while not rivalling other use.

2. Smallholder farmers may be less reliant on feed millers that provide feed for fly larvae for on-farm and local use centred on costly and unsustainable soybean meal or fishmeal. In order for smallholder farmers to be able to interact effectively with the value chain of agribusiness and to supply fly larvae to national feed millers, it is important that they can supply enough amount. Farmers probably ought to unite in cooperatives to do so. Not only can this increase the level of supply, but it will also motivate them throughout the value chain. The novel production of insects by smallholder farmers as a feed ingredient is associated with different SDGs: smallholder farmers may benefit from the new markets while producing meaningful earnings and growing economic stability in societies with low incomes.

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Savouriness of Aromatic Rice

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Summary of Article

Aroma in rice is a natural gift to the human which gives a special preference to rice among the entire food crop. Basically, two rice namely Basmati and Jasmine rice dominates the local and World trade for its aroma, taste and cooking quality. Accumulation of 2-acetyl-1-pyrroline (2AP) provides natural aroma to rice. Due to continuous consumer's demand all over the World, the cultivation of scented rice is increasing day by day which gives a fair income to the farmers.

Introduction

"Rice is life" and is one of the most essential, important, food and energy cereal crop and staple food, feeding more than half of the world's population (Wakte et.al., 2017). China, India, Indonesia, Bangladesh, Viet Nam, Myanmar and Thailand are the largest rice producing countries located in Asia, Thailand and Vietnam are two highest rice exporting country of the world. With advancement of agriculture and green revolution, we are now able to eradicate hunger and self-sufficient in food production. Apart from yield now more emphasis is given to increase the quality of rice, in term of nutrition, cooking quality, taste and aroma. Taste and aroma are two important factors, human needs in their diet for his fully satisfaction. So aromatic rice is now having highest demand in society where money is not a problem for consumption and it will be good source of earning for the farmers those who want to produce in large scale for commercial basis.

Premium quality aromatic rice has a great demand in the countries like South Asia, the Middle East, and particularly India, Pakistan, and Thailand which fetches high price also. U.S., Hong Kong, China, Singapore and Côte d'Ivoire are the major Thai jasmine importing countries and Saudi Arabia, United Arab Emirates (UAE) and Iran are the major Indian Basmati rice importing countries of the world. Now the export of basmati rice dramatically increased to the countries like Iran, Kuwait, Yemen Republic, Iraq, Jordan, and Netherland.

Origin, Diversity, Classification and Distribution of Aromatic Rice

First time term Sali and sugandha is used for rice during Budhist period (600 BC to 700 BC). Scholars like Charaka and Susrutra identified Mahasali, sugandhika, Promodaka, Pundrika and Pushpandaka as scented (Vidyalankar, 1994).

Scented Rice of World

Sl. No.	Country	Variety
1	Afghanistan	Barah, Lawangin
2	Bangladesh	Chinigura, Radhuni pagal, Sakkokhora, Kataribhog, Radhuni Pagal
3	Cambodia	Somali
4	China	Xiang keng 3, Xiang nuo 4, Zhao xing 17
5	India	Type 3, Basmati 370, Pusa basmati 1, CSR30, Tilak Chandan, Sonachur
6	Indonesia	Mentek wangi, Rojolele, Sukanandi
7	Iran	Dom siah, Gerdeh, Hassani, Mehr, Mirza, Sadri, Salari, Anbar-boo
8	Iraq	Anbarboo
9	Japan	Miyakaori, Iwaga, Sari queen, Kouikuka 37
10	Myanmar	Balugyun, boke hmwe, Nama tha lay, Pawsan Hmwe, Taungpyan Hmawe
11	Nepal	Brahmphool, Jetho budho, Rato

12	Philippines	Azucena, Milagrosa, Milifore
13	Thailand	RD 15, RD6, Som hong, Jao mali, Nahng nuan, Khao Dawk Mali
14	Vietnam	Di Huong, Nang huong ran, Nang thom cho dao, Tam Canh, Nep Bac

Scented Rice of India

Sl. No.	State	Varieties
1	Assam	Ranga Jaha I, Joha, Bongali, Bhabeli, Kanjoha, Kanku, Khorika, Kala
2	Bihar	Basmati 3, Katarani, Kari Bank, Sagarbhog, Hansraj, BR9, BR10
	CG	Badshabhog, Dubraj, Gangaprasad, Kapursar, Samodchini
3	Gujarat	Pankhali, Kamod, Krishnakamod, Kohlapur scented, Zeersal
4	Haryana	Basmati 370, Karnal Local
5	Himachal	Mushkan, Ramjawain, Baldhar Basmati, Madhumalti
6	Karnataka	Ambemohar, Ganddsali, Gulvadi, Kusum Kesari, Kalabatta
7	Kerala	Gandhaksala, Jeerakasala, Velumbala, Chomala, Kayama
8	MP	Amarjyoti, Adamchini, Chhatri, Chinoor, Chakarbhatta, Ganju, Laloo
9	MH	Ambemohar, Krishna Sal, Banaspatri, Gham, Ghanasal
10	Manipur	Chakaoangouba, chakao amubi, Phoren mubi
11	Mizoram	Tai, Pharate, Zongam
12	Odisha	Thakurbhog, Prabhatjeera, Nalidhan, Manasi, Jhingasali, Sitakesari, Barangamali, Jhilipanjiri,Lekhtimahi, Kalajeera, Durgabhog, Pimpdibasa
13	Punjab	Basmati 370, Quadian Basmati
14	Rajasthan	Danger, Sutar, Pathania, Ratipanne, Zed Zeera
15	Tami Nadu	Jeerakasambha
16	Tripura	Govindbhog, Sada Khaja, Kalakhau, Kalijira
17	UP	Kalanamak, Bindli, Batanphul, Benibhog, Dhania, Dulhania, Hansraj, Jeerabati, Kamalijira, Lalmati, Laungchoor, Phool Chameli, Shakarchini, Sonachur
18	WB	Radhunipagla, Badshabhog, Kataribhog, Seetabhog, Gandheswari, Chinisakar,

On the basis of allelic combinations at 14 isozyme loci (Glaszmann,1987) with 4 additional loci: Acp-2, Pox-3, Pgd-1 and Enp-1 rice is classified into six group, group I represents indica and group VI represents as japonica are aromatic while most of cultivars belongs to group V are aromatic. Major scented rice is in group I, V, and VI. Jasmine rice belongs to group I whereas Basmati rice belongs to group V. Most of landraces aromatic rice is native to Asia.

Genetics of Aromatic Rice

Rice that possesses scent in plant parts, grains and emits fragrance in the fields and during milling and retains scent on storage and cooking is called aromatic rice. Single recessive gene (fgr) found in chromosome 8 and a number of QTLs identified in the chromosome 3, 4, 5, 8 and 12. Recently 3 QTLs on chromosome 5 and 2 QTLs on chromosome 8 are responsible for grain fragrance. *OsBadh1*, *OsBadh2, OsGly* and *OsP5CS* are major gens which are responsible for rice fragrance. Aroma of rice is controlled by a major gene *osBadh2* (betaine aldehyde dehydrogenase 1) (also recognized as *fgr / badh2 / os2AP / osbadh2*, *LOC_Os08g0424500*) present in chromosome 8, which is a muted form expressed only at homozygous recessive condition. Insertions/deletions of *OsBadh2causing* single nucleotide polymorphisms which lead to accumulation of 2-acetyl-1-pyrroline (2AP) responsible for aroma in rice. Aro4-1 located in chromosome 4 and Aro3-1 located in chromosome 3, also related to rice aroma. *OsGlyI* gene located in chromosome 5 related to rice aroma. All the genes responsible for aromahave not been fully isolated. Two P5CS genes like [*OsP5CS1* (*LOC_Os05g38150*)and *OsP5CS2* (*LOC_Os01g62900*)] and their higher expression increases proline content, P5CS activity and 2AP level in transgenic aromatic rice. Aroma quality of rice is highly affected by the cultivation process along with the environmental factors like temperature, soil type, abiotic stress, water, CO2,light, salinity and shading.

Biochemical Bases

More than 100 compounds like alkanals, alk-2-enals, alka-2,4-dienals, 2-pentylfuran, 2-phenylethanol, 2-amino-acetophenone and 3-hydroxy-4, 5-dimethyl-2(5H)-furanone are responsible for the aroma of the rice. Out 100 volatile compound 2-acetyl pyrroline (2-AP) major one which has special tendency provides fragrance to rice. 2-AP composed of two components that methyl ketone group and pyrroline group. Among the two components methyl ketone group is reactive and pyrroline group is nonreactive. Mutation of badh2 (betaine aldehyde dehydrogenase homologue 2; a gene with 15 exons) by deletion of 8 bases and 3 three single nucleotide polymorphisms (SNPs) in exon 7, and 7 base pair deletion in exon2 is responsible for the fragrance in rice but the normal badh2 is responsible for non-aroma in rice. Loss in the function of the betaine aldehyde dehydrogenase enzyme leads to the accumulation of the 2-AP leads to the fragrance in rice with L-proline as precursor molecule. Y-amino butyraldehyde (GABald) is an effective substrate for badh2, and its accumulation and spontaneous cyclization to form Δ1 -pyrroline due to a non-functional badh2 enzyme is responsible for 2-AP accumulation in rice. Basmati rice from India and Jasmine rice from Thailand are the two highly aromatic rice of the world which is cultivated in commercial basis and farmers earn higher profit.

Basmati Rice

It is grown in the Indo-Gangetic Plains and has a higher length of grain after cooking; the cooked grains have distinctive aroma and unique flavour. Pusa Basmati 1121 and Pusa Basmati 1 are two variety which grown abundantly in India and varieties includes Basmati 217, Basmati 370, Taroari Basmati (HBC-19, Karnal local), Basmati 386, and Ranbir Basmati and the evolved group, Punjab Basmati 2, Punjab Basmati 3, Pusa Basmati 1, Kasturi, Haryana Basmati 3, Yamini, Pusa Basmati 1121, improved Pusa Basmati 1, Pusa Basmati 6, and Pusa Basmati 1509 and Pusa RH 10 is the world's first basmati hybrid.

Jasmine Rice

It is one of the best qualities of aromatic rice exclusively grown in Thailand, and grown in Thung Kula Ronghai Plain which is also known as Thai Hom Mali Rice. Khao Dawk Mali 105 (KDML105) and RD15 are the two certified jasmine rice variety.

Conclusion

Almost all the scented rice is native to Asia, Thailand, India, and Pakistan but recent study revealed that Myanmar aromatic Pearl Paw San rice won the World's Best Tasting Rice over Thailand's Jasmine rice, and Hom Mali rice from China came in fourth. So, it very clear other countries are also in the favour of aromatic rice development. Cultivation, commercialization and export of this aromatic will lead to higher income due to high consumer demand.

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Stevia: A Highly Remunerative Crop and a Boon for Diabetic People

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Stevia (*Stevia rebaudiana*) is an incredibly sweet perennial herb, commonly known as the sweet leaf, sugar leaf, *Mitha pat*, honey leaf *etc*. Stevia sweetening power is mainly due to the presence of two substances in stevia leaves; Stevioside (about 10 % to 20 % of dry matter) and Rebaudioside (about 1% to 3 % of dry matter). The essence of the *Stevia rebaudioside* is around 300 to 400 times sweeter than the sucrose. Notably, stevioside may remain stable at the temperature of 100ºC. This fact is the significant benefit of stevioside over various other sweeteners. Because of these ingredients, the research on this plant also stated as the safe sweetener in the world. Stevia leaves are 30 times sweeter as compared to the normal sugar and sweetness of stevia leaves can be sensed over a long time.

Climatic Requirement

Stevia is a perennial herbaceous plant native to between 22° - 24° South and 53° - 56° west in Paraguay and Brazil (Jain et al. 2009; Sivaram et al. 2003). It is a semi-humid subtropical plant that shows higher leaf production under high light intensity and warm temperature. Day length is more critical than light intensity for stevia plant. Vegetative growth is reduced when temperatures are below 20°C and less than 12 hours day length. Increasing day length to 16 hours and increasing light intensity can increase vegetative growth and stevioside levels (Metivier and Viana, 1979; Yermakov and Kochetov, 1996). Short days also trigger blossoming. Stevia prefers partial shade during considerable summer sunshine (Mengesha et al. 2014; Singh et al. 2014). And Plants grown at higher latitudes actually have a higher percentage of sweet glycosides. Temperature in the range of 24°-35 °C with appropriate soil moisture is required during first two weeks to obtain plantlets from stem cuttings. 20°-35°C temperature is required for proliferation of shoots from cuttings after field transfer. High temperature and water stress are unfavourable for its growth (Singh et al. 2014).

Soil

Stevia grows well in well-drained fertile sandy loam or loamy soil, rich in organic matter having pH range of 6-7. It is naturally growing in low lying areas on poor sandy acidic soils adjacent to swamps, and so is adapted to and requires constantly wet feet or shallow water tables (Antonie, 2000; Oddone, 1999).

Propagation

Stevia can be propagated by seeds, suckers, vegetative cuttings and tissue culture. Vegetative cutting is the best way for multiplication due to low seed germination capacity of stevia (Randi, 1980) .Vegetative propagation and tissue culture provides uniform quality but the cost of planting material is high. Initial growth from cuttings is extremely slow and requires good nursery hygiene to prevent disease infection. Top cuttings of the main shoot with 4 internodes, 15cm long are best as planting material (Tirtoboma, 1988; Chalapathi et al. 2001). The lower leaves are clipped and the cuttings are planted under partial shade and high humidity condition for fast root development. Media containing vermicompost, soil, FYM (1:1:1) is found to be best for cuttings with highest survival percentage (Singh and Verma, 2015).

Planting Method

Stevia are planted in raised beds and are considered to be the most economical way to grow stevia. The raised bed should be of 15 cm in height with row to row distance of 40-60 cm and plant to plant of 20-25 cm accommodating 70,000-100,000 plants per hectare.

Irrigation

Stevia is highly sensitive to water stress and requires frequent light irrigation as it cannot grow in dry conditions. It requires a consistent supply of moisture. Mulching can be done to conserve moisture and reduce high temperature effect. Proper drainage should be provided as it cannot with stand waterlogged condition.

Harvesting

The first harvest of the crop can be done four months after planting depending on land type, variety and growing season and subsequent harvesting can be done after every 3-4 months a year. It is harvested just prior to flowering to get maximum steviol glycoside content in the leaves (Sumida, 1980). On average, three commercial harvests can be obtained in a year. As it is a perennial herb it remains in the field up-to five years. After that, the percentage of stevio side level in leaves tend to decline. But there are reports of stevia plant as old as 11 years.

Drying

Immediately after harvest the herb is dried to eliminate moisture. Drying can be accomplished on a glass sheet, net or under clean surface or by using simple drying racks inside transparent polyhouse or transparent glass roofing or by-passing dry air just above room temperature. The freshly harvested plants can also be made into bunches, hung upside down and dried in a shade. In case of large-scale production drying can be done by using drying wagon, a kiln or done naturally. Depending on weather conditions and density of loading, it generally takes 24 to 48 hours to dry stevia at 40 to 500C. The drying process does not require excessive heat but good air circulation. Longer drying time will lower the stevioside content of the final product and high temperature negatively affects the final quality of the product, diminishing their medicinal properties and their commercial value (Cuervo et al. 2012). Of the dried leaves, around 10% stevioside can be extracted. After adequate drying, the leaves are stripped of the stems / twigs, packed and stored in a cool and dry place.

Economic Yield

The yield of dry leaves can vary from 15 to 35 g per plant. According to the different reports, an estimated 2.0-2.5 tonnes/ha of fresh biomass can be obtaining from two harvest which increase to 4.0-4.5 tonnes/ha in subsequent years. On an average stevia yield 3.0-3.5 tonnes/ha of dry leaves in a year which fetches market price of about Rs. 100 to Rs. 120/kg resulting in net return of around 2.0-2.7 lakhs/ha in a year.

Conclusion

India is the largest consumer of cane sugar and has largest diabetic population of 77 million next to China in the world. By the year 2045, it is predicted that India will have around 134 million people with diabetes. Moreover, the unique selling points of stevia sweetener are very strong due to the prevalence of diabetes and other metabolic diseases including obesity. Stevia is becoming a major source of natural sweetener as an alternate of sugar and is rapidly replacing the chemical sweetener like Sucralose, Saccharine and Aspartame. Also, the present scenario is that people are more incline to products with natural and low calorie. So, it has more chance of getting a great demand in the local and international market than other crop farming and gardening farming.

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Application of Remote Sensing in Modern Agriculture

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Agriculture is the backbone of Indian economy and the allied sector for ensuring food security. Timely availability of information on agriculture is vital for taking informed decisions on food security issues. India is one of the few countries in the world that uses space technology and land-based observations for generating regular updates on crop production statistics and providing inputs to achieve sustainable agriculture. Satellite-based optical and radar imagery are used widely in monitoring agriculture. Radar imagery are especially used during monsoon season. Integrated use of geospatial tools with crop models and in-situ observation network enables timely crop production forecasts and drought assessment & monitoring. In India, agriculture plays a vital role in the Indian economy.

Introduction

Remote sensing can provide data that help identify and monitor crops. Remote sensing techniques are widely used in agriculture sector. The emerging concept of remote sensing may provide a framework to systematically consider these issues of smart farming technology and to embed high-tech agriculture better. Remote sensing can significantly contribute to providing an accurate picture of the agricultural sector, as it is very suitable for gathering information over large areas with high revisit frequency. Application of remote sensing specially in agriculture including soil surveying, development of land evaluation methods, most Earth Science disciplines, soil resources mapping, unique identification, technical parameters, 2D/3D view, identification of problematic soil and any other requirement customized. These advances have been made over recent years and foundations for future research established and can be efficiently used in agriculture for better results.

Remote Sensing

Remote sensing is the science of obtaining information about an object or area through the analysis of measurement made at distance from the object or without making physical contact with the object.

Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines (for example, ecology, hydrology, oceanography, geology, etc.); it also has military, intelligence, commercial, economic, planning, and humanitarian applications.

The term "remote sensing" generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on electromagnetic radiation which is normally used as information carrier in remote sensing. It may be split into "active" remote sensing (i.e., when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor) and "passive" remote sensing (i.e., when the reflection of sunlight is detected by the sensor). The output of image usually an image representing the scene being observed.

Remote Sensing in Agriculture

A recent report by the FAO projects that an increase in world population to 9.15 billion by 2050, which may need the current food production to increase by 60%. Many efforts are underway to increase overall production to feed the burgeoning population by increasing efficiency in production such as high intensity agriculture, efficient water use, and high yield varieties. The use of remote sensing is indispensable in monitoring of agricultural field, crop & soil health, water management and its quality, and atmospheric conditions with emphasis to yield. During the last two decades, remote sensing techniques are applied to explore agricultural applications such as crop discrimination, crop acreage estimation, crop condition assessment, soil moisture estimation, yield estimation, precision agriculture, soil survey, agriculture water management, agro meteorological and agro advisories. Some important application of remote sensing in agriculture are-

1. Precision Agriculture: Precision agriculture is a collection of agricultural practices that focus on specific areas of the field at a particular moment in time. Precision agriculture is defined as a set of technologies that combines acquisition, analysis, management, and delivery of information to help make site-specific decisions, with the ultimate goal of optimizing production will play an important role in addressing this grand challenge. At the heart of the evolving tools, technologies, and information management strategies found in precision agriculture is remote sensing. However, the technology of capturing, analysing, storing, and delivering the remotely sensed observations associated with precision agriculture is changing rapidly, thus making it difficult to keep up with the ever-expanding volume of scientific research. It is time to take stock of the current state-of-the-art in the remote sensing associated with precision agriculture.

2. Soil Mapping: Soil maps are another type of maps and it is one of the most common yet most important uses of remote sensing. It is developed with using remote sensing data. These maps can be compiled on the basis of airborne or satellite images acquired when the degree of soil coverage by plants is less than 35-50%. Through soil mapping, farmers are able to tell which soils are ideal for which crops and which soil require irrigation and which ones do not. Remote sensing is a good method for mapping and prediction of soil degradation and identification of problematic soil such as waterlogged soil, acid soil, alkali soil, etc. This information helps in precision agriculture. Soil maps present homogeneous soil zones with similar properties and conditions for plant growth.

3. Crop Identification: Remote sensing has played an important role in crop identification of a particular crop, its growth cycle (germination, growth, pollination, senescence) especially in cases where the crop under observation shows some mysterious characteristics. In addition, we need to know in advance, how the crops reflect the near-infrared at each of their various growth stages. The crop data collected will be taken for analysis and this information serves to predict grain crop yield, facilitating crop rotation records, mapping soil productivity, collecting crop production statistics, identification of factors influencing crop stress, assessment of crop damage.

4. Water Resources Mapping: Remote sensing is instrumental in the mapping of water resources that can be used for agriculture over a given farmland. Through remote sensing, farmers can tell where water resources are available for use over a given land and whether the resources are adequate.

5. Identifying Stressed Plants: With the help of remote sensing we can directly estimate how much chlorophyll there is in a plant. Chlorophyll is an essential part of the process of photosynthesis. By combining more than one bands of the recorded remote sensing data, we can create vegetation indices and use them to estimate crop status. Depending on the visible and near-infrared reflectance, the produced vegetation indices give us an indication on the amount of chlorophyll present in n the plants. With this information we can estimate if and how much stress the plants are under.

6. Land Cover Mapping: Remote sensing data are used for detection of land cover change. It is necessary for updating land cover maps and the management of natural resources. Land cover corresponds to the physical condition of the ground surface, for example, forest, grassland, concrete pavement etc., while land use reflects human activities such as the use of the land, for example, industrial zones, residential zones, agricultural fields etc Initially the land cover classification system should be established, which is usually defined as levels and classes.

7. Detection, Diagnosis and Control of Plant Diseases: Remote sensing assist in protecting the plants from potential attacks of pests, fungi or bacteria. Remote sensing technology plays a significant role in identification of pests in farmland and gives data on the right pests control mechanism. it is possible to have early warning and prevent a pest or a disease from affecting the crops, by taking appropriate action at an early stage.

8. Monitoring of Droughts: Drought monitoring is an essential component of drought risk management. Remote sensing technology is used to monitor the several key variables related to drought that include land surface temperature, evapotranspiration, soil moisture, and precipitation of a given area. The technology also monitors drought patterns of the area too. Remote sensing-based drought indices that could help in identifying, classifying, and communicating drought conditions

9. Forecasting of crop Production and yield estimation: Remote sensing is used to forecast the expected yield and crop production over a given area and determine how much of the crop will be harvested under specific conditions. Information on expected yield is very important for government agencies, commodity traders and producers in planning harvest, storage, transportation and marketing activities. Researchers can be able to predict the production of crop, which helps in lower the economic risk, translating into greater efficiency and increased return on investments.

Conclusion

The decision makers can visualize all the farmlands with their allied information and current situation on one click. Remote sensing as a device will provide information frequently and at an inexpensive value to permit, in the appropriate time, interference for recovery of crop state. The tasks like yield estimation & crop damage assessment done by traditional means take month or two and a whole lot of manpower to complete the work. By using these technologies, the same task can be completed within half or even in lesser time frame with minimum number of resources and high accuracy. Remotely sensed information can help with identifying yield gaps and monitoring related agricultural practices. Balancing the inputs and outputs on a crop farm is essential to its success and cost-effectiveness. The ability of Remote sensing to study and envisage agricultural environments and workflows has proved to be favourable to those involved in the farming industry.

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Hydroponics: A New Era for Farming

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What is Hydroponics?

Hydroponics is a Greek term, made from two words - Hydro means water and Ponos means labour and hence "working water" is its raw meaning. To put simply, Hydroponics is the method of growing plants without soils. Plants are grown in a soilless medium and come into contact with the nutrients in the water for their growth.

Soil is not Medium for Growing a Plant then what is "Growing Medium"?

Growing medium is the material in which the roots of the plant are growing. This covers a vast variety of substances which include rockwool, perlite, vermiculite, coconut fibre, gravel, sand and many more. The growing medium is an inert substance that doesn't supply any nutrition to the plants. All the nutrition comes from the nutrient solution (water and fertilizer combined).

You can therefore, easily control everything the plants receive. The strength and pH of the nutrient solution is easy to adjust so that the plants receive just the right amount of food. The watering/feeding cycles can be controlled by an inexpensive timer so that the plants get watered on schedule, as needed.

Types of Hydroponic Systems

1. The Wick System: This system is considered the simplest type of Hydroponic system. As the name means, this type works by pumping the nutrient solution from the reservoir up to the plants via the capillary movement like a wick into the growing media of the grow tray.

2. Deep Water Culture (DWC): DWC is an active recovery Hydroponic system. It works by hanging a net pot with plants held by boating Styrofoam platform so that the roots are submerged with the nutrient solutions.

3. Nutrient Film Technique (NFT): NFT works by continuously flowing nutrient solutions onto the grow tray, so it doesn't need a timer. The solutions then run through the roots system of the plants till it reaches the channels' end then drains back to the reservoir. It is able to do that because the tube is slightly downward. NFT does not need any growing medium.

4. Ebb and Flow (Flood and Drain): Ebb and Flow method works by using a timer to set the pump to pull the nutrients from the reservoir to the grow tray periodically. After the nutrient surrounds plants' roots, it drains back to the system.

5. Drip Systems: In Drip systems, growers use a timer to set the pump to draw the nutrient solutions through a network of drip lines. These drip lines will drop tiny amounts of water onto the plants.

6. Aeroponics: Probably, the most high-tech type among the six. In this type of system, plants hung in the air, so no growing media are used. A timer controls the nutrient water pump to spray onto the root systems constantly. The spray cycle is quite quick because the roots are exposed to the air and need sufficient moistures.

What are its Benefits?

Hydroponic gardening is fast becoming a popular choice for many growers around the world due to its more sustainable approach to resource usage than the usual growing methods. Here are a few of its many benefits:
1. By providing constant and readily available nutrition, hydroponics allows plants to grow up to 50% faster than they would in soil. Also, fresh produce can be harvested from a hydroponic garden throughout the year.

2. Great for both the environment and the grown product, hydroponic gardening virtually eliminates the need for herbicides and pesticides compared to traditional soil gardening.

3. Any water that is used in hydroponic gardening stays in the system and can be reused, reducing the constant need for a fresh water supply!

4. Arable land is often in short supply and gardening space continues to decrease. A great option when you lack yard space or have a tiny balcony, hydroponics also lends itself really well to indoor gardening.

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Organic Theatre: Redefining Agriculture as "Agri-Culture"

Article ID: 32182

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Introduction

Organic farming is a modern and sustainable form of agriculture that provides consumers fresh natural farm products. Organic farming works in synchronization with nature rather than against it. Organic theatre is a concept that aims to revive the natural bond between agriculture and art. It aims to show the new generation the natural bond that exists between the fertility of the soil and fecund imagination that goes with the tilling of land.

It is a combination of both organic produce and theatrical performances which coexisted even from the medieval times. The focus is on traditional farmers and organic farming and organic theatre is a stepping stone. The theatre will carry messages and impart information on agrarian culture. Organic theatre agriculture is redefined as "AGRI-CULTURE". This initiative aims to educate people on the dangerous side effects of pesticides and the need to promote organic farming and to create a new work culture and food culture which is closely linked with Mother Nature and the climate.

Organic theatre is a heart-warming idea where farming and folk theatre flourished alongside each other. The concept not only takes agriculture as a science but also an art bringing in the true spirit of the word agri-culture. It speaks about the importance of linking agriculture with tradition and culture. Organic theatre revolves around the idea of organic farming where farmers adopt eco-friendly practices for cultivation alongside with folk theatre.

The farmers work in their fields during the day time and in the night, they practice music, dance and drama in the stages constructed near the field. The final performance of the art is made on the day of harvest, usually 3-4 months after the sowing.

Organic Theatre and Rural Development

1. Women Empowerment: The concept of organic theatre has helped in empowering women and thereby helps in rural development. Most of the workers in farms were women and it helped them in earning a good source of living. Participation in cultural performances will also help them in developing their talents and social interactions. With the coming of women into main stream it would help in empowering them.

2. Employment Opportunities: Organic theatre provides employment opportunity to all spheres of life. In this initiative, not only farmers but students, IT professionals, teachers, doctors and people from different walks of life join hands right from sowing the seed till the final stage.

3. Better Crop and Pest Control: Better weed and pest control is obtained through adopting techniques like crop rotation, biological diversity, natural predators, and organic manures, suitable chemical, thermal and biological intervention. The farmers usually use endangered seeds for cultivation which would help in protecting various endogenous germ-plasms.

4. Higher Market Prices: Since the concept of organic theatre uses complete organic method of cultivation, the crops produced through this method would fetch higher prices. This would further help in increasing the farmer's income, improve their standard of living and thereby help in rural development.

5. Social and Political Aspect: Food is an emotional topic. Food often has a strong cultural, religious or even political meaning attached to it. Organic food is no different in that respect. Organic theatre is a concept which is in close relationship with the society. The various performances of dance, music and drama also take up relevant social and political issues.

A time where more and more conventional farmers are opting out of farming, But the mouths to feed are increasing exponentially day by day, it is crucial that more and more individuals and government bodies should take up farming to maintain the balance. Similarly, art and theatre should not be confined to auditoriums alone; instead they should go to the fields where they can make the change. Agriculture depicts the relation which humans have with art and soil. We should adopt this culture of cultivation to promote organic farming. The message of this concept is to recall our nature, culture and the equilibrium.

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Agricultural Extension Reforms in India; Pre- and Post-Independence

Article ID: 32183

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Introduction

Over the years the agricultural extension system operating in the country has witness pluralistic and multiplicity of extension reform in India. Agriculture development in India is basically a state subject. While investments in research and extension have increased in recent years, their impact on smallholder farmers' livelihoods remains debatable. Even when these investments may address relevant problems of the farmers, the benefits of improved technologies will not fully accrue to the farmers. The yield gap between research stations and farmers' field remains high. For translating research results into tangible gains at farm level, well-functioning agricultural extension and advisory services are required. The Indian public agricultural extension system is one of the largest knowledges and information dissemination institutions in the world. The evolution of agricultural extension system in India has a long history. Its contribution to productivity enhancement during the Green Revolution era has been well documented. Along with extension services, the price policy and procurement support through public agencies provided additional encouragement to the farmers for adoption of high yielding varieties in the 1960s and 1970s. By the end of 1970s, the Green Revolution type of extension system had largely achieved its major goal of increasing the area under high-yielding varieties.

In developing countries, the major role of agricultural extensions is to disseminate farm technologies developed by the public funded research organizations, through demonstrations, field visits and farmers' meetings or through media and others. Earlier, the extension personnel were involved in technology diffusion, but in the last two decades, the nature of agricultural technology design and integration is drawing attention of the extension professionals and practitioners across the globe. In India, different models for transfer of farm technology have been tested and also robust extension education approaches have been validated. Furthermore, the frontline extension system of the country has been sharpened through more farmer-centric approaches for technology adaptation and dissemination. Globally too, the adjustment in public extension system is seen. Using China and USA as case studies, we highlight the changes the public extension system has undergone. The operational paradigm of the country's extension system has been suggested to move beyond technology and beyond commodity through ensured reciprocal farmer-research-extension linkages.

The of extension role as a facilitator of agricultural knowledge system would only increase as more participants from private sector would get involved in extension. The public sector extension would still continue to be the major extension provider in most parts of the country as the private sector alone would not be able to meet even partially the varied needs of farmers. The ability of the system to perform these roles would entirely depend on the pace of internal reforms, the system would undergo. Experience the world over is that it is easy to change farmers than to change government agencies. Internal reforms are thus going to be the greatest challenge for the Indian Extension System.

Extension Systems During Post-Independence Period

The first planned attempt started with the launching of Community Development Programme in 1952, followed by the National Extension Service in 1953. These programs were able to educate responsive farmers to take up improved methods of farming across the country. The other important Area-Based Special Programmes were; Intensive Agricultural District Programme (IADP, 1960), Intensive Agriculture Area Programme (IAAP, 1964), High Yielding Varieties Programme (HYVP, 1966), Farmers Training Centres (1967) to train farmers on high yielding varieties and improved methods of farming to back up the above programs.

The cumulative effect of these programs resulted in increased productivity, which made way to usher in 'Green Revolution' in Indian agriculture during late 1970s. However, the widened gap between resource rich and resource poor farmers was observed as the could not be addressed in many aspects. In order to enable resource poor farmers to take benefit of improved farm technology, many client-based programs were introduced viz., Small Farmers Development Agency (SFDA, 1969), Marginal Farmers and Agricultural Labourers Programme (MFAL, 1969), District Rural Development Agency/Society (DRDA, 1976), Integrated Rural Development Programme (IRDP, 1978) and Lab to Land Programme sponsored by ICAR (LLP, 1979). Although, these programs were able to improve the socio-economic conditions of beneficiaries, they were isolated in a given time and implemented in a phased manner.

Reorganization of Extension System

By the middle of 1980s it was observed that extension services in the developing countries were suffering from a number of weaknesses, including the dissipation of extension workers' energies on low priority tasks; the lack of single as well as clear line of command; and low level of agricultural knowledge and skill among field level functionaries. As a means of reforming and strengthening the extension service, a reorganized agricultural extension system known as 'Training and Visit' (T & V) system was introduced in the country.

Training and Visit System

This system was introduced in India in 1974 with the World Bank assistance. Training and Visit system became the dominant method of restructuring the extension services in over sixty countries in Asia, Africa and Latin America. The system aimed to achieve change in production technologies of farmers through professional assistance for the contact farmers from well-trained extension personnel supported by supply, service and marketing facilities which were earlier lacking in National Extension Service. The main weakness of T&V system was it largely remained as Departmental program characterized by centralized operations with inadequate farmer driven and farmer accountable feedback systems resulting in low level of farmers' involvement. This further lacked focus on location specific needs of regions, disadvantaged areas, and target groups.

Broad Based Extension System (BBES)

This system aimed at rectifying the defects of T & V system in some of the states. In the BBES, the role of subject matter specialists was amplified and they were invited to formulate messages suitable to their land based activities, village extension workers had full time job by offering messages during lean season also, and the concept of broad based education laid emphasis on formulating and delivering composite messages to the farmers to meet the needs of their full agricultural environment.

District Level Agriculture Technology Management Agency (ATMA) Model

Agricultural Technology Management Agency (ATMA) was introduced as a pilot (1998-2003) in 28 districts. The evaluation report of Indian Institute of Management (IIM) Lucknow revealed that the ATMA's extension approaches have been proving to be very promising in execution of the reforms and thus the progress was extended to other states. Though the State Department of Agriculture serves as a nodal agency for implementing ATMA, the programme aims to increase coordination and integration among developmental departments. Emphasis has been laid on providing flexible working environment and establish effective integration of all the stakeholders at the district level and thereby increase input in to programme planning and resource allocation, especially at the block level and thereby increase accountability of stakeholders. Every district has to prepare the Strategic Research and Extension Plan (SREP) for implementing ATMA in respective districts. Agricultural Technology Management Agency (ATMA) was introduced as a pilot (1998-2003) in 28 districts. The evaluation report of Indian Institute of Management (IIM) Lucknow revealed that the ATMA's

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ICAR Initiatives

The Indian Council of Agricultural Research (ICAR) took up number of extension activities and programmes since its inception in the year 1929. National Demonstration Scheme (1964) initiated during 1964-65 focused to demonstrate the production potentiality of major crops in the farmers' field. Operational Research Projects (ORPs) was started during 1975 to identify technological as well as socio-economic constraints and to formulate and implement the problem-solving technology modules on area/watershed/ target group basis in operational area. Whereas, Lab-to-Land programme was launched during 1979 on the occasion of ICAR golden jubilee, to transfer low cost technologies in agriculture and allied enterprises. Frontline demonstration was started in 1990-91 as a part of technology mission on oilseeds and pulses. Institution –Village Linkage Programme was also launched funded by National Agricultural Technology Project (NATP) during 1998-2004. Agriculture-Technology Information Centre (ATIC) in State Agricultural Universities to work as single window support system linking the various units of research institution with intermediary users and farmers in decision making and problem-solving exercise through availability of technology inputs, products, information and advisory services under one roof. Since 2006-07, ICAR is implementing National Agricultural Innovation Project (NAIP), in a consortium mode.

Krsihi Vigyan Kendra (KVK) - the Knowledge Hub

1. Krishi Vigyan Kendra (Farm Science Centre) is an innovative institution of ICAR established at district level. The first KVK was established during 1974 and has grown as a largest network in the country with 611 KVKs during 2011.
2. KVKs are funded by ICAR and administered by ICAR institutes / SAUs /Deemed Universities / Non-government Organizations or State Department of Agriculture.
3. KVKs play a vital role in conducting on farm testing to identify location specific agricultural technologies and demonstrating the production potential of crops at farmers' fields through frontline demonstrations. They also conduct need-based training programmes for the benefit of farmers and farm women, rural youths and extension.
4. KVKs are creating awareness about improved agricultural technologies through large number of extension programmes.
5. Critical and quality inputs like seeds, planting materials, organic products, biofertilizers and livestock, piglet and poultry strains are produced by the KVKs and made available to the farmers.

State Agricultural Universities (SAUs)

State Agricultural Universities apart from lending support in implementing ICAR sponsored extension programmes, have evolved several innovative extension models to effectively reach the farming community. The type of extension activities undertaken by SAUs vary from state to state. The SAUs are undertaking transfer of technologies to farmers through extension educational activities viz., farm trials, demonstration, meetings, discussion, conventions, training programme, farmers field school, field days, krishi mela, exhibition, educational tours, exposure visits, diagnostics visits , farm advisory services etc. The SAUs publish agriculture literature (books, package of practices, booklets, folders, and leaflets) in local languages for dissemination of agricultural technologies to the farmers and extension personnel. Expert Centres and Village Resources Centres are established in collaboration with Indian Space Research Organisation (ISRO) for interaction of farmers with experts on a variety of agricultural information. Mobile message services and Kissan Call Centre (established at ATIC) as well as KVKs are providing timely information to the farming community regarding agricultural technologies, weather data and market information.

Extension Activities of Commodity Boards, Financial Institutions, Input Agencies, Non-Government Organizations

Commodity Boards (Coffee board, Spice Board, Tobacco board, Coconut development board etc.) are extending crop/ commodity specific technical know-how to the farmers to a limited extent as many of these boards do not have grass root level functionaries throughout the country. Financial institutions normally provide assistance in preparation of agriculture project proposals by their technical staff to the farmers and others.

Agricultural input agencies besides providing critical inputs like seeds, planting materials, fertilizes, plant protection chemicals etc, they also sponsor/organize training programme to educate farming community. Various committed NGOs and Philanthropists are also rendering rural extension services to the rural community in the field of agriculture and allied sectors, health, sanitation, education, water supply etc., across the country.

Suggestion and Policy Implication

To be effective and to remain relevant in the years to come, the central and state extension agencies should initiate the following organizational and structural reforms that could enhance agricultural production and productivity.

1. Strengthen its understanding on matters with respect to technology, markets, prices, demand and policies. Departments have to either recruit specialists or have to hire the services of professionals in these areas.

2. Improve social science skills of extension personnel. Apart from technical skills, "extension personnel needs several social science skills with respect to need assessment, group formation, negotiation, conflict resolution, mobilisation, management of CPRs, use of IT, data collection, analysis and documentation"

3. Decentralise the operations of the extension services and provide flexibility to field level officers to decide appropriate extension programmes. Initiate activities for developing Strategic Research and Extension Plans in all the districts to be followed up with Block level plans.

4. Improve the capabilities of extension managers-Extension managers need skills to operate effectively in the pluralistic extension environment. They need to know, how their organisation can do better or cheaper than other organisations, how can it co-operate with other actors in this system to provide all farmers better knowledge to survive and succeed in a competitive society; and how to create the social climate for a successful learning organization.

Conclusion

The purpose of extension is to disseminate knowledge and practical based extension to farmers. Knowledge gaps contribute to yield gaps. Services and quality inputs are essential productivity-enhancing tools. However, their optimum use requires knowledge. The “resource-poor” majority, growers of much of India’s food, need external, science-based, extension to complement local knowledge. Much debate focuses on how best to achieve the desired outcomes that extension can convey. Many countries have neglected extension and indeed agriculture as a whole. In 2009, a National Seminar on Agriculture Extension discussed knowledge management, convergence of extension systems, the role of information and communication technology and mass media, private sector initiatives including public–private partnerships, and farmer- and market-led extension systems. Despite the concerted efforts made through various Extension systems, the present extension systems appear to be inadequate to address the challenges faced by the farmers in the context of changing agricultural scenario. The public extension system would continue to play an important role in technology dissemination to serve the large section of small and marginal, besides the other extension service providers to supplement and compliment public extension service. At the same time, extension mechanism has to be demand driven, location specific as well as those of proper marketing and value addition mechanism. This calls for organized arrangement of farmers. An effective decentralized, farmer centric and demand driven extension mechanism have to be ensured at the lowest cutting-edge administrative level to cater to the needs of the farming community.

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Mechanisms Which Promoted Autogamy & Allogamy

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Introduction

Pollination refers to the transfer of pollen grains from the male organ (anther) of a flower to the female organ (stigma). The goal of every Plants, is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds. Pollination is of two types:

1. Autogamy or self-pollination.
2. Allogamy or cross Pollination.

Autogamy (Self Pollination)

When pollen grains are transferred from the anther to the stigma of same flower, it is known as autogamy or self-pollination. Autogamy leads to homozygosity. Autogamy is the closest form of inbreeding. These species, as a rule, must have hermaphrodite flowers. But in most of these species, self-pollination is not complete and cross pollination may occur up to5%,the degree of cross pollination being affected by several factors like variety, environmental conditions(temperature and humidity), and location.

Mechanisms Promoting Self-Pollination

There are several mechanisms which promote autogamy. These are discussed below:

1. Bisexuality and homogamy: All the self-Pollinated Plants have hermaphrodite flowers. In Case of hermaphrodite flower male and female organs present in same flower. Maturation of anthers and stigma of a flower at the same time is called homogamy.

2. Cleistogamy: Cleistogamy is the Phenomenon, where flowers never open and in such flowers, only Self-Pollination occurs within the unopened flower. Cleistogamy has been reported in some varieties of wheat, barley, oats and several other grass species.

3. Chasmogamy: Opening of flowers only after the completion of pollination is known as chasmogamy. This occurs in many cereals, such as wheat, barley, rice and oats.

4. Position of Anthers: In some species stigmas are surrounded by anthers in such a way that self-pollination is ensured. Such situations are found in tomato and brinjal.

Genetic Consequences of Self-Pollination

Populations of self-Pollinated species are highly homozygous. These species do not show inbreeding depression, but may exhibit considerable heterosis.

Allogamy (Cross Pollination)

Transfer of Pollen grains from the anther of one plant to the stigma of another plant is called allogamy or cross pollination.

Mechanisms Promoting Cross-Pollination

1. Unisexuality: Unisexuality is a condition, in which the flowers are either staminate or pistillate. This is of two type (1)- monoecy and (2) dioecy. When male and female flowers are separate but present in the same plants, it is known as monoecy. When staminate and pistillate flowers are present on different plants, it is called dioecy.

2. Dichogamy: In this case stamens and pistils of hermaphrodite flowers may mature at different times. Dichogamy promotes cross pollination even in the hermaphrodite species. Dichogamy is of two types:

- **a. Protandry:** Stamens mature before pistils.
- **b. Protogyny:** Pistils mature before stamens.

3. Herkogamy: Hindrance to self-pollination due to some physical barriers such as presence of hyline membrane around the anther is known as herkogamy.

4. Self- Incompatibility: It refers to the failure of pollen from a flower to fertilize the same flower or other flowers on the same plant. Self-Incompatibility is of two types: sporophytic and gametophytic.

5. Male-Sterility: In some species, the pollen grains are non-functional. Such condition is known as male sterility. It prevents self-pollination and promotes cross pollination.

6. Heterostyly: When styles and filaments in a flower are of different length, it is called heterostyly.

Genetic Consequences of Cross-Pollination

Cross-pollinated species are highly heterozygous and show mild to severe inbreeding depression and a considerable amount of heterosis.

S.N.	Mode of Pollination	Crop Plants & their Mode of Reproduction	
		Seed Propagated Plants	**Vegetatively Propagated Plants**
1.	Self-Pollinated Crops.	Rice, Wheat, Barley, Chickpea, Cowpea, Field pea, Lentil, Green gram, Black gram, Soyabean, Linseed, Khesari, Sesame, Peanut, Sunhemp, Chillies, Brinjal, Tomato, Okra etc.	Potato
2.	Cross pollinated Crops.	Carrot, Kenef, Oilpalm, Coconut, Papaya, Garlic, Onion, Squash, Pumpkin, Cucumber, Watermelon, Muskmelon, Castor, Sugar beet, Maize, Pearl millet, Rye, Radish etc.	Sugarcane, Coffee, Cocoa, Tea, Apple, Pears, Peaches, Cherries, Almond, Strawberries, Pine apple, Banana, Cashew nut, Cassava etc.
3.	Often Cross-pollinated Crops.	Sorghum, Cotton, Triticale, Rai, Pigeon pea, Tobacco, etc.	

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Waste to Wealth: Municipal Solid Waste Management in Indian Scenario

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Introduction

India is one of the fastest developing countries in the world. India's economy has overtaken the UK for the first time in more than 100 years. India is the sixth-largest economy in terms of gross domestic product (GDP). At 7.6% of growth rate in fiscal year 2016, India is now the fastest-developing economy and second most populous nation in the world. The level of urbanization in India increased from 27.8% to 31.6% during the period 2001–2011, and it is expected that up to 50% of the Indian population will live in cities in the next 10 years (Devi et al. 2016). The high rate of population growth, fewer opportunities in rural areas, and a shift from the low-paying agriculture sector to higher-paying urban occupations are mostly responsible for urbanization. According to the census of 2011, the Indian population was 1,027 million, of which 377 million were urban people (around 31% of the total population) living in 7,936 towns. This is an effect of India rapidly shifting from an agricultural-based nation to an industrial and service-oriented country.

Rapid industrialization, population explosion, and economic growth in India led to the migration of people from villages to cities, generating thousands of metric tons of MSW daily in terms of kg/capita/day, as a consequence of improved lifestyle and social status (Devi et al. 2016). According to the Central Pollution Control Board (CPCB 2016), urban India generated 62 Mt of MSW in 2015, or 169,864 t/day or 450 g/capita/day. Approximately 82% (50 Mt) of MSW was collected, and the remaining 18% (12 Mt) consisted of litter. Waste treated was only 28% (14 Mt) of the collected waste, and the remaining 72% (36 Mt) was openly dumped. MSW composition in India is approximately 40%–60% compostable, 30%–50% inert, and 10%–30% recyclable.

Current Status of MSW Management in India

A door-to-door waste collection system has been introduced in 18 states only, whereas 11 others are still waiting for this facility. Only five states are working on source segregation of waste, and others are still dumping mixed waste at the dump sites. There are 95 sanitary landfill sites in the country, and a total of 1,285 sites have been identified for construction of new landfill sites by 242 ULBs. Around 553 ULBs operate composting/vermicomposting facilities, and 173 ULBs are working on it. In addition, 645 small-capacity biogas plants are operated, of which 600 are in Kerala state. So far, only six WtE plants are under operation, and the remaining five have been shut down due to lack of technical expertise and high moisture content of the waste (or getting poor quality of waste to make fuel).

Table 1. Current status of MSW management in India:

Parameter	Status
House-to-house collection of waste	18 states (of 29)
Segregation of waste at the source	5 states (of 29)
Number of unsanitary landfill sites identified	1,285
Number of sanitary landfill sites constructed	95
Number of ULBs operating compost/ vermicomposting facilities	553
Number of ULBs under construction compost/ vermicomposting facilities	173
Number of operating pipe composting facilities	7,000
Number of operating RDF facilities	12
Number of operating biogas plants	645
Number of energy generation plants	6

Waste generation	143,449 Mt/day
Waste collection	117,644 Mt/day (82%)
Waste treated	32,871 Mt/day (28%)

Source: CPCB (2016).

Composting Technologies for Municipal and Urban Waste

Composting is the biological decomposition of organic matter under controlled aerobic conditions to form a stable, humus-like final product. A diverse population of microbes is responsible for this process, whose population dynamics vary greatly both temporally and spatially, and usually involves the development of thermophilic temperatures as a result of biologically produced heat. During aerobic composting, organic materials are degraded to end products in the presence of oxygen by micro-organisms. The organic matter content in municipal and urban waste feed stocks to be composted can range from yard and food waste to mixed household wastes, in which the biodegradable proportion vary from 50 to 90% depending upon country. The need to treat and dispose organic wastes has made compost production and its agricultural application an economic and attractive solution. The composting application of materials with high organic matter content and nutrients, such as food and yard wastes, has become a common environmental practice for soil amendment. For instance, composting can be an ideal disposal method for food waste since it has high moisture content, a high organics-to-ash ratio, and a loose physical structure, whereas the application of yard residues as a compost to soil is considered as a good management practice since it stimulates soil microbial growth and activity

Table 2. Waste to wealth: Current compost capacity in India:

Compost Potential	54 Lakh MT
Current Compost Installed Capacity	10 Lakh MT (56 Plants)
Current Compost Production	1.5 lakh MT
Compost Capacity under Construction	7.25 Lakh MT (42 Plants)

Source: MNRE (2016).

Methods Followed in India for Composting of Municipal Solid Waste Management

1. Windrow composting is suited for large volumes such as that generated by entire communities and collected by local governments, and high-volume food-processing businesses (e.g., restaurants, cafeterias, packing plants). It will yield significant amounts of compost, which might require assistance to market the end-product. Local governments may want to make the compost available to residents for a low or no cost.

2. Aerated static pile composting produces compost relatively quickly (within three to six months). It is suitable for a relatively homogenous mix of organic waste and work well for larger quantity generators of yard trimmings and compostable municipal solid waste (e.g., food scraps, paper products), such as local governments, landscapers, or farms. This method, however, does not work well for composting animal by products or grease from food processing industries

3. In-vessel composting can process large amounts of waste without taking up as much space as the windrow method and it can accommodate virtually any type of organic waste (e.g., meat, animal manure, food scraps). This allows good control of the environmental conditions such as temperature, moisture, and airflow. This method produces compost in just a few weeks. It takes a few more weeks or months until it is ready to use because the microbial activity needs to balance and the pile needs to cool.

4. Bin and Box composting is practiced at the local community level, a series of bins may be used to accommodate all incoming waste. The bottom of the bin should be covered with a thick layer (~15cm) of coarse material.

5. Vermicomposting is the process of compost generation by earth worms. The earth worms break down this material into high quality compost called castings. Worm bins are easy to construct and are also available for

purchase. One pound of mature worms (approximately 800-1,000 worms) can eat up to half a pound of organic material per day. It typically takes three to four months to produce usable castings.

Conclusion

Reducing waste generation and maximizing the recycling rate are major challenges and will remain in the future also. Waste minimization at source is the first important action for managing the MSW and material recycling represents the best environmentally friendly way for MSWM; Recycling is truly an eco-friendly technology through which we can convert all organic waste into a product which is rich in nutrient content and can replace chemical fertilizer.

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Role of Entrepreneurship in Economic Development

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Abstract

Economic development essentially means a process of upward change whereby the real per capita income of a country increases over a period of time .Entrepreneurship has an important role to play in the development of a country. It is one of the most important inputs in economic development. The number and competence of entrepreneurs affect the economic growth of the country. The crucial and significant role played by the entrepreneurs in the economic development of advanced countries has made the people of developing and under developed countries conscious of the importance of entrepreneurship for economic development.

Keywords: Entrepreneurship, Economic, Development, Growth etc.

Introduction

Economic development is the result that entrepreneurship may be a cause. Economic development basically suggests that a method of growth whereby the per capita financial gain of a country will increase over period of time .Entrepreneurship has a vital role to play within the development of country. The quantity and competency of entrepreneurs have an effect on the economic process of the country. The crucial and vital role compete by the entrepreneurs within the economic development of advanced countries has created the folks of developing and underneath developed countries alert to the importance of entrepreneurship for economic development. The role of entrepreneurs isn't identical within the varied economies. The contribution of entrepreneurs is also additional in favourable conditions than in economies with comparatively less favourable conditions.

Role of Entrepreneurs in Economic Development

The role of entrepreneurs is not identical in the various economies. Depending on the material resources, industry climate and responsiveness of the political system, it varies from economy to economy. Entrepreneurship helps within the method of economic development within the following ways that.

The role of entrepreneurship in economic development varies from economy to economy depending upon its material resources, industrial climate and the responsiveness of the political system to the entrepreneurial function. The entrepreneurs contribute more in favourable opportunity conditions than in the economies with relatively less favourable opportunity conditions. Viewed from the opportunity conditions point of view, the underdeveloped regions, due to the paucity of funds, lack of skilled labour and non-existence of minimum social and economic overheads, are less conducive to the emergence particularly of innovative entrepreneurs.

1. Employment Generation: Entrepreneurs generate employment both directly and indirectly. Directly, self-employment as an entrepreneur and indirectly by starting many industrial units they offer jobs to millions. Thus, entrepreneurship is the best way to fight the evil of unemployment.

Entrepreneurs provide immediate large-scale employment to the unemployed which is a chronic problem of underdeveloped nations. With the setting up of more and more units by entrepreneurs, both on small and large-scale numerous job opportunities are created for others. As time passes, these enterprises grow, providing direct and indirect employment opportunities to many more.

In this way, entrepreneurs play an effective role in reducing the problem of unemployment in the country which in turn clears the path towards economic development of the nation. Growing unemployment particularly educated unemployment is the problem of the nation.

2. National Income: National Income consists of the goods and services produced in the country and imported. The goods and services produced are for consumption within the country as well as to meet the demand of exports. The domestic demand increases with increase in population and increase in standard of living. The export demand also increases to meet the needs of growing imports due to various reasons.

An increasing number of entrepreneurs are required to meet this increasing demand for goods and services. Thus, entrepreneurship increases the national income. Entrepreneurs are always on the lookout for opportunities. They explore and exploit opportunities, encourage effective resource mobilization of capital and skill, bring in new products and services and develops markets for growth of the economy. In this way, they help increasing national income of a country. Increase in gross national product and per capita income of the people in a country, is a sign of economic growth.

3. Balanced Regional Development: The growth of Industry and business leads to a lot of Public benefits like transport facilities, health, education, entertainment etc. When the industries are concentrated in selected cities, development gets limited to these cities. A rapid development . When the new entrepreneurs grow at a faster rate, in view of increasing competition in and around cities, they are forced to set up their enterprises in the smaller towns away from big cities. This helps in the development of backward regions.

4. Dispersal of Economic Power: Industrial development normally may lead to concentration of economic powers in a few hands. This concentration of power in a few hands has its own evils in the form of monopolies. Developing a large number of entrepreneurs helps in dispersing the economic power amongst the population by weakening the harmful effects of monopoly.

5. Better Standards of Living: Entrepreneurs play a vital role in achieving a higher rate of economic growth. Entrepreneurs are able to produce goods at lower cost and supply quality goods at lower price to the community according to their requirements. When the price of the commodities decreases the consumers get the power to buy more goods for their satisfaction. In this way they can increase the standard of living of the people.

6. Creating Innovation: An entrepreneur is a person who always looks for changes. Apart from combining the factors of production, he also introduces new ideas and new combination of factors. He always tries to introduce newer and newer technique of production of goods and services. An entrepreneur brings economic development through innovation.

7. Capital Formation: Entrepreneurship promotes capital formation by mobilizing the idle saving of the public and put it under continues transaction so as to improve the value of the capital by utilizing in a profitable way under different stages of enterprise.

8. Resource Mobilization: The natural resources including the human resource skill can be effectively utilized for functioning of an enterprise towards economic development which might otherwise remain unutilized and idle.

9. Backward and Forward Linkages: Entrepreneurship will give the opportunity for the people to involve at different levels starting from production to ultimate consumption, the backward and forward linkages which stimulate the process of economic development in the country.

10. Promotes Country's Export Trade: Last but no means the least, it also promotes country's export trade i.e., an important ingredient to economic development.

Conclusion

If we understand the advantages and disadvantages of entrepreneurship, with a well composed approach to promoting entrepreneurship will absolutely result in a progressive influence on country's economy and ultimately society. Entrepreneurship adds new business thoughts into practice. Which creates jobs that enables personal development of peoples.

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Artificial Fruit Ripening Agent

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These are the substances which hasten the ripening process. Since the fruits are sent to different places, requiring several days at ordinary or refrigerated transportation, only firm, but mature fruits are least damaged during marketing. As a part commercial practice these are ripened at the destination markets before retailing. Artificial ripening of fruits for the commercial purposes is achieved utilizing different chemicals as ripening agents. Thus, ripening agents allow many fruits to be picked prior to ripening (Park et al., 2006).

Ethylene

Ethylene is thought to regulate fruit ripening by coordinating the expression of genes responsible for enhancing a rise in the rate of respiration, autocatalytic ethylene production chlorophyll degradation, carotene synthesis, conversion of starch to sugars and increased activity of cell wall-degrading enzymes.

Ethylene plays a central role in physiological and developmental processes, such as germination, growth, flower initiation and opening, senescence of leaves and flowers, organ abscission and fruit ripening. It is applied artificially also to the plants. It is used in ripening and colouring fruit, including bananas, pears, mangoes, tomatoes and citrus10.

It also induces flowering in pineapples when applied in the field and used to improve growth and appearance of bean sprouts. It is applied artificially using gas emission systems or ethylene generator systems. Food Safety and Standards, second Amendment Regulation, 2016: "Fruits may be artificially ripened by use of Ethylene gas at a concentration up to 100μl/L depending upon the crop, variety, and maturity" (Anonymous, 2012).

Ethephon

Ethephon is known as one of the most common ethylene-generating chemicals and used in post-harvest treatments. Ethephon is (2-chloroethylphosphonic acid), which penetrates into the fruit and decomposes to ethylene. Ethephon is used to promote pre-harvest ripening of top fruit, soft fruit, tomatoes, sugar beet, fodder beet, coffee and many other products.

It is also used to facilitate the harvest of fruit and berry crops (by loosening the fruit) and to accelerate post-harvest ripening (e.g. bananas) prevents lodging in cereals, maize and flax Ethylene glycol: Ethylene reacts with peroxide to produce the agent ethylene glycol. Ethylene glycol is colourless, odourless and sweet tasting liquid which is found in everyday materials used in the present day, such as coolant, antifreeze. In case ethylene glycol is applied (after being diluted with water) to various fruits, then it will speed up the ripening process on the fruits in colder climactic conditions, cutting down at least a quarter of the time it usually takes for the fruits to ripen.

Ethrel

Ethrel is a natural ripening agent of fruits. On dipping the mature fruits in ethrel, it enters fruit cells, releases ethylene and hastens the ripening process. Changes in ascorbic acid content may occur with ethrel spray which influences the carbohydrate metabolism in related fruits. Calcium carbide: Calcium carbide (available as greyish black powder) is commercially intended for welding purpose but its use in the artificial ripening of climacteric fruits is rampant in many developing countries. Calcium carbide, once dissolved in water, produces acetylene which acts as an artificial ripening agent. There are reports that in developing countries like Bangladesh, India and Pakistan.

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Calcium Carbide

Fruits ripened with calcium carbide are soft and have good peel colour development but are poor in flavour. Calcium carbide, popularly known as masala, is used extensively in mangoes, bananas and papayas and sometimes in apples and plums. Being cheap (one kg of this chemical costs Rs. 25-30, which can ripen 10 tonnes of fruit), it is indiscriminately used by the traders in preference to other recommended practices of inducing ripening like dipping fruits in a solution of ethephon, or exposure of fruits to ethylene gas. However, treatment of fruits with calcium carbide is extremely hazardous because the chemical is known to contain traces of arsenic and phosphorous. Acetylene gas produced by calcium carbide may affect the neurological system by inducing prolonged hypoxia As per the rule 44 AA of the Prevention of Food Adulteration Rules 1955 “No person shall sell or offer or expose for sale or have in his premises for the purpose of sale under any description, fruits which have been artificially ripened by use of acetylene gas, commonly known as carbide gas.” In spite of such a restriction, calcium carbide is often utilized as a ripening agent in commercial front.

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Hydroponics as an Agribusiness Opportunity

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Introduction

The science of soilless gardening is called hydroponics. Hydroponics is basically growing plants without soil. It is a more efficient way to provide food and water to plants. Plants don't use soil; they use the food and water that are available in the soil.

Soil's function is to supply plants nutrients and to anchor the roots. In hydroponics, we provide plants with a complete nutrient formula and an inert growing medium to anchor roots so they have easier access to the food and water. As the food is dissolved in water, it goes directly to the roots. Plants grow faster and ready for harvest sooner.

Types of Hydroponics

Static solution culture: In static solution culture, plants are grown in containers of nutrient solution, such as glass jars, plastic buckets, tubs, or tanks.

Continuous flow culture: In continuous-flow solution culture, the nutrient solution constantly flows past the roots. It is much easier to automate than the static solution culture.

Nutrient Film Technique: It is a hydroponic technique wherein a very shallow stream of water containing all the dissolved nutrients required for plant growth is re-circulated past the bare roots of plants.

Ebb and Flow: In this, there is a tray above a reservoir of nutrient solution. Either the tray is filled with growing medium (clay granules being the most common) and planted directly or pots of medium stand in the tray.

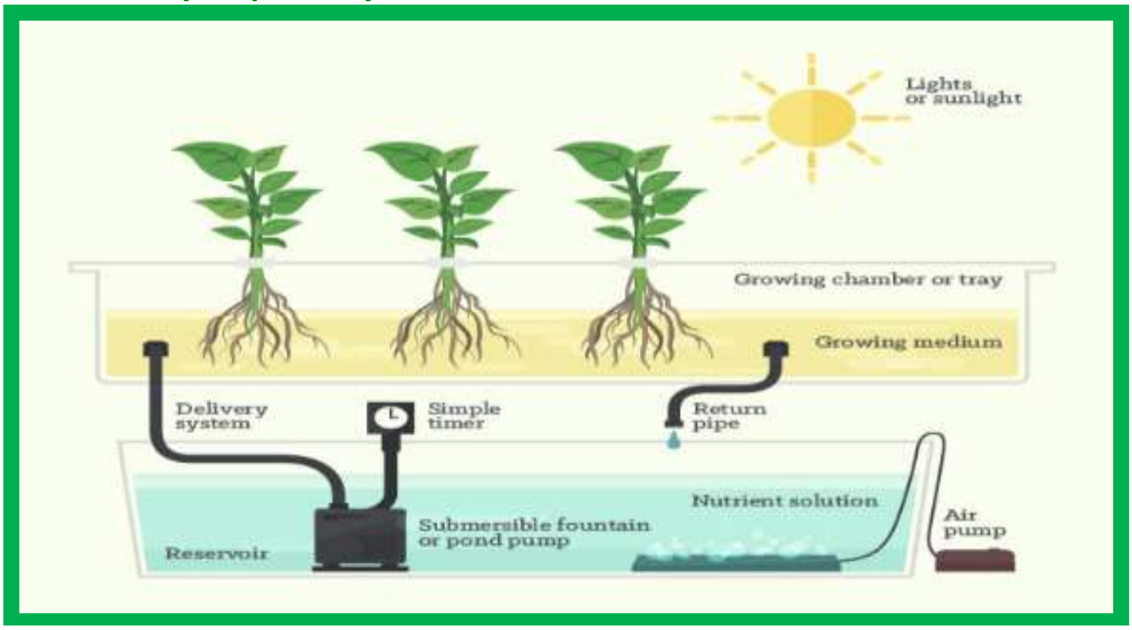
Mediums Used for Hydroponics

Expanded clay aggregate, Growstones , Coir, Perlite, Sand, Gravel.

Nutrients Required

Plant nutrients used in hydroponics are (calcium), (magnesium), and (potassium); the major nutrient anions are (nitrate), (sulphate) and (dihydrogen phosphate).

The Basic Parts of a Hydroponic System



Advantages of Using Hydroponics

1. Requires no soil.
2. Enables for the reuse of water.
3. Provides greater control of nutrients to prevent over nourished crops.
4. Enables ease of harvesting.
5. Better use of space and location.
6. Enables ease of pest management and food safety controls.
7. Increases food production stability, providing higher yields.
8. Provides off-season production when market prices are highest.

Opportunities

The India Hydroponics Market is expected to grow at a CAGR of 13.53% during the forecasting period (2020-2027). There is a viable market due to population growth that is ready to purchase hydroponically grown food within India. This customer market includes retail and hotel, and fast-food chains, railway catering, foreign food service companies, NGO's, and defence establishments.

How hydroponics is a lucrative opportunity to deploy in India:
1. India has rich climatic conditions positioning it favourably for market hydroponic produce.
2. Labour costs are favourable with intelligent human capital.
3. An abundant growth market already exists due to India's large population.
4. In depth knowledge of crop cycles, food safety and pest management, and hydroponic methodologies exists.

Government Initiative

Govt. is providing subsidy for commercial units 1000sqm or above is given by the National Horticulture Board. Also, there is a provision for hi-tech horticulture project credit linked assistance programme by the NHB for 2500 sqm or above.

Revenue Potential

When the land is already owned, capital costs per acre every 5 years are Rs 30.5 lakhs. Operational costs, with tomatoes as the example crop, in 1 acre per year are Rs 9 lakhs and revenue typically averages around 33.5

lakhs. If the land is independently owned the profit potential of 15 lakhs per year is slightly less than if it were leased, averaging around 16.5 lakhs per year.

Future Scope

1. As population increases and arable land declines, people will turn to new technologies like hydroponics. This technique gives 1,000 times greater yield than the same sized area of land.

2. Feeding millions in areas of Africa and Asia, where both water and crops are scarce. Serving the future of the space program. NASA has extensive hydroponics research plans, benefiting current space exploration, as well as future colonization on Mars or Moon.

3. Potential for a larger variety of food, called a bio-regenerative life support system. Hydroponics technique presents a new door of science helping more crop production for food and ornamental use.

Challenges in Adopting Hydroponics

1. Innate to soil-based agriculture, there are certainly challenges relevant to hydroponics. Issues facing the use of hydroponics in India include droughts and unpredictable weather, rising temperatures, polluted water systems, lack of irrigation, poor water management, and high freight costs from India.

2. The lack of tax cuts and incentives is a key factor that hinders the growth of hydroponics in developing regions, the high set-up costs and running costs too.

3. Since high cost of production, it is imperative for hydroponics growers to keep a check on the competition arising from the local produce in the price-sensitive Indian market.

4. Major hindrance to hydroponic farmers is the threat of waterborne diseases.

5. Both the capex and the opex of a hydroponic farm is higher than soil grown produce, which results in a higher selling price. In the case of commodity crops like wheat and rice, the price will be four times more that soil-grown crops.

Conclusion

Industry is expected to grow exponentially in future also, due to increasing challenges of soil agriculture. Government intervention and Research Institute's interest can propel the use of this technology. Harvest quality is good as the size of fruits is bigger and chances of soil born disease / pest infestation are also null or minimized. Hydroponics is the answer for sustaining the World's Food Supply.

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A Review on Food Preservation Methods: Comparison of Traditional and Modern Food Preservation Methods

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Introduction

Fresh and healthy foodstuffs are the requirement of human body and all living organisms. Naturally available food is sometime pernicious and not edible for long time. Occasionally unprocessed, raw food are harmful to our body, hence some processing methods and preservation techniques for food are very important in our daily routine. We can improve quality, taste, storage time, features and structure of any raw food after preservation processing. Millions to billions of types of resources, materials are involved in our daily meal. Various foodstuffs having its own specialty and the quality, hence the culinary/cooking and preservation terms of each are different. The food cooking or preservation techniques are mainly divided into two types, traditional food preservation and modern food preservation.

Review on Food Selection and Priority

In our daily life many types of food are involved, which can be depending on availability, climate, quality, taste, choice or habit, fashion, marketing and time. After such surveys and from human tendency, the first preference goes to the fresh fruits and vegetables. Fruits and vegetables are the central contents of the food. In the sense of healthy food and necessity of food contents, fruits and vegetables are having highest priority in daily food and is shown in figure 1 (food priority pyramid). Food pyramid shows the fruits and vegetables that are the primary food requirements for the humans and animals. Zind et al reported [1] the U.S. consumers approach for fresh fruits and vegetables. In his survey, 96% of peoples prefer ripened and fresh fruits and vegetables, 94% prefer look and state, whereas 66% use nutritive importance and 63% cost. The classification / categorization and preservation of fruits and vegetables depend on their ripening, spoilage and maturity processes. Ripening stages (under ripe, ripe / edible and over ripe) are typical in the case of fruits whereas freshness and spoiled states are the measures of vegetables.

Fig. 1. Food priority pyramid [2].

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Traditional Food Preservation Methods

All fruits and Vegetables are raw materials or natural food that needs the preservation and some cooking procedures before eating. The food preservation methods are different for hugely available food and at small scale food. The preservation methods are based on the traditional and the advanced or modern techniques. Traditional methods include pickling, boiling, cooling, heating, drying, freezing, sugaring, salting, jellying, canning and jugging, etc [3] and are easy compared to the other methods and can be done at home.

These methods are useful for small scale storage of fruits/vegetables. Canning and pickling processes are useful for under riped fruits. Drying and freezing are applied for the riped fruits preservation process. Cooking and freezing are done with the overriped fruits [4]. Figure 2 shows some of the traditional food preservation methods [5-7].



Fig. 2. Traditional food preservation methods.

Modern Food Preservation Methods

Many of the preservation methods are advanced and modern methods which can be done in industries, companies and hotels, where a large number of samples (food) are available. Radiation, pasteurization, modified atmosphere, pulsed electric field electroporation, vacuum packing, high-pressure food preservation, nonthermal plasma and artificial food additives are the examples of modern preservation methods [3-5]. Figure 3 shows the modern food preservation methods [8-10].

Conclusions

Usually all types of foodstuffs have varying nutrients, physical and chemical properties (like colour, size and taste) with respect to the time. Freshness of fruits and vegetables is directly associated with the quality of the food which can decide the edible variety for selection. Healthy and fresh food provides maximum minerals, vitamins, nutrients, proteins, fats or carbohydrates to the human body.

Whereas, the unhealthy or spoiled or rotten food cannot provide all the above quantities, in addition it is harmful and dangerous for human health. Hence fresh and healthy food with food preservation processes are obligation for almost all the consumers.


Fig. 3. Modern and advanced food preservation methods.

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Detection Methods of Fertilizer Adulteration

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Introduction

Fertilizer is any organic or inorganic material of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants. India, being the third largest producer and consumer of fertilizers, consumes nearly 40 million tons of fertilizer materials, equivalent to over 18 million tons of nutrient, consisting of a variety of nitrogenous, phosphatic, potassic and complex fertilizers, catering to nearly 106 million farming families. Adulteration of fertilizers involves the practice of adding extraneous material to a standard fertilizer to lower its quality. It is rampart in many states of India and farmers and suffering great losses. According to tests carried out by Soil Research Development Institute (SRDI), nearly 40 per cent of all fertilizers used by farmers are adulterated, as reported in a leading Bangla daily. Mixing of harmful chemical substances degrades fertility of the land and causes serious health issues for humans. Moreover, by applying such contaminated fertilizers, farmers are cheated and production suffers. Though the department of agriculture extension along with other agencies regularly test fertilizers available in the market.

A Fertilizer is Said to be Adulterated when

1. It contains harmful or deleterious ingredient or unwanted to harm crop or weed seeds in quantities sufficient to harm the plant when applied according the directions on the label.
2. Its composition as below or differs from that given on the label.
3. Useless extraneous material like salt, sand, soil, ash, and other waste material are added it.

Harmful Effects of Adulterated Fertilizer Use

1. The use of adulterated fertilizers with nutrient deficiencies over the year affected soil fertility and caused losses to farmers.
2. Fertilizer adulteration affects economic of farmers as fertilizers with low nutrient contents force farmers to buy more fertilizers to get enough crop nutrients.
3. Adulterated fertilizers also reduce crop productions, affect the food quality.
4. Effects on soil health like use of adulterated fertilizers would cause soil poisoning.

Method of Detection of Adulteration

1. For presence of Nitrogen: By mixing small quantity of lime in sample and rubbing, the smell of pungent Ammonia gas indicates the presence of Nitrogen. Sodium Hydroxide (concentrated) to be added and by heating the tube from the side then put moist red litmus paper on the mouth of the tube. Observe the change of the red litmus paper to blue which confirms the presence of Nitrogen and no change indicates the absence of the nitrogen and the fertilizer may be considered suspected.

Used for ammonium nitrate or ammonium sulphate nitrogen. Ammonium nitrate and ammonium sulphate produce when they react with formaldehyde produce nitric acid and sulphuric acid respectively. The liberated acids can be titrated with standard sodium hydroxide using phenolphthalein indicator. The result obtained as ammonium nitrate and ammonium sulphate can be converted to %N by multiplying with the factors 0.349978 or 0.212 respectively.

2. For presence of Phosphorus: On adding 2 ml of Ferric Chloride-Ammonium acetate reagent and formation of yellow precipitate, which gets dissolved in 5-6 drops of concentrate Nitric Acid confirms presence of phosphate. Non formation of yellow precipitate indicates absence of Phosphate and the sample is suspected.

Likewise, with the use of filter paper, take 1 ml silver nitrate in the filtrate. If the formation of yellow precipitate is also dissolved in 5-6 drops of nitric acid it confirms the presence of phosphate in the material.

3. For presence of Potassium: By adding 5-6 drops of Cobalt Nitrite reagent in the filtrate and formation of yellow precipitate indicates the presence of potassium in the fertilizers. The non-formation of the precipitate indicates that the material is spurious. These are for testing the NPK Complexes.

These are quick testing kit and there are limitations also. It is only for qualitative test. Samples failing in the quick test are likely to fail in the detailed laboratory analysis.

Urea

White, shining and round shaped grains of approximately uniform size. Completely soluble in water and when solution is touch, it feels cold. It melts when it is put on hot plate and nothing remains if it is heated.

To detect adulteration in the Urea, take 1 gm fertilizer in test tube and add 5 ml distilled water to dissolve the material. Add 5-6 drops of Silver Nitrate Solution. The formation of white precipitate indicates that material is adulterated. The non-formation of any precipitate indicates that Urea is pure.

Di Ammonium Phosphate (DAP)

Hard, granular, brown or black in colour and difficult to erase with nails. If some grains of DAP are mixed with lime and rubbed, it produces sharp odour which is un bearable to smell. The grains swell if put on a hot plate.

For DAP and MOP take 1 gm fertilizer, add 5 ml distilled water and shake well. Then add 1 ml Nitric Acid and again shake. If it is dissolved and forms semi-transparent solution then DAP is pure and if any insoluble material remains, then it is adulterated.

Potassic Fertilizer

Potassic fertilizer adulterated by mixture light white powdery salt and red chili. If the potash particles are moist, they do not stick and fertilizer is not adulterated. If dissolved in water, red portion of the fertilizer comes up.

Super Phosphate

This is a hard granular, brown or black in colour which cannot be easily broken by the nails. It is available in the form of powder also. There is a possibility of adulterating it often with mixture of DAP and NPK.

If this granular fertilizer is heated, it does not swell whereas grain of DAP and other complex swells. In this way, adulteration can easily be identified.

Zinc Sulphate

Magnesium sulphate is most commonly used chemical for adulteration in Zinc sulphate. As they are physically similar in appearance, it is difficult to identify fake fertilizer. If zinc sulphate is mixed with DAP, a thick precipitate is formed but it does not happen so with Magnesium sulphate. If zinc sulphate solution is mixed with light caustic solution, a dark muddy precipitate is formed. Which dissolves completely in concentrate caustic solution, if there is Magnesium sulphate in place of Zinc sulphate, precipitate does not dissolve.

Steps Against Fertilizer Adulteration by Government

The fertilizer Control Order which first came into effect in 1957, Government feels that it has served the purpose in that the farmers spread over the length and breadth of the country are assured of getting quality fertilizers. For effective enforcement of quality, the state Government have set up Fertilizer Control Laboratories to test the fertilizer Inspectors. However, some qualitative test has been developed by the Central Fertilizer Quality

Control & Training Institute, Faridabad which can help the farmers to know if the fertilizer is genuine or adulterated.

To ensure that the fertilizer reaches the farmers in the right quality, such checks are carried out by the field staff of the industry. The samples are drawn randomly for analysis in the laboratories of the manufacturer. These samples are drawn from various storage points /warehouses as also from the companies on a regular basis to keep a check on the quality of the fertilizer. Analytical reports of such samples are reviewed on a regular basis. These are simple tests and only indicate if the product is genuine or adulterated, but the extent of deficiency will not be known and also it may not lead to the prosecution of offender in a court of law. However, it may forewarn the farmer to be careful from those dealers or suspected material.

Steps Against Adulteration by Farmers

Chemical fertilizer is the costliest among different farm input material used in agriculture. The manufacturer and retailers try to place fake and adulterated fertilizers in the market before Kharif and Rabi season when the demand of fertilizer is highest. It has direct impact on the farmers. Though the government is committed to control the problem of fake and adulterated fertilizer, the farmers should check the purity of fertilizers at the time of purchase in the same manner as they do at the time of purchase of seeds by cracking it with teeth, check the quality of clothes by touching it or quality of milk by pouring the finger in it.

Often fake and adulterated DAP, Zinc, Urea and MOP is placed in the market which is commonly used by the farmers. Farmers can test it first at the time of purchase by adopting following methods and if the fertilizer is found fake, it can be confirmed by testing at Kisan Seva Kendra by using testing kit. Testing kit has been made available at all Kisan Seva Kendra. In such circumstances, information can be given to Deputy Director, Agriculture (Extension), District Agriculture Officer and Director, Agriculture of the state for further action.

Conclusions

However, the quality of the food changed forever. The pesticides and chemical fertilizers impacted the nutrition value of the crops and the soil. Adulteration diminishes the quality of the food by adding unnatural substances and most of the chemicals used in adulteration are poisonous and hazardous to health. So, analysis of fertilizers before application is necessary for the soil health and food quality. the authorities to take necessary steps to stop this harmful practice by strengthening, monitoring and meting out exemplary punishment to those involved in fertilizer adulteration.

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Transgenic Onion (Tearless Onion)

Article ID: 32191

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Summary

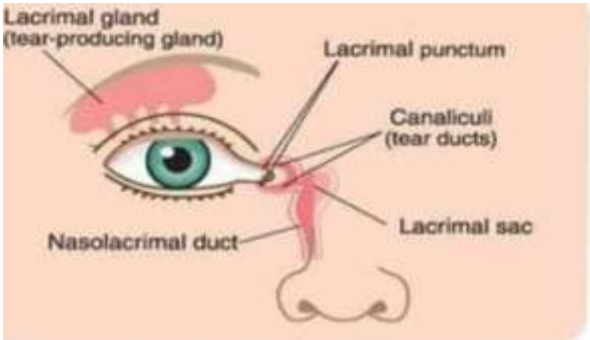
Onion (*allium cepa*.L fromscilis Latin cepa onion) is well known species in allium and its closely related with garlic also. Here while disrupting of onion, amino acids derivatives that produces allinase. This allinase enzyme is corresponding for producing sulfenic acid that makes tears in our eyes and that lachrymatory factor sythase transcript gene can be manipulated by Rna interference (RNAi) splicing. By doing this genetical manipulation when we disrupting onion that won't irritate our eyes.

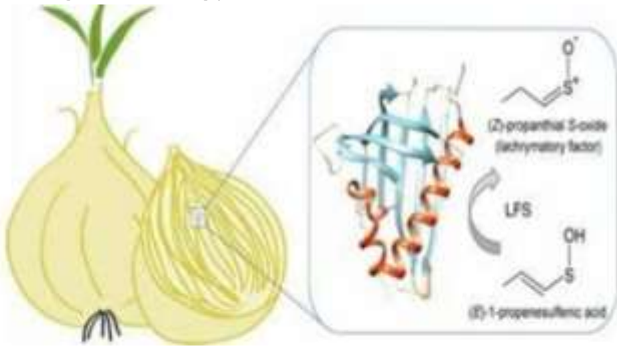
Introduction

Did you notice that some onion makes use cry and some does not that because of sulphur content in the soil? High sulphur soil content onion makes us cry a lot and less sulphur content soil onion doesn't make us much cry. In general garlic also an allium family but while chopping it won't make us cry. In onion there is a defence mechanism so which we get tears by the irritating chemical like propanthial s- oxide, this volatile chemical is known as lachrymatory factor.

This quickly evaporates and find its way into our eyes and there it dissolves in the water covering surface of our eyes to from sulfenic acid and this acid is produced is so small so it only effect in irritating and not harmful. According, to the nature of the sulphur content in the soil it has the effect in onion by it absorbs from the ground and hold in a compound called PRENCSO1 (1-propenyl-L-cyteini sulphide).

When the onion gets cut or damaged it release allicinase, thus allicinase reacts with PRENCSO to produce ammonia and another chemical called 1- propenyl sulphenic acid and it produce lachrymatory factor sythase we can switch off the gene which cause tears by gene splicing technology.

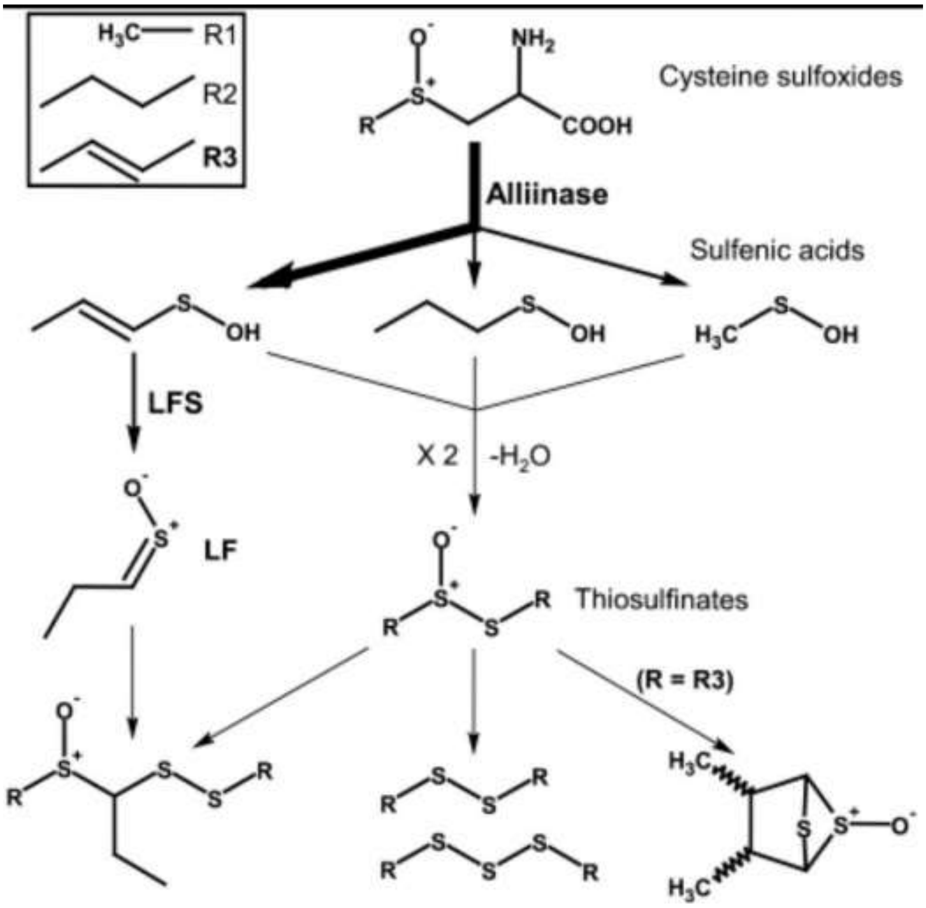




Gene Manipulation

Onion is a very difficult biological system to work with because of its large genome, and it's a heterozygous, has a slow generation time also. Lachrymatory factor is responsible for the chemical which causes irritate eyes. Through a single genetic transformation in onion . Here we suppressed the lachrymatory factor sythase gene by using RNA interference.

This reduces lachrymatory sythase activity by up to 1,533 folds. This can be confirmed by novel colorimeter aasay. This silencing had shifted the trans-s-1-propenyl-L-cysteine sulfoxide breakdown pathway so that more 1-propenyl sulfenic acid was converted into di-1-propenyl thiosulfinate. Consequence of this raised thiosulfinate level increased in downstream production of nonenzymatically produced zwibelane isomers and other volatile sulphur compounds, di-1-propenyl disulphide and 2-mexapto-3,4 dimethyl-2-3-dihydrothiopene, that in trace amount or had not been detected on onion.



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QTL Mapping and Fruit Quality Traits in Tomato

Article ID: 32192

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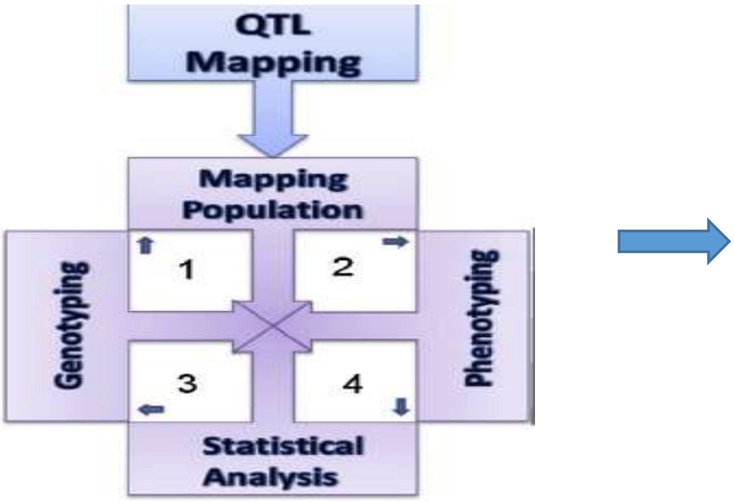
Introduction

Tomato (*Solanum lycopersicum* L.) is one of the important vegetable crops grown and consumed throughout the world. It has versatile use both in fresh as well as processed form and it also supplies many vitamins, minerals to the human health. As the present market is driven by the quality of the produce, hence, quality improvement is one of the important objectives in tomato breeding. Important fruit quality parameters of tomato are fruit shape, fruit size, fruit colour, pH, titrable acidity, firmness, locule number, pericarp thickness, TSS etc. Nutritional parameters like Vit A, Vit C, minerals etc. are also very important quality attributes. Most of these quality parameters are complex, governed by polygenes, hence, conventional breeding based on phenotypic selection is ineffective to transfer these genes into a desired genetic background.

With the advancement of biotechnological tools, now it is possible to identify the markers for these quantitative traits and locate them on genetic linkage map through QTL mapping. These QTLs were proved potential in improving the desirable traits through molecular breeding. In tomato, greater genomic resource information is available and many QTLs have been mapped for traits of agronomic importance. Quantitative trait loci (QTL) QTLs are short segments of DNA (locus) that have some contribution towards the phenotypic value of quantitative traits. Such locus may carry single or group of genes that are tightly linked and mostly inherited together. Many such loci determine the total phenotypic value of the trait (e.g., yield). Each of these loci are called QTLs. Major QTLs are those loci that have major impact on the phenotypic value, whereas minor QTLs have minor impact on the phenotypic value. In QTL Mapping, association between observed trait values and presence/absence of alleles of markers, that have been mapped onto a linkage map is analysed. When it is significantly clear that the correlation that is observed did not result from some random process, it is proclaimed that a QTL is detected. In addition, the size of the allelic effect of the detected QTL can be estimated.



QTL

It is defined as “a region of the genome that is associated with an effect on a quantitative trait”. Conceptually a QTL can be a single gene, or it may be a cluster of linked genes that effect the trait.

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QTL Mapping

"QTL mapping is process of locating genes with effects on quantitative traits using molecular markers."

Why QTL Mapping?

1. Direct mean to investigate the number of genes influencing the trait.
2. To know the location of the gene.
3. To know the effect of dosage of these genes on variation of the trait.
4. For DNA based marker assisted selection.
5. Genetic mapping is the first step to map based cloning.
6. To study linkage between genes of interest.

Principle of QTL Mapping

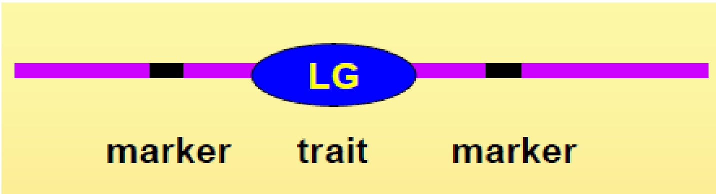
QTL analysis is based on the principle of detecting an association between phenotype and the genotype of markers. Based on the presence or absence of a particular marker loci, the mapping population is partitioned into different genotypic groups and these groups are analysed for significant differences with respect to the trait.

Objective of QTL Mapping

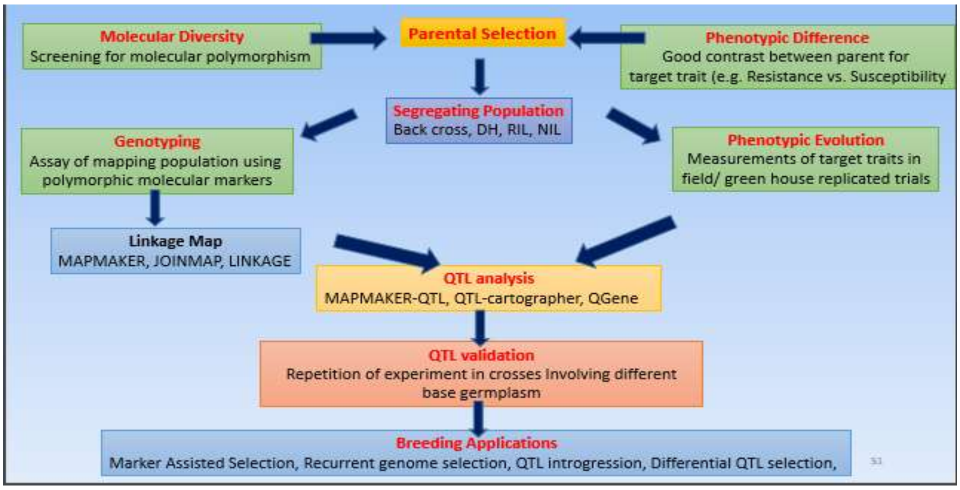
To identify the region of the genome that affect the quantitative trait of interest. To analyse the effect of the QTL on the trait.
1. How much of the variation for the trait is caused by a specific region.
2. What is the gene action associated with the QTL.
3. Which alleles are associated with the favourable effect.

Marker

An entity helps to identify something. Where, genetic marker is a gene or DNA sequence with a known location on a chromosome and associated with a particular gene or trait.
Trait: Our desirable character
The marker should be closely linked with the trait of interest..........



Steps Involved in QTL Mapping



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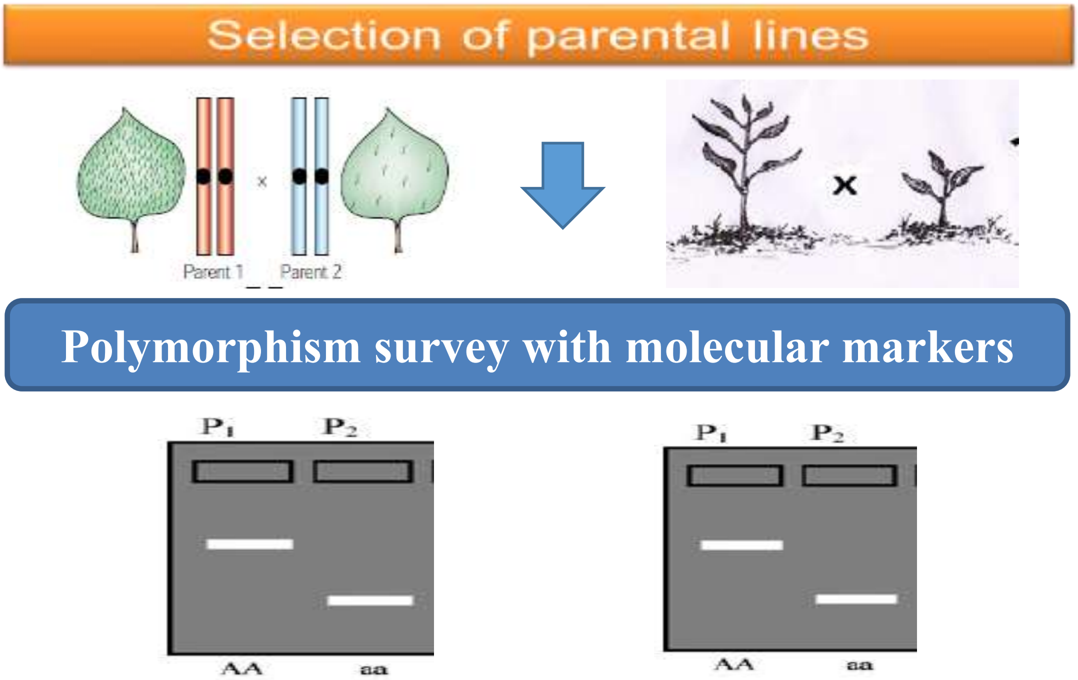
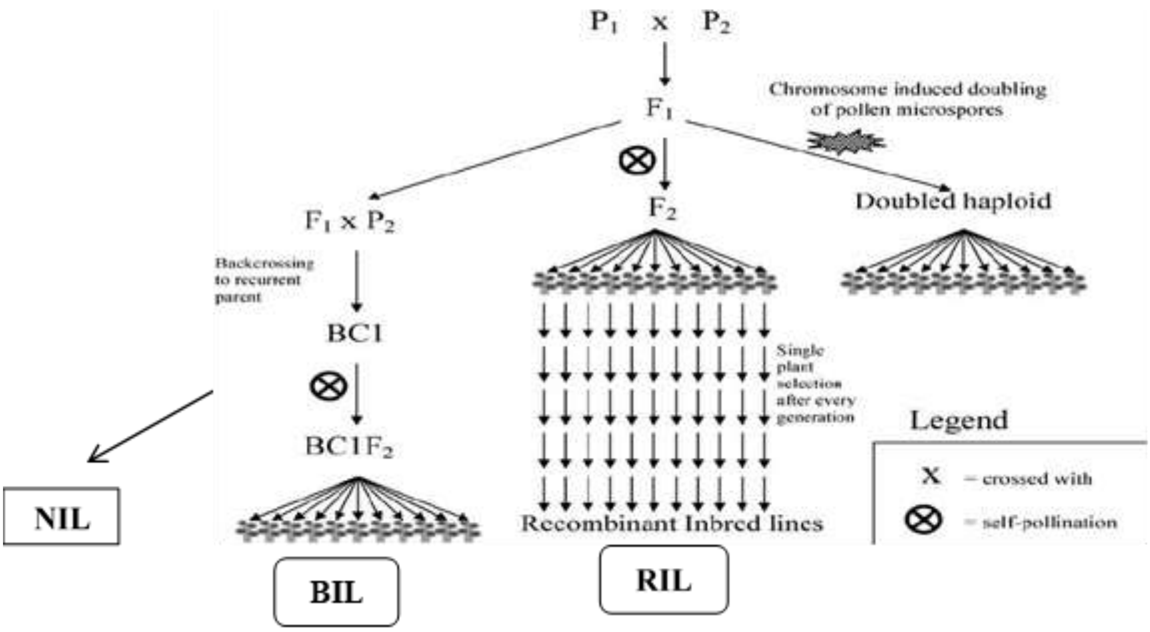


Mapping Population

Mapping population consists of individuals of one species, or in some cases they are derived from crosses among related species. It is a group of individuals on which genetic analysis is carried out. It can be either segregating for traits under study or a set of near homozygous lines representing a F2 variation. In both situations mapping population is generally derived from a single cross whose parents were polymorphic for the trait of interest.

Mapping Population



Type of Population Used for QTL Mapping

1. F_2 population.
2. Recombinant inbred lines (RIL'S).
3. Backcross inbred lines (BIL'S).
4. Near Isogenic lines (NIL's).

5. Doubled Haploids (DH's).

Methods for QTL Detection

1. Single Marker Approach.
2. Simple Interval Mapping (SIM).
3. Composite Interval Mapping (CIM).
4. Multi trait Interval Mapping (MIM).

Applications of QTL Mapping

1. Sequence analysis.
2. Marker assisted selection.
3. Pharmacology.
4. Bioinformatics.
5. Gene expression.
6. Crop improvement.
7. Map based cloning.

Conclusion

Recent advances in molecular marker technology is available for precise detection of QTL and Transfer of the complex traits into the desired genetic background. Since the tomato genome sequence is available and number of QTL studies identified many potential QTL for the various traits including fruit quality.

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Impact of Climate Change on Insects

Article ID: 32193

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Introduction

The distribution, abundance, physiology, behaviour and ecology of all species will be affected by climate change (Hughes L., 2000, Andrew et. al., 2013). Species are expected to respond idiosyncratically, resulting in changes in interactions, such as competition, predation or parasitism, with far-reaching consequences for community structure, composition and function (Hughes L., 2012, Tylianakis et. al., 2008). The decoupling of present-day interactions between plants and insects may be particularly important. Insects have already responded to climatic changes over the past few decades, via range shifts and changes in phenology (Forister and Shapiro., 2003, Wilson et. al., 2007). Mismatches in interactions between species have occurred, due to temporal(Parmesan., 2007, Visser and Both C 2005) and spatial (Merrill et. al., 2008, Parmesan et. al., 1999) decoupling. Further, significant changes in the structure of species assemblages are already apparent in both temperate and tropical regions(Walther GR.,2010, Sheldon et. al., 2011) Increasing temperature may have particularly profound impacts on the composition of insect communities because it will affect almost all life history parameters, including emergence, growth rate, and voltinism (Bale et. al., 2002, Cornelissen, 2011). A field-based warming experiment that manipulated several factors (temperature, CO2 and water) showed that temperature had the largest effect on insect community composition and structure as a result of individualistic responses of both individual species and of different feeding guilds.

Attempts to assess and predict the biological impacts of climate change, are two of the most important and intensive research endeavours of our time (IPCC, 2007; Loarie et al., 2009). The knowledge base for the information relating to biological impacts of climate change is highly integrative, covering broad disciplines of behaviour, biogeography, ecology, evolution, genetics, genomics, phenology and physiology. In spite of the large amounts of data that are being accumulated addressing biotic responses of organisms to climate change, we are still a long way from understanding whether there are generalities across space, taxa, and time in terms of responses and adaptability to rapid change, or whether most organisms will respond idiosyncratically, and the implications of this on species interactions both within and among trophic levels. In addition, the lack of long-term records (>50 years) means that much of the research today is being conducted without a strong baseline to assess species and community responses to climate change, with the exception of a few charismatic species in some regions. Insects are the most dominant groups of organisms on the planet in terms of species richness, abundance and biomass (Gullan & Cranston, 2010). There has been a substantive amount of research dedicated to assessing potential insect responses to human-induced climate change. One of the major challenges we face is to determine the impacts of climate change on insects, broadly, and gather enough information to develop mechanistic models on single species (Angilletta, 2009; Kearney et al., 2009) and species interactions (e.g. game theory Mitchell & Angilletta, 2009) across a range of species to assess multi-trophic community responses to climate change. Published research on climate change and insects to assess the type of research being carried out, it's geographic location and identify the Orders, variables and factors being tested.

On climate change affecting insects is being assessed, what factors are being tested and the localities of studies, from 1703 papers published between 1985 and August 2012. Most published research (64%) is generated from Europe and North America and being dedicated to core data analysis, with 29% of the studies analysed dedicated to Lepidoptera and 22% Diptera: which are well above their contribution to the currently identified insect species richness (estimated at 13% and 17% respectively). Research publications on Coleoptera fall well short of their proportional contribution (19% of publications but 39% of insect species identified), and to a lesser extent so do Hemiptera, and Hymenoptera. Species specific responses to changes in temperature by assessing distribution/range shifts or changes in abundance were the most commonly used methods of assessing the impact of climate change on insects (Andrew et al. 2013).

Table 1. Categories given to each study for data type, region, the main climatic drivers that authors identified, the type of information that authors collected and presented in their results, and the habitat in which the study was carried out. (Andrew et al. 2013).

Data type	Region	Climatic drivers	Information	Habitat
Data only	Africa	Temperature (Temp)	Abundance	Native
Data and modelling	Antarctic	Moisture	Distribution/ Range shift	Agricultural
Desktop	Arctic	Temp and Moist	Interactions	Native/Agricultural
Modelling	Asia	Evolution	Assemblage composition	Forestry
Review	Australia/ Oceania	Carbon dioxide (CO_2)	Phenology	Human/Domestic
No Theme	Europe	Temp and CO_2	Development time	Animal
	Global	Variety	Survival	Non-specific
	Middle East	Non specific	Physiology	
	New World	Fire	Non-specific	
	Non-specific	CO_2 and Ozone	Genetics/Genomics	
	North America	UVB	Behaviour	
	South America	Others	Morphology	
	Tropics		Body weight	
	Variety		Other life history traits	

Impact of Climate Change on Pests in India

Conditions are more favourable for the proliferation of insect pests in warmer climates. Longer growing seasons will enable insects such as grasshoppers to complete a greater number of reproductive cycles during the spring, summer, and autumn. Warmer winter temperatures may also allow larvae to winter-over in areas where they are now limited by cold, thus causing greater infestation during the following crop season. Altered wind patterns may change the spread of both wind-borne pests and of the bacteria and fungi that are the agents of crop disease. Crop-pest interactions may shift as the timing of development stages in both hosts and pests is altered. The possible increases in pest infestations may bring about greater use of chemical pesticides to control them, a situation that will require the further development and application of integrated pest management techniques.

Impact of Climate Change on Insects in USA

Most analysis concur that in a changing climate, pests may become even more active than they are currently, thus posing the threat of greater economic losses to farmers.

With temperatures within their viable range, insects respond to higher temperature with increased rates of development and with less time between generations. (Very high temperatures reduce insect longevity.) Warmer winters will reduce winterkill, and consequently there may be increased insect populations in subsequent growing seasons. With warmer temperatures occurring earlier in the spring, pest populations can become established and thrive during earlier and more vulnerable crop growth stages. Additional insect generations and greater populations encouraged by higher temperatures and longer growing seasons will require greater efforts of pest management.

Warmer winter temperature will also affect those pests that currently cannot overwinter in high-latitude crop regions but do overwinter in lower-latitude regions and then migrate to the crops in the following spring and summer. For example, the potato leafhopper *(Empoasca fabae)*, a pest of soybeans, alfalfa and other crops, may expand its overwintering range (now limited to a narrow band along the Gulf of Mexico) and thus be better positioned to travel to the U.S. Midwest earlier and in greater numbers during the cropping season.

Some species are pests in America's South but not in the Midwest, because they do not migrate to the Midwest early enough or in significant numbers. Corn earworm *Heleliothis zea* (Hubner)) is an example of a current pest of corn and soybean in the South that is not a serious pest in field corn and soybean in the Midwest. With climate change, extension of overwintering range may bring the corn earworm to field corn and soybean crops in the Midwest.

The damage of the European corn borer *(Osrinia nubilalis)*, a major insect pest of corn in the U.S. and elsewhere, is limited in many regions due to current climate conditions. For example, in Iowa the insect has only two generations per corn-growing season because the third-generation pupa cannot complete development before the winter. Warmer conditions will ensure a third generation of the insect and would make its overwintering population significantly larger.

Since warmer temperature will bring longer growing seasons in temperate regions, this should provide opportunity for increased insect damage. A longer growth period may allow additional generations of insect pests and higher insect populations. The Mexican bean beetle and bean leaf beetle, both major pest of soybeans, presently have two generations in the U.S. Midwest and three in the Southeast. An additional generation may be possible in the Midwest if the growing season there lengthens. The preponderance of evidence indicates that there will be an overall increase in the number of outbreaks of a wider variety of insects.

Impact of Climate Change on Pests in Europe

Crop protection in Europe became strongly chemically oriented in the middle of the last century. An excellent climate for fast reproduction of pests and diseases demanded high spray frequencies and, thus, resulted in quick development of resistance against pesticides. This initiated a search for alternatives of chemical pesticides, like natural enemies for control of pests. A change from chemical control to very advanced integrated pest management programs (IPM) in European greenhouses took place at the end of the last century. For the main greenhouse vegetable crops in northern Europe, most insect problems can now be solved without the use of insecticides. IPM without conventional chemical pesticides is a goal that will be realized for most of the important vegetables in Europe, not limited to greenhouse vegetables. At the same time, however, climate change affects the distribution, the phenology, the susceptibility and the interrelationship of insects drastically, which emphasize the risk of sustainable crop protection by losing the control on pests - natural enemies' populations. Mean annual temperature changes between 3 and 6oC are estimated to occur across Europe, with greatest increases occurring at high latitudes. An increase of 6oC in temperature, and precipitation deficit of 300 nm reduced the maize yield by 36% in the European Union. Under the climatic changes projected by the Goddard Institute for Space Studies general circulation model, northward shifts in the potential distribution of the European corn borer of up to 1220 km are estimated to occur, with an additional generation found in nearly all regions where it is currently known to occur.

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Locust Information

Article ID: 32194

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Introduction

Locust (sleeping giants) are short horned grasshopper with highly migratory habit , marked polyphenism and various feeding behaviour. They are capable of forming swarms and hopper bands. Locust problems in southwest Asia have a long history and probably began when crops were first cultivated Four species viz.,desert locust , migratory locust, Bombay locust and tree locust are found in India. Among all these, desert locust is the most important in India.

Host Crops

Desert locust are polyphagous feeding on wide range of plant species viz. Gramineae (Barley, Maize, Sorgum, Wheat), perl millet, rice, pasture grasses, rye, sugarcane, cotton, fruit trees, date palms, banana plant, vegetables, citrus, corn, peanuts, rangeland grasses, acacia, pines and weed.

Nature of Damage

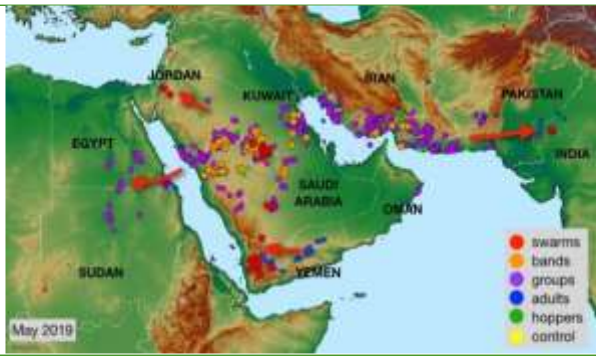
Both nymphs and adults are polyphagous and feed on leaves, shoots, flowers, fruit, seeds, stems and bark.

Habitat and Ecology

Desert locust is well adopted to live in a vast arid and unpredictable land scape. During recession years, they live in a broad belt of arid and semi-arid habitat that spans from the western coast of Africa to north-west India which has 0-400 mm sporadic and unpredictable annual rainfall.

Distribution

The invasion area of locust covers about 30 million square kilometres which covers whole or parts of nearly 64 countries including north, west and east Africa countries, Arabian Peninsula, the southern republic of USSR, Iran, Afghanistan and the India sub-continent.



Economic Importance

Damage to crops caused by locust during 1926-31 cycles, on a conservative estimate was about 0 crore. During 1940- 46 and 1949-55 locust cycle the damage estimated was Rs. 2 crore each and it was only rs. 50 during the last locust cycle (1959-62). Damage estimated was rs. 2 lakhin1978 and Rs. 7.18 lakh in 1993. Thereafter, insignificant damage by locust upsurges were reported.

In Gujarat, approximately 6000 hectares of farmland has come under the attack of locust. Of the 11 talukas of Banaskantha, Suigam, Danta, Tharad and Vav are the worst affected.

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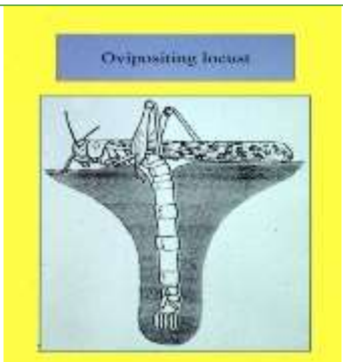
Life Cycle

Locust life cycle has three distinct stilly immature has soft wages, viz., eggs, hoppers and adults.

Eggs are laid in pods in moist sandy soil at the depth of about 10 cm at an interval of 7-10 days. Gregarious female usually lay 2-3 egg pod having 60-80 eggs in average. Solitaries female mostly lay 3-4 times having 150-200 eggs in average.

There are 5 instars in gregarious and 5-6 in stars in solitary's population.

Fifth instar nymph moults into adult stage. This change is called 'fledging' and the young adults is called "Fledgling or immature" adult means they are sexually immature has soft wings that must dry and harden before it can fly. In suitable condition the adult may mature in 3 weeks and under cool and dry condition it may take 8 months.



Locust Phases

Tactile stimulation on hind femur or a combination of visual and olfaction stimuli from conspecifics will induce behavioural phase change. Locust is generally found in solitary and gregarious phase change.

Breeding Seasons

There are mainly three breeding seasons viz., summer, winter and spring.

Management

1. Preventive control strategies: LWOs and all concern units under takes regular surveys in scheduled desert area to monitor the presence of desert locust. If locust found above ETL (10000 adults/ha and 5-6 hopper/bush) immediate control measures are under taken.

2. Non chemical methods: Ploughing field infested with egg pods. Use of flame throwers and burning roosting locust at night.
Dug trenches and herded hopper bands into deep trenches and burning, drowning or crushing them.
Scattering straw over roosting sites and burning it.
Lighting fires or making noise to prevent swarms from setting in crops.
The oil formation of the entomopathogenic fungus *Metarizium flavoviride* effectively managed hopper bands in the field. In caged samples of treated insects 99 % mortality was observed in 15 days.
Systemic action of neem seed product against desert locust immature stage infesting potted millet plant in sudan and revealed that all neem seed product induced significant systemic antifeedant activity ranging from 52 to 99 per cent.

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Sugarcane Borer Pest Information

Article ID: 32195

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Introduction

For centuries, farmers have cultivated sugarcane to produce sugar. This remarkable crop is of big importance as a cash crop for families and smallholders in developing countries. Sugarcane is mostly cultivated warm climates, therefore top producers are Brazil, India, China, Thailand, and Pakistan. The main purpose of its cultivation today is also sugar production. However, the use of sugarcane is expanding into the products such as ethanol and biofuel, biomass used for electricity, and bioplastics. While the average yield of sugarcane worldwide is close to 60 t/ha, some countries manage to produce more than 100 t/ha. However, pests represent one of the biggest threats for farmers who are growing this powerful cash crop. Scientists estimate that insect pests cause almost 20 to 40% of farmer's yield losses. Borers are one of the most significant insect pests that attack sugarcane, thus endangering farmer's productivity.

Early Shoot Borer

1. Biology:

a. Egg: Flat – scale like eggs are laid in 3-5 rows on the lower surface of leaves in masses of 4-100. The masses are slightly overlapping like tiles. It hatches 4-6days.

b. Larva: Larva is dirty white with five dark violet longitudinal stripes and dark brown head. Duration 16-30days.

c. Pupa: Pupation takes within the tunnel. Caterpillar before pupating makes a large exit hole in the stem and blocks the opening with silken discs.

d. Adult: Pale greyish brown moth with black dots near the coastal margin of the forewings and with white hind wings.

				
Dead heart	**Bore holes**	**Larva**	**Pupa**	**Adult**

2. Damage symptoms: Dead heart in 1-3-month-old crop, which can be easily pulled out, rotten portion of the straw-coloured dead – heart emits an offensive odour. A number of bore holes at the base of the shoot just above the ground level.

Internode Borer

1. Biology:

a. Egg: Scale – like oval, flat, shiny and waxy white eggs are laid by female moths in batches of 9-11, near the midribs, on leaf sheaths or on stem.

b. Larva: White larva with four violet longitudinal stripes and light brown head.

c. Pupa: Pupation takes place in semi – dried sheath. Pupal period 7 - 10 days.

d. Adult: Straw coloured with a dark spot on each of the forewings.

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Bore hole with extract	**Larva**	**Pupa**	**Adult**

2. Damage symptoms: Internodes constricted and shortened with a number of bore holes and frass in the nodal region Affected tissues reddened.

Top Shoot Borer

1. Biology:

a. Egg: Eggs are laid on the lower surface of top leaves in clusters particularly near midribs. The clusters are covered with buff coloured hairs. : 10-80 eggs per egg mass.
b. Larva: Smooth, white or cream coloured with a red coloured mid – dorsal line and yellow head.
c. Pupa: Pupation takes place within the larval tunnel in a chamber with an exit hole Constructed by the caterpillar. Pupal period 6 - 21 days.
d. Adult: White Coloured moth (with a buff Coloured anal tuft in the abdominal tip of female).

			
Parallel hole	**Larva**	**Pupa**	**Adult**

2. Damage symptoms:

a. Dead heart arises on after sixth month grown up canes, which cannot be easily pulled.
b. Parallel row of shot holes in the emerging leaves.
c. Bore holes at the top of the shoot and shows bunchy top appearance.

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A Survey: Groundnut Area, Production and Productivity

Article ID: 32196

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Introduction

The survey which was carried out to discuss the groundnut area, production and productivity in India and Karnataka as it occupies the significant position in the agricultural economy of the country. In world scenario, India is the 2nd largest producers of oilseeds and occupies first position in terms of area, second position in terms of production and 8th position in the productivity of groundnut. The estimated production of nine oilseeds viz., Groundnut, Rapeseed-Mustard, Soybean, Sunflower, Safflower, Sesame, Niger Castor and Linseed were accounted for an area of 23.44 million hectares with the production of 25.14 million tonnes [1].

Groundnut is scientifically known as Arachis hypogea, a major kharif crop also known as king of oilseeds and an important cash crop in our country. The groundnut is valued for its protein content (26 percent). In addition to protein, groundnuts are a good source of calcium, phosphorous, iron, zinc and vitamin E and Vitamin B. The nutrient found in groundnuts, including folic acid, phytosterols, phytic acid, and resveratrol have anti-cancer effects [2]. The groundnut grown worldwide is 24.7 million hectares with 33 million tonnes of production and an average productivity of 1.33 tonnes per hectare. Developing countries constitute 97% of the global area and 94% of the global production of groundnut crop. The production of groundnut is intensive in Asia and Africa (56% and 40% of the global area and 68% and 25% of the global production, respectively) [3].

Climate, Soil and Varieties

Groundnut is classified as tropical crop and its cultivation exceeded to sub-tropical region lying between 45° North and 35° South. Groundnut being a rainfed crop, a uniform distribution of rainfall is required during critical times viz., flowering & pegging. The suitable rainfall distribution for groundnut crop is 500 - 1250 mm.

The average rainfall required for groundnut crop:
1. Pre sowing operation → 100 mm.
2. Sowing → 150 mm.
3. Flowering and Pod development → 400-500 mm.

The groundnut crop, however, cannot stand frost, long and severe drought or water stagnation [3].

Groundnut grows well in sandy loam and loamy soils and in black soils if proper drainage is provided. Its development is hampered if it is grown in heavy and clayey soils. Groundnut can be classified into three varieties with respect to habit of growth, viz., bunch, semi- spreading and spreading. In Karnataka both bunch type and spreading type varieties are grown. The different bunch varieties like, JL-24, R-8808, R-9251, S-205, ICGS-11, KRG-1, KADARI-9, DH-3-30, DH-8 and spreading varieties like S-230.

Area, Production and Productivity in India

Table 1: Area, Production and Productivity of groundnut crop in India

Year	Area (ha)	Production (tonnes)	Productivity (kg/ha)
2000-2001	6559	6410	977
2001-2002	6238	7028	1127
2002-2003	5936	4121	694
2003-2004	5987	8127	1357
2004-2005	6640	6774	1020

2005-2006	6736	7993	1187
2006-2007	5615	4864	866
2007-2008	6292	9183	1459
2008-2009	6165	7168	1163
2009-2010	5478	5429	1830
2010-2011	5856	8266	1411
2011-2012	5264	6964	1323
2012-2013	4721	4694	994
2013-2014	5505	9714	1765
2014-2015	4769	7402	1552
2015-2016	4597	6733	1465
2016-2017	5338	7462	1398
2017-2018	4888	9253	1893

The state wise area, production and productivity of groundnut crop in India during the year 2017-2018 are presented in Table 2.

Table 2: State wise area, Production and Productivity of Groundnut crop in India

States	Area (ha)	Production (tonnes)	Productivity (kg/ha)
Andhra Pradesh	735.00	1048.41	1426
Arunachal Pradesh	0.92	0.91	980
Bihar	0.57	0.58	1019
Chhattisgarh	20.30	33.39	1645
Goa	1.54	3.47	2258
Gujarat	1679.00	3937.13	2345
Haryana	3.00	3.61	1202
Himachal Pradesh	0.04	0.04	1028
Jammu and Kashmir	0.00	0.00	0.00
Jharkhand	32.27	35.86	1111
Karnataka	564.00	552.62	980
Kerala	0.27	0.38	1394
Madhya Pradesh	224.00	349.00	1558
Maharashtra	291.00	344.32	1183
Manipur	3.34	3.14	941
Nagaland	0.27	1.01	1041
Odisha	33.32	37.77	1134
Puducheery	0.27	0.82	3000
Punjab	1.20	2.34	1950
Rajasthan	640.57	1259.36	1966
Tamil Nadu	327.35	1007.53	3078
Telangana	167.00	372.40	2230
Tripura	2.27	2.76	1215
Uttar Pradesh	88.00	89.14	1013
Uttarakhand	1.00	1.38	1377
West Bengal	70.50	165.20	2343

The year wise area production and productivity of groundnut in Karnataka is graphically presented in figure 1:

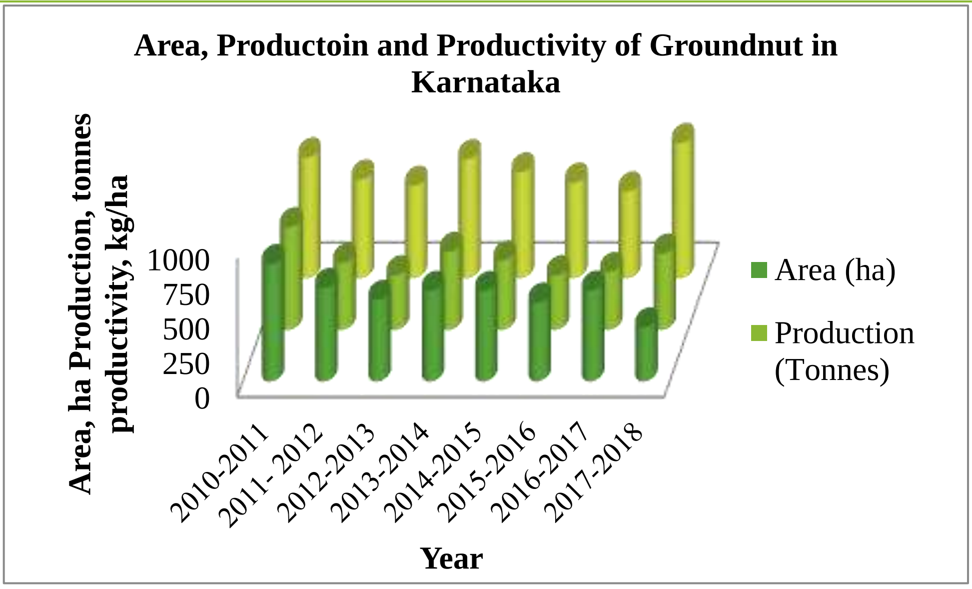

Fig 1: State wise Area, Production and Productivity of Groundnut in Karnataka

Conclusion

The area under groundnut gauged for about 45% of the total cropped area and 55% of the total oilseeds area. Groundnut is exported to other countries and occupies third position in exporting. On an average the productivity in India was 1893 kg/ha during 2017-2018. In India, Gujarat stands first followed by Andhra Pradesh, Rajasthan, Karnataka and Tamil Nadu respectively, in groundnut production.

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Vibration Characteristics of Power Tiller

Article ID: 32197

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Power tillers or two-wheel tractors are the main sources of power supply in small and medium size farms. Due to their economic benefits and user capabilities in various conditions, they are also engaged in land preparation, inter-cultivation, puddling operation in paddy fields, transportation of agricultural product and human beings on rural roads (Ahmadian et al., 2013; Dewangan and Tewari, 2009). In agricultural machinery operation, especially those controlled by operator’s hand, transmit high level of vibrations to operators’ hand and whole body. In spite of power tillers applications and benefits, they generate high level of vibrations due to their single cylinder diesel engine and lack of vibration damping facilities. The operator of a power tiller has to endure various environmental stresses.

The mechanical vibration is the most important parameter that affects sensitivity and reaction rates of the operator fatigue. Besides, the power tiller operators work in harsh environment and this is the reason for importance of ergonomic characteristics. Long term of continues working with power tillers, creates movement disorders, damage to various body organs including the ear, spine and gastrointestinal disorders, and neurological diseases (Salokhe et al., 1995; Tewari et al., 2004). In India, the power tillers are classified in two types, namely walking and riding control type power tillers. In the walking control type, vibrations are transmitted to the operator’s body through the hands i.e. hand-transmitted vibration (HTV). In the case of a riding control type, vibrations are transmitted to the operator’s body from two possible ways: one way is through the seat as whole-body vibration (WBV) and the other through the hands as HTV.

Causes of Vibration

Exposure to hand–arm vibration can be increased by factors such as:

1. Tool characteristics:

a. Higher magnitude of acceleration of vibration.
b. Poor tool maintenance.
c. Minimal handle insulation.
d. Increased weight of tool.
e. Increased surface area of hand in contact with tool.
f. Harder material being contacted.

2. Work organization:

a. Long exposure during each work shift and years of exposure.
b. Lower duration and frequency of rest periods.
c. Lower temperature of work environment.
d. Operators, drivers and passengers of machines and vehicles in workplaces can be exposed to harmful levels of whole-body vibration.
e. The main sources of harmful WBV in vehicles and machines are:
   i. Rough road and surface conditions and resistance forces, e.g. mobile plant with scraper blades.
   ii. Engine vibration.

Effect of Vibration

Hand-arm vibration (HAV) long term exposure from using hand held tools such as pneumatic tools (e.g. concrete breakers), chainsaws, grinders etc, causes a range of conditions and diseases, including:

1. White finger (also known as "dead finger") - damage to hands causing whiteness and pain in the fingers.

2. Carpel tunnel syndrome (and other symptoms similar to occupational overuse syndrome).
3. Sensory nerve damage.
4. Muscle and joint damage in the hands and arms (e.g. 'tennis elbow').
5. These conditions and diseases can have very serious consequences for people. The effects can be permanently disabling even after a few years of uncontrolled exposure.

Ways to Control the Vibration in Both Off Road and On Road Conditions

1. Anti-vibration tools, (anti-vibration pneumatic chipping hammer, pavement breakers) anti-vibration chain saw reduces accelerations levels by the factor of about 10.
2. Anti-vibration Gloves, personal protective equipment (PPE) are used while doing any operation.
3. Safe work practices- By avoiding the continuous exposure to work, use of standard tools wear sufficient clothing including gloves, to keep warm.
4. Training programs are conducted to the operators to give awareness of hand arm vibration syndrome (HAVS) in the workplace.
5. In order to reduce the whole-body vibrations- limiting time spend by the workers on the vibrating surface.
6. Design of vibration equipment's and engine mounting are the best methods of controlling vibration.
7. Apart from these guidelines we have to use Threshold Limit Values (TLVs), these are based on recommendation given by International Organization for Standardization (ISO). The guidelines of ISO 5349 (2001) standard for HTV and ISO 2631 (1997) standard for WBV are the examples for limit working hours and duration of vibration exposure.

Conclusion

1. The vibration of power tiller can cause the health problems to human beings.
2. In this HTV can cause white finger syndrome in operators.
3. Life of operators age is reducing.
4. Vibration isolators are used to reduce the HTV and WBV both in walking and riding type power tillers.

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Nutrient Management in Vegetables Under Protected Conditions

Article ID: 32198

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Vegetables are recognized as health foods globally and play an important role in overcoming micronutrient deficiencies as well as in providing balanced diet for the population. India is the largest producer and consumer of vegetables in the world next to China. However, the production is not enough to meet the required demand, and the challenges associated with increased production include non-availability of land for area expansion, climate change events, increased incidence of pests and diseases and high labour charges. Nevertheless, being an integral component of the daily diet increasing production of vegetables assumes significance in the agricultural plans of every nation.

Cultivation in protected structures – a closed housing such as glass houses, greenhouses, walk in tunnels etc. or a roof top covering alone (rainshelters) has been proven a feasible strategy for enhancing the productivity, augmenting the country's output for export and distribution. According to Singh (2005), protected cultivation refers to creation of favourable environmental conditions around plants, offsetting or minimizing the detrimental effects of prevailing or expected to prevail abiotic and biotic factors, to maximize the yield and resource saving. The increase in productivity is nearly 3-5-fold that under open conditions.

Some of the important vegetable crops suited for protected cultivation are tomato, capsicum, chillies, salad cucumber, yard long bean, cabbage, cauliflower, broccoli, French beans, palak and coriander.

Advantages of Protected Vegetable Cultivation

The comparative advantages of protected cultivation include:

1. Year-round and off-season production of vegetables.
2. Offsetting adverse environment conditions.
3. Feasibility of multiple cropping.
4. Production of high quality and healthy seedlings.
5. Extended growing season.
6. Increased productivity and input use efficiency.

Nutrient Management

As in any crop production programme, supply of the 17 essential elements is critical for crop growth under protected conditions. The modified environment within the protected structure ensures an extended growing period and higher productivity which calls for intense management practices, especially the nutrient inputs. An increased and balanced use of inputs becomes pertinent as the crop has to develop a vegetative and reproductive framework that enables it to bear higher number of flowers and fruits.

The 4R nutrient stewardship concept of nutrient management was developed for the efficient and effective planning and management of plant nutrients so that when implemented it would improve the social, economic and environmental performance of mineral and organic fertilizers. Nutrient scheduling in 4R concept includes the use of the right source in the right quantity at the right time and by the right method to optimize nutrient use, reduce losses and improve yields.

Right Sources

The nutrient sources recommended for protected cultivation are mostly the water-soluble fertilizers (e.g. Urea, MOP, 19:19:19, SOP, potassium nitrate, calcium nitrate) and organic liquid formulations/preparations (e.g.

liquid humic acid, liquid biofertilizers, vermiwash, diluted cow urine, supernatant solution of fermented oilcakes etc). The dependence on chemical sources can be attenuated with integration of organic sources especially biofertilizers, FYM, vermicomposts etc. which would sustain the soil heath promoting microbial activities in soil.

Right Quantity / Rate

The indiscriminate use of chemical fertilizers has added to the problems of environmental pollution and health risks, though indirectly in the latter, and hence use of these inputs in right quantities are important. The nutrient use efficiency of most fertilizers lies in the range of 30-40 % indicative of the losses and unused amounts in soil. Moreover, the build-up of particular nutrients in soil can lead to imbalances, which interfere with the uptake of other essential nutrients. Under protected conditions, as the growing season is extended and higher yields are expected, a higher quantity is required and it is preferable to spread the quantum throughout the growth period rather than confining to the 2-3 splits as practiced under open field cultivation. It is best to start with moderate amounts of nutrients early in the season and increase the concentrations as the crop grows. Supplying plants with small amounts of nutrients on a continual basis can be as satisfactory as supplying large amounts in less frequent additions. Further a soil test-based decision on the quantity minimizes excessive application and pollution in soil.

Table 1. Recommended frequency of fertigation in selected vegetable crops under protected conditions (adhoc recommendation)

Crop	Duration(days)	Splits	Frequency (days)
Yard long bean	110-120	40	3
Cabbage	90-100	30	3
Salad cucumber	80-90	30	3
Capsicum	120-130	40	3
Tomato	140-150	50	3

Right Time

The critical periods of nutrient requirement in crops are identified so as to guarantee the timely application of nutrients. Application of nitrogen (N), phosphorus (P) and potassium (K) through organic and inorganic sources at the critical growth stages (right time-flowering, fruit setting and fruit development) in tomato has been reported to enhance their growth and development(Ahmad et al., 2018). N requirement of tomatoes is moderate during foliage growth, until fruit development, P is very important for vigorous growth and fruit production and K is needed for fruit development and enlargement. They also opined that although the application of NPK @ 80:80:90 kg ha-1 at 15 days interval in tomato under protected conditions resulted in the highest nutritional quality of fruits, a 30-day interval was found to be more economical and confirmed the implementation of the concept of 4Rs as an effective tool for the production of high-quality off-season tomatoes in high tunnels.

Right Method

Phosphorus, the queen of nutrients should be applied basally and as most of the conventional P fertilisers are water insoluble, band application is recommended while the water-soluble fertilizers can be applied through irrigation water in soil (drip fertigation) or to the above ground parts (foliar nutrition).

Fertigation, the most common method of fertilizer application under protected conditions offers precise control on fertilizer application and can be adjusted to the rate of plant nutrient uptake. In addition to the controlled application of nutrients and water, the method improves nutrient use efficiency, minimizes leaching and also the negative environmental impacts. The luxuriant growth of weeds and crop-weed competitions are lowered as the fertilizer is precisely applied to crop root zone alone. The NPK formulations used for fertigation apart from the common water-soluble fertilizers are 20:10:10 + TE+ Mg, 19:19:19 +TE, 16:08:24 + TE + Mg, 13:40:13 + TE, 20:20:20, 6:12:36, 13:5:26 etc.

Foliar nutrition is the regarded as the most effective and practical method for deficiency correction and is presumed to meet15-25 per cent of major nutrient requirements. A complete coverage of the foliage is important and addition of a wetting agent to the spray solution will improve the coverage and also enhance absorption. As many micronutrients are not readily translocated within the plant, a repeat spray will be needed two weeks later to cover the new foliage. However, when a known nutrient deficiency develops, spray the crop with the appropriate nutrient at the recommended rate, every 10 days until the deficiency is corrected.

Multi nutrient formulations (19:19:19, MAP, 13:0:45 etc), IIHR Vegetable special, Sampoorna mix are combination fertilizers recommended for foliar spray.

Major Nutrient Related Problems Encountered in Vegetables in Field Under Protected Conditions

			
Deficiency of Boron	**Deficiency of Magnesium**	**Deficiency of Calcium**	**Deficiency of Potassium**
Management: Foliar spray Borax 0.2 %	Management: Foliar spray, $MgSO_4$ 1-2 %	Management: Foliar spray, $CaNO_3$ 0.5 %	Management: Foliar spray SOP: 0.5-1.0 %

Conclusion

Protected cultivation assures a 4-5fold vegetable yields compared to open condition. Nutrient management through fertigation is recommended for improved nutrient use efficiency as it allows for precise and homogeneous application of nutrients in the area where the active roots are concentrated, at frequent intervals. Soil characteristics like pH and nutrient status availability have to be considered before fertilizer application and the 4Rs have to be given prime importance. Foliar application of nutrients is recommended for managing nutrient deficiencies on a standing crop. Intensive and hi-tech cultivation practices for bountiful yields calls for balanced fertilization through an integrated nutrient management approach in view of the sustainability of production and soil health.

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Bio Fertilizers: Importance and Application in Indian Agriculture

Article ID: 32200

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Introduction

Plant requires multiple nutrients for their proper growth and development at different stages (germination, vegetative growth, flowering, fruiting and ripening) of their life. Agricultural crops extract their part of nutrients from soil and these nutrients occur naturally through soil weathering or supplied by grower in the form of synthetic fertilizers or sometimes in form of manures and bio-fertilizers.

Chemical fertilizers generally supply only primary nutrients i.e. Nitrogen, Phosphorus and Potassium which is removed by crop plants in huge amount but these fertilizers leave the soil deficient in micro-nutrients. This is the reason that Indian soils are found deprived in micro-nutrients like zinc, iron, magnesium etc. On the other hand, major cropping sequence of Indian agriculture is rice-wheat or rice-rice-rice.

These both crops of Gramineae family considered as exhaustive crop and require large volume of nutrients during their life cycle. Chemical fertilizers in such a vast amount destroy soil health through pollution; harm the soil micro flora fauna adversely. So, use of bio-fertilizers is a better substitute for constructing a pollution free soil environment.

When micro-organism alone or in combination are used to escalate crop production through biological nitrogen fixation, solubilisation of insoluble plant nutrients, simulating plant growth or decomposing of plant residues, then it is termed as bio-fertilizers or a substance which contains living micro-organism and enhances plant growth after the application to seeds, plant surface or substrate (soil) through fixation and solubilisation of nutrients.

These fertilizers have potential to convert nutritionally significant element from non-functional form to functional form. They are the chief modules of integrated nutrient management as they speed up microbial process in soil and start mobilization of fixed nutrients to the plant root.

Characteristics of Bio–Fertilizers

1. They are reasonable and nature friendly fertilizers which contain microbial inoculants of algae, fungi and bacteria either alone or in combination.
2. Highly suggested for improving soil fertility and health.
3. They are easily applicable and do not require any extra proficiency.
4. They require in less quantity in comparison to synthetic fertilizers.
5. They help in enrichment of soil through micro- flora build up.

Types of Bio–Fertilizers

There are mainly 6 types of bio - fertilizers being use in agriculture for replenishment of various nutrients to crop plants.

1. N2 fixing bio-fertilizer:

- a. Symbiotic nitrogen fixers: Rhizobium, Anabaena azollae.
- b. Free living nitrogen fixers: Azotobacter, Clostridium, Anabaena, Nostoc.
- c. Associative Symbiotic: Azospirillum.

2. P solubilizing bio-fertilizer:

- a. Bacteria: Bacillus subtilis, Pseudomonas striata.

b. Fungi: Penicillium sp, Aspergillus awamori.

3. P mobilizing bio-fertilizers:

a. Arbuscular Mycorrhiza: Glomus sp., Scutellospora sp.
b. Ectomycorrhiza: Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.
c. Ericoid Mycorrhiza: Pezizella ericae.
d. Pseudomonas, Bacillus megaterium.

4. Bio –fertilizers for micro-nutrients: Silicate and Zinc solubilizes: Bacillus sp.

5. Plant growth promoting Rhizobacteria: Pseudomonas: Pseudomonas fluorescence.

6. Earthworm.

Bio–Fertilizers Application Methods

There are three techniques to use these bio fertilizers.

1. Seed treatment: Seed treatment is a most general mode to apply all type of inoculants. It can be done with any of two or more bacteria. Seed must be coated first with *Rhizobium* or *Azotobactor* then the P.S.M. inoculant has to be applied on external layer of the seeds.

2. Root dipping: This method specifies application of *Azospirillum* with paddy or vegetable plants. Roots of plants are dipped in the *Azospirillum* mixture for half an hour before sowing.

3. Soil application: Phosphate solubilizing bacteria has to be used as soil application. Mixture of cow dung, rock phosphate and PSB is used as soil application in rows or during levelling of soil.

Role of Bio–Fertilizers in Agriculture

1. Bio fertilizers supplement synthetic fertilizers and fulfil he nutrient requirement of crops.
2. Bio-fertilizers add 20-180 kg N/ha in soil and enhance crop production and nutrient use efficiency in a particular optimum environment.
3. They efficiently reduce use of synthetic fertilizers and create chemical free yield.
4. Application of bio-fertilizers results in improved nutrient and water uptake, soil quality, rhizosphere development etc.
5. These bio-fertilizers promote growth of plant through release of growth simulating substances.
6. These bio-fertilizers includes variety of micro-organism which successfully reduces harmful pathogens resulting various diseases thus control many diseases.
7. Bio-fertilizers improve soil fertility, physical properties of soil, tilth and crop- productivity.

Factors Affecting Bio-Fertilizer Response

1. Efficiency of any inoculant and micro-organisms to be determined by host plant and genotype.
2. Quality of inoculant largely influences its results in term of nitrogen fixation and solubilisation of particular nutrients.
3. Package of practices and management of crop alter results of bio- fertilizers.
4. Soil physical and chemical properties highly influence impact of different inoculants and micro-organisms.
5. Climatic conditions like temperature, relative humidity, rainfall and photoperiod affect response of bio-fertilizers significantly.

Constraints in Bio-Fertilizer Application

1. There is lack of good quality of strain which efficiently provide required nutrients in soil.
2. Non- existence of storage facility makes it difficult to adopt bio- fertilizers.
3. Field conditions like extremely high or low pH, temperature, nutrients deficiency not only influence the response of inoculants u also limits heir benefits.

Conclusion

Bio- fertilizers play vital role in enhancement of crop production by improving soil health, supplying various growth promoting organic acids and mobilizing micro nutrients from soil profile to rhizosphere. They reduce total input cost which becomes advantageous after including them in farming. Largely reduce soil pollution created due to synthetic and chemical fertilizers. There is huge need of developing efficient strains for particular crop which contribute efficiently in replenishment of nutrients to the soil.

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Microgreens-Emerging Solution for Food Security

Article ID: 32201

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Due to many folds rise in the world population, there is urgent need for changing food system for the supply of enough nutrition. The problem of malnutrition or hidden hunger world widely affects the people. Microgreens are the distinct group of vegetable that are identified as a source to overcome the problem of malnutrition. These are basically a small version of young green plants, having full nutrition in them. About 80-100 crop varieties, which can be grown as microgreens. Microgreens are easy in cultivation and can be grow for house or at commercial scale. As compared to fully grown plant, microgreens contain higher nutritional status. In this article, there is detail of microgreen production and its role are explained to encounter the malnutrition problem.

Introduction

Malnutrition is defined as shortfall of enough minerals, nutrients, vitamins and phytochemicals including chlorophyll, terpenes, organo-sulphur and poly-phenol compounds in the regular diet. Due to the imbalanced consumption pattern of food without nutrients, the diet associated diseases such as diabetes, hypertension, obesity, cardiovascular problems, cancer and stroke are escalating in world-wide nations. Itis estimated by FAO (Food and Agricultural Organization) that currently, near 795 million people or 10% of total world population are undernourished and 4.5% of children are under weight. Seven million children's those who are under the age of five dies annually because of hidden hunger (World Health Organization). In addition, the human populace is expanding consistently and are to be incredible in future. Hence the issue of malnutrition problem and endeavours towards finding the imaginative implies that can assist with mitigating the issue and guarantee for nutritional security must be seriously concerned. Vegetables known as a productive food are an immense source of nutrition. Numerous studies had indicated that consumption of vegetables can reduce several diseases. In order to address the requirements for the diet with rich of nutrients and freshness a new product "microgreen" has been introduced by the vegetable industry.

What are Microgreens?

Microgreens (vegetable confetti or micro herbs) are grown for their immature tender greens that are been raised from herb, vegetable or grain seeds (Kou et. al., 2014). Microgreens comes under the special group of vegetable that differs from sprouts and baby greens. In recent years, the popularity of microgreens is widened up as novel culinary ingredients for its broad range of alluring colours and strong flavour as shown in fig. They are severed in sandwiches, soups, salads and also in main dishes. Quick growing and the crops that can be easily germinated are competent for the production of microgreens. Crops species that are grown as microgreens includes radish, cabbage, carrot, turnip, chard, beet, broccoli, pea, bok choy, kale, celery, amaranth, sesame, lettuce, cress, arugula, endive, alfalfa, mustard, sorrel, clover, chia, canola, fennel, flax, dill, chervil, basil and cilantro as shown in table 1.

Nutrition Status

Microgreens have gained increasing popularity as food ingredients in recent years because of their high nutritional value. Functional compounds such as minerals, antioxidants, phenolics and vitamins are present in a broadly differing amount in various microgreens. The level of phytonutrients varies according to the stages of growth in plants and found decreasing from seedling stage (sprouts and microgreens) to fully matured stage. Microgreens are mostly consumed raw, retaining all its chemical compounds, that helps in the intake of all the nutrients without being lost. However, growing, harvesting and the storage conditions have a determinable effect on nutrient content of microgreens.

Microgreens Production

Microgreens can be produced by an individual for a house hold purpose at a small scale or for commercial marketing in a large scale. Microgreens can be grown indoor (Greenhouse) or outdoor(Open field) conditions. Soil or soil less media can be used for its production where individual is recommended with traditional soil cultivation and the hydroponics system of growing for large scale production. Seeds of species that are grown into mature plants can be used for microgreen production. Seed treatment becomes compulsory when the media being used is not sterilized. Proper light should be provided since phytochemical accumulation in microgreens are based on it. It is noted that natural sunlight with good air circulation and low humidity were required for quality production of microgreens. The seedlings of microgreens must be kept moist by watering it twice a day.

Depending on the nature of species, microgreens are harvested from 7-14 days of germination, exceptionally income species such as celery it is harvested in 21 days. The microgreen plants reach the height of 2.5 cm - 7.6 command have a fully expanded cotyledon leaves with emerging or slightly expanded first pair of true leaves at the time of harvest. The scissors are used to harvest the microgreens that are cut along with the stem. If microgreens are not harvested at proper stage there is a rapid elongation of stem and leave that leads to the deterioration of flavour and colour. The higher respiration rate with immature tissue and delicate structure makes microgreens highly perishable. They usually have a very short shelf life of about 3 to 5 days of harvest ambient temperature. Hence an appropriate post-harvest care should be given immediately after the harvest is done. Pre-cooling is one of the techniques that expands the self-life where hydro cooling technique sounds good. Some of the packaging technologies such as modified atmospheric packaging can also be used for shelf life extension without the quality or freshness being lost. Treatment of microgreens with sodium hypochlorite after harvest may prevent them from microbial contamination.

Conclusion

Overall, microgreens are the vital novel source to overcome malnutrition problem and can be produced in larger extent in both urban and peri-urban areas. Microgreens would be the cheapest source for phytonutrients and bioactive compounds for maintaining a well-balanced diet. The researchers must take into consideration in extending their shelf life as it is highly perishable in nature and technology for their extended shelf life must be standardized.

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Table 1: Major families of crops used as microgreens (Turner et. al., 2020):

Family		Grown as microgreens
1.	Alliaceae	Chives, scallions, shallots, onions, garlic
2.	Amaranthaceae	Spinach, amaranth, beets, swiss chard
3.	Apiaceae	Celery, cilantro, chervil, fennel, parsley, carrot
4.	Asteraceae	Lettuce, endive, sunflower, garland chrysanthemum

5.	Brassicaceae	Mustards, cabbages, broccoli, cauliflower, radishes, tatsoi,wasabi, arugula, cresses, kohlrabi, mizuna, turnip
6.	Cucurbitaceae	Cucumber
7.	Fabaceae	Sweet pea, alfalfa, fenugreek
8.	Lamiaceae	Mint, basil, chia
9.	Oxalidaceae	Wood sorrels, clover
10.	Poaceae	Corn, lemongrass

Figure 1 List of plant species used as microgreens in recent years.

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The Medicinal Properties of Brahmni Leaf "Bacopa Monnieri"

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Introduction

Ayurveda has been known to treat innumerable ailments for centuries and continues to do so by its age-old practice of balancing the various systems in our body through herbal treatments. One such unique herb is Brahmi which has often been regarded as a brain booster. Brahmni is a typical herb originated all over India. It is a plant which lives more than two years (perennial) of 10 cm high.

It even grows in hot and moisture place. It is one of the medicinal plants in India. The word Brahmni comes from the word 'Brahman' which means Consciousness of God. Brahmni gives a state of calmness to the body, soul and spirit. It is mainly originating from Karnataka, Kerala, Odisha, Bihar, Punjab, Haryana, Bengal, Tamil Nadu, Himachal Pradesh and Uttrakhand.


The whole plant including the flowers can be used for medicinal purposes. It has a bitter and sweet taste and is known to impart a cooling energy. Brahmi is a therapeutic herb commonly used as a memory enhancer, aphrodisiac and a health tonic.

"Brahmi is excellent for improving your brain functions and strengthening your memory. It enhances the three aspects of memory which include long term memory, short term memory and the retaining capacity. Brahmi has a cooling property which keeps the mind calm and free of anxiety. It also promotes sound sleep." Here are eight wonderful benefits of Brahmi and how it can help you achieve good health.

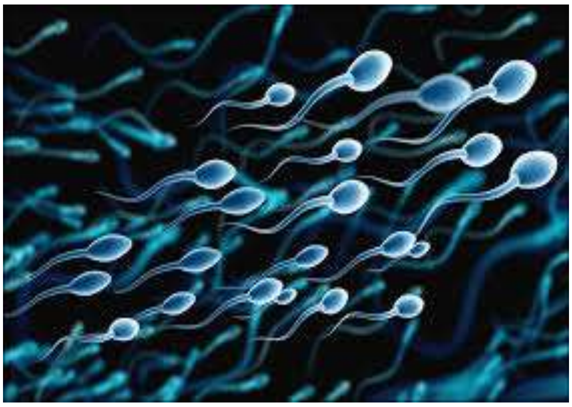

Pharmacological Properties of Brahmni Leaf

1. Anxiety and Depression: Brahmi acts as an adaptogen, which simply means that it helps the body adapt to new or stressful situations. When consumed, it is believed to increase the serotonin levels in the brain that help the mind keep calm and give relief from anxiety and nervousness.

2. Cure with diabetes: Brahmin leaves are known for anti-hyper glycaemic properties and are widely recommended for diabetics. Studies reveal that regular consumption of Brahmi leaves can improve the symptoms related to diabetes and help in leading a healthy life.

3. Cure with asthma: Brahmi helps to reduce the symptoms of asthma. According to Ayurveda, the main doshas involved in asthma are Vata and Kapha. The vitiated 'Vata' combines with deranged 'Kapha dosha' in the lungs causing obstruction in the respiratory passage. This results in difficulty in the breath. This condition is known as Swas Roga or Asthma. Brahmi helps to calm Vata-Kapha and removes excess mucus from the lungs. This gives relief from the symptoms of asthma.

4. Aid in to improve sexual performance: Brahmi may be useful in managing certain sexual problems. In males, it improves sperm quality and sperm concentration. In females, it may be useful in managing infertility. Brahmi may also stimulate sex drive.



5. It treats with epilepsy: It is believed that Brahmi can help with certain mental disorders, like bipolar disorder. Such mental disorders impact the way your mind perceives the world around it. It can affect the way memories are remembered, and even the way certain memories are formed. Therefore, using Brahmi can boost memory function even for people suffering from mental disorders.

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6. Treatment of Insomnia: Sleep is extremely essential for physical and mental relaxation and rejuvenates us. The fast-paced life, stress, unhealthy eating and sleeping habits disturb our sleep pattern, leading to insomnia and other sleep disorders. Consumption of Brahmi calms us. It effectively reduces stress and anxiety. Brahmi at bedtime induces sleep and is helpful in insomnia.

7. Act as Antioxidants: Brahmi leaves contain proteins which are good antioxidants. Antioxidants protect against cell damage caused by free radicals, known as oxidative stress. Oxidative stress has been linked to diseases of heart, cancer, arthritis, stroke, respiratory diseases, immune deficiency, other inflammatory conditions etc. Thus, brahmni protects us from a variety of diseases of different organ systems.

8. Reduces Blood Pressure level: Stress and unhealthy eating habits lead to a rise in cases of high blood pressure or hypertension. Such patients are further susceptible to heart diseases, stroke, congestive heart failure etc. Brahmni is found to reduce blood pressure.

9. Excellent for Hair Growth: Brahmi is a usual constituent of hair oil as it nourishes the hair roots, strengthens the hair and prevents dandruff.

Conclusion

In this study it shows that Brahmin is very useful for Alzheimer's disease, improving memory, anxiety, attention deficit-hyperactivity disorder (ADHD), allergic conditions, irritable bowel syndrome, and as a general tonic to fight stress and it is one such herb that supports a restful sleep, calms emotional turbulence and also helps improve concentration and alertness.

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Tomato Seed Oil - An Alternative Source of Edible Oil

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Abstract

Tomato seed oil (TSO) is a vegetable oil extracted from the tomato seeds rich in antioxidants such as lycopene, carotenoid, lutein, zeaxanthin, vitamin E compound and the unsaturated fatty acid namely linoleic acid. Lycopene helps to combat free radicals in the body and prevent many diseases. This can be used in salad dressing and in several cosmetic products.

Introduction

Tomato is one of the widely used vegetable in every kitchen. Various products such as juice, sauce, and ketchup have great demand in the National and International market. Tomato comprises of 27% skin, 33% seeds, and 40% fleshy part presents as pulp (Singh and Bawa, 1998). The main waste in tomato processing industry is skin and seeds. Tomato seeds have oil content ranging from 20 to 36 %. Antioxidant activity of this oil is high when compared to other culinary oils and it is capable of preventing various diseases such as atherosclerosis, vasodilatation, and cholesterol level.

Properties of Tomato Seed Oil

Tomato seeds are considered as a rich vegetable oil and the content ranges from 20 to 37 % (db). When compared to the world production seed has the potential to deliver 0.14 million tons of oil per year. The overall amount of polyunsaturated fatty acids present in tomato seed oil is 80.1 g/ 100 g and it has 23.8 g/100g of oleic acid and 53.7g/100g of linoleic acid. The antioxidant activity of TSO is higher associated with another consumable oils such as olive and soybean oil (Shao et al., 2015). The TSO could prevent diseases viz., thrombosis, atherosclerosis, and dilates blood vessels, inflammation and high cholesterol, (Shao et al., 2013). Since the fatty acid composition of above-mentioned oils are similar, it might serve the purpose of as an edible oil (Vigo et al., 1977, Karunanithi et al., 2019).

TSO is found to be with high antioxidant properties due to rich in carotenoid and lycopene, which indicates the significant character for inhibition of various chronic diseases such as:

1. Cancer in the digestive tract, pancreas.
2. Prostate inflammation.
3. Cardiovascular diseases.
4. Skin damage.
5. Protection from eczema, aging, psoriasis, and UV damage.

Quality parameter of the TSO is depicted in table 1. The viscosity of TSO is similar to the cottonseed and olive oil. Due to the presence of tocopherol, refinery process doesn't influence much on the oil's peroxide value. TSO also have more degree of unsaturation level, reflecting higher iodine value. Most of the quality parameters of TSO are within the range (Lazos and Kalathenos, 1988).

Conclusion

Tomato production all over the world is around 130 million tonnes. One-third is utilized and marketed as processed foods. Huge amount of seeds of tomato are discarded during processing. It can be converted as an edible oil for various purposes.

Table 1. Important characteristics of tomato seed oil:

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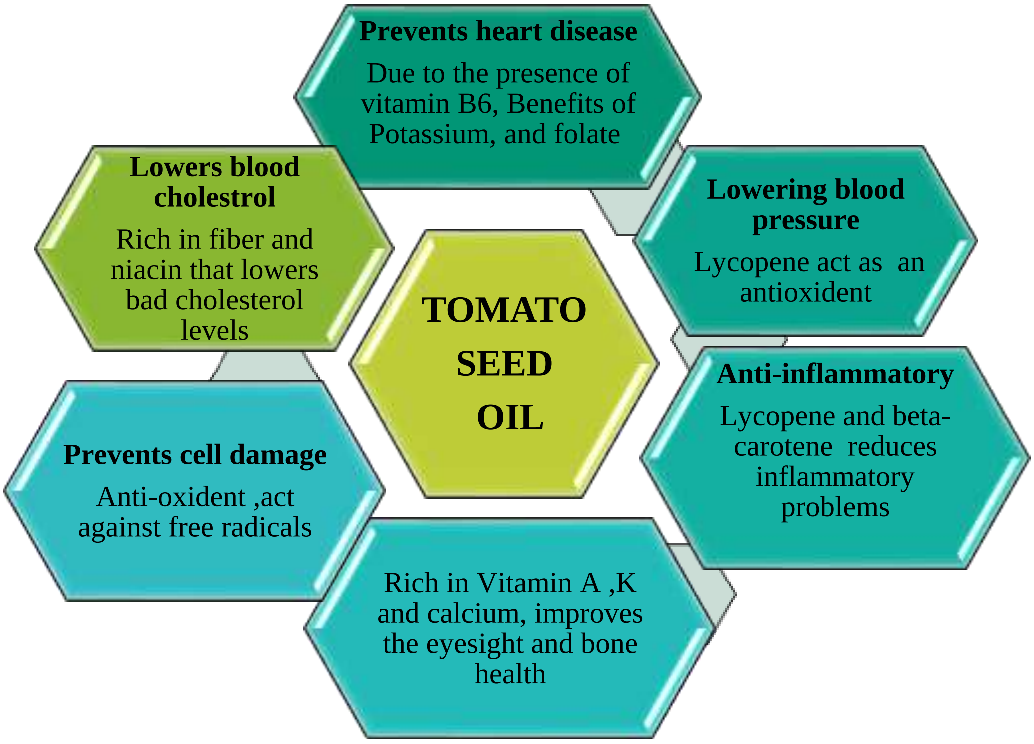
Various Properties of Tomato seed oil	
Energy (218 gm or 1 cup)	1927 kcal.
Colour	Pale yellow, brown
Odour	Strong
Smoking point	260 degrees
Total saturated fatty acid	13-19%
Total unsaturated fatty acid	75-82%
Most abundant fatty acid is linoleic acid (18:2)	50-55%
Uses	Salad dressing and various dishes Psoriasis, eczema, cellulite and skin ailments. eliminate scars, wrinkles, rashes, stretch marks, acne scars, burns, cracked skin, and dry skin Used in non-yellowing alkyds, soaps, margarine and salad oils



Health benefits of tomato seed oil

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Site Specific Nutrient Management (SSNM)- A Nutrient Expert

Article ID: 32204

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Introduction

Site-specific nutrient management (SSNM) is a precise technology that provides an approach for timely application of fertilizer at optimal rate. SSNM is a dynamic, field-specific nutrient management in a particular cropping season to minimize the supply and demand of nutrients based on their variation in time and space. SSNM has shown the potential to close existing yield gaps in the intensive rice cropping systems of Asia (Dobermann et al., 2002). The SSNM approach was originally based on modification of QUEFTS models (Smaling and Janssen, 1993) that required information on the yield potential and yield goals, estimates of the indigenous nutrient supply, recovery efficiencies of applied fertilizer, plant nutrient accumulation and its relationship to grain yield (Dobermann and Witt, 2004). The approach has since been systematically transformed into a simplified framework that estimates fertilizer requirements based on an established attainable yield target and the anticipated crop response to the fertilizer application using omission plot technique (Dobermann et al., 2003; Pampolino et al., 2007).

Principles of SSNM

1. Set an attainable yield target based on 85% of yield potential.
2. Estimate indigenous N supply – yield without N fertilizer.
3. Estimate N response – the difference between target yield and yield without N fertilizer.
4. Estimate N rate Improving nitrogen fertilization in rice by site-specific N management.

Important Features of SSNM

1. Nutrient doses viz., N, P and K is based on site specific (or) area specific in precise manner.
2. Recommended doses of nutrient are based on previous season application and current nutrient available status in soil.
3. SSNM gives profit analysis data.
4. It ensures higher productivity in crops.
5. Application of fertilizer based on target yields and nutrient status.
6. Reduce the nutrient losses and nutrient pollution.

Challenges to Adoption of SSNM

1. Technology and knowledge requirements: SSNM requires knowledge of underlying soil properties and the ability to monitor crops' nutrient status and adjust fertilizer inputs accordingly. While the need to conduct on-farm nutrient trials and soil tests has historically been a barrier to implementation of SSNM, the development of decision support systems and farmer-friendly tools and techniques that use proxy information to calculate nutrient requirements make SSNM more accessible to farmers and farm advisors.

2. Availability of fertilizers: Cost and access to fertilizers—whether synthetic or organic—is not universal. Development of input markets or identification of on-farm nutrient sources may be a necessary precursor to adoption of SSNM, though SSNM can help farmers make best use of limited nutrient resources.

3. Variable economic benefit: For SSNM to increase farmers' profits, SSNM must deliver either a) savings from reduced fertilizer use without a reduction in yields, or b) yield increases that are valued higher than the costs of acquiring and using SSNM technology. Farmers are more likely to see positive net returns with high-value crops, where yield increases can substantially increase profits, or when fertilizer prices are high.

Software for SSNM: Nutrient Expert® and Crop Manager

Computer or mobile phone-based tools are increasingly used to facilitate improved nutrient management practices in farmers' fields, especially in geographies where blanket fertilizer recommendations prevail. These tools provide small-scale maize, rice and wheat farmers with crop and nutrient management advice customized to their farming conditions and needs. Nutrient Expert® and Crop Manager are examples of decision-support systems developed for SSNM in cereal production systems.

Nutrient Expert®

Nutrient Expert® is an interactive, computer-based decision-support tool that enables smallholder farmers to rapidly implement SSNM in their individual fields with or without soil test data. The software estimates the attainable yield for a farmer's field based on the growing conditions, determines the nutrient balance in the cropping system based on yield and fertilizer/manure applied in the previous crop and combines such information with expected N, phosphorus (P) and potassium (K) response in target fields to generate location-specific nutrient recommendations. The software also does a simple profit analysis comparing costs and benefits between farmers' current practice and recommended alternative practices. The algorithm for calculating fertilizer requirements was developed from on-farm research data and validated over 5 years of testing.

Crop Manager

Crop Manager is a computer-and mobile phone-based application that provides small-scale rice, rice-wheat, and maize farmers with site- and season-specific recommendations for fertilizer application. The tool allows farmers to adjust nutrient application to crop needs based on soil characteristics, water management, and crop variety on their farm. Recommendations are based on user-input information about farm location and management, which can be collected by extension workers, crop advisors, and service providers.

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Marketing Initiatives for Doubling the Farmers' Income in Telangana

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Agricultural price policy has an important role in obtaining growth in Indian economy in general and in agriculture in particular. The main aim of price policy was to protect as well as consumers. Minimum Support Prices are an important component of agriculture price policy in India. The scheme provides the floor price for farm produce and also makes food grains available for buffer stock and PDS. It provides security for long-term investment decisions of the farmers. Another important objective of MSP is to incentivize the farmer to allocate resources in socially desired cropping patterns. MSP is expected to provide a sense of price security to the farmer and motivate them to diversity the crops (Aditya et al., 2017).

In Telangana main objective of the MSP operations is to provide remunerative price to the farmers. Government of Telangana has been implementing the M.S.P. operations for the purchase of paddy, maize and other coarse grains and pulses. The Government have taken timely and prompt action by opening of required number of paddy / maize purchase centres in the districts by the Collector (CS) concerned. In Telangana 73.02 lakh MT of paddy was procured in 2018-19 which was worth of 12, 906.38 crores at MSP. It is going to be distributed through PDS and different schemes of govt. at minimal prices. Telangana at the top in the procurement, contributing 52.23 lakh MT tonnes out of 83.01 lakh MT tonnes procured at the national level in COVID-19 pandemic through PM-AASHA. The Telangana unit of FCI had supplied 2.87 lakh tonnes of free rice allotted to the State for distribution to 1.91 crore people under Prime Minister's Garib Kalyan Anna Yojana. Also, it was seen to it that 19,162 tonnes of free rice allotted to State under Atma Nirbhar Bharat for distribution to migrant labour and the FCI was issuing another 1.32 lakh tonnes of subsidised rice to Telangana to benefit 88 lakh people not covered by NFSA.

e-NAM

In order to eliminate the deficiencies in the existing marketing structure, there is an immense necessity to integrate markets over space and time. Initiatives have already been taken like creating e-platform for farmers that will remove inter-state barriers in moving farm produce and to liberalize agricultural markets. National Agriculture Market (NAM) is a pan-India electronic trading portal launched on 14th April, 2016 with the vision of creating "One nation one market" for the farm produce,

In Telangana it was implemented five markets on pilot basis namely Warangal, Hyderabad (Malakpet), Nizamabad, Badepally and Tirumalagiri. Then it was extended to 57 markets e-NAM has been implemented successfully around 92 commodities were being traded in Telangana through e-NAM. Nearly 18 lakh farmers, 5647 traders 4621 commission agents and 54 FPOs are participating under e-NAM in Telangana. The state is a leader in the roll out of this platform – it is the first to implement the weighment integration and digital payments. Within two years of implementation in 2018 e-NAM Nizamabad received the best e-NAM award from the honourable Prime minister for the best services it offered to the farmers.

Secondary data on e-trade for identified commodities were collected from 2016-18 and triennium averages were calculated. Data revealed that most of e-trade is happening within the mandi in all the markets covered under e-NAM scheme. Inter mandi transactions are occurring only in 13 markets under e- NAM and only one interstate trade has occurred so far between Kurnool (A.P) and Gadwal (Telangana) for Groundnut. The data also revealed that in all selected commodities total arrivals and value of trade has increased in 2017, one year after implementation of this scheme in the state.

Thus, the data revealed that more than 60 percent of arrivals in the state, in crops namely, Paddy, Maize and Groundnut, 45 per cent in Turmeric, 40 per cent in Chillies, 35 per cent in Redgram, 27 per cent in Soybean and 22 per cent in Cotton arrived to markets covered under e-NAM. And more than 85 per cent of arrived quantity in Paddy, Maize, Chillies, Turmeric, Redgram, and Groundnut was traded through e- platform. While in Cotton and Soybean it was 75 and 73 percent respectively. Among all the crops, the value of e-trade was found to be more in Paddy (446.77crs) followed by Cotton (429.68 crs), Chillies (339.15 crs) and Turmeric (332.96 crs).

Warehousing

An efficient marketing system alone is not sufficient and cannot guarantee the desired benefits to farmers. To make an efficient system effective, in terms of utilisation, particularly for small and marginal farmers, the sufficiency condition is met by providing a mechanism that will help them to transact at choice, when they want to. Warehousing provides this opportunity and is an important tool which improves time utility and enables the farmers to avoid an immediate sale in the surplus environment that occurs at each harvest period for certain commodities. The post-harvest period results in a supply glut, in advance of demand and these manifests in a fall in commodity price. Warehousing, therefore, allows farmers to balance their supply to markets and in the interim, enables them to avail pledge finance to meet their immediate financial requirements. Warehousing availability, of suitable type and quality, makes it an important component of the agricultural marketing system. Warehousing in Telangana was meant to provide and maintain adequate, scientific infrastructure facility to farmers for storages of their produce. It will provide easy accessibility to the farmers, to minimize storage loss and to improve rural liquidity. To support market to overcome from volatile market prices of agricultural commodities to the possible extent. Total warehouses in Telangana are 1004 with total capacity of 2237479 MT, in these 147 warehouses with capacity of 333177 MT in selected e-NAM mandi areas. Capacity utilization of total warehousing in Telangana is 68.3 per cent and with 31.7 per cent of slack. Capacity utilization of total warehousing under selected e-NAM mandies is 68.1 per cent and with 31.9 per cent of slack.

Conclusion

All produce - every grain; every ounce; every drop - from agriculture sector must find gainful end-use. Demand-driven production of agricultural produce, rather than production-propelled marketing, is the need of the day now. The major challenge faced by the agricultural marketing is farmers have to receive fair and remunerative price and also supply commodities to consumers at affordable price. Telangana is the pioneering state in India in adopting reforms in the agricultural marketing. To create an effective and efficient marketing system there should be quality based price discovery, supportive price policy and procurement and warehousing. Agricultural marketing in Telangana is need to focus Quality based Price Discovery and removal of manual open auction system/Tender system. To avoid the distress sale, need to create awareness on warehouses and e-NWR (Negotiated warehouse receipt system). Create enough awareness about e-NAM, need to promote more and more and FPO's which will immensely benefit small and marginal farmers.

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Use of Botanicals and their Mode of Action

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Introduction

Botanicals have been in use for a long time for pest control. The compounds offer many environmental advantages. However, their uses during the 20th century have been rather marginal compared with other bio-control methods of pests and pathogens. Improvement in the understanding of plant allelochemical mechanisms of activity offer new prospects for using these substances in crop protection. I'm trying in this article to present different kinds of botanical pesticides came from different recourses and their mode of actions as well as I will try to examine the reasons behind their limited use and the actual crop protection developments involving bio pesticides of plant origin for organic or traditional agricultures to keep our environment clean and safer for humankind and animals.

Botanicals

Botanical pesticides are naturally occurring chemicals extracted from plants. Natural pesticidal products are available as an alternative to synthetic chemical formulations but they are not necessarily less toxic to humans. Some of the major botanicals summarized in the present manuscript are:

1. Nicotine: An alkaloid obtained from the foliage of tobacco plants (*Nicotiana tabacum*) and related species, has a long history as an insecticide. Nicotine and two closely related alkaloids, nornicotine and anabasine, are synaptic poisons that mimic the neurotransmitter acetylcholine. As such, they cause symptoms of poisoning similar to those seen with organophosphate and carbamate insecticides (Regnault-Roger and Philogène 2008). Owing to the extreme toxicity of pure nicotine to mammals (rat oral LD50 is 50 mg kg^{-1}) and its rapid dermal absorption in humans, nicotine has seen declining use, primarily as a fumigant in greenhouses against soft-bodied pests.

Mode of Action: In both insects and mammals, nicotine is an extremely fast-acting nerve toxin. It competes with acetylcholine, the major neurotransmitter, by bonding to acetylcholine receptors at nerve synapses and causing uncontrolled nerve firing. This disruption of normal nerve impulse activity results in rapid failure of those body systems that depend on nervous input for proper functioning. In insects, the action of nicotine is fairly selective, and only certain types of insects are affected.

2. Rotenone: As a pesticide, rotenone has been in use for more than 150 years, but its use as a fish poison dates back even further Rotenone is one of several isoflavonoids produced in the roots or rhizomes of the tropical legumes *Derris*, *Lonchocarpus*, and *Tephrosia*. Most rotenone used at present comes from *Lonchocarpus* grown in Venezuela and Peru and is often called cubè root. Extraction of the root with organic solvents yields resins containing as much as 45 % total rotenoids; studies indicate that the major constituents are rotenone (44 %) and deguelin (22 %) (Cabizza et al. 2004). As a pesticide it is considered a stomach poison because it must be ingested to be effective. Pure rotenone is comparable to DDT and other synthetic pesticides in terms of its acute toxicity to mammals (rat oral LD50 is 132 mg kg^{-1}), although it is much less toxic at the levels seen in formulated products.

Mode of Action : Rotenone is a powerful inhibitor of cellular respiration, the process that converts nutrient compounds into energy at the cellular level. In insect's rotenone exerts its toxic effects primarily on nerve and muscle cells, causing rapid cessation of feeding. Death occurs several hours to a few days after exposure.

Rotenone is extremely toxic to fish, and is often used as a fish poison (piscicide) in water management programs. It is effectively synergized by piperonyl butoxide (PBO) or MGK 264.

3. Synthetic Pyrethroids: The earliest synthetic pyrethroids retained most of the beneficial properties. Allethrin varied from pyrethrin I only in the three-carbon length of the side chain on the cyclopentenone ring. In the 1970s, great strides were made in the United Kingdom and Japan toward enhancing insecticidal potency, increasing photostability, and improving the chemistry to achieve a host of commercially viable synthetic pyrethroid pesticides.

Mammalian and avian studies on the toxicity of the synthetic pyrethroids have demonstrated, in general, retention of safety for warm blooded. The widely used pyrethroids seem to present no problem to birds or other wildlife. Bees, important non-target arthropods, are only affected if sprayed directly; otherwise, the pyrethroids effectively repel them from foraging in fields that have been sprayed. Aquatic arthropods are generally very susceptible to these compounds, but the bioavailability of them depends on suspended solids in the water.

Mode of Action: Synthetic pyrethroids are generally recognized as neurotoxicants that act directly on excitable membranes. These compounds induce intense repetitive activity in sense organs and in myelinated nerve fibres. In the lateffects eral-line sense organ this repetitive activity increases with cooling, a phenomenon that may be related to the negative temperature coefficient of toxicity of pyrethroids in insects. It has been suggested that the sodium channel in the nerve membrane is the major target site of pyrethroids. Other results showed that these compounds modify sodium channel gating in a strikingly similar way and reduce selectively the rate of closing of the activation gate.

4. Neem Products (Azadirachtin): Two types of botanical pesticides can be obtained from seeds of the Indian neem tree, *Azadirachta indica* (Meliaceae). Neem oil, obtained by cold-pressing seeds, can be effective against soft-bodied insects and mites but is also useful in the management of phytopathogens. Apart from the physical effects of neem oil on pests and fungi, disulphides in the oil likely contribute to the bioactivity of this material. More highly valued than neem oil are medium polarity extracts of the seed residue after removal of the oil, as these extracts contain the complex triterpene azadirachtin.

Neem seeds actually contain more than a dozen azadirachtin analogues, but the major form is azadirachtin and the remaining minor analogues likely contribute little to overall efficacy of the extract. Seed extracts include considerable quantities of other triterpenoids, notably salannin, nimbin, and derivatives thereof. Neem seeds typically contain 0.2–0.6 % azadirachtin by weight, so solvent partitions or other chemical processes are required to concentrate this active ingredient to level 10–50 % seen in the technical grade material used to produce their products.

Mode of Action: In insects, neem is most active as a feeding deterrent, but in various forms it also serves as a repellent, growth regulator, oviposition (egg deposition) suppressant, sterilant, or toxin. As a repellent, neem prevents insects from initiating feeding. As a feeding deterrent, it causes insects to stop feeding. As a feeding, either immediately after the first “taste” (due to the presence of deterrent taste factors), or at some point soon after ingesting the food (due to secondary hormonal or physiological effects of the deterrent substance). As a growth regulator, neem is thought to disrupt normal development interfering with chitin synthesis. Susceptibility to the various effects of neem differs by species.

Conclusion

The sites and mode of action of these compounds and extracts are being investigated and probably correspond to a combination of antifeedant action as midgut phenol oxidase, proteinase, AChE, tyrosinase, or other PPOs and cuticle synthesis inhibition, as well as moulting, sclerotization, toxicity, and nerval system inhibition, as has been found for other phenolics and terpenoids. Since these approaches refer to control of insect pests, many of them can be extrapolated and also considered suitable for medicinal chemistry studies, because the mode of action of these inhibitors is similar to that from human and other animals (Guerrero and Rosell 2004, 2005).

Thus, by studying the plant organisms that protect themselves against the pest attack, we can learn to control this attack in an ecological way and in addition can get pesticide active substances.

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Vermicompost: An Amendment Promoting Soil Health

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Vermicompost is a nutrient enriched, microbiologically active organic amendment obtained after physical, chemical and microbial transformation of organic residues. The decomposition process is conducted by different worm species such as earthworms, red wigglers and white worms and the process is known as vermicomposting while the rearing of worms is known as vermiculture. It is increasingly emerging as a possible recycling technology for the reuse of available organic waste as a source of quality manure. Vermicompost is growing as a promising organic fertiliser for soil health and crop growth as well as reliance on synthetic fertilizers. The present work represents significant role of vermicompost in enhancing soil health.

Vermicompost Production

Vermicompost is nothing but humus rich excreta of earthworms. Worms can be artificially be reared in a brick tank or near trunk of a tree. By feeding earth worms with biomass (organic waste) and water, a sufficient amount of vermicompost is generated. The efficient species of earthworms generally involved in production of vermicompost are:

Eisenia	foetida
Amyanthes	differigens
Eudrillus	eugineae

(Source: agri-horti.assam.gov.in)

1. A plastic or concrete tank is to prepare compost. The size of the tank depends upon the raw material available.
2. Collect the biomass and place it under the sun for about 8-12 days for decomposition. Chop off the hard material to required size.
3. Prepare a cow dung slurry and sprinkle it over the heap to accelerate its decomposition.
4. Add a thin layer of surface soil/sand (2-3inches) at the bottom of the tank.
5. Now prepare fine bedding by adding partially decomposed cow dung, leaf litter and other biodegradable wastes such as crop residue and kitchen waste. Distribute it evenly on the soil layer.
6. Continually start adding chopped bio-waste and partially decomposed cow dung in layers up to depth of 0.5-1.0 ft.
7. After adding all the waste now release 1000-2000 worm per meter sq. of any of the above- mentioned species. Cover the mixture with dry straw or gunny bags.
8. Sprinkle water on regular basis to maintain 70%-80% moisture content.
9. Cover the compost mixture to prevent entry of ants, snake, mouse, lizard and to protect the compost from direct sun rays and rainwater.
10. Have frequent checks to avoid overheating of compost and maintain proper moisture as well as temperature.

11. When 80-98% of waste is decomposed stop sprinkling water. Maturity could visually be judged from granular structure of compost at surface of the tank.
12. Collect vermicompost by scrapping layer-wise from top of tank and keep it under shade.

Utilization of Vermicompost

People these days are more drifted towards organic agriculture which condemns the use of chemical fertilizers for crop production. Organic agriculture demands for organic inputs only and vermicompost is rising as a potential organic fertilizer. Moreover, utilization of vermicompost assists in growth of country's economy by lowering the consumption of inorganic fertilizers and avoiding land degradation problems. Vermicompost has been utilised extensively as a soil conditioner because of the below mentioned properties of vermicompost.

Properties of Vermicompost

1. Vermicompost is a homogenous, peat like compound which is easy to handle and apply. It the stable form of organic matter.
2. It is more saturated both with macro and micro nutrient than any other commercial organic manure.
3. It's physical properties such as bulk density, porosity and water holding capacity are better than other manures.
4. The nutrients are released slowly so it makes vermicompost a good plant growth promoter.
5. Vermicompost in rich in microbes which makes the nutrients of the soil available to plants and also helps in mitigating the problem of nutrient leaching.
6. It is free from pathogens and toxic elements.
7. Vermicompost is high in various humic compounds and they accelerate humification process and keeps organic matter to an optimum level.
8. Various plant growth regulator hormones are present in vermicompost such as auxins, cytokinins and gibberellins.
9. High surface area and concentrated hydrophilic groups present in vermicompost offers more site for easy microbial decomposition and good nutrient absorption.
10. It has ideal C:N ratio of 15-20.

Advantages of Vermicompost

1. Vermicompost promotes overall growth of plants.by encouraging emergence and growth of new shoots and leaves and it helps in production of quality produce with good shelf life.
2. It improves the soil texture, structure, aeration, Water holding capacity and prevents soil erosion.
3. Helps in neutralizing soil pH.
4. It prevents nutrient leaching and hence increases the use efficiency of chemical fertilizers and make more nutrients to plants.
5. Vermicompost contain cocoons of earthworms hence assists in increasing their population as well as activity in the soil.
6. More organic matter is added to the soil so activity of microbes is enhanced. It lowers incidence of pest and diseases.

Significance of Vermicompost in Enhancing Soil Health

In recent years, the indiscriminate use of inorganic fertilizers and pesticides in farming has increased. It has a negative impact on the sustainability of the agricultural production through the degradation of soil properties which in turn deteriorates the overall crop productivity. Thus, it is necessary to maintain healthy and lively soil by restoring soil fertility and reviving microbial activity through organic modifications. Compost has risen as a potential organic fertilizer over the years and have played a significant role in improving soil quality. Now a days the use of vermicompost over compost has gained momentum because it provides more nutrients than traditional compost and is more stable form of organic manure. So vermicompost can play a vital role in promoting soil health.

Organic manures have been marketed as a supplement for chemical fertilisers as biologically rich soils can lead to healthy nutrient- dense foods along with preserving soil health. Vermicompost is one of the challenging organic improvements as agricultural fertilisers. It is the most stable form of organic matter being extensively used because it contains both macro- and micronutrients for plant uptake. It is abundant in helpful microbes such as N2-fixers, P-solubilizers and cellulose decomposing microbes. Owing to its capacity to retain more water makes its better over other manures. All these properties make it a very beneficial manure for improving soil health and thus increasing growth and productivity of plants. Its application along with plant growing material, synergistically affects plant growth directly or in directly by dying to its chemical, physical and biological properties. Vermicompost has a beneficial effect on these properties and thereby enhanced soil health.

Soil health is characterised as the ability of a particular type of soil to work within natural or controlled ecosystem boundaries to sustain plant and animal productivity, and promote human health and habitation. Soil health is critical for both regenerative and sustainable crop production and land management.

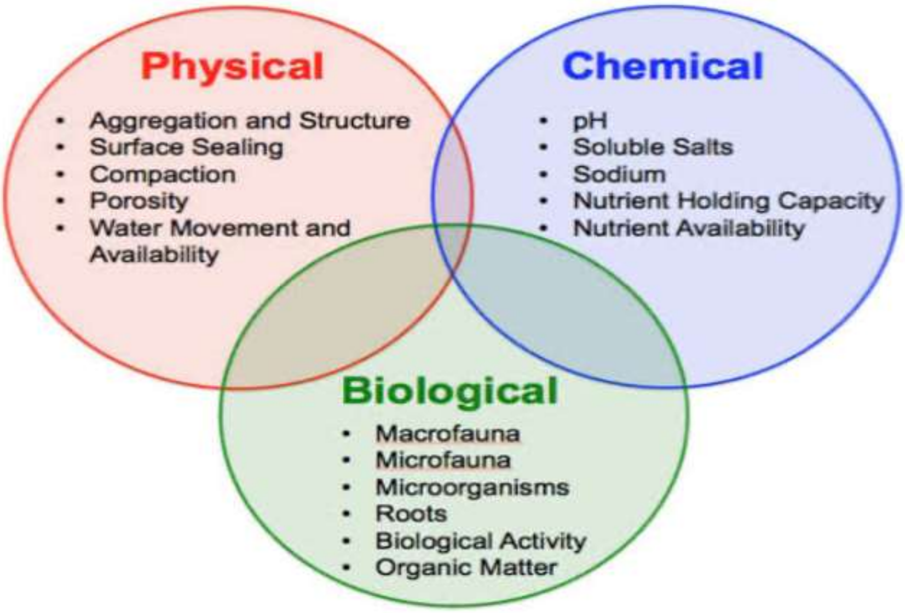

Figure depicting Physical, Chemical and Biological properties of soil amended by vermicomposting (Source-ndsu.edu).

How Vermicompost Affect Soil's Health

1. Physical properties: Various experimental studies have shown that, in presence of vermicompost, soil particles are more aggregated thus elevating the aggregation stability of soil (AS). Soils modified with vermicompost have less bulk density due to reduction in the overall porosity which is further attributed to an increased volume of rounded pores that increase the water holding capacity and soil moisture content. Also, the increased aeration in the pores augments the supply of oxygen to plant roots.

2. Chemical properties: Addition of vermicompost increases the total N, Zn and P concentration in soils. It also improves the phosphatase activity and physical material mineralization. In addition, there is alleviation of soil pH is reduced in presence of vermicompost. The rise in soil organic matter results in decreased K and P fixation. It therefore uplifts the absorption of essential nutrients by the plant roots. With increased application, Electrolytic conductivity (EC) of soil also increases substantially. Also amended soils have more Cation exchange capacity as compared to soils treated with compost and other chemical fertilisers. When vermicompost is applied to the soils it enhances the biological activity and increased vitamin C content and enzymes in soil.

3. Biological properties: The soils amended with vermicompost exhibits an increased microbial biomass of bacteria, fungi and actinomycetes. These microbial communities further decelerate the leaching of plant nutrients. Dehydrogenase enzyme production also improves due to increased organic matter content. Studies have stated that Humic substances such as humines, humic acid and fulvic acid, extracted from vermicompost stimulates activity of plasma membrane proton ATPase for lateral root growth in plants is producing effect similar to that of exogenous application of Indole-3-acetic acid.

Conclusion

It can therefore be inferred that vermicompost plays an important role in enhancing soil quality by altering its physical, chemical and biological properties and is very advantageous for organic farming. It allows variety of flora and fauna (microbes) to grow productively in soil. Physical properties such as improved soil structure, total porosity and air and water permeability prevent soil erosion and preserve soil fertility. It promotes more availability of oxygen and water to roots which supports plant health and soil health constructively. However, the chemical alterations brought about by vermicompost in soil has made both macro and micro nutrients such as total N, available P, K, Ca, Fe and Zn to be available to plants in judicious amount so that soil is never exhausted of these nutrients. In addition to this the activity of enzymes such as hydrogenase ,phosphates and urease. Moreover, vermicompost reduces pH so it could be used to amend alkaline soils thereby improving soil health. Biologically soil becomes rich in organic matter when vermicompost is applied. The increased organic matter accelerates more microbial growth which favoured various soil reactions and supplied plants with more nutrients. Microbes also mitigates nutrient leaching thereby keeping soil's nutrient reservoirs full. Also, humic substances from vermicompost tends to enhance root growth and respiration. It promotes good growth of plants by reducing plant diseases and suppressing various plant pathogens. As a result, vermicompost improved not only plant growth and productivity but also the physiochemical as well as biological properties of soil. So, it is the best suited option to maintain soil health.

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Pathogens Invading Honey Producer

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The honey bee, important pollinator and producer of hive products, is threatened by a various pests and pathogens. Colony losses of managed honey bee colonies have been reported during winter but also summer from many countries. Monitoring and surveillance are necessary tools to address the problem of colony losses. Firstly, they describe the status-quo of bee health and can show trends in loss rates, if regularly conducted. Secondly, they guide towards improvements of bee health by hinting towards important factors through modelling.

As disease occurrence and colony losses vary widely between different countries and climatic regions a complete picture of the distribution of bee diseases is necessary to understand problems on national but also on international level. So hereby we can discuss few Bacterial and Fungal diseases of honeybee which cause a drift in loss in the bee industry.

Bacterial diseases of Honey bee include: a) American foul brood & b) European foul brood.

American Foul Brood

Causative organism: *Paenibacillus larvae*

Symptoms and control for the brood disease are: American foul brood(AFB), caused by the spore forming Paenibacillus larvae (formerly classified as bacillus larvae) is the widest spread and destructive of the bee brood diseases. The pathogen is a rod-shaped bacterium which is highly resistant to heat desiccation and disinfectant. Larvae up to 3 days old become susceptible by ingesting the spores that are present in their food. Young larvae less than 24hrs old are prone to infection. Larvae over 3 days old are not affected. Infected larvae normally die in pre-pupal or pupal stage their cell is sealed. Their bodies remain stretched on their backs and head inclined towards cell capping. Later, larvae turn brown and putrefy emitting fishy odour. Dead larvae when touched with a tooth pick or twig shows stickiness and ropiness when drawn out. They dry up and cell capping becomes dark and sunk inwards.

When cleaning infected cells, bees distribute spores throughout the colony. When the colony becomes weak from AFB infection, robber bees may enter and take contaminated honey back to their hives thereby spreading the disease to other colonies and apiaries. There is a probability that bee-keepers also may spread disease by moving equipment i.e. frames or supers from a contaminated section to a healthy one.

Management or control of this disease is done by:
1. Hive to be burned completely.
2. Fumigate hives, covers, bottom boards in an ethylene oxide gas chamber which kills diseased spores.
3. Dipping the hive parts in hot paraffin wax or 3% Sodium hypochlorite solution also renders the AFB spore inoculation.

European Foul Brood (EFB)

Melissococcus plutonius is the causative bacterium that infests the midgut of a bee larvae. EFB is less deadly to a colony than American foul brood. Larvae die in a coiled, twisted, irregular position in their hives. Sour odour may be present. Most of the insects die in uncapped stage.

Fungal diseases of Honey bee include chalk brood and stonebrood.

Chalk Brood

Causative organism: *Ascosphaera apis*

It is a fungal disease that infects the gut of the larvae. The fungus will compete with the larvae for food, ultimately causing is to starve. The fungus will the go to consume the rest of the larvae body, causing it to appear white and chalky. Hives the chalk brood can generally be recovered by increasing the ventilation through the hive.

Stone Brood

Stone is a fungal disease caused by *Aspergillus fumigatus, Aspergillus flavus*, and *Aspergillus niger*. It causes mummification of the brood of the honey bee colony. After death the larvae turns black and become difficult to crush, hence the name Stone brood.

Control:

1. Moving the hive to sunny location.
2. Adding bees to strengthen the hive.
3. Re-queening the colony.

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Biofertilizers as an Important Component of INM for Sustainable Crop Production

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Plant nutrition has played a key role in this dramatic increase in demand for and supply of food. Management of nutrients for crop growth & development as well as soil fertility are both integral parts of modern agriculture. Integrated Nutrient Management (INM) is need of the hour to increase the productivity of a crop by maintaining soil fertility as well as productivity. Several studies have indicated that application of FYM, vermicompost, green manure, crop residue ,biofertilizer and/or other wastes either alone or along with inorganic fertilizers increases organic carbon and other plant nutrient in soil. Among the essential nutrients, nitrogen, phosphorus and potassium play a significant role in enhancing crop and soil productivity. It is also well noticed that more than 50% of the applied N- Fertilizers are lost through different environmental or agricultural processes which not only pollute the environment, but also lead to less economic viable returns. However, plant nutrients like N, P and K are highly essential for plant growth and metabolism, besides soil fertility for sustained crop production, and the improved varieties or hybrids and intensive cultivation practices require more nutrients in from soil needs replenishment.

What are Biofertilizers?

Biofertilizers are products of beneficial microorganisms which increase agricultural production by enhancing nutrient supply, especially nitrogen and phosphorus, besides other macro or micro nutrients in soil and their subsequent uptake by plants.

The main concept of biofertilizers is an identification of the useful microbes from the plant rhizosphere and growing them in large quantity by using artificial media. Application on seeds or in soil by broadcasting in fields is done after mixing with suitable carriers. Such products are developed from an array of morphological and physiological diverse genera, classes and phyla ranging from bacteria to yeasts and fungi.

These can support and increase nutrient mobilization to the plants and protect plants from abiotic or biotic stress. Most of the microorganism's possess multifarious traits and generally are plant growth promoting (PGP). However, the major biofertilizers belongs to nitrogen fixers or diazotrophs, followed by phosphate mobilizers. The major advantage of biofertilizers is that they can be applied to crop or soil in many ways, including seed treatment or seed inoculation, seeding root dip soil dressing at the time of sowing or a week after transplanting in rice or application of chemical fertilizers.

Biological nitrogen fixation is very significant for agriculture as the air we breathe comprises mainly a mixture of nitrogen and oxygen, which exists a column of air over a hectare of land containing approximately 80,000 tonnes of nitrogen, but is not useful to plant or animal life, as nitrogen is an inert gas. Most of microorganisms have a unique enzyme nitrogenase, limited to only prokaryotes, which can convert this N to NH_3.

Some of the agriculturally significant biofertilizers are given below:

1. Rhizobium inoculants: *Rhyzobium* establishes efficient symbiotic associations with pulses, leguminous oilseed and fodder crops and fix 50-100 kg/ha, besides being able to provide sizeable amount of residual nitrogen in soil to meet a part of nitrogen requirement of the succeeding crop in rotation. Since *Rhizobium* is specific to each legume, it should only be used for the recommended leguminous crop.

2. Azotobacter inoculants: *Azotobacter* is a Gram negative, aerobic, heterotrophic and free-living diazotrophic bacterium. The use of *Azotobacter* inoculants is recommended in non-leguminous crops like wheat, paddy, maize etc. *Azotobacter* fixes atmospheric nitrogen in soil and helps in saving chemical fertilizers by 15-20 kg

N/ha. Besides this, Azotobacter also secrets growth promoting substances which helps in better seed germination and proliferation of roots, thus, improving nutrient availability for plants.

3. Azospirillum inoculants*:* The bacteria of the genus *Azospirillum* are isolated from the root and above ground parts of a variety of crop plants. *Azospirillum* is a less investigated genus, which is Gram negative. These organisms proliferate under both anaerobic and aerobic conditions, but prefer micro- aerophilic conditions, in the presence or absence of combined nitrogen in the medium. Generally recommended in non-leguminous crops like millets, fodder grasses and oats. Inoculation brings about increases in grain and fodder yields of millets equivalent to that attainable with 15-20 kg N/ha.

4. Phosphate mobilizing bacterial inoculants: The majority of agricultural soils contain large reserves of phosphorus, of which a considerable part has accumulated as consequence of regular applications of P-fertilizer and the phenomenon of fixation and precipitation of P in soil.

The soil being a habitat for diverse group of organisms that employ variety of solubilization reactions to release soluble phosphorus from insoluble phosphates, this potential is utilized as bio inoculants for crop growth in soils poor in available P. Inoculation with efficient P solubilizing microorganisms improves the availability of phosphorus from insoluble sources of phosphate.

The most efficient bacterial isolates were identified as *Pseudomonas striata, Pseudomonus rathonis* and *Bacillus polymyxa* and fungal isolates as *Aspergillus awamori, Penicillium digitatum*, *Aspergillus niger* and a yeast- *Schwanniomyces occidentalis.* These efficient micro-organisms have shown consistently their capability to solubilize chemically-fixed soil phosphorus and rock phosphate from diverse sources.

5. Blue Green Algal (BGA) inoculants: Blue green algae or Cyanobacteria play diverse roles in the environment, as nutrient supplements (inoculants), besides having tremendous ecological significance as carbon sequestering and bio remediating agents. The role of cyanobacteria in the sustained fertility of flooded/irrigated rice field soils is well established not only because of the fixation of nitrogen and carbon, but also because they release useful nutrients which promote plant growth and reduce the rate of loss of water and soil through erosion.

After intensive trials, a mixture of selected cultures of BGA and formulations using soil wheat straw, multani mitti, compost etc. have been developed which have proved beneficial not only in flooded paddies, but in a number of other crops – wheat, cotton and different vegetables. If chemical fertilizers are not used, BGA inoculants gives a benefit of 20-30 kg N/ha.

6. Azolla inoculants: Azolla is a free-floating water fern which is important agronomically due to its capacity to fix atmospheric nitrogen at cheaper and faster rates and making it available to crop plants. Nitrogen fixing capacity of the system is due to presence of a symbiotic cyanobacterium *Anabaena azollae* which inhabits the dorsal lobe of the leaves.

The system is important as it helps in maintaining the long-term soil fertility and by enrichment of soil organic matter and enzymes, in addition to nitrogen fixation and sustaining higher yield of crops. Under ideal tropical conditions it contributes 40-60 kg N/ha per crop.

Its quick decomposition in soil promotes efficient availability of its nitrogen to the crop. *Azolla* has a high rate of biological nitrogen fixation as well as biomass production capability due to its rapid growth. There are other products which indirectly help in recycling of nutrients and improving their availability to plants viz.

7. Arbuscular-Mycorrhizal inoculants (AM fungi): Arbuscular-Mycorrhizae is a symbiotic relationship between plants and specific group of fungi. The hyphae of AM form a bridge between plant and soil and serve to cater to the nutrient's requirements of the plants, especially P and trace elements like Zn, Fe, Cu, Co, Mg & Mo etc.

8. Plant growth promoting rhizobacteria*:* Interaction between microorganisms and higher plants in soil occur mainly in the rhizosphere i.e. on the plant root or its close vicinity, most often organized in microcolonies. Plant growth promoting rhizobacteria are a class of beneficial bacteria inhabiting the soil ecosystem, which associate with roots of many different plants.

The direct effects have been most commonly attributed to the production of plant hormones such as auxins, gibberellins and cytokinins, or by supplying biologically fixed nitrogen.

Conclusion

Microbes represent an integral part of soil and contribute an important role to soil and plant health. A number of microorganisms have the ability to fix atmospheric nitrogen, solubilize and mobilize phosphorus, produce antibodies and disease suppressing molecules. On account of these properties, they are used in agriculture as biofertilizers and biopesticides. With the growing concern about environment and its sustenance for sustainable agriculture, microorganisms offer a suitable alternative technology to replenish crop nutrients and supplement chemical fertilizers.

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Participatory Rural Appraisal in Extension

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Introduction

Participatory methods developed in the context of Participatory Rural Appraisal (PRA) today became the central tool for development agencies to embrace participation. RRA had already taken in insights and methods from many other sources and provided a quick way of gathering information on local realities building from local people's insights. It is a way of organizing people for collecting and analysing information within a short time span. The approach was developed in early 1990s with considerable shift in paradigm from top-down to bottom-up approach and is based on village experiences where communities effectively manage their natural resources.

Definition of PRA

PRA is a family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act" (Chamber 1994).

It can be defined as any systematic process of investigation to acquire new information in order to draw and validate inferences, hypothesis, observations and conclusions in a limited period of time.

Participator Rural Appraisal (PRA) is a field-based methodology that enables multidisciplinary team to join with village leaders to gather data, rank village needs and priorities and thereby help mobilize rural communities to participate in preparing and implementing village resource management plans.

Key Tenets of PRA

1. Participation: People's input into PRA activities essential to value as a research and planning method.

2. Team work: A team of local people with knowledge of the area, traditions, social structure etc. Represents socioeconomic, culture, gender and generational perspectives.

3. Flexibility:

a. PRA does not provide blueprint for practitioners.
b. Combination of techniques appropriate to context of development.

4. Optimal Ignorance:

a. To be efficient in terms of both time and money
b. Intends to gather just enough information to make the recommendation and decisions.

5. Triangulation:

a. PRA works with qualitative data.
b. Other sources/techniques must be used.

Differences Between RRA and PRA

Particulars	RRA	PRA
Evolved in	Late 1970s/80s	Late 80s/90s
Valuable resources	People's knowledge	People's capabilities
Innovation	Methods	Changes, behaviour and attitudes
Predominant mode	Elective extractive	Facilitating participatory
Instrument mode	Interview schedule & discussion verbal	Participatory & diagramming visual
Objectives	Learning from outsiders	Empowerment of local people
Outsider's role	Investigator	Initiator and catalyst

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Insider's role	Respondent	Presenter, analyst and planner
A model who demands outcome	For participatory intervention donor organizations plans projects publications	For interaction insiders, field organizers NGO/GO Sustainable local action and institution.

The Need for PRA

1. Need for accurate and timely information.
2. Advocates that the people themselves are "solution Agent" for their problems.
3. It cuts down the "Normal Professional Bias"- poverty bias towards people.
4. Reduces down the normal time-consuming long methods of survey.

The Purposes of PRA

1. To use farmers criteria and understand the local environment with clear local priorities.
2. To learn farmers' indigenous technologies.
3. To achieve for triangulation using different methods and involving various people to check and re-check the findings.
4. To develop self-critical analysis and direct contact with local needs and commitment.

Type of Participatory Method

Participatory Rural Appraisal is of various types viz. Exploratory, Topical, Deductive etc. As per the need, combination of tools is used.

1. Exploratory PRA: It is common and explores different aspects of socio-economic issues of village life and suggests important needs to be taken into account for improvement various useful ideas also emerge out of exploratory PRA for further probing and help in understanding the exercise.

2. Topical PRA: Topical PRA is concerned with a particular topic or area of investigation. The topic or investigating area can be suggested by the villagers or outsiders may also indicate the key area. The topic can be probed through different groups without taking into consideration the caste, age, gender etc. Its main objective is to generate maximum information on specific topic. It is intensive in nature and helpful in analysing collected information at length.

3. Deductive PRA: Social situation of a village are taken into account under the study. In this type of PRA generally the main problem is not tackled directly. But various aspects of social systems are studied by relating other factors to deal with the sensitive issues of the society. It is used when facts are required and probing cannot be done directly e.g. corruption, social tension, community struggle, etc.

Steps of PRA

Generally, PRA is used for data gathering for report preparation. A typical PRA has eight clearly defined steps:
1. Site selection and clearance from local administrative officials.
2. Primary site visit
3. Data collection
4. Data synthesis and analysis
5. Problem identification and setting of opportunities to resolve them.
6. The ranking of opportunities and the preparation of a village resource management plan.
7. Adoption and implementation of the plan.
8. Follow up, evaluation and dissemination of findings.

Outcomes of Using PRA Techniques

1. First-hand Information.
2. Maps.

3. Baseline information.
4. List of priorities.
5. Involvement of different groups of the villages in the process.
6. Identification of matrix.
7. Village natural resource management plan.
8. Understanding potential conflicts between various groups in the village in implementing these prioritized plan and proposals for identifying these priorities.
9. A common frame of reference for implementation, management, monitoring and evaluation of the programme.

Conclusion

Development programmes will bring desired results only if they are people centred, environmentally friendly, participatory and build local and national capacities for self-reliance. For this, RRA is an appropriate methodology for evaluating, diagnosing and identifying rural situations, by a multidisciplinary team, particularly when quick action is required in the planning and management of development projects and programmes.

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Insect Pests in Onion

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Introduction

The onion crop is attacked by many insect pests at different crop growth stages which cause considerable losses in yield. Apart from reduction in crop yield, insect pests also pose harmful effects during harvesting, post harvesting, processing and marketing stages, which lower the quality and export potential of the crops that significantly causes the economic loss. The insect pests alter the cropping pattern and also affect the local and export markets. The consistent use of chemicals to control the plant insect pests not only poses a serious threat to the environment and mankind but also slowly build up resistance in the insect pests (Haile et. al., 2016). Most of the new generation pesticides are systemic in their mode of action which may leads to certain level of toxicity in the plant system and thus resulting health hazards (Mishra et. al., 2014). Further, it disturbs the microbial diversity which is an important part of the ecosystem. All these factors have led to new dimension in research for biological control and integrated approach for the management of plant insect pests. Important insect pests affecting the onion crop along with their management are briefly summarized in the present manuscript.

Thrips *(Thrips tabaci)*

Symptoms:

1.Thrips infestation at an early stage (transplanting to 45 days) can be identified by curling and twisting of leaves.
2. Typical symptom is the presence of white or silvery patches on the leaves which shine in the sun.
3. In severe infestation, whole plant looks blemished and turns white.

Management:

1. Planting of two rows of maize or one outer row of maize and an inner row of wheat as a barrier crop surrounding onion crop (250 sq. m.) at least 30 days prior to planting of onion helps to block the movement of adult thrips.
2. Spray insecticides Profenofos (0.1%), Carbosulfan (0.2%) or Fipronil (0.1%) when thrips population crosses the economic threshold level of 30 thrips/plant.

Eriophyid Mite *(Aceria tulipae)*

Symptoms:

1. Leaves do not open completely. Whole plant shows stunting, twisting, curling and yellow mottling.
2. Mottling is seen mostly on the edges of the leaves.

Management: Spray Dicofol (0.2%) or sulphur (0.05%) as soon as the symptoms appear. Repeat the spray after 15 days, if necessary.

Red Spider Mite *(Tetranychus urticae)*

Symptoms:

1. White discoloration of leaves with small patches of faeces, eggs, larvae and adult mites.
2. Yellow or bronze spots on the leaves.
3. Spider webbing on leaves.

4. Webbing encircles onion umbels.

Management: Spray Dicofol (0.2%) or sulphur (0.05%) as soon as the symptoms appear. Repeat the spray after 15 days, if necessary.

Stem and Bulb Nematode *(Ditylenchus dipsaci)*

Symptoms:

1. *D. dipsaci* enters through stoma or plant wounds and create galls or malformations in plant growth. This allows for the entrance of secondary pathogens like fungi and bacteria.
2. Symptoms are stunted growth, discoloration of bulbs, and swollen stems.

Management:

1. Bulbs that show signs of disease should not be planted.
2. Proper sanitation of fields and tools is essential because this nematode can survive and reproduce in infected plants and residue.

Conclusion

The insect pests in onion were the major factors responsible for the yields and reduction in yield quality. In order to manage insect pests of onion, some functional action plan including awareness creation training on insect pest identification and their management has to be designed. Moreover, an integrated pest management approach should be introduced in the study area. For identified economically important (major) insect pest regular inspection of onion fields, monitoring of some known pests and fast control measure is advised.

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Foliar Application of Nutrients to Enhance Productivity of Pulses

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Introduction

Foliar nutrition is a technique of feeding plants by applying liquid fertilizer directly to their leaves. Plants are able to absorb essential elements through their leaves. Foliar nutrient uptake is a means of rapid nutrient supply, especially when soil nutrient availability or root activity is reduced. The translocation of photosynthates from source to sink is very important for the development of economic part. Among the methods of fertilizer application, foliar nutrition is recognized as an important method of fertilization. Since foliar nutrients usually penetrate the leaf cuticle or stomata and enter the cells, it facilitates easy and rapid utilization of nutrients. Foliar nutrition is designed to eliminate the problems of fixation and immobilization of soil applied nutrients. Nutrients applied through foliage would be easily absorbed and translocated in the plant without any loss (Sathishkumar et al., 2020).

Advantages

1. It can be effectively used at varying topographical condition.
2. Poor and marginal lands could be used effectively.
3. Foliar fertilization can apply fertilizers in combination with herbicides insecticides fungicides.
4. It reduces fertilizer requirement of crop by increasing nutrient availability.

Disadvantages

1. If concentrations of nutrients in the foliar spray are too high, then leaf damage can occur and in severe cases may kill the plant.
2. If rain occurs shortly after an application, most of the spray will be washed off the leaves and reapplication will be necessary.
3. Foliar fertilization is unable to meet the total plant requirements for the major nutrients Viz., Nitrogen, Phosphorus and Potassium.

Recommended Fertilizers / Growth Regulators

Di-Ammonium Phosphate (DAP): It is the most popular phosphatic fertilizer because of its high nutrient content and good physical properties. The composition of DAP is 18 per cent Nitrogen and 46 per cent Phosphorus.

Urea: Urea is the most important nitrogenous fertilizer, with the highest Nitrogen content about 46 per cent. The main function of Urea fertilizer is to provide the plants with nitrogen to promote vegetative growth and make the plants look lush. Urea also aids the photosynthesis process of plants. It is primarily used for bloom growth.

Naphthalene Acetic Acid (NAA): It is a purely synthetic auxin. It is more effective auxin in promoting root growth of the plants.

Salicylic Acid: It is a phenolic phytohormone and is found in a plant which plays major roles in plant growth and development, photosynthesis, transpiration, ion uptake and transport.

Recommended Dose

DAP 2 per cent: Soak the 10 kg of DAP for overnight with some quantity of water using earthen or plastic vessel. It should be stirred meanwhile. After this soaked DAP mixture is sieved through muslin cloth or through nylon net and collect it in plastic or earthen plot. This solution should be sprayed by adding 500 litres of water for 1-hectare area (20 ml in one litre of water).

Urea 1 per cent: Dissolve 5 kg of urea in 500 litres of water (10 gram in 1 litre of water) for one-hectare area and spray.

NAA 40 ppm: Dissolve 20 gram of NAA in 500 litres of water (40 milligram in 1 litre of water) for one-hectare area and spray.

Salicylic acid 100 ppm: Dissolve 50 gram of salicylic acid in 500 litres of water (100 milligram in 1 litre of water) for one-hectare area and spray.

Time of Application: It should be sprayed once at pre-flowering and another at 15 days thereafter.

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Entomology Entomopathogens, Pathological Symptoms and their Role in Present Scenario of Agriculture

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Introduction

Entomopathogens are microorganisms that are pathogenic to arthropods such as insects, mites and ticks. Entomopathogens include several species of bacteria, fungi, viruses, protozoa and nematodes. These play a very important role in the management of insect pests. Using entomopathogens as biopesticides in pest management is called microbial control, which can be a critical part of Integrated Pest Management (IPM) against several pests. Understanding the mode of action, ecological adaptations, host range and dynamics of pathogen arthropod plant interactions is essential for successful utilization of entomopathogens.

1. Entomopathogenic bacteria: Bacteria are widespread in the environment and they have different types of interactions with insects including essential symbiosis. While many bacterial species inhabit bodies of insects establishing different levels of mutualistic relationships, only a limited number behave them as insect pathogens. The insect's pathogenic bacteria have multiple strategies to invade the host, to overcome its immune responses, to infect and to kill it.

Mode of action - when Bt is ingested, alkaline condition in the insect's gut activates a toxic protein (delta-endotoxins) that attaches to the receptors sites in the midgut and creates pores in midgut cells. This leads to the loss of osmoregulation, midgut paralysis and cell lysis. Contents of the gut leak into the insect's body cavity (hemocoel), and the blood (hemolymph) leaks into the gut, disrupting the pH balance. Bacteria that enter the body cavity cause septicemia and eventually death of the host insect.

2. Entomopathogenic fungi: A group of fungi that kill an insect by attacking and infecting its insect host is called entomopathogenic fungi.

Pathogenic symptoms - loss of appetite and an attempt to climb higher are the symptoms of fungi disease. They are followed by decreased irritability, general or partial paralysis, discoloured patches on integument and increased acidity in the blood. The body hardens and the insect is upright on its legs at the time of death. Death occurs within a week or even within 24 hours

The causes of death may be as follows - hyphae may force apart muscles. Blood cells may stop circulating due to increased hyphae. Blockage of the gut and by the toxin produced by the fungus.

3. Entomopathogenic viruses: Entomopathogenic viruses also need to be ingested by the insect host as similar to entomopathogenic bacteria and therefore it is ideal for controlling pests having chewing mouthparts.

Pathogenic symptoms - when larvae were fed with OBs, the larva exhibits certain symptoms. At the early stage of disease, the caterpillar becomes sluggish and avoids food intake and cuticles become oily. Finally, the cuticle turns fragile and ruptured liberating milky fluid which consists thousands of polyhedral. The restless movement of the infected caterpillars made them occupy the apical region of the twig and hung their head downwards by their prolongs. The initial symptoms will be the loss of appetite, slowly the central side turns pale whitish or milky yellow. Change in colour appeared to be dependent on the larval age at the time of infection. The infected larva moulted like its counterpart of healthy larva and grew larger than normal healthy larva and finally died.

4. Entomopathogenic nematodes: Nematodes that are pathogenic to the insects are referred to as entomopathogenic nematodes. Mode of action and symptoms - infective juveniles of entomopathogenic nematodes actively seek out their hosts and enter through natural openings such as mouth, spiracles and anus or the intersegmental membrane. Once it enters the insect body, the nematodes release symbiotic bacteria that kill the host through bacteria septicemia. The nematode initiates its development by feeding on host tissues. In the blood, the nematode-bacterium complex causes septicemia and kills their host usually within 48 hrs of infection.

Role of Entomopathogens in Present Scenario of Agriculture

It is time to reduce the environmental footprint of insect pest control.

1. Ecologically benefit - inherently less harmful and less environmental load.
2. Target specificity - designed to attack only one specific pest, in some cases few target organisms.
3. Environmental beneficence - often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems.
4. Suitability - when used as a component of an integrated pest management programme, entomopathogens can contribute greatly.

Conclusion

Entomopathogens show great promise as biocontrol agents of insect pests. Suggests that several insect pests are susceptible to those entomopthogens as a result of preliminary field studies. Due to hazardous insecticides, in IPM particularly organic farming, entomopathogens can be used as an alternative.

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Nutritional Value and Multipurpose Uses of Moringa

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Introduction

Moringa is really a miracle plant and a divine gift for the nourishing and healing of man. *Moringa oleifera* L. belongs to the moringaceae family. The nickname of moringa is "never die" because of its unimaginable ability to survive harsh weather and even drought. Moringa is alleged to cure concerning 300 diseases and virtually have all the vitamins found in fruits and vegetables. It's found in several tropical and sub-tropical regions. Moringa is one such utile tree, normally utilized in spices and cosmetic oils and has varied medicative and therapeutic applications. It's additionally used for food and has various industrial, medicative and agricultural uses, as well as animal feeding. Nutritious, invasive and drought-tolerant, this ancient plant was rediscovered within the 1990s and its cultivation has since become more and more fashionable in Asia and Africa, wherever it's among the foremost economically valuable crops. It's been dubbed the "miracle tree" or "tree of life" by the media. Moringa is an outstanding source of nutritional components. Moringa has anti-fungal, anti-viral, medicinal drug and anti-inflammatory properties. India is the main exporter of Moringa: canned leaves, fresh fruits (1.2 million t in India), oil and leaf powder.

Morphology and Physiology of Moringa

Moringa could be a little to a medium invasive, deciduous tree that will reach a height of 10–12 m and a trunk diameter of 45 cm. Young shoots have purplish or greenish-white, hairy bark. The leaves build up a feathery foliage of tripinnate leaves. The flowers are fragrant and asexual, surrounded by five unequal, thinly veined, yellowish-white petals. The flowers are about 1.0–1.5 cm long and 2.0 cm broad. The inflorescences are 10-20 cm long, spreading panicles bearing many fragrant flowers. Flowering begins inside the primary six months when planting. In seasonally cool regions, flowering only occurs once a year between April and June. The fruit is green when young and turns brown at maturity. The fruit is a hanging, three-sided brown capsule of 20–45 cm size which holds dark brown, globular seeds with a diameter of around 1 cm.

Climatic Requirements

Climatic: The moringa trees are mainly grown in semi-arid, tropical, and subtropical areas.
Soil: Moringa tolerates a wide range of soil conditions but prefers a neutral to slightly acidic (pH 6.3 to 7.0), well-drained sandy or loamy soil.

Temperature: Moringa does well where average temperatures are high, ranging from 25 to 30°C. Low temperatures and frost can kill the plant back to ground level but re-growth occurs quickly once the temperatures increase.

Nutritional Values of Moringa

Nutritional value per 100 g		
	Moringa raw leaf	**Moringa raw pods**
Energy	64 kcal (270 kJ)	37 kcal (150 kJ)
Carbohydrates	8.28 g	8.53 g
Dietary fiber	2.0 g	3.2 g
Fat	1.40 g	0.20 g
Protein	9.40 g	2.10 g
Water	78.66 g	88.20 g
Vitamins		
Vitamin A Equiv.	378 µg	4 µg
Thiamine (B1)	0.257 mg	0.0530 mg
Riboflavin (B2)	0.660 mg	0.074 mg
Niacin (B3)	2.220 mg	0.620 mg
Pantothenic acid (B5)	0.125 mg	0.794 mg
Vitamin B6	1.200 mg	0.120 mg
Folate (B9)	40 µg	44 µg
Vitamin C	51.7 mg	141.0 mg
Minerals		
Calcium	185 mg	30 mg
Iron	4.00 mg	0.36 mg
Magnesium	147 mg	45 mg
Manganese	0.36 mg	0.259 mg
Phosphorus	112 mg	50 mg
Potassium	337 mg	461 mg
Sodium	9 mg	42 mg
Zinc	0.6 mg	0.45 mg
Units: µg = micrograms, mg = milligrams		

Source: USDA Nutrient Database (https://ndb.nal.usda.gov/ndb/search/list)

As seen within the chart on top of, not solely will moringa contain vitamin A and C, Calcium, Potassium, Iron, and Protein. The chart above highlights some of the commonly known nutrients needed by the human body.

Multipurpose Uses of Moringa

1. Used as Food: All parts of the moringa are consumed as food. The plant produces leaves during the dry season and during times of drought and is an excellent source of green vegetables when little other food is available. Leaves, pods, roots and flowers can be cooked as vegetables. The leaves are very nutritious and rich in protein, vitamins A, B and C and minerals.

Moringa usually cooked (boiled, pan-fried) and consumed like spinach or put in soups and sauces. Moringa utilized in soups and curries and other traditional dishes like – South Indian sambar and the Thai dish Kaeng som which is a sour curry with drumsticks and fish. Tender moringa leaves, finely chopped, are used as a garnish for vegetable dishes and salads, such as the Kerala dish Thoran. It is also used in place of or along with coriander. Flowers are used to making tea, added into sauces or made into a paste and fried. The immature seeds can be cooked in many different ways while the mature seeds are roasted and eaten like peanuts. Moringa leaf powder is used to aid the restoration of infants suffering from malnutrition.

2. Used as feed: Moringa leaves are a rich source of protein for ruminants but they have moderate palatability. Moringa leaves used as feed for poultry, pigs and fish are feasible because of the presence of limited amounts of fibre and anti-nutritional factors. Moringa oilseed cake, the by-product of oil extraction, is not very edible to livestock and mainly used as green manure or a flocculating agent in water purification.

3. Agricultural uses of Moringa: The whole plants are used as living hedges, fences and wind breaks. Moringa contains plant hormones (including Zeatin) that plants and crops to produce greater yields. Phytohormones extracted from moringa leaves have been shown to have growth-enhancing the effect on various plants, including black gram, peanut, soybean, sugarcane and coffee. Spraying moringa leaf extract on leaves increased plant production by 20-35%.

4. Medicinal uses: Moringa helps in fighting with cold and flu and boosts the immune system, reducing cancer levels and intestine tumour or ulcer, very helpful in asthma, bronchitis, tuberculosis patients and it additionally helps in reducing women period cramping. Moringa is a good tonic for growing children, brain injury people, skin, diabetic patients and eye and retina health.

5. Malnutrition relief: Moringa trees are wont to combatable nutrition, especially among infants and nursing mothers. Moringa thrives in arid and semi-arid environments and it provides a versatile, nutritious food source throughout the year. Moringa leaves have been proposed as an iron-rich food source (31% Daily Value per 100 g) to combat iron deficiency.

Services

Erosion control: Moringa is suited to those areas where strong winds and long, dry spells occur simultaneously, causing serious soil erosion.

Soil improver: The green leaves make useful mulch. The press cake left after oil extraction from the seeds can beused as a soil conditioner or as fertilizer.

Ornamental: The species is widely planted as an ornamental.

Boundary / barrier / support: Planted as a hedge in courtyards, it provides wind protection, shade and support for climbing garden plants. Widely used for live fences and hedges in Kenya, Nigeria, Tanzania, India and elsewhere. Stakes root easily and are stable, and cuttings planted in lines are used particularly around houses and gardens.

Intercropping: The tree provides semi-shade, useful in intercropping systems where intense direct sunlight can damage crops.

Conclusion and Future Prospects

The moringa (Drumstick) plant is the most in expensive and credible alternative to not only providing good nutrition, but also the cure and prevention of diseases. We have to design and develop a strategy in order to explore and utilize the full benefits of this miracle tree (moringa). Moringa truly appears to be a “Miracle” plant having benefits for human and thus should be taken as a high-quality gift of nature at a very low price. For future prospects, the research project should be made for commercial production of food products, nutraceuticals, Moringa oil (edible as well as cosmetics), fortified feed for cattle, biogas, and plant fertilizer. In the purification of water moringa plant should be used. In this type, we utilized the moringa tree for multiple purposes.

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Organic Farming in India

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Introduction

Organic farming in India has tremendous chance to rise as significant providers of organic items. India had brought more than 5.21-million-hectare area under organic certification measure by 2013-14. India has developed as one of the biggest possible business sectors for organic food utilization internationally with developing mindfulness towards sound food, flooding pay levels, and moves in consumer behaviour.

Organic food market is developing at a pace of 14 percent and a development pace of 20 percent in the following five years is conceived. Organic production systems can possibly accomplish supportability of agricultural systems. Organic production systems impact soil profitability through their impact on soil physical, chemical and biological properties. Higher crop productivity under organic than non-organic systems has been accounted for by a few scientists (Das et al., 2008).

Organic Farming

Organic farming is a production system which evades or to a great extent avoids the utilization of synthetically chemical fertilizers, pesticides, growth controllers, hereditarily changed life forms and domesticated animals' food added substances. To the most extreme degree conceivable organic farming system depend upon crop rotations, utilization of crop deposits, animal manures, vegetables, green manures, off ranch organic squanders, bio composts, mechanical development, mineral bearing rocks and parts of natural control to keep up soil efficiency and tilth to flexibly plant nutrients and to control creepy crawly, weeds and different pests.

What is the Need of Organic Farming in India?

Green revolution innovations including more prominent utilization of manufactured agrochemicals, for example, chemical fertilizer and pesticides with reception of supplement responsive, high-yielding varieties of crops have supported the production yield per hectare in India.

In any case, this expansion in production has eased back down and indicating multi supplement insufficiency which lead to diminishing profitability. In addition, the achievement of green revolution influencing environments and deterioting quality of food which lead to create health problems.

Organic farming is help to soil stay in good health through the use of biological wastes, organic wastes and bio-fertilizers. Using organic sources of nutrients to help sustainable crop production along with good quality food production. Sometime it is called 'green farming'.

Salient Features of Organic Farming

1. Protecting soil fertility.
2. Providing supplements through the microbial activity.
3. Encouraging natural movement in soils.
4. Using legumes to satisfy the nitrogen prerequisites of the soil.
5. Maintaining the degree of organic matter.
6. Managing insect, pests and diseases out the utilization of methods like crop rotation, maintaining diversity, natural predators and growing resistant varieties etc.

Fig. 1 Organic farming in India

Conventional Farming Versus Organic Farming

Conventional farming	Organic farming
Cultivating land, using science and technology to dominate nature	Least interference with natural processes and eco friendly
Low quality of food	High quality of food
Mono cropping/culture, less efficient rotations	Diversified and more efficient rotations
Productivity gains in long-run are in declining order	Productivity gains in long-run are in incremental order
Crop residues removal or burning	Crop residues surface retention or incorporation in to soil
Mostly depend for nutrient chemical fertilizer such as urea, amonium sulphate etc.	Mostly depend for nutrient organic sources such as farm yard manures, bio fertilizer etc.
For plant protection mostly use chemical pesticidies eg. mancozeb etc.	For plant protection mostly use organic pesticides eg. cow urine, neem oil etc

Advantages of Organic Farming

1. It assists with keeping up condition wellbeing by lessening the degree of contamination.
2. It helps in keeping productivity at a sustainable level.
3. It reduces the cost of cultivation and also improves the soil health.
4. It decreases human and creature wellbeing risks by diminishing the degree of deposits in the item.
5. It ensures optimum utilization of natural resources for optimum production and also helps in conserving resources them for future generation.
6. It improves the soil physical properties for example, soil structure, soil organic matter and improves water-holding capacity, and reduces erosion.

Conclusion

The enthusiasm for organic agriculture in creating nations is developing since it requires less money related input and places more dependence on the common and human resources accessible. It advances soil wellbeing and carbon sequestration and gives different ecosystem services including relief of environmental change. Coordinated organic farming system won't just advance organic food production yet additionally lessen reliance on outer assets through effective reusing of on-ranch biomass and different assets particularly irritation and malady the executives actually stay a genuine test.

Studies to date appear to demonstrate that organic farming offers near favourable position in area with less precipitation and generally low regular and soil fruitfulness levels. Work understands a decent return and this is significant where paid work is nearly non-existent. Organic agriculture doesn't require expensive interests in water system, vitality and outer data sources, but instead organic farming policies arrangements can possibly improve nearby food security, especially in marginal areas.

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The Role of Dietary Fibre in Human Health

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Introduction

Dietary fiber is an essential component of a healthy diet. It could be easily traced in cereals, certain fruits and also vegetables. It is a kind of carbohydrate that has indigestible parts or plant compounds which pass relatively unchanged through the stomach and also the intestines. Since it could pass relatively unobstructed within the stomach and intestines, it keeps the digestive system in our body healthy.

Types of Dietary Fibre

Soluble fibre: This type of fibre dissolves in water to form a gel-like material. It can help lower blood cholesterol and glucose levels. Soluble fibre is found in oats, peas, beans, apples, citrus fruits, carrots, barley and psyllium.

Insoluble fibre: This type of fibre promotes the movement of material through your digestive system and increases stool bulk, so it can be of benefit to those who struggle with constipation or irregular stools. Whole-wheat flour, wheat bran, nuts, beans and vegetables, such as cauliflower, green beans and potatoes, are good sources of insoluble fibre.

Functions of A Dietary-Fibre Diet

1. Normalizes bowel movements: Dietary fibre increases the weight and size of your stool and softens it. A bulky stool is easier to pass, decreasing your chance of constipation.

2. Lowers cholesterol levels: Soluble fibre found in beans, oats, flaxseed and oat bran may, help lower total blood cholesterol levels by lowering low-density lipoprotein, or "bad," cholesterol levels.

3. Blood sugar control: Soluble fibre may help to slow your body's breakdown of carbohydrates and the absorption of sugar, helping with blood sugar control.

4. Heart health: An inverse association has been found between fibre intake and heart attack, and research shows that those eating a high-fibre diet have a 40 percent lower risk of heart disease.1

5. Stroke: Researchers have found that for every seven-grams more fibre you consume on a daily basis, your stroke risk is decreased by 7 percent.2

6. Weight loss and management: Fibre supplements have been shown to enhance weight loss among obese people,3likely because fibre increases feelings of fullness.

7. Skin health: Fibre, particularly psyllium husk, may help move yeast and fungus out of your body, preventing them from being excreted through your skin where they could trigger acne or rashes.4

8. Diverticulitis: Dietary fibre (easily insoluble) may reduce your risk of diverticulitis – an inflammation of polyps in your intestine – by 40 percent.5

9. Hemorrhoids: A high-fibre diet may lower your risk of hemorrhoids.

10. Irritable bowel syndrome (IBS): Fibre may provide some relief from IBS.

11. Gallstones and kidney stones: A high-fibre diet may reduce the risk of gallstones and kidney stones, likely because of its ability to help regulate blood sugar.

Health Risk Due to Excess Consumption of Dietary Fibre

1. Cramping: Cramping occurs because the body cannot properly break down fibre. If too much fibre is consumed, food digestion can be momentarily slowed or even stopped. This can lead to intestinal cramping and discomfort.

2. Diarrhoea: If you increase your fibre intake too suddenly, then your body will not have enough time to adjust. One of the biggest benefits of fibre is that it increases the speed in which food moves throughout the digestive tract. By consuming too much fibre, you may increase this speed too much, which can lead to diarrhoea.

3. Constipation: If you eat too much fibre without enough water, then you may become constipated. The body's digestive tract requires fluids to help move things along. If you do not have enough fluids in your system, then your intestines will not be able to work properly and you may become constipated.
Intestinal gas: By eating too much fibre in a short amount of time, you may experience flatulence, bloating and intestinal gas. This occurs as a reaction the natural bacteria in your digestive tract has to the fibre. To avoid this side effect, simply gradually increase your fibre intake so the natural bacteria can adjust to the fibre.

4. Intestinal blockage: An intestinal blockage would be the worst side effect you could get from consuming too much fibre. This occurs when individual eats too much fibre and does not consume enough water. Fibre can cause a blockage in the intestines, preventing any other foods to get past. Intestinal blockages can be serious health conditions and may require surgery.

Deficiency of Dietary Fibre

1. Constipation: Fibre helps to soften stools and move things along. Without enough fibre in the diet, stools become hard and the elimination process is slowed down.

2. High Blood Pressure: Several studies suggest that high fibre intake can lower both systolic and diastolic blood pressure.

3. Diabetes: Fibre helps to regulate blood sugar. People who consumed fibre from cereals and grains (averaging 16.6 grams per day) had a 27 percent lower risk of developing type 2 diabetes than those that averaged 6.6 grams per day.

4. Cardiovascular Disease: People who have diets lacking fibre have higher levels of C-reactive protein. High levels of C-reactive protein can increase the risk of heart disease, stroke and diabetes. Fibre also has a cholesterol lowering benefit. Studies show that by increasing average daily fibre intake from 10 to 20 grams per day, the risk of dying from heart disease can be lowered by 19-27 percent.

5. Obesity: Fibre seems to slow down fat absorption. Stools from people eating a diet high in fibre have more fat in them than stools from those with minimal fibre in their diet. Those deficient in fibre may have a harder time controlling their weight.

6. Cancer: Inadequate fibre intake may increase the risk of developing colon cancer. Populations with high fibre consumption have a much lower incidence of developing this disease. One theory suggests that fibre prevents toxins from having an adverse effect on colon cells, by sweeping them out of the body before they have a chance to do damage.

Recommended Dietary Allowances

The recommendations of the fibre is a minimum intake of fibre 20-35gm of fibre is conducive for long-term good health can be a positive guideline. Even the WHO committee on chronic degenerative diseases recommended a daily intake of 30 gm dietary fibre. Based on energy intake level of about 40 gm/kcal in a diet is considered reasonably safe. Intake in excess of 60gm of fibre over a day can reduce the absorption of nutrients and may cause irritation in the bowel apart from leading to diarrhoea. Studies to date appear to demonstrate that organic farming offers near favourable position in area with less precipitation and generally low regular and soil fruitfulness levels. Work understands a decent return and this is significant where paid work is nearly non-existent. Organic agriculture doesn't require expensive interests in water system, vitality and outer data sources, but instead organic farming policies arrangements can possibly improve nearby food security, especially in marginal areas.

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Challenges of Elderly Days and Geriatric Nutrition

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Introduction

Older persons are particularly vulnerable to malnutrition. Moreover, attempts to provide them with adequate nutrition encounter many practical problems. First, their nutritional requirements are not well defined. Since both lean body mass and basal metabolic rate decline with age, an older person's energy requirement per kilogram of body weight is also reduced. Adequate nutrition, especially in older age, aids in the maintenance of health and in decreasing the onset of chronic diseases, contributes to vitality in everyday activity, to energy and mood and helps in maintaining functional independence. Older people – 65 and up – are more vulnerable to nutritional deficiencies and nutritional problems are more common among them.

Challenges and Problems to the Gereatric People

Old age people, 65 years old people suffers from many kinds of challenges that obstruct the proper nutrition of them.

1. Reduces the sensitivity: As they advance in age, the senses of elderly people become numbed down; it takes more energy and time to trigger a stimulus. Their sense of smell and taste decreases reducing your appetite. In some cases, they even have trouble differentiating fresh food from stale since their senses are compromised.

2. Side effects of medication: Sometimes medications cause nausea, reduced appetite, and change food tastes perceptions. In this case, the side effects can discourage them from eating, and they end up skipping there meals.

3. Dental caries: Dental issues are more likely to come up as they grow older such as missing teeth, receding gums that cause your teeth to be shaky, mouth sores, and jaw pain. All these factors make chewing painful and uncomfortable hence reducing the likelihood of taking healthy foods among elderly people.

4. Physical disability occurs: Elderly people become weaker with their age, especially when dealing with conditions like arthritis and disability. Pain and poor physical strength can make simple tasks appear to be challenging and tough. In old age performing basic functions like standing for long while cooking, carrying groceries, or even peeling a fruit may become daunting tasks.

5. Memory loss occurs: Memory loss, dementia, and Alzheimer's disease occurs in the elderly people. Old age people may forget to follow their recommended meal program or skip a meal or even forget to buy food from the store. This poses a nutritional challenge also.

6. Depression: In elderly age a lot of changes take place, (the children move away, and old age people lose their friends and loved ones due to death, they feel lonely.

All these issues compounded can lead to depression. Geriatric people may become apathetic about their health and avoid eating. If left untreated, depression can lead to much more significant health problems.

Geriatric Nutrition

1. Water and liquid intakes: Water constitutes the main component of the body. Water is present in the food and drinks. The most recommended drink is water, it is important to drink water in and between meals. It contains minerals, which are important for the body, e.g., calcium, magnesium and fluoride.

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2. Pulses and legumes: Grains and legumes are the major foods that contain mainly starch (carbohydrates) and a certain amount of proteins. For example: bread, noodles, potatoes, oats, corn, wheat, buckwheat, rice, morning cereals. Most of the foods in this group also contain fibres (especially when they are eaten as whole grain), vitamins and minerals.

3. Green leafy vegetables and fruits: Vegetables and fruits contain carbohydrates (sugars), water, fibre, vitamins and minerals. For example, vegetables and fruits rich in vitamin C: cabbage, tomato, pepper, lettuce, citrus fruits, kiwi, melon, strawberry. It is recommended to eat unpeeled vegetables and fruits as much as possible. It is recommended to include vegetables and fruits of different colours in every meal. Vegetables contain less sugar and calories compared with fruits; therefore, it is recommended to maintain a ratio of 2/3 vegetables and 1/3 fruits.

4. Protein rich foods: This group contains meat products (source of iron), milk products (source of calcium), eggs and legumes (source of iron and calcium). The group provides other components: zinc, vitamin B12– in animal products, fibre – in legumes, Omega 3 – in fish. It is recommended to diversify and eat animal products (meat, chicken, fish, milk, eggs) and plant products (legumes like lentils, beans, humus). It is recommended to consume low fat foods: cheeses up to 5%, milk and yogurt 1-3%, lean, skinless meat products.

5. Oil rich foods: This food group contains foods like oil, avocado, mayonnaise, nuts, almonds, olives, margarine and butter. These foods are important to one's health, but the body needs them in moderation. From this group it is recommended to use the foods rich in various types of unsaturated fats, like vegetable oils, instead of foods rich in saturated fat of animal sources (e.g., butter), or in plants (such as hard margarine). Cholesterol (of animal source) and trans-fat (from processed foods) are not recommended.

6. Sweets, snacks and sweet beverages: This group contains foods rich in fat and sugar and oftentimes also salt. These foods are not essential to the physical and nutritional health, but are associated with eating and cultural habits. It is recommended to eat these foods sparingly.

Conclusion

Adequate nutrition, especially in older age, aids in the maintenance of health and in decreasing the onset of chronic diseases, contributes to vitality in everyday activity, to energy and mood and helps in maintaining functional independence.

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Effect of Foliar Application of Plant Growth Regulators on Flowering, Growth, Fruit Set, Fruit Drop, Yield, Quality of Kinnow Mandarin *(Citrus reticulata)*

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Abstract
A field experiment was carried out during the months of March to November , 2019-2020 at Horticulture Research Farm, Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Pray4agraj to study the " Effect of foliar application of plant growth regulators on flowering, growth, fruit set, fruit drop, yield, quality of Kinnow Mandarin (Citrus reticulate). The research was conducted under the Prayagraj Agro climatic conditions and Randomised block design is followed. The Experiment was conducted on Kinnow mandarin with various treatments (Control, NAA-25ppm, 52ppm, 75ppm, 100, 2,4-D -5ppm, 10ppm, 15ppm, 20ppm, GA3- 25ppm, 50ppm, 75ppm, 100ppm) in three replications. The Maximum plant height ranged from (211 .18cm to 240.04cm). The Minimum plant height (167.31cm) was recorded in control (water spray) compared to the other treatments. Based on the results recorded during the trial the greatest number of flowers obtained after the spraying of growth regulators are (188.56), the maximum number of fruits per plant (171.93), the maximum fruit weight per plant (126.93), the maximum fruit length per plant (6.16cm) was found superior in the plants treated with 2,4-D 20ppm. Among these treatments, the most effective treatment of foliar spray for plant height(cm) number of flowers, fruits per plant, fruit weight, fruit drop, fruit length is 2,4-D at 20ppm.

Keywords: Kinnow Mandarin (Citrus reticulate), Plant growth regulators, flowering, fruit drop, fruit set, yield, quality.

Introduction
Kinnow, a mandarin hybrid between King Mandarin (Citrus reticulate) was introduced in India in 1958 at the Regional Fruit Research Station, Abohar (Punjab). In India this variety was introduced by J.C. Bakhshi in 1954 at the Punjab Agriculture University, Regional Fruit Research Station, Abohar. Citrus fruits have special importance due to their distinct flavour and therapeutic values. These are rich in Vitamin-C with the fair amount of vitamin A & B. They are rich source of minerals like calcium, phosphorus and iron. It is a hybrid of two citrus cultivers- King (Citrus Nobilis) x willow leaf (Citrus deliciosa). The genus Citus L. belongs to subfamily Aurantioideae of the family Rutaceae. It was first developed by Howard B. Frost in 1915 and released in 1953 at the university of California, Citrus experiment station.

Materials and Methods
The experiment was carried out using Kinnow plants at the Central Research Field of Department of Horticulture, Naini Agriculture University, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad.The experimental site is situated at of a latitude of 20o and 15o North and longitude of 6003" East and at an altitude of 98 meters above mean sea level (MSL).

Results and Discussion

Based on the observations recorded during the trial, the Maximum plant height is 240.04cm. The Minimum plant height 167.31cm was recorded in control (water spray) compared to the other treatments. The greatest number of flowers obtained after the spraying of growth regulators are (188.56), and the minimum number of flowers are 116.36cm. the maximum number of fruits per plant (171.93) and the minimum number of fruits per tree are 98.87.

The maximum fruit weight per plant (126.93) and the minimum fruit weight per plant was91.59gm. The maximum fruit length per plant (6.16cm) was found superior in the plants treated with 2,4-D 20ppm and the minimum fruit length was 4.06cm. 2,4-D is most effective in controlling the fruit drop. Among these treatments, the most effective treatment of foliar spray for plant height(cm) number of flowers, fruits per plant, fruit weight, fruit drop, fruit length is 2,4-D at 20ppm.

Table 1 Treatment combination data of Foliar application of plant growth regulators like NAA, 2,4-D, GA3 used for Kinnow mandarin (Citrus reticulate).

Treatment symbol	Treatment combination	Plant height Maximum	No.of flowers	No.of fruits	Fruit weight	Fruit length	Yield per plant	Yield per hectare
Control	Water spray	209.85	116.36	98.87	91.59	4.06	9.06	25.08
NAA	25 ppm	209.54	135.59	120.39	106.56	5.54	12.83	35.53
NAA	50 ppm	219.84	137.59	119.31	109.53	5.41	13.07	36.20
NAA	75 ppm	214.10	139.26	121.07	112.52	5.32	13.62	37.74
NAA	100 ppm	220.99	148.30	124.63	109.19	5.76	13.61	37.69
2,4-D	5 ppm	226.28	181.93	162.19	119.93	6.12	19.45	53.88
2,4-D	10 ppm	228.87	183.76	164.12	121.93	6.26	20.01	55.44
2,4-D	15 ppm	234.84	184.98	168.53	122.89	6.30	20.71	57.37
2,4-D	20 ppm	240.04	188.56	171.93	126.93	6.16	21.82	60.45
GA3	25 ppm	222.77	182.63	169.56	113.89	5.85	19.31	53.47
GA3	50 ppm	217.27	179.35	170.58	116.27	5.94	19.83	54.93
GA3	75 ppm	219.38	177.89	168.60	112.34	5.64	18.94	52.46
GA3	100 ppm	223.00	177.10	166.96	110.57	5.30	18.46	51.14

Conclusion

Based on the result obtained, the most effective treatment of foliar spray for better flowering, fruit set, yield, fruit drop, quality of kinnow mandarin is found to be T8 having the proportion 2,4-D at 20 ppm as shown in the Table 1.

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Different Types of Slow-Release Fertilizers

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Slow-release fertilizers are excellent alternatives to soluble fertilizers. Because nutrients are released at a slower rate throughout the season, plants are able to take up most of the nutrients without waste by leaching. Slow-release fertilizers are generally categorized into one of several groups based on the process by which the nutrients are released. Application rates vary with the different types and brands, with recommendations listed on the fertilizer label.

Types of Slow Released Fertilizer

Pelletized: One type of slow-release fertilizer consists of relatively insoluble nutrients in pelletized form. As the pellet size is increased, the time it takes for the fertilizer to breakdown by microbial action is also increased. An example of this type is MagAmp, a 7-40-0 fertilizer that is available in a coarse grade lasting two years and a medium grade lasting one year. MagAmp is used commercially for container plants, but is appropriate for use on turf, tree seedlings, ornamentals, vegetables, and flower borders.

Chemically Altered: A fertilizer may be chemically altered to render a portion of it water insoluble. For instance, urea is chemically modified to make Ureaform (ureaformaldehyde) -- a fertilizer that is 38 percent nitrogen, 70 percent of which is water-insoluble. This percentage is often listed on fertilizer labels as the Percent W.I.N., or the percent of water-insoluble nitrogen. This form of nitrogen is released gradually by microbial activity in the soil. Because microbial activity is greatly affected by soil temperature, pH, aeration, and texture, these variables can affect the release of nitrogen from Ureaform. For example, there will be less fertilizer breakdown in acid soils with poor aeration -- an environment unfavourable to soil microorganisms. Ureaform is used for turfgrass; landscaping; ornamental, horticulture, and greenhouse crops.

IBDU *(isobutylidene diurea)* is similar to Ureaform, but contains 32 percent nitrogen, 90 percent of which is insoluble. However, IBDU is less dependent on microbial activity than Ureaform. Nitrogen is released when soil moisture is adequate. Breakdown is increased in acid soils. IBDU is used most widely as a lawn fertilizer.

Coated fertilisers Controlled- or slow -release fertilizers are broadly divided into uncoated and coated products. Uncoated products rely on inherent physical characteristics, such as low solubility, for their slow release. Coated products mostly consist of quick-release N sources surrounded by a barrier that prevents the N from releasing rapidly into the environment. Different mechanisms, but similar (though not identical) end results.

The terms “controlled-release” and “slow-release” can mean different things to different people, but for purposes of this discussion, the two terms are synonymous. Except for a few slow-release K sources, almost all slow-release fertilizers are N sources. They represent a relatively small segment of the total fertilizer industry (3 to 4 percent), but their use is growing faster than soluble (quick-release) materials. This is primarily because they reduce the overall environmental impact of N fertilizers, as now mandated in BMPs.

Coated: Water-soluble fertilizers may be coated or encapsulated in membranes to slow the release of nutrients. For example, Osmocote, a controlled-release fertilizer is composed of a semipermeable membrane surrounding water-soluble nitrogen and other nutrients. Water passes through the membrane, eventually causing enough internal pressure to disrupt the membrane and release the enclosed nutrients. Because the thickness of the coating varies from one pellet, or prill, to another, nutrients are released at different times from separate prills. Release rate of these fertilizers is dependent on temperature, moisture, and thickness of the coating. Osmocote is recommended for turf, floriculture, nursery stock, and high-value row crops.

Another type of coated fertilizer is sulfur-coated urea (SCU), which is manufactured by coating hot urea with molten sulfur and sealing with a polyethylene oil or a microcrystalline wax. Nitrogen is released when the sealant is broken or by diffusion through pores in the coating. Thus, the rate of release is dependent on the thickness of the coating or the sealant weight. SCU is broken down by microorganisms, and chemical and mechanical action. The nitrogen in SCU is released more readily in warm temperatures and dry soils. SCU appears to be more effective when applied to the soil surface, rather than mixed into the soil. Any method of application that crushes the granules will increase the release rate to some extent.

SCU is best used where multiple fertilizer applications are normally necessary, such as on sandy soils or in areas of high rainfall or irrigation. SCU is used on grass forages, turf, ornamentals, and strawberries.

Nutricote is characterized by coating nitrate compound fertilizers with a special resin. The duration of nutrient release is controlled by the porosity of the resin coating. A more porous coating results in quicker release. This technology ensures consistency and precision of nutrient release from Nutricote controlled release fertilizers.

When Nutricote is applied to the soil, the water in the soil enters the granule through micropores which dissolves the nutrient elements. The nutrient elements will then be released steadily through the same pores. Most Nutricote granules are 3 to 4 mm in diameter and the nutrient content are NPK: 14-14-14 and NPK: 20-7-10.

Nutricote's release rate is influenced by soil temperature, the higher the soil temperature, the greater the release rate. Absorption of nutrients and water by plants is generally increased with increasing temperature and plant growth will become more vigorous as a result. Nutrient supply through Nutricote nicely matches the physiology of plant response to temperature.

The release rate of Nutricote is not significantly influenced by soil moisture levels nor by soil type or pH. Nutricote does not depend upon microbiological decomposition for its action.

Polymer-Coated Fertilizers

Polymer-coated fertilizers (PCF) represent the most technically advanced state of the art in terms of controlling product longevity and nutrient efficiency. Most PCFs release nutrients by diffusion through a semipermeable polymer membrane, and the release rate can be controlled by varying the composition and thickness of the coating. The type of fertilizer substrate also may influence the rate of N release.

Meister products: Meister products are produced by using thermoplastic resins as coating materials. The coatings are applied to a variety of substrates including urea, diammonium phosphate, potassium sulfate, potassium chloride and ammonium nitrate. Release-controlling agents such as ethylene-vinyl acetate and surfactants are added to the coating to obtain the desired diffusion characteristics, while coating thicknesses remain similar for most products. Release rates can also be altered by blending talc resin into the coating.

Reactive Layer Coating: A relatively new coating technology known as reactive layer coating (RLC) combines two reactive monomers as they are simultaneously applied to the fertilizer substrate. These reactions create an ultra-thin membrane coating, which controls nutrient release by osmotic diffusion. RLC products include coated basic fertilizer materials such as urea, potassium nitrate, potassium sulfate, potassium chloride, ammonium sulfate, ammonium phosphate and iron sulfate, in various particle sizes. Coating weights on urea vary from 1.5 to 15 percent, depending on the release duration desired.

Multicote products: In the production of multicote products, fertilizer granules are heated in a rotating pan and treated with materials that create multiple layers of a fatty acid salt. This is followed by the application of a paraffin topcoat. Coating weights are relatively large compared to other technologies, but this is offset by the comparatively low cost of the coating materials. Substrates include potassium nitrate, urea and triple superphosphate. The various coated components are blended together into different grades.

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Slow Release N Fertilizers and their Release Pattern

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Slow-release fertilizer are incredible options in contrast to dissolvable composts. Since supplements are discharged at a slower rate all through the season, plants can take up the vast majority of the supplements without squander by filtering. A moderate discharge compost is increasingly advantageous, since less regular application is required. Compost consume isn't an issue with moderate discharge manures even at high paces of utilization; be that as it may, it is as yet essential to follow application suggestions. Slow-discharge composts might be more costly than dissolvable kinds, yet their advantages exceed their detriments.

Slow- release fertilizer is commonly sorted into one of a few gatherings dependent on the procedure by which the supplements are discharged. Application rates fluctuate with the various kinds and brands, with suggestions recorded on the manure name.

Coated N Fertilizers

Urea formaldehyde reaction products: Urea formaldehyde (UF) reaction products represent one of the oldest controlled-release N technologies, having been first produced in 1936 and commercialized in 1955. Urea and formaldehyde are reacted together to various extents to produce polymer-chain molecules of varying lengths. The more these products are reacted, the longer the chains tend to be. Chain length, in turn, affects release characteristics.

Ureaform is the oldest class of UF reaction products. It is sparingly soluble, and contains at least 35 percent total N, with at least 60 percent of the total N as cold-water insoluble N (CWIN). Ureaform is composed largely of longer-chained molecules of UF polymers. The unreacted (and, therefore, quick-release) urea N content in UF is usually less than 15 percent of the total N.

Methylene ureas are a class of sparingly soluble products that evolved during the 1960s and 1970s. These products predominantly contain intermediate-chain-length polymers. The total N content of these polymers is 39 to 40 percent, with between 25 and 60 percent of the N present as CWIN. The unreacted urea N content generally is in the range of 15 to 30 percent of the total N. UF solutions are clear water solutions. They contain only very-low-molecular weight, water-soluble UF reaction products, plus unreacted urea. Various combinations of the UF solutions are produced. They contain a maximum of 55 percent unreacted urea with the remainder as one or more of methylolureas, methylolurea ethers, MDU, DMTU or triazone.

Isobutylidene diurea (IBDU): Unlike the reaction of urea and formaldehyde, which forms a distribution of different UF polymer chain lengths, the reaction of urea with isobutyraldehyde forms a single type of molecule. Although similar in chemical structure to methylene diurea (MDU), its physical properties are quite different. IBDU is a white crystalline solid available in fine (0.5 to 1.0 mm), coarse (.7 to 2.5 mm) and chunk (2.0 to 3.0 mm) particle sizes. The product contains a minimum of 30 percent N with 90 percent of the N in water-insoluble form. The typical commercialized product contains about 31 percent N.

Crotonylidene Diurea (CDU): This slow acting nitrogen compound is formed by reaction with crotonaldehyde or acetaldehyde. Powdered CDU containing 30 percent N has been directly used as a fertilizer. The microbial decomposition of the chemically bound CDU is temperature dependant.

Agronomic Properties and Nutrient Release Mechanisms of UF Materials

The conversion of UF reaction products to plant-available N is a multi-step process, involving dissolution first, and then microbial decomposition. Once in the soil solution, UF reaction products are converted to plant-available N through either microbial decomposition or hydrolysis. Microbial decomposition is the primary mechanism of N release. Environmental factors such as soil temperature, moisture, pH and aeration affect microbial activity and, therefore, the rate of N release.

The rate of N release from UF reaction products is directly affected by polymer chain length. The longer the methylene urea polymer, the longer it takes for the N to become available. For ureaform and methylene urea products, the rate of mineralization is reflected by the CWIN content and its Activity Index. The higher the AI value, the more rapidly the N will become available. It is questionable if the very long methylene urea polymers (HWIN) are effectively used by the plant.

Agronomic properties and nutrient release mechanisms of IBDU: Nitrogen from IBDU becomes available to plants through hydrolysis. In the presence of water, the compound will hydrolyse (break down) to urea and isobutyraldehyde. The rate of hydrolysis is accelerated by low pH and high temperature. Unlike UF polymers that rely on soil microbial populations to make the N available, IBDU is primarily dependent on water as the critical element in N availability. Its low water solubility controls the transport of the product into the soil solution.

Agronomic properties and nutrient release mechanisms of SCU: The mechanism of N release from SCU is by water penetration through micropores and imperfections (i.e., cracks) or incomplete sulphur coverage in the coating. This is followed by a rapid release of the dissolved urea from the core of the particle. When wax sealants are used, a dual release mechanism is created. Microbes in the soil environment must attack the sealant to reveal the imperfections in the sulphur coating. Because microbial activity varies with temperature, the release properties of the wax-sealed SCUs are also temperature dependent during the cool-season growth period.

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Carbon Nanotubes in Agriculture

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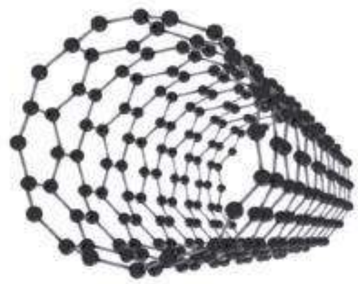
Introduction

Carbon nanotube (CNT) is one of the major allotropic forms of carbon. Carbon can make infinite number of allotropic forms due to its abundant properties. A CNT is a strong long tubular shaped structure. For formation of carbon nanotubes, carbon atoms are arranged in benzene like structure (Rudakiya et. al., 2019). For manufacturing of carbon nanotubes, the graphene sheets are wrapped in different ways to get different types of tubes. Hence these carbon nanotubes are classified into Single walled (SWCNTs) and Multi walled carbon nanotubes (MWCNTs) (Ganesh, 2013). The main difference between is that the rolling of number of graphene sheets.



Carbon Nanotube

The carbon nanotubes are discovered and initially used by Ijima (1991). CNTs have boundless applications, because these have greater strength, electrical conductivity, thermal conductivity, large surface to volume ratio, strong photoluminescence, higher immobilization efficiency etc., These properties of nanotubes depend on its length, diameter, chirality or twist and wall nature (Hirlekar et. al.,2009).

For the most part, CNTs applications in different fields of sciences (biological and biomedical) may obstruct due to its hydrophobic nature (Yang et. al., 2007). It forms aggregates in aqueous media during solubility process and it reduces the aspect ratio of nanotube and their effectiveness. To disperse this problem, some researchers have introduced the functionalization of CNT to modify the surface CNT. Solubility of CNTs can be improved by adjoining some other functional compounds like amino and carboxyl groups. Moreover, these functional groups also helpful in further bonding with like molecules (Banerjee et. al., 2005).

Preparation of Carbon Nanotubes

Carbon nanotubes are manufactured from graphite rod. It is a laboratory method, though these CNTs are natural. There different methods to produce CNTs in laboratory. Those are Arc-discharge, Laser ablation and Chemical Vapour Decomposition (CVD) (Rudakiya et. al., 2019).

Applications of CNTs

Up to minute, different forms of CNTs got huge attraction due to its unique properties mostly in medical and biological sciences. Comparatively in plant science, there are very few studies on plant cells to know the effect CNTs. Even now plants are major source on earth. There are some applications of CNTs in plant science as described below. Basically, these publications show both merits and demerits on growth, water intake ability and other crop parameters, depending upon type of CNT and its concentration.

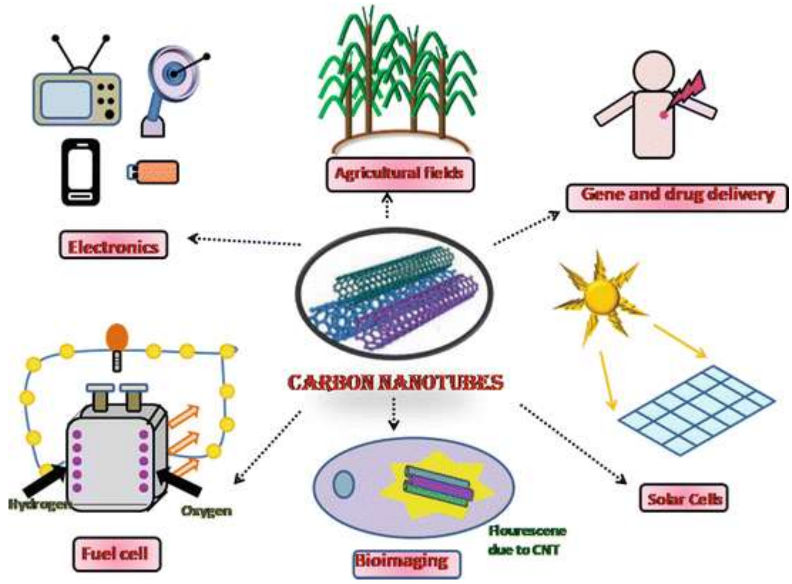


Fig: General applications of CNTs in different fields (Vishwakarma et. al., 2017)

Conclusion

From aforementioned points, Carbon nanotube is a wonder material. The effectiveness of CNT on plant dependent on its length to diameter ratio, concentration of CNTs, duration of time, type of crop etc. As per some studies, the researchers observed the both desirable and undesirable effects are also observed. At low concentrations of MWCNTs, the plant growth, water uptake and nutrient intake are increased meanwhile; time taken for germination also got reduced. Moreover, at those concentration levels, length of root and shoot increased and yield of biomass was high. In contrast to low concentration results, at high concentration levels, the growth and yield of biomass was diminished. Similarly, these high concentration CNTs are harmful to plants and animals. By excluding high concentration of CNTs, the low concentration of CNTs creates a new prospect in this era of Nano agriculture. Hence, these findings suggested that effective utilization of CNTs for enhancing the water transportation in arid zone agriculture and increase the biomass yield of plants.

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Application of Molecular Markers in Improvement of Vegetable Crops

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Abstract
Crop improvement is the most important aspect of any strategy aimed for increasing crop production and productivity. Crop improvements take place in terms of yield, quality and resistance to biotic and abiotic factors. Molecular markers are key tool for plant identification and plant improvement. Recent advances in development of molecular markers have made it possible for reliable selection and to speed up the breeding cycle in vegetable crops. In that view need to review the role of molecular markers to assist breeding programme of important vegetable crops.

Introduction
Molecular marker is defined as any mark for identification. Molecular markers are basically a DNA sequence that is readily detected and whose inheritance can be easily be monitored. There are three different types of markers viz., morphological, biochemical, and molecular. Morphological markers are related to shape, size, colour & surface of various plant parts. Biochemical markers are related to variation in protein & amino acid banding patterns and molecular markers are related to variation in DNA fragments generated by restriction of endonuclease enzyme. Out of these three, molecular markers directly reveal the polymorphism at the level of DNA.

Role of Molecular Marker in Vegetable Crops
1. Assessment of genetic diversity.
2. Development of saturated genetic maps.
3. Gene tagging.
4. Breeding lines and accession identification.
5. Disease resistance genes.
6. Hybrid seed purity testing.
7. Pyramiding of BT genes.
8. Sex identification.
9. Tagging of male sterility genes.
10. Heterosis breeding.
11. Gene pyramiding.
12. MAP based gene cloning.
13. Cultivar identification.

Assessment of Genetic Diversity
Molecular markers have proved to be excellent tools for assessment of genetic diversity in a wide range of plant species. It provided very useful information about the overall genetic range of crop germplasm. For breeders this information is important to take decisions regarding the utility of germplasm particularly in search for rare and unique genes. Germplasm of narrow genetic base is obviously unlikely to harbour novel genes e.g. those conferring resistance to biotic and abiotic stresses. Example:
1. RAPD analysis of pepper breeding lines (Heras et. al., 1996) revealed very narrow genetic base with more than 50% of the DNA bands being common among all the lines.

2. In an assessment of the world collections of tomato, (Villand et. al., 1998) found South American accessions to have greater diversity than old world accessions.

Development of Saturated Genetic Maps

Saturated linkage maps are prerequisite for gene tagging, marker assisted selection and map-based gene cloning. Example- A genetic map of an interspecific cross in Allium based on amplified length polymorphism markers constructed by Van Heusden et. al., (2000). The map based on A. cepa markers consisted of eight linkage groups whereas map based an *A. roylei* marker comprised 15 linkage groups.

Gene Tagging

Gene tagging refer to mapping of genes of economic importance close to known markers. The RFLP maps, several genes of economic importance like disease resistance, stress tolerance, insect resistance, fertility restoration genes, yield attributing traits have been tagged. Molecular marker very closely linked to gene act as a tag that can be used for indirect selection of gene in breeding programmes. In case of tomato TMV resistance Tm-2 locus, nematode resistance, *Mi gene*, *Fusarium oxysporum* resistance gene, powdery mildew resistance gene, has been tagged.

Breeding Lines and Accession Identification

Several situations during a breeding programme may require identification of breeding lines and accessions. Mislabelling is a common problem in breeding experiments due to the large number of lines that need to be handled. Breeding lines can get contaminated due to mixing of seed samples and cross contamination in field. Molecular markers are ideal for distinguishing closely related genotypes that differ in few morphological traits. Example-Ten pairs of potential duplicate accessions in a total of 134 capsicum accessions were identified by Rodriguez et. al., (1999) on the basis of RAPD markers.

Disease Resistance Genes

The identification of molecular markers closely linked with resistance genes can facilitate expeditious pyramiding of major genes into elite background, making it more cost effective. Once the resistance genes are tagged with molecular marker the selection of resistant plant in the segregating generations becomes easy. Example- Huang et. al., (2000) tagged powdery mildew resistance gene ol-1 on chromosome 6 of tomato using RAPD and SCAR markers.

Hybrid Seed Purity Testing

To determine the hybrid seed quality, it is to be verified that the designated cross has occurred, the number of self-pollination between the female parents meet the necessary purity and the product has adequate quality. For years, the only method to check the hybrid seed purity has been the grow out test. Now the RAPD and RFLP are markers are used to test the purity of F1 hybrids. Example- Study in tomato using male specific markers SSR 218, SSR 306 and Ty2 gene CAPs gene marker testing F1 purity of Pbc × EC 538408, Pbc × EC 520061 and H 86 × EC 520061 tomato hybrids.

Pyramiding of BT Genes

The insecticidal cry (crystal) genes from Bacillus thuringiensis (Bt) have been used for insect control in transgenic plants. Discovery of new insecticidal genes have of importance for delaying the development of resistance in target insects.

Example- Bt genes were incorporated in the Broccoli line (Cao et. al., 2002). cry1Ac and cry1C mRNAs were detected in the hybrid lines which also produced stable Cry1Ac and Cry1C proteins at levels comparable to the parental plants carrying individual genes. Plants with pyramided cry genes did not show leaf damage and killed the DBM larvae resistant to Cry1A or Cry1C.

Sex Identification

Early identification of male and female plants can bring considerable efficiency in breeding programmes of dioecious species. Example- Jiang and Sink (1997) developed SCAR markers in asparagus which were linked to the sex locus at a distance of 1.6 cM.

Tagging of Male Sterility Genes

A cytoplasmic male sterile system is desirable for use in hybrid seed production, as it eliminates the need for hand emasculation. CMS is a maternally inheritable trait characterized by the inability to produce viable pollen but without affecting the female fertility. Several restorer loci have been identified using RAPD and STS in different crop and DNA markers linked to these loci enable the molecular study of the CMS system. These co-dominant markers are useful in identifying the homozygous restorer genotypes after the backcrossing for production of restorer lines.

Heterosis Breeding

Another important application of DNA marker is their prediction of heterosis in hybrids. Evaluation of hybrids for heterosis or combining ability in field is expensive. Molecular markers have been used to correlate genetic diversity and heterosis in several cereal crops. It has been reported that measures of similarity based on RFLP and pedigree knowledge could be used to predict superior hybrid combinations. However, both low and high correlations between heterosis and DNA based genetic distance have been observed.

Gene Pyramiding

It is essentially a way of determining and introducing multiple genes which impart resistance to an independent insect/microbial pest, or impart resistance to a single pest through independent host pathways. One strategy for increasing the durability of resistance is to incorporate multiple resistance genes into a single variety. Plants with only one resistance gene are just as resistant as plants that contain three resistance genes, although the resistance of the latter is probably more durable.

Cultivar Identification

In crops like tomato, pepper, potato, alliums, cucurbits, lettuce and spinach, microsatellites have been developed to enable highly reliable identification of cultivars. In pepper, Gaikwad et. al., (2001) found ISSR markers to most efficient in detecting polymorphism. However, due to very high number of markers generated per assay by AFLP, the marker index of AFLP markers was prominently higher than that of ISSR and RAPD.

Conclusion

Most advanced and most reliable technique is utilized for characterization of numerous vegetable cultivars known as molecular characterization. It is a new breeding tool is now available to make more accurate and useful selections in breeding populations.

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Plant Genome Sequencing: Gate Way for Crop Improvement

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Introduction

Agricultural development lags behind due to the lack of advanced technology, changing climate, environmental pressure and various biotic and abiotic factors. Hence, many challenges are need to be faced plant scientists, in particularly those working on crop production. To resolve these constrains, it is necessary to develop improved crop varieties. For this a better understanding of crop genetics is necessary. Advances in genome sequencing and re sequencing can play a role in response to meet these challenges.

Genome sequencing is the process of determining the precise order of nucleotides within DNA molecule. It includes any method or technology that is used to determine the order of the four bases: adenine, guanine, cytosine, and thymine. It may use to determine the sequence of individual genes, larger genetic regions, full chromosomes or entire genomes. It helps to understanding the structure and functions of gene, compare DNA between organisms and to identify changes in genes associated with phenotypes. To date, the genome sequences for more than 55 plant species have been produced (Varshney et. al., 2014) In recent years genome sequences of several eukaryote organisms have been reported, including yeast (Saccharomyces cerevisiae), a nematode *(Caenorhabditis elegans)*, an insect *(Drosophila melanogaster)*, a plant *(Arabidopsis thaliana)* and human *(Homo sapiens)*.

Purpose of Genome Sequencing

1. Sequencing of complete genome or transcriptome of a genotype.
2. Deciphering code of life.
3. Detecting mutations and Designating polymorphisms.
4. Sequencing of microbiomes.
5. To obtain base by base view of gene and exome.
6. Identifying haplotypes.
7. Understanding of crop genetics.
8. Detecting methylated regions of the genome.
9. Characterizing different isoforms of genes.
10. Provides thousands of nuclear markers for phylogenetic and population level studies.

Methods of Genome Sequencing

There are mainly two types of sequencing methods. The older, classical methods called first generation sequencing and newer method i.e, High Throughput Sequencing (HTS) or Next Generation Sequencing (NGS). First-generation sequencing was originally developed by Sanger in 1975 called Chain-termination method and in parallel, the chemical method of DNA sequencing was explained by Maxam and Gilbert in 1977 (chemical cleavage method) (Maxam and Gilbert, 1977). These methods were less technically complex and more amenable to being scaled up and can be used when a small region of DNA on a limited number of samples or genomic targets because these methods only sequence a single fragment of DNA at a time. The chief limitation of first-generation sequencing methods was low throughput, more time requirement as well as high cost. To address these problems commercial NGS tools emerged in 2005.

Second generation sequencing tools achieve much higher throughput by sequencing a large number of DNA molecules in parallel at low cost. SGS technology was born symbolized by Roche's 454 pyrosequencing, Illumina (Solexa), HiSeq Sequencing by Oligonucleotide Ligation and Detection (SOLiD) DNA nanoball sequencing by BGI Retrovolocity. With most SGS technologies, tens of thousands of identical strands are anchored to a given location to be read in a process consisting of successive washing and scanning operations. The general workflow for SGS is the preparation and amplification of libraries prepared from DNA or RNA samples, clonal formation, sequencing, and analysis. These SGS methods can not only greatly reduce sequencing cost, but also dramatically increase the speed of sequencing, maintaining high accuracy.

Third generation sequencing methods (TGS) (Emerging technologies for single molecule sequencing). Third generation sequencing is all about DNA read length. Because in SGS DNA is broken into short pieces, amplified, and then sequenced. Third generation technologies do not break down or amplify the DNA, directly sequence a single DNA molecule. Long reads contain more information compared to short reads as used in genome assembly and detecting rare variants study and to detect large DNA insertions. Third generation sequencing technology includes Single-molecule real-time (SMRT) sequencing by pacific biosciences, Nanopore-sequencing, Helicos sequencing by the genetic analysis system and TGS by electron microscopy. Hence, Next-generation sequencing (NGS) provides an opportunity to sequence millions to billions of DNA nucleotides in parallel, yielding extremely high-throughput from multiple samples at much reduced cost and minimizing the need for the fragment-cloning methods that were used with Sanger sequencing.

Applications

Genomics: A detailed organizational analysis: structure and function of genome and an understanding of the full landscape of a genome are possible only after de novo whole-genome sequencing. It is aimed to detect and catalogue SNPs, mutations, and sequence variants such as indels, copy number, and structural variations (Mardis and Wilson, 2009).

Transcriptomics and RNA sequencing: RNA-seq is the NGS method that sequences the transcriptome, that is, all the RNA transcript sets expressed by the genome. RNA-seq provides unambiguous maps of the transcribed regions of the genome with high accuracy in quantitative expression levels, identification of tissue-specific transcript variants and isoforms; SNPs and mutations, transcription boundaries and splicing events, transcription factors (TF), and small and large noncoding RNAs involved in the regulation of gene expression.

Proteomics: Scientific discipline concerned with systematic analysis of the structure, function, identification and characterization of peptides and proteins. This includes information on protein abundance, variations and polymorphisms, modifications, and their interactions and networks in cellular processes. Gene sequencing helps to the sequence translation of open reading frames (ORF) of genomes, exons and transcripts.

Metagenomics: Metagenomics is the study of the total genomic content of a microbial community that bridges the three domains of life, Archaea, Bacteria, and Eukaryotes. The total DNA and/or RNA is isolated from a microbial population without prior cultivation, sequenced, and compared with previously known sequences to identify known species or to discover previously unknown species.

Mining genes of agronomic importance: This is particularly true for complex traits which are controlled by many interacting minor genes with environment. Hence, producing a finished genome sequence for a crop is an important step in identification of key genes controlling important agronomic traits, their function and to understand the inheritance of agronomic traits.

Molecular marker discovery: Advances in DNA sequence technology enabling the discovery of markers like SNPs, now dominate molecular marker in MAS.

Genetic mapping: High density of markers that can now be generated from genome sequence data offers the potential for generating very high-density genetic maps.

Association studies: The advances in genome sequencing technology, provides an increasing ability to generate large quantities of molecular marker genotyping data, which favours association studies over traditional QTL mapping.

Limitations of Genome Sequencing

1. Because a TGS system by definition assays a single molecule, there is no longer any safety in numbers to minimize raw read errors.
2. If a base fail to progress through a nanopore or a DNA transistor as intended and gets counted twice, there will be an insertion in the raw data. Hence, the frequency of errors for raw reads will likely be greater (Schadt et. al., 2010).
3. The increased information content will demand new types of mathematical models and algorithms to get the most from the data.
4. Demand a new generation of analysis tools to derive maximal information from the raw data.
5. Presence of high percentage of repeated and complex regions in many plant genomes makes it difficult to assemble the short reads from the NGS platforms.
6. Failure to capture the information embedded in the repetitive fraction of the genome.
7. Functions of many genes identified by genome sequencing remain unknown
8. Genetic control of the majority of agronomic traits has yet to be determined.

Conclusion

Recent advances in genome sequencing technologies are radically changing biological research and will have major impact on crop improvement. Now whole genome sequencing has become increasingly easier, faster, and cheaper because of technological improvements and the availability of hundreds of sequenced genomes that can be used as references for annotation. The large-scale genome sequencing of diverse genotypes from different species help in identification of genetic region and candidate genes. The integration of traditional breeding methods, QTL and association studies, whole genome and transcriptome sequencing data would help in accelerating crop improvement and designing breeding strategies. Furthermore, genome sequencing stands ready to provide snapshots of complex system that will enable a more accurate network view and also provide greater predictive power.

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Carum Carvi- An Underutilized Spice of Trans Himalayas

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Caraway (*Carum carvi* L.) is one of the widely cultivated plant in the world, since the time of ancient Romans, Egyptians and Greeks. In India, *Carum Carvi* is known as Siya jeera. It has special place among the widely used spices that are used in various food products for its pleasant flavor and antispoilage properties. The caraway seeds contain essential oils rich in nutraceutical compounds used as food supplements and plant-based medicine.

Introduction

Carum carvi (caraway) is a perennial aromatic plant belonging to the family Apiaceae. This temperate spice distributed abundantly in arid and cold regions of the northwest Himalayas. The climate conditions are dominated by extremely harsh, snowy winters and dry summer. The chilling and prolonged winters required for seed ripening and to meet the need of germination and later ensure flowering (Rasooli *et. al.,* 2016). More than 25 species reported so far that shows economic importance and being used as spice in several high-altitude regions. During the summer season, formation of underground tubers and aerial shoot takes place, but aerial portion dies out in winter and only seeds and tubers remain dormant in the soil for long interval of time.

It is abundant in alpine regions above 3000 m and distributed in regions of Himachal Pradesh Jammu Kashmir and Uttrakhand which specifically dominated by shrubs and grasses. The herb is originated in Europe and *often confused with Niglella sativa in* Northern Europe because of the similar vernacular names, but they are botanically different from each other. The plant species shows multipurpose properties and used by Buddhist, lahoulis, dongri and ladhakis communities as major flavouring spice and in cooking. This importance of this medicinal herb is well utilized by amchis and help explained in local flora and medicinal systems. The plant exhibits the properties of antidiabetic, analgesic, antioxidant, antidiuretic, antimicrobial, hypolipidaemic, gastrointestinal, anticancer and shows bronchial relaxant activities (Sachan *et. al.,* 2016). In Latin herb got its named as *carum* means caraway, and the *karavi*, translated as "caraway". The dried fruits are categorizes as a mild spice and significantly grown on a huge scale in the Netherlands, Germany, Hungary, Ukraine, Poland, and Romania, Sweden, Norway, Spain and Austria, were mentioned as caraway producers, however Netherlands' hold prime position in cultivation or production, worldwide. The high-altitude spices are erect in nature, with a fleshy and fusiform tap root. The species is pollinated by bees having both male and female organs in single plants (hermaphrodite). The plant self-fertile in nature and grown in moist, semi-shade or places that devoid of direct sunlight.

Botanical Description

The plant is erect and attains the height of 25 to 100 cm having well established root systems. The stems are branched, filled with latex and angular in shape. The stem is angular, filled with latex, glabrous, grooved and sharply branched. Each branches of main stem terminates in a compound flowering and arranged in clusters of minutes' flowers. These are orange to white in appearance and represents its umbel inflorescence. Fruits are oblong or ellipsoid present in huge number on single branch. The plant enriched with chemical constituents including various essential oil such as α-pinene, β-pinene, limonene, carvone, cymene, terpene, cuminaldehyde and p-cymene are present in higher amount (Goyal et. al., 2018).

Caraway seeds contain a several components and more than thirty chemicals has been reported so far in C. carvi, which is 97.58% of the total oil. The major phytochemicals of C. carvi essential oil was carvone, limonene, pinene, cis-carveol and myrcene. The fruits, usually used whole, have a pungent, anise-like flavour and aroma that comes from essential oils, mostly carvone, limonene, and anethole.

Leaves are pungent and consumed as raw or act as flavouring agents in soups and bevarages. The leaves are not much spicy at young stage as compared to seeds and are consumed as good salad, giving flavour of mild parsley-dill or give an aromatic tang to salads. The seeds are crushed and brewed into a tea that provides soothing effect on the digestion. However, excessive intake tea contains seeds can lead to liver kidney and liver damage.

Figure 1. Health benefits of *Carum carvi* suggested by organic India

Propagation

The plant propagation takes 4-5 years through seeds, but 3–4-year-old bulbs, initiate early the flowering takes and may took place in the single year itself. The harvesting of seeds mainly done in June - July. Harvesting is when the fruits turn light brown and before full ripening, to avoid shattering. Plants are cut and stacked for drying and then threshed by beating with sticks. Seeds are winnowed, dried, cleaned and stored in airtight containers.

Economic Importance

Carum carvi L. is being utilized and cultivated in several regions due to its economic importance. Caraway has a long history of use as a household remedy especially in the treatment of digestive complaints where its antispasmodic action soothes the digestive tract. The seed is antispasmodic, antiseptic, expectorant, carminative, galactogogue and stimulant (Sachan et. al., 2016). Seeds can be chewed raw for immediate relief of stomach pain and indigestion. It is also used in the treatment of children suffers from bronchitis and cough and problems associated with respiratory diseases. Seed are also used in lactation period to increase the production of breast milk in nursing mothers.

The Tibetan medicinal practitioners used its seeds to treat low vision, loss of appetite and dyspeptic problems. The essential oil extracted from seeds used commercially as components of mouthfreshners, bath additives, perfumery and scenting soap.

Figure 2. Ayurvedic health benefits of caraway oil in ailment of various health issues.

Conclusion

This valuable herb is endemic in nature and shows multipurpose importance. The overexploitation and unskilled agriculture threated plant population with extra pace in recent need. Moreover, this herb empowers economy of regional farmers, so need much attention and strategies of conservation.

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Induced Systemic Resistance

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Plant possess a wide range of defence systems that help to cope up from various stresses. The responses triggered numerous mechanism that help to reduce infection or prevent their entry into plants. The systemic induced resistance represents the achieved status of plant having some kind of capability to withstand against the attack of biotic agents like herbivorous insect or pathogenic microbes. Such resistance acquired earlier, triggered by some biological and chemical inducers. The signal initiated locally from the site of infection to spread resistance throughout the plant for any future attack. There are dual kinds of resistances: Induced acquired resistance (ISR) (caused by beneficial root colonizing mutualistic microbes) and Systemic acquired resistance (caused by pathogens). They are differentiated by elicitor and the regulatory signalling pathways, although share some components. ISR is induced by SA (Salicylic acid) independent pathways where JA and ethylene are the principal regulators and comes into action without the involvement of pathogenesis activation genes. JA/Ethylene signalling is functionally activated in the cytosolic region in contrast to nucleus restricted SA signalling. Moreover, signalling pathways which are participated in the ISR induction varies according to microbial and plant species.

Elicitors and Active Regulators

The elicitors involved in ISR are Microbe-Associated Molecular Patterns (MAMPs), Volatile Organic Compounds (VOCs) and siderophores. MAMPs are the category which involves conserved microbial molecules such as chitin, flagellin and lipopolysaccharides (LPS). VOCs are the compounds having low molecular weight with elevated vapor pressure so that it has high evaporation and dispersion rate. There are more than 1000 VOCs involving alcohols, alkanes, esters, ketones, sesquiterpenes, sulphides and terpenoids. The Fe chelating molecules, siderophores released into the surrounding by the bacteria to acquire Fe from the environment. The elicitor perception mediated the level of various phytohormones which play principal role in the ISR to induce defence related responses. The microbes sometimes produce hormones such as cytokinin and auxin which are perceived by their receptors to trigger the plant morphological and physiological responses. The most important characteristic of ISR is the redundancy to microbial elicitors. It implies that defect in the one elicitor can be overcome by some other elicitor. For instance, the mutant defective in siderophores pseudobactin was showing equal effectiveness in inducing ISR in contrast to its wild type microbial strain Meziane et al., (2005).

Host Specificity to Beneficial Microbes

The phenomenon of mutual benefit is only established between microbe and host whenever the defence responses must be shut down to continue the colony establishment and their perpetuation. For example, the genes associated with the defence responses of host under the induction of flagellin elicitor must be suppressed by the microbes for mutual interaction. The beneficial microbes regulate the plant hormones induced signalling pathways to suppress defence responses in their respective host. Similarly, the symbiotic association in legumes allows to immediately suppressing the defence responses and allows the establishment in the roots. The regulation of microbial count must be maintained whose minimal concentration is 105–107 colony forming unit (CFU) /gm of root for a number of days Romera et al., (2019). In the rhizosphere the microbial count has been maintained at 108-109 CFU and its diversity is lessening by the plant exudates who determining the root microbiome by repressing or stimulating the microbial community members. It has been reported that antimicrobial compound coumarins scopoletin produced by the root of Arabidopsis plant stimulate the rhizobacterium *Pseudomonas simiae* whereas suppresses the soil borne pathogens. Moreover, coumarins also produced by the Fe deficient roots for acquisition of Fe in plants Aznar et al., (2015).

Conclusion

Dissimilar to PR proteins accumulation, the ISR is exhibiting an alternative hallmark to systemic resistance. The induction and the expression of the leading JA and ethylene are not first and foremost effected by the colonization in Arabidopsis root. However, the systemic tissue sensitivity has been enhanced to these hormones which are characterized by the JA/ethylene regulated gene expression. Such kind of whole plant preparation to fight with the pathogen is characterized by fast and strong level defensive responses of plant for further attacks and known as priming. The fields soils are rich in microbial diversity and it is reasonably obvious that, may all plant be in the state of ISR? The answer is not based on the microbial load however it is not directly related with effectiveness. Therefore, the ISR only be achieved when threshold population density is present.

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Drones for Agriculture

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Introduction

Climate change and environmental pollution are the major global issues of the current era and severely impacting agricultural productivity. Conventional agricultural practices along with other factors like deforestation, fossil fuel combustion, etc. also contribute towards amplification of global warming and related issues.

Sustainable agriculture is one of the solutions to combat environmental pollution and reduction of greenhouse gas emissions, thereby offsetting the effect of climate change. In conventional agriculture systems, farmers generally apply fertilizers, pesticide, and other agrochemicals in heavy amounts indiscriminately.

The higher dose of fertilizers is not utilized by crops properly, and thus unutilized fertilizers act as a source of pollution in the environment generating greenhouse gases. Therefore, there is a need for clean and green technologies to perform agricultural practices in a sustainable manner. In this context, drone or UAV comes into the picture.

DRONE (Dynamic Remotely Operated Navigation Equipment), also known as UAV, is a device which can fly either with the help of autopilot and GPS coordinates on the pre-set course or can be operated manually with radio signals using the remote control or smartphone app. Various sensors are used in the drones based upon the purpose. Mostly the sensors sensitive to the following bands of electromagnetic waves are used in agriculture:

Red, Green, and Blue (RGB) bands are used for counting the number of plants, for modelling elevation, and visual inspection of the crop field. Near Infra-Red (NIR) band is used for water management, erosion analysis, plant counting, soil moisture analysis, and assessment of crop health.

Red Edge band (RE) is used for plant counting, water management, and crop health assessment. Thermal Infra-Red band has applicability in irrigation scheduling, analysing plant physiology, and yield forecasting. Drones are nowadays emerging as a component of precision agriculture along with contributing to sustainable agriculture.

Application of Drone in Agriculture

1. Crop Health Monitoring.
2. Soil and field analysis.
3. Planting crops and trees.
4. Spraying of fertilizer, pesticide, herbicide.
5. Disease monitoring.
6. Weed identification.
7. Irrigation monitoring and management.
8. Livestock management.
9. Crop mapping and Surveying.
10. Crop insurance.
11. Surveying farms.

Benefits of Using Drones

1. It helps in achieving more yields by using resources effectively.
2. Drones can detect the things which are beyond the visible range of human sight. Therefore, real-time, more accurate, reliable, and objective information can be derived from drones in greater detail and fewer errors.
3. Reduce agricultural input cost by optimum use of fertilizer, pesticides, irrigation.
4. It is used in large scale farming where agricultural manpower is unavailable.
5. It saves time in determining status of field.
6. Thermal sensors help in finding wet and dry patches; this helps farmers avoid wastage of water.
7. Reducing pollution.

Challenges

There are several challenges in the application of drones in Indian agriculture, which is responsible for its limited adoption.

1. It requires basic knowledge and skills to operate the agricultural drones.
2. Expensive for small and marginal farmers.
3. Need to obtain government clearance in order to use it.
4. Difficult to fly them in extreme weather condition.
5. Power sources for operation.
6. High operational cost.

Conclusion

Drones have great potential to transform Indian agriculture. With the advancement of technology in the future, the production of drones is expected to become economical. The modern youth are not attracted towards farming due to hard work and drudgery involved in it. The implication of drones may fascinate and encourage the youth towards agriculture. The next agricultural revolution would be data-oriented, and drones can play a major role in it. Appropriate usage of data may increase agricultural productivity without any adverse effect on the environment, along with improving the livelihoods of farmers. Therefore, drones may become part and parcel of agriculture in the future by helping farmers in managing their fields and resources in a better and sustainable way.

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Precision Farming: Future of Agriculture

Article ID: 32227

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Agriculture is one of the major occupations being practised in India. It is not only the source of livelihood for a large number of farmers in our country, but also makes a major part of the Indian gross domestic product (GDP). However, due to the increased burden on the agricultural sector in the past few years, owing to the rise in the food demand and increased climate variability, it is vital to introduce some new technologies to make it more farmer and environment friendly, and ensuring the farmers with better resource management strategies, outputs and profits. One such innovation interesting various farmers across the globe is precision farming.

Precision farming refers to highly modernized agriculture involving the use of geospatial and sensor-based technology viz. remote sensing, GIS and GPS for site specific crop management, the ultimate objective of which is to provide only need based inputs so as to achieve sustainability in agriculture along with enhanced profitability as well as environmental protection. The advanced techniques of remote sensing, geographic information system (GIS) and global positioning system (GPS) are used for spatial analysis of farmer's fields giving them an idea about the soil conditions in various corners of the field which further help in deciding the time, duration and amount of input required for the crop. For example, if a field has less soil moisture in one part as compared to the other, the farmer can irrigate the field accordingly, which will not only save his money, but also ensure a good crop.

Thus, precision farming is a requirement-based approach involving the application of right amount of inputs at right location and right time so as to maximize input use efficiency and minimize environmental impacts. Precision agriculture deals with observation, measurement and response to inter- and intra-field variability with the help of geospatial and variable rate technology on-the-go sensors, which are able to assess field level variability and its immediate implementation by controlling input supply. As a result, precise amounts of inputs are applied as per requirement.

Major Elements of Precision Farming

1. Global Positioning System (GPS): The introduction of GPS system in the tractors led to the introduction of precision agriculture in 1990s which was a great change leading to better resource management efficiency of farmers. GPS makes estimation of precise location while in motion, which allows mapping of soil and crop condition in the field. GPS receivers mounted on the implements enables the farmers to treat specific locations as per the requirement.

2. Yield mapping and soil sampling: Yield mapping and soil sampling are two basic steps involved in precision agriculture. Yield maps are obtained from the combines equipped with GPS and yield recording system. Yield mapping is very important component of decision making as it reflects the effect of different management inputs viz. seed, tillage, fertilizer, pesticide and irrigation etc. Similarly maps of soil nutrient status are prepared based on either grid soil sampling or with on-the-go sensors. Based on this, need based fertilizer application is made in different parts of the fields.

3. Remote sensing sensors: Remote sensing means recording information from a distance. These sensors may be hand-held or mounted on implements/tractors or aircraft/satellites. These sensors are crucial to identify various stresses in the field viz. nutrient, moisture, disease etc. By determining the location and severity of stress, need based site-specific management is made.

4. Geographic Information System (GIS): GIS involves hardware and software systems to depict spatial variability of various attributes along with their locations. Based on maps of various entities viz. soil, crop health, yield etc. variable rates of inputs are managed.

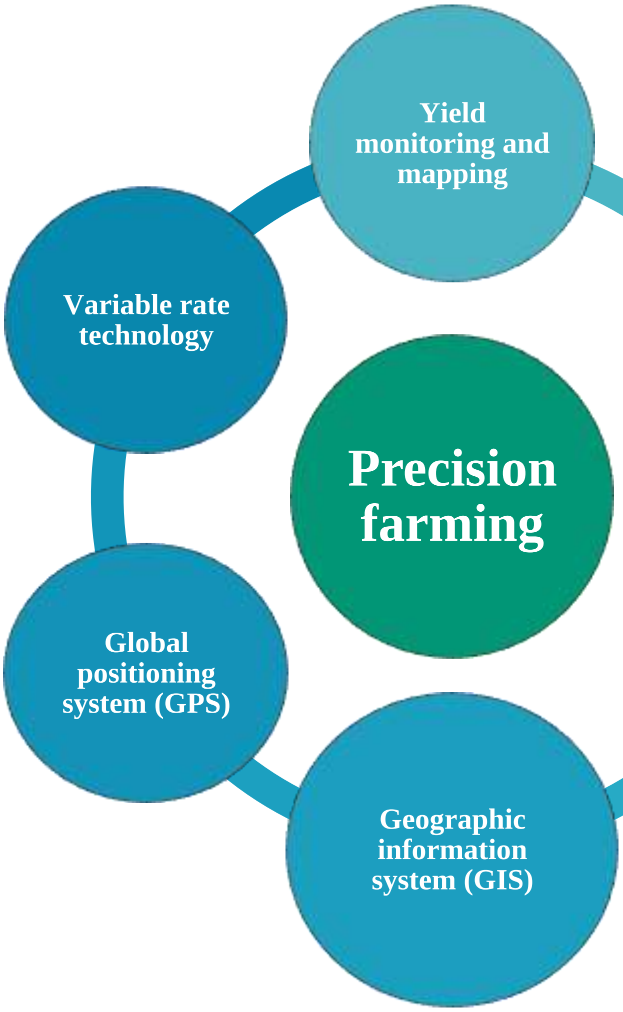

Fig. Major elements of Precision Farming

5. Variable rate technology: `Variable rate technology involves different machines and systems for application of required rate of inputs at specific locations. They can be either sensor based or map based, based on which rate of application of inputs is controlled.

Main Objectives of Precision Agriculture are as Following

1. To enhance input use efficiency.
2. To sustain crop productivity.
3. To minimize hazardous environmental impacts.
4. To improve the economic condition of the farmer.
5. To improve soil health and productivity.

Advantages of Precision Farming

1. Improved field monitoring by the farmer: The farmer will be able to monitor various aspects of the field including rainfall levels and irrigation requirement, fertilizer inputs, requirement of nutrients by the crop and so on.

2. Better crop protection: Farmer will be able to assess the exact requirement of crop fertilizers leading to administration of chemicals only at the required time, in the required amount, hence ensuring better crop protection.

3. Improved economic status of the farmers: Since the farmers will know the exact amount of input required in their field, this will ensure reduced wastage and more profit to the farmer.

4. Better accessibility of farm records: The farmer will no longer have to be present in the farm to manage the records of the farm and manage it.

5. Better decision making: The farmer will be able to choose the crop according to the condition of the field, hence leading to better output and profits to the farmer.

6. Environment friendly approach: Due to less wastage and over-consumption of resources , problems such as soil intoxication by certain nutrients and other environmental problems such as surface runoff can be avoided.

Summary

Although precision farming is highly advanced and proven technology, but it has certain limitations at implementation level. Small size of land holdings is a major limitation for its adaptation in India. Use of advanced tools and techniques requires skill at farmers' level. In our country, adoption of this technology requires identifying major areas with mechanized farming practices, growing same type of crop over large area and co-operative farming practices. If well managed, this technology can help ameliorate various stresses like nutrient, water, attack of pests and diseases and significantly improve input use efficiency, profitability along with minimizing harmful environmental impacts.

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Effect of Herbicides on Soil Biology and Environment

Article ID: 32228

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Introduction

There is a growing awareness among farmers about the importance of soil for sustaining crop production and providing beneficial ecosystem services. Over last two decades, herbicide use has increased worldwide as farmers have shifted to more sustainable conservation tillage practices and have adopted herbicide-tolerant varieties of crops.

The implications of increased herbicide use for soil biology are being questioned. In general, most studies suggest that the impacts of herbicide application on soil function are only minor and temporary. However, there are some instances where findings consistently suggest effects that could significantly alter soil function. These include disruptions to earthworm ecology in soils exposed to glyphosate and atrazine; inhibition of soil N-cycling by sulfonylurea herbicides in alkaline or low organic matter soils; and site-specific increases in disease resulting from the application of a variety of herbicides.

Issues with extrapolating these findings to broadacre farming include the lack of a consistent framework for assessing herbicide risk to soil biology, the relevance of the magnitude of herbicide impacts compared with the impacts of other soil management practices such as tillage or crop rotation, the complexity of herbicide formulations and mixtures, and the limited number of long-term field studies. Weed control in both, agricultural and non-agricultural lands is rapidly shifting towards chemical methods because of its time, labour and cost advantages. Herbicides have widely variable toxicity.

The acute toxicity due to exposure had led to long-term problems and a range of health effect from skin rashes to death. Herbicides got entry in the farmer's field much later than insecticides and fungicides but its global consumption has already exceeded that of the other pesticides. In modern agricultural production, herbicide application is a regular practice. The problems caused by the increased application of herbicides call for multidisciplinary approach. Incorrect and indiscriminate application of herbicides affects negatively the health of humans, plants and animals. Particularly hazardous are the poorly degradable herbicides (triazines) whose persistence may lead to long-term accumulation.

Soil microorganisms are an important link in soil-plant-herbicide-fauna- man relationships. They take part in herbicide:

1. Degradation, their activity, number and diversity may serve.
2. Bio indicators of changes in soil biological activity following herbicide application and, finally, some microbial species may be used.
3. Bio herbicides.

Soils contain micro-organisms viz. bacteria, fungi, yeasts, photosynthetic organisms including algae and macro organisms such as protozoa, nematodes, mites, springtails, spiders, insects and earthworms. The functions of this complex array of biota are diverse, and include residue decomposition, nutrient storage and release, soil structure and stability, resistance against disease and degradation or immobilisation of soil pollutants.

Effect of Herbicides on Soil Biology

The total microbial count is the direct measurement of qualitative change appearing after herbicide treatments. The observations varied from adverse to no effect or even stimulatory effect on microbial growth after herbicide application. Pendimethalin steadily increased the total population of bacteria, fungi and actinomycetes in soil under cotton after a short lag phase during the crop growth period. However, after harvest the soil microorganisms were affected by the pendimethalin residue in soil (Balasubramanian and Sankaran 2001). VAM fungi are beneficial and live in association with plant roots. The dissimilarity in the results obtained with herbicides belonging to the same group of chemicals, or even with the same herbicide makes it more difficult to generalize the effect of herbicides on VAM. An herbicide may inhibit the VAM colonization by some individual strains but not by others, clearly showing the direct impact of herbicide on fungus.

Due to the technical and practical limitations, the total count data do not distinguish between inactive microorganisms and those really active in soil. Measurement of the activity of the soil microflora provides indexes of the biological state of the soils and hence the soil fertility. Assessment of the enzymes present in soils offers potential as an integrative index of the soil's biological status. Dehydrogenase activity is generally used as an index of metabolic activity of the microbial population in soil. Except a slight depression initially, butachlor at field rate 12 was generally non-inhibitory in its effect on dehydrogenase activity in rice on a Vertisol (Rao and Saroja Raman 1998). While an initial stimulation in dehydrogenase activity following fluchloralin, butachlor, oxyfluorfen and 2,4-D application was reported by Shukla (1997). Baruah and Mishra (1986) reported that the herbicides 2,4-D, butachlor or oxyfluorfen at the manufacturer's recommended rates to a paddy soil initially stimulated but subsequently (after 7 days) inhibited dehydrogenase activity. Similarly, diuron at 10-100 ppm stimulated dehydrogenase activity in black, laterite and coastal saline soils of India (Sarawad 1987).

The soil fauna plays an important part in the decomposition of litter in soil, they may indirectly increase aeration and drainage in the soil while feeding on decayed woods, contribute to the formation of humus in association with soil bacteria; and hence considered to be beneficial in relation to the structure and fertility of soil. On the other hand, there are some injurious groups of soil fauna, e.g. parasitic nematode. Nematodes occupy an important place in microscopic life and belong to the soil microfauna group. The interactions of herbicides with nematodes of higher plants are generally noticed. Changes in the incidence of plant diseases may result from the application of herbicides through the effect they have on the pathogen, the host or microorganisms in the environment. Herbicides belonging to different chemical groups were found to increase or decrease nematode diseases of many plants (Trivedi 1988). In a long-term study under tea plantation, Gope and Borthakur (1991) noticed that nematodes (*Helicotylenchus, Meloidogyne, Paratylenchus* and *Trichodorus* spp.) population was increased by glyphosate, dalapon and simazine, while adversely affected by diuron. Swain et al. (1991) compared the application of bensulfuron-methyl, butachlor, quinclorac, thiobencarb, pretilachlor, pendimethalin, piperophos and 2,4-D at field rates with manual weeding for the control of nematode Hirschmanniella mucronate in rice. Butachlor and pretilachlor were the most toxic and resulted in the lowest nematode populations one month after application. While, application of alachlor and fluchloralin at field rates to soybean increased the soil nematode population in a deep alluvial soil (Mohammed 1987). However, the effect of these herbicides varied depending upon the nematode species and the crop growth stages. Alachlor increased *Longidorus* spp. until crop maturity as well as *Aphelenchus* and *Hoplolaimus* during crop branching. Fluchloralin markedly increased the numbers of *Tylenchorhynchus* spp., especially towards the end of the growing season.

Effect of Herbicides on Environment

Important environmental effects associated with the use of herbicides include unintended damage occurring both on the sprayed site, and offsite. For example, by changing the vegetation of treated sites, herbicide use also changes the habitat of animals such as mammals and birds. This is especially true of herbicides use in forestry, because biodiverse, semi-natural habitats are involved. This is an indirect effect of herbicide use, because it does not involve toxicity caused to the animal by the herbicide. Nevertheless, the effects can be severe for some species. In addition, not all of the herbicide sprayed by a tractor or aircraft deposits onto the intended spray area. Often there is drift of herbicide beyond the intended spray site, and unintended, offsite damages may be caused to vegetation. There are also concerns about the toxicity of some herbicides, which may affect people using these chemicals during the course of their occupation (i.e., when spraying pesticides), people indirectly exposed through drift or residues on food, and wildlife. For these and other reasons, there are many negative opinions about the broadcast spraying of herbicides and other pesticides, and this practice is highly controversial.

An important problem with broadcast applications is that they are non-selective, they affect many plants and animals that are not weeds, the intended target of the treatment. This is especially true of herbicides, because they are toxic to a wide variety of plant species, and not just the weeds. Therefore, the broadcast spraying of herbicides results in broad exposures of non-pest species, which can cause an unintended but substantial mortality of non-target plants. For example, only a few species of plants in any agricultural field or forestry plantation are abundant enough to significantly interfere with the productivity of crop plants. Only these competitive plants are weeds, and these are the only target of an herbicide application. However, there are many other, non-pest species of plants in the field or plantation that do not interfere with the growth of the crop plants, and these are also affected by the herbicide, but not to any benefit in terms of vegetation management. In fact, especially in forestry, the non-target plants may be beneficial, by providing food and habitat for animals, and helping to prevent erosion and leaching of nutrients.

This common non-target effect of broadcast sprays of herbicides and other pesticides is an unfortunate consequence of the use of this non-selective technology to deal with pest problems. So far, effective alternatives to the broadcast use of herbicides have not been discovered for the great majority of weed management problems. However, there are a few examples that demonstrate how research could discover pest-specific methods of controlling weeds that cause little non-target damage. These mostly involve weeds introduced from foreign countries, and that became economically important pests in their new habitats. Several weed species have been successfully controlled biologically, by introducing native herbivores of invasive weeds. For example, the klamath weed (Hypericum perforatum) is a European plant that became a serious pasture weed in North America, but it was specifically controlled by the introduction of two species of herbivorous leaf beetles from its native range. In another case, the prickly pear cactus (Opuntia spp.) became an important weed in Australia after it was introduced there from North America, but it has been successfully controlled by the introduction of a moth whose larvae feed on the cactus. Unfortunately, few weed problems can now be dealt with in these specific ways, and until better methods of control are discovered, herbicides will continue to be used in agriculture, forestry, and for other reasons.

Most herbicides are specifically plant poisons, and are not very toxic to animals. (There are exceptions, however, as is the case with the herbicide paraquat.) However, by inducing large changes in vegetation, herbicides can indirectly affect populations of birds, mammals, insects, and other animals through changes in the nature of their habitat. The herbicides most commonly used in forestry are not particularly toxic to animals. Their use does however, cause large changes in the habitat available on clear-cuts and plantations, and these might be expected to diminish the suitability of sprayed sites for the many species of song birds, mammals, and other animals that utilize those habitats. Modern, intensively managed agricultural and forestry systems have an intrinsic reliance on the use of herbicides and other pesticides.

Conclusion

The effect of herbicides on soil properties, chemistry, and microbial populations depends upon herbicide concentration and characteristics, soil type, temperature, and moisture content. Herbicides can influence soil pH and soil microbial activity. Although herbicides can have direct toxic effects on soil fauna, herbicides typically affect these organisms indirectly via removal of aboveground vegetation and through changes to soil decomposer community structure and reductions in nutrient cycling. Herbicides can also reduce the growth and function of mycorrhizal fungi, which increase the ability of plants to absorb and translocate nutrients from the soil. The use of herbicides and other pesticides carries risks to humans through exposure to these potentially toxic chemicals, and to ecosystems through direct toxicity caused to non-target species, and through changes in habitat. Nevertheless, until newer and more pest-specific solutions to weed-management problems are developed, there will be a continued reliance on herbicides in agriculture, forestry, and for other purposes, such as lawn care.

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Senescence in Plants, its Patterns, Types, and Events Associated with it

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Summary

All living organisms have a fixed life span and they are mortal. As life starts, after germination, all annual, biennial, and perennial plants start a vegetative growth phase. Later on, flower formation or development of reproductive structures marks the beginning of the reproductive phase, by this time the plant acquires maturity. Metabolic activities of plant retard as the time ticks away, slowing down its functional activities. Thus, the plant becomes old and it reaches the senescence phase. Eventually, the plant dies. As a result, occasionally or seasonally, leaves and other organs fall from the plant. This very process is known as abscission and it is an orderly feature with all the plants.

Aging, Senescence, and Death

Aging is the process of growing old, whereas, death is the termination of functional life. On the other hand, stages of developmental processes that eventually lead to the death of an organism are called senescence. This very phenomenon is distinctly visible in plants having a short life span.

Aging

Aging can be defined as the total of changes occurring in the whole plant or some of its organs. All chemical and structural changes in cells, tissues, organs, and the whole plant during their life cycle are part of aging only.

Senescence

Senescence can be described as a consequence of aging. During senescence, metabolic activities show a steady decrease while cellular breakdown increases with a decrease in functional activities. However, this can further be described as a synthetic (anabolic) biochemical process which gives way to a degradative (catabolic) process. Thus, due to some highly ordered degenerative processes, it ultimately leads to the death of plants.

All living organisms including plants and their organs have a well-defined life span during which they undergo development like growth, attain maturity, and in the same manner death. Although before death, these degenerative processes are terminated naturally by their functional life and thus known as senescence, however, the plants or plant organs at this very stage are known as senescent. Additionally, senescence is a process of development that depends upon energy and it is controlled by the plant's genetic program and owing to it the death of the plant or its part is known as programmed cell death (PCD).

Senescence does not affect the whole plant directly it, however, may limit to a particular plant part such as leaves, flowers, or cells like xylem, phloem, and cell-organelles such as chloroplasts and mitochondria, etc. Senescence and aging are considered almost the same by many workers. However, Medawar in 1957 stated that the term senescence must be used to express natural changes concerning life termination on the other hand aging refers to the time change regardless of the natural death.

Pattern of Senescence

1. Cellular Senescence: In case of cellular senescence single cells or very few cells in numbers of particular organism senesce while the other remaining cells do not senesce. The process gametogenesis and embryo development in case of plants involves cellular senescence in an orderly sequence. At the time of formation of female gametophyte, degeneration of three out of the four cells produced by meiosis happens and at the time of embryo growth, the synergids and the suspensor cells also senesce.

2. Tissue Senescence: Large groups of cell or tissues also undergo disintegration and death like the layer of cells surrounding the microsporocyte cells or pollens (tapetum) gets degenerated, also the cells growing near to embryo (nucellar cells) may also undergoes disintegration. Besides, various mechanical tearing and detachment of some branches from the plant causes tissue death as the tissues gets deprived of various nutrient and hormonal supply. In the course of, abscission of plant parts, specialized layers of cells, abscission zones, are differentiated preparatory to separation and this is the senescence process. The formation of xylem tracheid or vessels which are devoid of protoplasm is also a case of senescence.

3. Organ Senescence: There is a divergence in the senescence pattern of even a single organ for example leaves. Senescence of leaves may show progression such as the older leaves senesce as new leaves are produced. However, in monocarpic senescence, all the leaves may senesce more or less at a time. Not only this, sometimes within a leaf the cells senesce at different rates and time. There are some leaves in which senescence begins from the apex towards the base, while others senesce over the main veins showing vein yellowing that further continue in the interveinal regions too.

4. Organism or Whole Plant Senescence: The introduction of whole plant senescence begins with a decrease or cessations of both shoot and root growth. In both monocarpic and polycarpic plants, the reduction in vegetative growth which occurs during the reproductive phase has been recognized for a long time. This is particularly visible in the shoot apex when it converts to an inflorescence as in corn and Xanthium, node production ceases coincident with the appearance of flower buds. However, in soybean, cotton, and pea, stem elongation decreases after flowering has started and halts when the fruits are growing. In the early root growth period, reproductive development may be affected which might be due to a nutrient deficiency resulting from a large-scale diversion of nutrient supply to developing fruit.

Types of Senescence

According to Leopold, 1961 there are 4 types of senescence patterns in the whole plant which are:

1. Overall Senescence/Whole Plant Senescence: This very senescence occurs in annuals which affects the whole plant and finally leads to death. Here, senescence begins with the productive maturity however, the whole plant dies after seed production. It is attributed to monocarpic plant species which flower and fruit only one time in their entire life cycle and the same manner senescence of the whole plant occurs in them. This is the characteristic of annuals and biennials.

2. Top Senescence/Shoot Senescence: Senescence, in perennial herbs takes place only in the parts which are present on the ground. While the aerial shoots only senesce and die every year after flowering but it's underground part (shoot and root) survive and emerge in new shoots. Zingier, Musa, and Chrysanthemum, etc and many other perennials show shoot senescence

3. Organ Senescence: In this senescence, only lateral organs like leaves and fruits occur and they die before the death of the whole plant. Organ senescence may be of the following type.

> **a. Simultaneous/Synchronous/Seasonal or Deciduous Senescence:** This senescence is a typical characteristic of deciduous trees in which almost all leaves senesce and fall more or less simultaneously at a particular season of the year.
>
> **b. Sequential senescence/Progressive Senescence:** This depicts progressive senescence of the lower and older leaves; however, new ones are added to the growing shoot in a sequence. As the leaves have a limited life span thus depending on the age of leaf, the senescence sequentially takes place.

4. Monocarpic senescence: This can be defined as senescence of the whole plant after a single reproductive cycle) The entire plant death process sometimes occurs after fertilization (called monocarpic senescence).

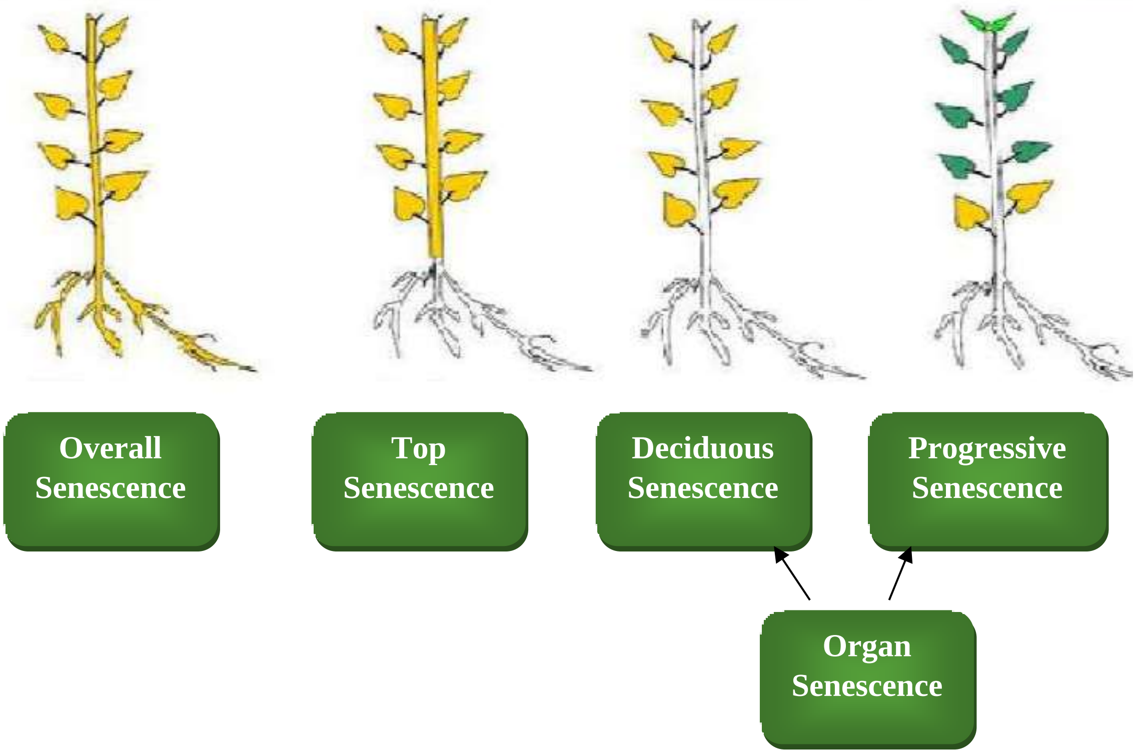

Fig.1: Types of senescence

Genesis of Senescence

1. An early loss in the chlorophyll of leaf marks the beginning of senescence accompanied by, Anand enzymes.
2. Decrease in cellular constituents owing to slower synthesis or faster break down.
3. Vegetative and reproductive organs undergo contest for nutrients.
4. In soybean fruits senescence factor (a hormone) is produced that moves to leaves and causes senescence.
5. Short-day and long-night conditions induce flowering and leaf senescence, whereas, degradation of food reserves and loss of integrity in food storage can be seen in cells of seeds.
6. Senescence can also be controlled hormonally.

Senescence and Events Analogous to it

1. Various structural and biophysical/biochemical changes.
2. Certain oxidative events occurring in the plant's cellular machinery.
3. Synthesis of nucleic acid and their breakdown.
4. Degradation of protein due to protease enzyme activities.
5. Plants following pathways like Ubiquitin-proteasome and Non-proteasomal pathway.
6. Various papain-like cysteine proteases activities.
7. Vacuole processing enzymes and Meta-caspases activities.

Various Physiological and Biochemical Changes Associated with Senescence

1. Loss of membrane compartmentation.
2. Change of Ultra-structure in the chloroplast.
3. Conversion of Chloroplasts into Chromoplasts due to loss of Chlorophyll.
4. A decrease in the amount of various soluble proteins.
5. As senescence progresses there is a reduction in Rubisco enzyme activity.
6. Reduction in Photosynthetic and Respiration rate.
7. A decline in the Nucleic Acid content of leaves.
8. The activity of biosynthetic enzymes decreases.

9. Increase in hydrolytic enzyme activity.
10. Hormones like Ethylene & ABA-Deteriorative increases.
11. Reduced activity of Growth promoting Hormones: Auxins & Cytokinin.

Senescence Promoters

Abscisic acid and ethylene promote the process of senescence. Everybody knows the very precise effect of senescence accelerating the ability of abscisic acid. Along with this, it is a well-known promoter of flower tissue senescence inclusive of colour fading initiation and blueing. As soon as senescence is initiated the ABA content of aging leaves shows a marked increase. Ethylene on the other hand plays a very pivot role in the senescence of certain plant parts, fruit, and petals in particular and in their abscission process too. The senescence of flower tissue is induced by Ethylene only. Senescence retardants: The primary plant hormones involved here are auxin, gibberellin, and cytokinin.

Factors Affecting Senescence

1. Hormonal and growth regulators.
2. Nutrients.
3. Water stress.
4. Light.
5. Temperature.

Abscission of Leaves

Abscission of leaves can be termed as the separation of the old leaves from plants. Abscission is common in deciduous trees and shrubs of temperate regions in the autumn season. It marks the fall of all leaves giving plants a bare appearance with the development of the new leaves in the succeeding spring season.

Gradual abscission of leaves occurs in evergreen plants in which the older leaves fall and simultaneously new leaves are developed all year round. Most of the herbs do not shed leaves even after they die rather, they are retained in withered dry conditions on dead shoots. Abscission of leaves starts at the petiole base which is marked internally by a peculiar zone of few layers of thin-walled cells transversally arranged across the petiolar base. This is the abscission zone or abscission layer.

Mechanism of Abscission

The young leaves only abscise when they become old and remain attached to the stem till then. On the other hand, if a cut is made on the blade of a leaf or leaf lamina portion, the abscission can be observed at the de bladed petiolar stump.

The abscission of the petiolar stump shows marked suppression when auxin (IAA) in lanolin paste is applied to the cut end of the petiole of such a young leaf. However, the intact young leaf does not show abscission because its lamina portion contains auxin synthesized by it. These experiments make us believe that auxin has a controlling influence in the leaf abscission. This belief is however supported by the fact that endogenous auxin concentration in leaves falls considerably at the time of normal abscission.

Another experiment shows that if auxin is applied to the distal side or blade side of the abscission zone of the de bladed petiole of young leaf, the abscission of the petiolar stump is prevented. However, abscission gets accelerated in case when the auxin gets applied on the proximal side or stem side of the abscission zone of the de bladed petiole.

Due to basipetal transport of auxin from the stem tip the auxin level of the stem side of the abscission zone is probably maintained however, the origin of the auxin on the blade side of the abscission zone is the blade or leaf lamina itself. According to the experiments stated above the establishment of the auxin, gradient hypothesis states that it is not the presence or absence of auxin but the relative concentration of auxin on the stem side of the abscission zone or almost equal concentration of auxin on both its sides which will promote abscission while a higher concentration of auxin on the blade side of the abscission zone will retard abscission.

Besides auxin, ethylene may also play a pivot role in abscission. The comparative auxin concentration on two sides of the abscission layer has a regulatory influence on the production of ethylene that stimulates leaf abscission.

During abscission, the concentration of auxin in the laminar region decreases with a simultaneous increase in ethylene production. This, in turn, increases the ethylene sensitivity of cells of abscission zone which in turn synthesizes various enzymes like cellulases and pectinases which are cell wall degrading in nature. Activity of these enzymes results in loosening of the cell wall and cell separation that leads to the leaves abscission.

Programmed Cell Death (PCD)

Programmed cell death (PCD) can be defined as senescence leading to the death of the plant or plant part. In PCD various nutrients and other substrates synthesised in particular part of the plant/ senescing cells and tissues gets translocated to other different parts of the plant that generally survive.

For efficient elements functionality and for water transport there is death and disappearance of protoplasts of xylem vessels and tracheid (developing tracheary elements). Whereas, formation of aerenchyma is generally seen in different parts of the plant in case of aquatic plants like roots and stems which enclose large air spaces that are created via PCD.

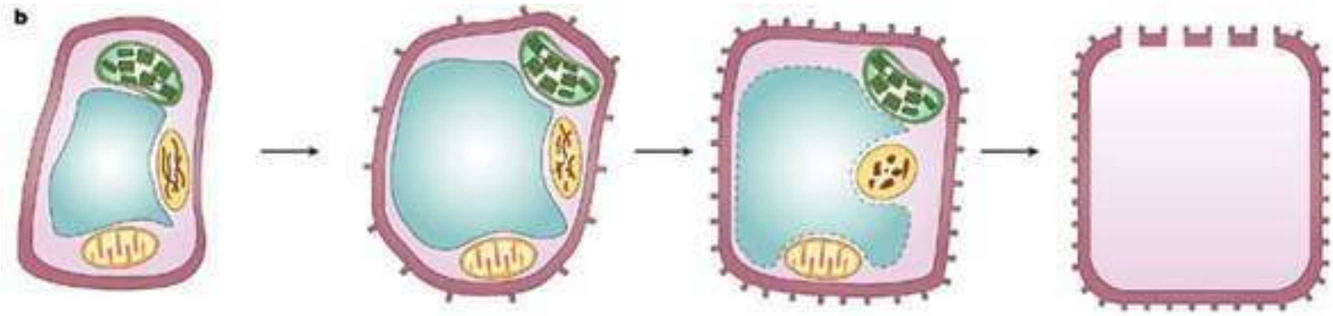

Fig.2: Nucleus and cytoplasm degraded by apoptosis

During the development of unisexual flowers, primordial for both male and female flowers are present in the earlier stages, however, only one of these two completes its development while the other aborts via PCD. Further, in ovules, the megaspore mother cell divides meiotically to form four megaspores out of which only one remains functional to form the female gametophyte while the rest degenerate.

This process is predetermined, controlled by genes, and is an example of programmed cell death. As soon as the host plant is infected by pathogens, the cells die rapidly around the injection site forming a necrotic lesion. This divests the pathogen of the nutrient supply and checks its spread in the host plant. This is a type of PCD that shows beneficial effects to plant.

Significance of Senescence

The senescence process has many advantages in the cellular mechanism:

1. Functionally new and efficient organs or organisms are created on the other hand functionally old inefficient are discarded.
2. It makes sure the recovery and utilization of minerals and organic nutrients from older senescing organs to the newly formed growing organs.
3. Due to transpiration in unfavourable season, synchronous or seasonal senescence avoids water loss and thereby, helps in the survival of the plant.
4. Falling of leaves due to senescence adds to the humus content of the surface layer of the soil and thus makes the soil rich in nutrients for germination and growth of new seedlings.

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A Critical Analysis of GDDP and NDDP of Neemuch District in General and of Manasa Division in Particular- Strategy for Enhancing Share of Agriculture Sector

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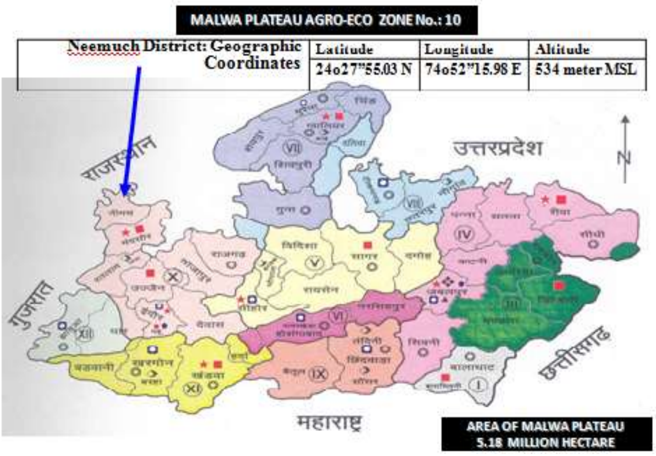
Preamble

India today is not only self-sufficient in respect of demand for food, but is also a net exporter of agric-products occupying seventh position globally. It is one of the top producers of cereals (wheat & rice), pulses, fruits, vegetables, milk, meat and marine fish. Agriculture is the largest enterprise in the country. An enterprise can survive only if it can grow consistently. Growth is incumbent upon savings & investment, both of which are a function of positive net returns from the enterprise. The net returns determine the level of income of an entrepreneur, farmer in this case. Attempts have been made to analyze the available information and present a diagnostic analysis of the underlying economic potential for enhancing the Agriculture GDP in Manasa Division and Neemuch district as a whole.

Neemuch District of Madhya Pradesh

Neemuch District, in the Ujjain region is a district of Madhya Pradesh with its administrative headquarters located at Neemuch city. This district was created on 30 June 1998 by separating Neemuch, Manasa and Jawad tehsils of the erstwhile Mandsaur district. According to 2011 census, the district encompasses a geographical area of 4256 sq. km and has a population of 8, 26,067 (persons) including 4,22,653 (males) and 4,03,414 (females). The district has a sex ratio of 954 (females for every 1000 males. The literacy rate in the district is 70.80% (persons), 83.91% (males) and 57.13% (females). Labour Force Participation Rate is 67.54% for the year 2017-2018. Main source of income in the district is from the agriculture sector and per capita income is Rs. 90,781. Total cropped area is 3,11,659 hectares and the forest area are 795.69 in sq km (2019). (District Factbook™ and its sample view).



There is a total of 800 Revenue villages in the 3 Divisions (Neemuch, Manasa and Jawad) and 6 Tehsils e.g. (i) Neemuch Rural (120 villages), Neemuch Urban, and Jiran (85 villages) of Neemuch Division, (ii) Manasa (170 villages) and Rampura (92 villages) of Manasa Division, and (iii) Jawad (134 villages) and Singoli (199 villages) of Jawad Division. The total area of Manasa Division is nearly one-third of the total area of whole district of Neemuch.

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Basic Information and Available Resources in Neemuch District

Neemuch district is located in western parts of the state of Madhya Pradesh, having Geographic coordinates of 24o27"55.03 N Latitude, 74o52"15.98 E Longitude and 534-meter MSL Altitude. It has been classified as:

1. Agro Ecological Sub Region (ICAR): Hot moist semi-arid ecological sub region (5.2).
2. Agro-Climatic Region (Planning Commission): Western Plateau and Hill Region (IX).
3. Agro Climatic Zone (NARP): Malwa plateau zone (M P-10).

The mean annual rainfall of the district is 819 mm mainly received from South-west Monsoon during June to September months and out of this amount of rainfall very meagre amount of rains (21.04 mm) are received in winter and sometimes summer months. The normal onset and withdrawal/ Cessation in this region is III week of June 25 SMW, and IV week of September 39SMW, respectively.

Major Soils in the district are Deep soils, Medium deep soil, and Shallow soils occupying an area of 143.00 (33.65 %), 91.80 (21.65%) and 190.20 (44.70 %) thousand hectares respectively. Land use pattern of the district is as Geographical area, Forest area, Land under non- agricultural use, Permanent pastures, Cultivable wasteland, Barren and uncultivable land, Current fallows, and Other fallows is 393.5, 94.4, 46.45, 8.14, 19.27, 37.19, 0.6 and 0.7 thousand hectares respectively.

Agricultural land use data revealed that Net sown area, Area sown more than once and Gross cropped area in the district is reported to be around 186.84, 104.27, and 290.11 thousand hectares respectively. The cropping intensity in the district of Neemuch fluctuates around 155.27 % depending upon water availability for irrigation and monsoonal conditions. Rainfed farming dominates in the district. Total rainfed area in the district is 214.21 thousand hectares, while gross irrigated area and net irrigated area in the district is 75.9 and 75.7 thousand hectares respectively. The major sources of irrigation in the district are open wells (50029 numbers) and Bore wells (6410 numbers) used for irrigating 47.2 and 17.2 thousand hectares respectively while canal water and tanks cover only 3.1 thousand and 4.2 thousand hectares land for irrigating it. In other words, we can say that of the 75.9-thousand-hectare irrigated area covered by Canals, Tanks, Open wells, Bore wells, and Other sources 3.0, 1.0, 61.0, 32.0, 3.0 per cent respectively.

Major crops of the area are:

1. Field crops- Soybean, Maize, Wheat, Mustard, and Gram.
2. Horticulture crops:
    a. Fruits- Orange and Other Fruits.
    b. Vegetables: (All vegetable crops).
    c. Spices- Coriander, Garlic.
    d. Medicinal and Aromatic: Ashwa Gandha, Isabgol and others.
    e. Flowers, etc. Area planted to fodder crops is about 20.9 thousand hectares.

Major cattle resource in the district include Cattle, Buffaloes, Commercial dairy farms, Goat, Sheep, and Others(Camel, Pig etc.) are 228, 60, 175, 15 and 3 thousand respectively. Commercial poultry population is almost nil while Backyard is 41115 in numbers. The crop productivity survey for the 3 years of 2006, 07 and 08 as depicted in Table 1 Clearly reveal that there is tremendous scope for enhancing the productivity of major crops of the region.

Table 1: Production and Productivity of major crops (Average of last 3 years: 2006, 07, 08)

Kharif			**Rabi**			**Major Horticulture Crops**		
Crops	Production ('000 t)	Productivity (kg/ha)	Crops	Production ('000 t)	Productivity (kg/ha)	Crops	Production ('000 t)	Productivity (kg/ha)
Soybean	134.5	1086	Wheat	73.7	2443	Isabgol	7.8	1200
Maize	51.8	1805	Gram	17.6	880	Garlic	58.2	7500
	-	-	Mustard	27.9	1047	Coriander	4.2	1490

What is GDP?

GDP is the final value of the goods and services produced within the geographic boundaries of a country during a specified period of time, normally a year. GDP growth rate is an important indicator of the economic performance of a country. It can be measured by three methods, namely, (1) Output Method: This measures the monetary or market value of all the goods and services produced within the borders of the country. In order to avoid a distorted measure of GDP due to price level changes, GDP at constant prices or real GDP is computed. GDP (as per output method) = Real GDP (GDP at constant prices) – Taxes + Subsidies, (2) Expenditure Method: These measures the total expenditure incurred by all entities on goods and services within the domestic boundaries of a country. GDP (as per expenditure method) = C + I + G + (X-IM) C: Consumption expenditure, I: Investment expenditure, G: Government spending and (X-IM): Exports minus imports, that is, net exports and (3) Income Method: It measures the total income earned by the factors of production, that is, labour and capital within the domestic boundaries of a country. GDP (as per income method) = GDP at factor cost + Taxes – Subsidies.

In India, contributions to GDP are mainly divided into 3 broad sectors – agriculture and allied services, industry and service sector. In India, GDP is measured as market prices and the base year for computation is 2011-12. GDP at market prices = GDP at factor cost + Indirect Taxes – Subsidies. The components of GDP include personal consumption expenditures (C), business investments (I), government spending (G), exports (X), and imports (M). GDP is equal to C+ I +G +(X - M).

Current Status of Agriculture in Neemuch

It is obvious from the data of the data that agriculture happens to be the major contributor in GDP, NDP and farmers income etc. The trend of these factors at state level as well as of Nemmuch district commensurate. In agriculture sector, the major contributor crops in GDP of the M. P. are soybean (90%), gram (36%), oilseeds (25%), pulses (24%) and food grains (8%), respectively. While the net value added by Neemuch district during the years 2011-12 - 2016-17 from different sectors of agriculture has been shown in Table 2. These data further indicate that in agriculture sector the major share of Neemuch district contributed by crops varying from 113733, 166746, 182605, 186167, 156834, and 221765 lakhs of Rs during the years 2011, 2012, 2013, 2014, 2015 and 2016. The growth of NVA added by Neemuch was at a very slow rate and in the year 2015-16 it declined severely due to bad weather conditions (Table 2). The current status of agriculture with respect to area, production and productivity of different arable crops and horticultural crops for the years 2019-20 has been depicted in the Tables 3 and 4, respectively.

Table 2: Summary of Sector wise Growth rate of Net Value Added (NVA) of Neemuch District (Current Prices) in different years (http://des.mp.gov.in/Portals/0/Estimates_SDP_2011-12-2016-17.pdf)

Sl. No.	Sector	(Rs Lakhs)					
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	Crop	113733	166746	182605	186167	156834	221765
2	Livestock	13686	17839	18995	28947	27140	31734
3	Forestry	9455	10518	9505	16551	13859	14145
4	Fishing & aquaculture	371	439	407	788	523	1082

Table 3: Area, Production and Productivity of Kharif Crops in Neemuch district during 2019-20 (Source: KVK Neemuch)

Name of Crops	Cropped Area (000 ha)		Production (000 Metric tons)		Productivity (Kg/ha)	
	2018	2019	2018	2019	2018	2019

1. Total grain (Maize + Others)	23.5	29.28	84.76	25.88	3607	884
2. Total Pulses (Urd+ Others)	12.15	8.215	13.01	1.48	1071	180
3. Soybean	126.5	128.22	144.21	52.57	1140	410
Total oilseeds (Including Soybean)	138.09	138.41	173.33	58.62	1255	424
Total kharif	**173.78**	**175.995**	**271.11**	**85.97**	**1560**	**489**

Table 4: Area, Production and Productivity of Rabi Crops in Neemuch district during 2019- 20 (Source: KVK Neemuch)

Name of Crops	Cropped Area (000 ha)		Production (000 Metric tons)		Productivity(Kg/ha)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
1. Total grain (Main Wheat)	77.55	105.24	315.79	502.8	4072	4778
2. Total pulses (Main Gram)	21.86	17.63	24.67	29.51	1129	1674
3.Total oilseeds (Only Mustard & Linseed negligible)	19.81	7.35	20.91	10.2	1055	1388
Total Rabi	**119.22**	**130.22**	**361.37**	**542.51**	**3031**	**4166**

Economy of Neemuch District

Neemuch economy is driven mainly by agriculture produce trading, service sector like CRPF (Central Reserve Police Force), Cement plants Vikram Cements of Aditya Birla Group and remittance from thousands of migrants all over the country. In fact, this small town is native to many senior corporate professionals including CEO of companies like Wipro, Key management professionals at Reliance Industries, Grasim and many IITians and doctors. There are 7 Divisions, 7 Tehsils and 800 villages in the district as detailed below.

Latest data of the year 2018 indicate that the major crops of Neemuch district are soybean (126500 ha), maize (23500 ha), wheat (77550 ha), pulses mainly gram (21860 ha) and Oilseeds mainly mustard (198100 ha) with corresponding productivity of 1140 kg/ha soybean, 3604 kg/ha maize, 4072 kg/ha wheat, 1129 kg/ha gram, and 1055 kg/ha mustard, respectively. It is one of the largest producers of opium in the world. The main horticultural crops of the district are as per the latest data of the years 2018- 2019 are Orange (4350 ha), Isapgoal (7000 ha), Garlic (25000 ha), Coriander (20150 ha) Ashwagandha (1264 ha). A total production of 7000 t @ 1000 kg/ha Isabgol, 225000 t @ 9000 kg/ha garlic, 20150 t @ 1000 kg/ha coriander and 884 t @ 700 kg/ha, was estimated. The data available from different sources (Tables 5 and 6) have been been utilized for setting the targets for enhancing production, productivity, farmers income and ultimately GDDP and NDDP of Neemuch district.

Table 5: GDDP and NDDP of Neemuch district and their share to M.P. state

S.No.	Years	GDP of M. P. (Rs Lakh)	NDP of M. P. (Rs Lakh)	GDDP of Neemuch (Rs Lakh)	GDDP Share (%) of Neemuch District to M.P. GDP	NDDP of Neemuch (Rs. Lakhs)	NDDP Share (%) of Neemuch District in M.P.
1	2011-12	31566159	28237104	394621	1.25	355724	1.26
2	2012-13	38092480	33393724	475863	1.25	425280	1.27
3	2013-14	43948344	39311528	592059	1.35	538361	1.37
4	2014-15	47993904	42902700	588474	1.23	533602	1.24
5	2015-16	54118863	48615534	676997	1.25	618399	1.27

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6	2016-17	64884875	58916816	879573	1.36	813446	1.38

Table 6: Different parameters and their share to GDDP and NDDP of Neemuch district:

S.No.	Years	Per capita Income of Neemuch (PCI) (Current Price) (Rs Laks)	Crop Share in GDDP of Neemuch (Current Price)	Crop Share(%) in GDDP of Neemuch district	Livestock Share in GDDP of Neemuch district (Current Prices) (Rs Lakhs)	Livestock Share(%) in GDDP of Neemuch district	Forestry Share in NDDP of Neemuch district (Current Prices) (Rs Lakhs)	Forestry Share (%) in GDDP of Neemuch district	Fishing & aquaculture Share in GDDP of Neemuch (Current Prices) RsLakhs)	Fishing & aquaculture Share (%) in GDDP of Neemuch district
1	2011-12	42698	113733	28.82	13686	3.47	9455	2.40	371	0.09
2	2012-13	50308	166746	35.04	17839	3.75	10518	2.21	439	0.09
3	2013-14	62765	182605	30.84	18995	3.21	9505	1.61	407	0.07
4	2014-15	61331	186167	31.64	28947	4.92	16551	2.81	788	0.13
5	2015-16	70026	156834	23.17	27140	4.01	13859	2.05	523	0.08
6	2016-17	90781	221765	25.21	31734	3.61	14145	1.61	1082	0.12

Gaps in Potential and Realisable GDDP in Neemuch and Manasa Area

Table 7: Strategy for Enhancing the GDDP of Neemuch district through Enhancing the Productivity and Production of Kharif and Rabi Crops

Crops	Base Year (2018-19) Productivity , Production, MSP of Neemuch District					Short Term Proposed Achievable Targets				Gap to be Bridged				
	Productivity (Kg/ha)	Total Area (000 ha)	Total Production (000 t)	MSP (Rs/t)	Total Value of Product (Rs 000)	Productivity (Kg/ha)	Total Production (000 t)	MSP (Rs/t)	Total Value of Production (Rs 000)	Increase over Base Year (%)	Productivity (Kg/ha)	Total Prod u-ctn (000 t)	MSP (Rs/t)	Total Value of Product (Rs 000)
1. Total grain (Maize + Others)	3607	23.5	84.8	14250	1207894	4000	94.0	18500	1739000	43.97	393	9.2	18600	5311
2. Total Pulses (Urd+ Others)	1071	12.2	13.0	52000	676520	1200	14.6	60000	874800	29.31	129	1.6	60000	1983
3.Soybean	1140	126.5	144.2	28500	4109985	1500	189.8	38800	7362300	79.13	360	45.5	38800	32523
Total Kharif		162.2	242.0		5994399		298.3		9976100	66.42		56.3		
4. Total grain (Main Wheat)	4072	77.6	315.8	17350	5478845	5500	426.5	19250	8210606	49.86	1428	110.7	19250	27318
5. Total pulses (Main Gram	1129	21.9	24.7	42500	1048475	1500	32.8	46200	1514898	44.49	371	8.1	46200	4664
6. Total oilseeds (Only Mustard & Linseed negligible)	1055	19.8	20.9	39000	815490	1200	23.8	44250	1051911	28.99	145	2.9	44250	2364
Total Rabi		119.2	361.4		7342810		483.1		10777415	46.78		121.7		

Attempts have been made to identify the gaps between potential and realizable GDDP of Neemuch district and Manasa area through agriculture assuming contribution of other sectors being same. GDDP share of Neemuch district to GDP of M.P. state was 1.25% in the year 2011-12 and increased at a very slow rate up to 1.36% in the year 2016-17 and the trend regarding NDDP Share (%) of Neemuch district in M.P. commensurate the same depicted in Table 7. This emphasize that there is tremendous scope for enhancing the income of farmers more than 2-fold and make significant contributions to GDP of the state and NDDP also. This can happen only through

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the contributions of agriculture sector. Based on the past experience of the team, available information from different sources we set the achievable targets of few selected commodities to enhance the agricultural productivity by at least 27.20 % per year over the base year 2018-19. This would definitely help increasing GDDP, NDDP and farmers' income of the area to a significantly highest level. The set targets for Kharif crops are comfortably achievable, while that of Rabi crops would depend upon availability of irrigation water. The data related to area, production, productivity of crops during considered base year of 2018-19, target is sets for 1 year and gaps in different parameters have been summarized in Tables 7 and 8, respectively.

Table 8: Strategy for Enhancing the GDDP of Neemuch district through Enhancing the Productivity & Production of Horticulture Crops

Crops	Base Year (2018-19) Productivity, Production, MSP of Neemuch District					ShortTerm Assumed Achievable Targets			Gap to be Bridged				
	Productivity (Kg/ha)	Total Area (000 ha)	Total Production (000 t)	MSP (Rs/t)	Total Value of Product (Rs 000)	Productivity (Kg/ha)	Total Production (000 t)	Total Value of Product (Rs 000)	Increase over Base Year (%)	Productivity (Kg/ha)	Total Product-ion (000 t)	MSP (Rs/t)	Total Value of Product (Rs 000)
1.Kinnow / Mandarin Orange	6125	4.4	26.6	30000	799260	6500	28.3	848250	6.13	375	1.6	48990	490
2. Other Fruit crop	15279	3.1	48.0	50000	2398750	20000	62.8	3140000	30.90	4721	14.8	741250	7413
Total Fruit Crops		7.5	74.6		3198010		91.1	3988250	24.71		16.5	790240	
3. Onion	20000	3.4	67.0	15000	1005000	25000	83.8	1256250	25.00	5000	16.8	251250	2513
4.Other vegetable crop	12996	4.5	58.9	20000	1177480	15000	68.0	1359000	15.42	2004	9.1	181520	1815
Total Vegetable Crop		7.9	125.9		2182480		151.7	2615250	19.83		25.8	432770	
5.Garlic	9000	25.0	225.0	80000	18000000	10000	250.0	20000000	11.11	1000	25.0	2000000	20000
6. Other Spices crops	1150	32.3	37.2	100000	3720000	1300	42.0	4204720	13.03	150	4.8	484720	4847
Total Spices Crop		57.3	262.2		21720000		292.0	24204720	11.44		29.8	2484720	
7.Ashwagandha	700	1.3	0.9	400000	353920	1000	1.3	505600	42.86	300	0.4	151680	1517
8. Isabgol	1000	7.0	7.0	150000	1050000	1100	7.7	1155000	10.00	100	0.7	105000	1050
TotalMedicinal Crops		8.3	7.9		1403920		9.0	1660600	18.28		1.1	256680	
Total Kharif + Rabi + Hort. Crops					**41841620**			**53222335**	**27.20**				**113807**

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Manasa Divisions (Manasa and Rampura Tehsils) of Neemuch District

In view of non-availability of data specifically for Manasa area, a justifiable approximation of resources of one-third of the whole district with respect to demography, area, production, and productivity of crops has been considered and conclusions in this document for Manasa area are based on these assumptions. The conclusions have been summarized as following in Table 9 and Table 10, which are self-explanatory.

Kharif and Rabi Crops: The major products in Manasa area are soybean, maize crops and other pulses in Kharif season and wheat, gram and mustard crops in Rabi season. To bridge the gap and achieve the targets, an increase in the total production of 59.2 (18.8 in Kharif + 40.6 in Rabi) thousand tons of all the 6 products of Kharif and Rabi season would be required in Manasa area (Table 7). For this purpose, soybean, wheat, gram and mustard crops deserve focus on top priority basis.

The data presented in Table 7 reveal that the total values Kharif products (soybean, maize, and other pulses) of Rs 19981.79 lakhs can be comfortably increased to Rs 33253.67 lakhs in one year merely by increasing the production of these crops by 15.2, 3.1 and 0.5 thousand tons over the considered base year of 2018-19. This would require integrated efforts for enhancing the productivity of soybean, maize and kharif pulses by 360, 393 and 129 kg per hectare, respectively. Similarly, the total values Rabi products (wheat, gram and mustard crops) of Rs 24476.08 lakhs can be increased to Rs 35924.72 in one season by increasing the production of these crops by 36.9, 2.7, and 1.0 thousand tons over the considered base year of 2018-19 with corresponding increase in the productivity of 1428, 371, and 145 kg per hectare, respectively over the base year.

Table 9: Strategy for Enhancing the GDDP of Manasa Tehsil of Neemuch district through Enhancing the Productivity & Production of Kharif and Rabi Crops

Crops	Base Year (2018-19) Productivity , Production, MSP of Manasa Tehsil of Neemuch District					Short Term Assumed Achievable Targets					Gap to be Bridged				
	Productivity (Kg/ha)	Total Area (000 ha)	Total Production (000 t)	MSP (Rs / t)	Total Value of Product (Rs 000)	Productivity (Kg/ha)	Total Production (000 t)	MSP (Rs / t)	Total Value of Product (Rs 000)	Increase over Base Year (%)	Productivity (Kg/ha)	Total Production (000 t)	MSP (Rs / t)	Total Value of Product (Rs 000)	Total Value of Product (RsLakh)
1. Total grain (Maize + Others)	3607	7.8	28.3	14250	402631	4000	31.3	18500	579667	43.97	393	3.1	18600	177035	1770
2. Total Pulses (Urd+ Others)	1071	4.1	4.3	52000	225553	1200	4.9	60000	291600	29.28	129	0.5	60000	66047	660
3. Soybean	1140	42.2	48.1	28500	1369995	1500	63.3	38800	2454100	79.13	360	15.2	38800	1084105	10841
Total Kharif		54.1	80.7		1998179		99.4		3325367	66.42		18.8		1327188	
4. Total grain (Main Wheat)	4072	25.9	105.3	17350	1826282	5500	142.2	19250	2736869	49.86	1428	36.9	19250	910587	9106
5. Total pulses (Main Gram	1129	7.3	8.2	42500	349632	1500	10.9	46200	504966	44.43	371	2.7	46200	155334	1553
6. Total oilseeds (Main Mustard & Linseed in traces)	1055	6.6	7.0	39000	271694	1200	7.9	44250	350637	29.06	145	1.0	44250	78943	789
Total Rabi		**39.7**	**120.5**		**2447608**		**161.0**		**3592472**	**46.77**		**40.6**		**1144863**	

Horticultural Crops: In economy dependent on agriculture in Manasa are, the major contributory products are Orange, garlic, spices, Isabgol and Ashwagandha crops. The total values of all these products in the 2018-19 were Rs 98364.70 lakhs realized from a total area of 28.11lakhs hectares. There exists a gap of Rs 14052.20 lakhs in between set target and actually realized in the considered base year or 2018-19 (Table 8). This gap can be easily bridged by enhancing the total production of all products by 29.99 thousand tons over the total production obtained (179.19 thousand tons) in the base year 2018-19. There is a scope of increasing these values of all the products to the tune of Rs 112416.90 Lakhs from the same area.

Total Kharif + Rabi + Horti crops: A brief summary of total value of main products of Manasa area in agricultural sector e.g. Kharif crops, Rabi crops, all horticultural crops (main fruits, vegetables, spices, medicinal and aromatic plants have been depicted in Table 8. Total value of these products of Rs 139473 Lakhs was recorded in the considered base year of 2018-19 which has a scope for enhancement up to Rs 177408 lakhs. The gap of Rs 37935 lakh can be bridged in a year time by employing a holistic approach by increased growth at the rate of 27.2% over the base year. This is further clarified that all the computations are related to agriculture sector and targets set by us are realistic and achievable. The contribution of Manasa area to GDDP and NDDP of Neemuch district may be highly significant and valuable for doubling the income within 2/ 3 years and prosperity of farmers of the area as well.

Table 10: Strategy for Enhancing the GDDP of Manasa Tehsil of Neemuch district through Enhancing the Productivity & Production of Horticulture Crops

Crops	Base Year (2018-19) Productivity , Production, MSP of Manasa Tehsil of Neemuch District					Short Term Assumed Achievable Targets					Gap to be Bridged				
	Productivity (Kg/ha)	Total Area (000 ha)	Total Production (000 t)	MSP (Rs / t)	Total Value of Product (Rs 000)	Productivity (Kg/ha)	Total Production (000 t)	MSP (Rs/t)	Total Value of Product (Rs 000)	Increase over Base Year (%)	Productivity (Kg/ha)	Total Production (000 t)	MSP (Rs / t)	Total Value of Product Rs 000) (	Total Value of Product (Rs Lakh)
1. Kinnow/ Mandarin Orange	6125	1.5	8.9	30000	266420	6500	9.4	30000	282750	6.13	375	0.5	30000	16330	163
2. Other Fruit crop	15279	1.0	16.0	50000	799583	20000	20.9	50000	1046667	30.90	4721	4.9	50000	247083	2471
Total Fruit Crop		2.5	24.9		1066003		30.4		1329417	24.71		5.5		263413	
3. Onion	20000	1.1	22.3	15000	335000	25000	27.9	15000	418750	25.00	5000	5.6	15000	83750	838
4. Other vegetable crop	12996	1.5	19.6	20000	392493	15000	22.7	20000	453000	15.42	2004	3.0	20000	60507	605
Total Vegetable Crops		2.6	42.0		727493		50.6		871750	19.83		8.6		144257	
5. Garlic	9000	8.3	75.0	80000	6000000	10000	83.3	80000	6666667	11.11	1000	8.3	80000	666667	6667
6. Other Spices crops	1150	10.8	12.4	100000	1240000	1300	14.0	100000	1401573	13.03	150	1.6	100000	161573	1616
Total Spices Crops		19.1	87.4		7240000		97.3		8068240	11.44		9.9		828240	
7. Ashwagandha	700	0.4	0.3	400000	117973	1000	0.4	400000	168533	42.86	300	0.1	400000	50560	506
8. Isabgol	1000	2.3	2.3	150000	350000	1100	2.6	150000	385000	10.00	100	0.2	150000	35000	350
Total Medicinal Crop		2.8	2.6		467973		3.0		553533	18.28		0.4		85560	
Total Kharif + Rabi + Hort. Crops					**13947257**				**17740778**	**27.20**				**3793521**	**37935**

Strategy for Enhancing Production, Productivity of Crops and Income of Farmers

Strategy for doubling the income of farmers and therefore enhancing the contribution of Agriculture/ farming in GDDP of Neemuch district as well as of Manasa Division includes the measures grouped into three categories:

1. Long Term Measures.
2. Medium Term Measures.
3. Short Term Measures or Measures to be taken with immediate Effects.

A lot of technological options are available which must be adopted by farming community for Improvement in crop productivity, Improvement in livestock productivity, Resource use efficiency or saving in cost of production, increase in cropping intensity, Diversification towards high value crops and Improvement in real prices received by farmers. For each of the components as referred above, packages of location or region specific have been developed by Agriculture Universities and KVKs and the models for these have been tested in front line demonstrations by state Department of Agriculture also.

Land Use According to Its Capability: All land types are not suitable for all kind of uses. Therefore, land use should be planned based on its capability classes as any abuse of land at any point of time would be the beginning of land deterioration at a very faster rate.

Alternate Land Use Systems (Agri-horticulture): In medium depth soil areas agric- horticultural systems consisting of a fruit trees intercropped with annual arable crop is recommended. Ber, Custard apple, Aonla, and pomegranate are some of the species suitable for pure plantations and mixed with crops. Cluster bean, cowpea, horsegram, and other grain legumes have been found useful. Results of a long-term experiment conducted at AICRPDA, Indore revealed tremendous scope of alternate land use of combining fruit trees and crops of Soybean, Pigeonpea and their intercrop combinations.

Agronomical Measures: Benefits of the improved technologies cannot be realized unless crops are grown with improved package of practices. These include:

a. Appropriate land management and seedbed preparation.
b. Selection of improved crops/ varieties.
c. Seed grading/ treatment.
d. Early but safe planting, intercultural operations.
e. Judicious use of fertilizers.
f. Control of weeds.
g. Control of pests and diseases.
h. Harvesting at physiological maturity.
i. Post-harvest technology and value addition etc.

Some tillage, land configurations and land treatments particularly for kharif crops and Soil, Straw and Green biomass mulching are useful for moisture conservation, providing safe drainage and enhancing resource use efficiency.

Inter-cropping Minimises Risk: Adoption of inter-cropping systems using appropriate crop components pay dividends as compared to sole cropping systems due to increased land and water use efficiency. Inter-cropping systems lead to higher returns by way of diffusing the adverse effects of drought to a greater extent. The potential inter-cropping systems for western parts of the state of Madhya Pradesh are Soybean + pigeonpea, Soybean + Sorghum, Soybean + maize, cotton + black-gram etc.

Integrated Nutrient Management: Integrated fertility management envisages the conjunctive use of organics such as FYM, compost, green manures, crop residues, and bio-fertilizers. Long term studies conducted on black soils of high rainfall region (Sharma, 1990b, Sharma, 1992, Sharma and Gupta, 1993) amply reveal that conjunctive use of FYM and chemical fertilizers lead to:

a. Improvement in organic pool and nutrient status of soil.
b. Mitigation of drought effect on crop.
c. Enhanced sustainable yield index.
d. Significantly higher biomass production per unit land than that obtained through use of chemicals alone.

Organic Manures, biofertilizers and Crop Residues Alleviate Drought Effects: Organic manures, green manuring, compost, FYM and incorporation of crop residues are very well known to improve hydro physical, chemical and biological properties of soils and thus alleviate the drought effects on growing crops for obvious reasons.

Water Conservation Measures/ Drainage at Small Scale: The measures for conserving rain water in-situ and its safe disposal at small scale level and cost-effective basis include:

a. Ridge and furrow system.
b. Graded furrows, and dead furrows.
c. Raised and sunken beds system.
d. Broad bed and furrows.
e. Broad bed and tied furrows, etc.

Long Term Measures: Long term measures ensure sustainability in agriculture. These measures aim at conservation of land for erosion control and drainage, rain water and its recycling for irrigating crops.

Watershed Development Approach: There are certain long-term measures which are essential to manage agriculture on a sustainable basis. In order to achieve these goals, we choose a piece of geographical area starting from the highest point and draining into a single outlet. The area thus delineated is called a “watershed”. The technology for the watershed development should consist of land and water management practices, and crop husbandry practices.

Land and water management practices: Land and water management practices would depend upon whether the erosion or water logging/ water stagnation or both are the problems. Practices of controlling soil erosion aim at slowing down the velocity of runoff water, allowing most of it to soak into the soil or to drain off slowly to the natural streams. Various activities are:

a. Stabilization of slopes > 6% with shallow soil by vegetative cover.
b. Bench terracing on land with slope > 6% and with deep soil.
c. Water diversion bunds.
d. Grassed waterways.
e. Mechanical structures for stabilization of waterways.
f. Graded bunds / planting appropriate vegetation on a grade.
g. Waste-weirs.
h. Gully reclamation works.
i. Water harvesting works.

Practices that control water logging and water stagnation are; water diversion bunds, grassing of waterways, graded drainage channels, and stabilization works for waterways and drainage channels. Fallowing of lands must be avoided by cropping during the period in which most of the rains received. Various activities are:

a. Afforestation of bare hillocks.
b. Planting grass on sloppy lands with shallow soil.
c. Short duration crops/varieties on moderately or less sloppy land with shallow soil.
d. Intercropping on medium deep soil.
e. Sequential cropping on deep soil after providing drainage in rainy season.
f. Growing more remunerative crops/ varieties.

Some low-cost conservation practices which have been found useful are:

a. Sowing crop against the slope on sloppy land.
b. Planting on grade rather than on graded broad ridges.
c. Providing surface drains / graded furrows on flat land (between crop rows).

Erosion Control Long Term Measures: Erosion control measures include various mechanical, biological and agronomic practices as discussed below:

a. Mechanical Measures: Some of the cost effective and promising erosion control measures are:

i. Gabion Structures.
ii. Graded Bunds.
iii. Conservation Ditches.
iv. Water Diversion Bunds.

v. Bench Terracing: measure of erosion control.
vi. Grassed Waterways.
vii. Stabilisation of Washes.
viii. Provision of Drainage Between Waterways.
ix. Gully Control measures.

b. Biological Measures: Biological measures are generally used as preventive measures. These include appropriate plant cover, straw mulching, vertical mulching with stalks of maize or sorghum or any other crop residues and vegetative barriers:

i. Planting of a Cover Crop.
ii. Mulching with Crop Residues.
iii. Vegetative Barriers/Hedges: hedge which should be regularly cut to maintain 30 cm height.

c. Agronomic Measures: Agronomic practices which encourage conservation of soil, rain water and plant nutrients and enhance use efficiency of these resources are soil mulching, plastic mulching, contour farming, strip cropping, integrated nutrient management practices and minimum tillage practices etc.

Conclusion

From the foregoing facts and discussion, it may be concluded that the production, productivity, farmers' income of Neemuch district in general and of Manasa Division area in particular can be increased in a year at the rate of about 27% over the same as has been realized in the year 2018-19. For achieving the target sincere efforts at various levels would be needed. These efforts include sincere and transparent implementation of agriculture technology. Administrative will for providing agricultural inputs in required amount at proper time, transfer of technology to farmers by extension agencies, support of financial institutions, market support and finally use of technology by farming community.

Acknowledgement

The present paper is dedicated to a Great Thinker, Social Worker and Leading Educationist Shri Narendra Nahata, Hon'ble Chancellor of Mandsaur University, Mandsaur (M.P.) who inspired me to critically analyze the facts so that Farmers of Neemuch district are able to enhance the production, productivity of major crops and double their income and contribute significantly to state as well as national GDP.

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Defence Mechanism of Host Insect Against Predator and Parasitoid

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Introduction

Parasite: Organism that live at the expense of another organism but do not kill it.
Parasitoid: A parasitoid is an insect parasite which is parasitic at immature stage and adult free-living.
Predator: A free-living organism throughout its life, kills its prey (more than one prey) to complete its development.
Defence: It is defined as protective behaviour of insect to avoid predation by other insects or predators, defence that reduces the probability of encounter by a natural enemy. Such as:
1. Primary defence: Crypsis, Camouflage, Mimesis(Masquerade).
2. Secondary defence: Mechanical defences, Chemical defences, Behavioural.
3. Tertiary defences: Mimicry, Hiding.

Primary Defence

1. Crypsis: Visual deception to avoid predator encounter.
2. Camouflage: Resembling the general background mimesis.
3. Masquerade: Resembling an object that is a particular feature of the environment and is uninteresting to the predator.

Secondary Defence

1. Behavioural responses: Behavioural responses are to escape predation includes burrowing into substrate and being active only through a restricted period of the day. Furthermore, insects may feign death (Thanatosis), Beetles and weevils are exhibit of this sort of acting. Bright colours may also be flashed to underneath cryptic ones. A startle display occurs when prey takes advantage of these markings after being discovered by a predator. The striking colour pattern, which often includes eyespots, is intended to evoke prompt enemy retreat. Better formed eyespots seem to result in better deterrence.

2. Mechanical defences: Insects have had millions of years to evolve a variety of mechanical defences. Perhaps the most obvious is the cuticle. Although its main role lies in support and muscle attachment, when extensively hardened by the cross-linking of proteins and chitin (sclerotized) the cuticle acts as a first line of defence.

a. Additional physical defences include modified mandibles, horns, and spines on the tibia and femur.
b. Some insects uniquely creates that appear un-interesting or non-edible to predators. This is the case in caddisfly larvae (order-Trichoptera) which encase their abdomenwith a mixture of natural materials like leaves, twigs, and stones.

3. Chemical defence:

a. Unlike pheromones, allomones harm the receiver at the benefit of the producer.
b. This grouping encompasses the chemical “arsenal” that numerous insects employ. Insects with chemical weaponry usually make their presence known through aposematism.
c. Aposematism is utilized by non-palatable species as a warning to predators that they represent a toxic danger. Additionally, these insects tend to be relatively large, long-lived, active, and frequently aggregate. Indeed, longer-lived insects are more likely to be chemically defended than short lived ones.

Examples

1. An assassin bug: Some insects inject their venom directly into their victims(targets), as is the case with the over 5,000 species in the family Reduviidae, the assassin bugs and thread-legged bugs. Interestingly, the assassin bug species *Platymeris rhadamanthus* is capable of spitting venom up to 30 cm. The saliva of this insect loaded with a mixture of at least six proteins including excess amounts of protease, hyaluronidase, and phospholipase causes intense local pain, vasodilation, and edema.

2. Cockroaches: Many cockroach species have mucus-like adhesive secretions on their posterior. Although not as effective against vertebrates, these secretions foul the mouths of invertebrate predators, increasing the chances of the cockroach escaping.

3. Ants: Venom is the defence of choice for many ants. It is injected from an ovipositor that has been evolutionarily modified into a stinging apparatus. These ants release a complex venom mixture that can include histamine. Within the Formicinae subfamily, the stinger has been lost and instead the poison gland forcibly ejects the fluid of choice, formic acid. Some carpenter ants (genus Camponotus) also have mandibular glands that extend throughout their bodies. When these are mechanically irritated, the ant commits suicide by exploding (Jones et al., 2007).

Tertiary Defence

1. Mimicry: Mimicry is the unique form of defence and describes when a spp. Resembles another recognized by natural enemies, giving it protection against predator. The superficial resemblance among mimics does not necessarily denote common ancestry.

Mimicry divided into two part:

a. Batesian mimicry: In Batesian mimicry, a phenomenon in which harmless organisms resemble harmful or unpalatable species (Katoh et al., 2017). Automimics are individuals that, due to environmental conditions, lack the distasteful or harmful chemicals of conspecifics, but are still indirectly protected through their visibly identical relatives. An example can be found in the Plain Tiger *(Danaus chrysippus)*, a non-edible butterfly, which is mimicked by multiple species, the most similar being the female Danaid Eggfly *(Hypolimnas misippus)*.

b. Mullerian mimicry: In Mullerian mimicry, a group of species benefit from each other's existence because they all are warningly coloured in the same manner and are distasteful. The best examples of this phenomenon can be found within the Heliconius butterfly genus.

2. Hiding: This adaptation allows them to effectively hide within their environmental because of a resemblance to the general background or an inedible object. When an insect looks like an inedible or inconsequential object in the environmental that is of no interest to a predator, such as leaves and twigs.

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Crypsis

Camouflage

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Mimesis	**Thandosis**
 	 
Batesian mimicry	**Mullerian mimicry**

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Poultry Housing: An Important Factor for Poultry Farming

Article ID: 32232

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Introduction

The best possible results in terms of milk, eggs, meat and physical output from variety of animals and birds which have been domesticated by human society on this planet required adequate amount of food, feed, water for higher returns from them similarly housing condition are also equally important. Housing and nutrition are two main factors for successful poultry farming business. Poultry products and their quality can be seriously affected by the housing system. Any housing system has advantage and disadvantage with regard to the bird performance, health and welfare. The appropriate housing system for layer chickens should be considered to maximize egg quality traits and egg production laying hen performance and production indices such as feed consumption, feed efficiency and Egg weight and egg production may be influenced by various housing system. A proper poultry house design must also aim at removing the excess moisture the birds breathe out from the lungs if the air in the house is loaded with the moisture, serious trouble from the diseases may develop. Proper ventilation is remedy for this, but poultry house should not expose to the strong winds. Poultry housing design plays a vital role in the determination of the internal climatic conditions of the house for optimum health, growth and productive per¬formance of the birds. Consequently, the type of poultry housing system employed by the proposed poultry farm is a function of the prevailing climatic conditions of the region where the farm is located. While open poultry house system has been adjudged a good method of housing in the tropical countries because of the simplicity of its construction, ease of heat management and minimal management cost the controlled housing system is most common in different temperate regions of the world. Drainage is another important consideration in selecting a site. Dampness is undesirable. An undrained site will encourage dampness in the house. Well drained sandy soil is the most suitable for the poultry house site as it dries off quickly and readily absorbs the droppings from the bird. Location near jungles should be avoided as wild and stray animals may attacks the birds. Light in poultry houses is essential for the well-being of the birds. Plenty of sunlight, well distributed throughout the house is good sources of their cheerfulness, thus we cay that poultry housing plays an important role in overall production of the poultry birds. In this article we have discussed different housing requirements and different environmental condition required for raising the poultry birds.

Why Poultry Housing?

1. To protect birds from adverse climatic condition such as extreme hot & cold.
2. To ensure scientific feeding in controlled manner.
3. To facilitate proper micro-climatic condition near the bird.
4. For optimum and uniform growth.
5. Ensuring better health and welfare.
6. Maximize flock performance.
7. To ensure proper monitoring and supervision.
8. To ensure easy economic operation.

Selection of the Sites

The selection of the site for poultry house plays a vital role in the construction of different poultry houses. The various factors which should be considered while selecting the poultry houses are it should be at appropriate distance from the residential and industrial areas, have basic amenities like water, electricity, proper roads and ventilation facilities.

Different Types of Poultry Houses

Brooder / chick house:

a. It is essential in raising and managing of chicks.
b. It is of two types stationary and portable.
c. A concrete or earth floor is desirable for a stationary house while wooden or close wire mesh floor are best for portable house.
d. It should be constructed such that it should be cool during summer.
e. It is used to brood and rear egg-type chicks from 0 to 8 weeks of age.

Grower house: It is used to raise egg-type birds from 9 to 18 weeks of age.

Brooders cum grower house:

a. Here, the birds are reared from 0 to 18 weeks of age.
b. Entire brooding and growing period of egg-type chicken.

Layer house:

a. In this bird over 18 weeks of age are reared.
b. Usually these are reared up to 72 weeks of age.

Broiler house: In these broilers are reared up to 6 weeks of age.

Breeder house: In which both male and female breeders are maintained at appropriate sex ratio.

Poultry Housing System

The importance of the type of poultry housing system employed for chicken production cannot be over emphasized. It protects the birds from the harsh environmental climatic conditions, which may have adverse effect on the chickens' performance and productivity. In a poultry house, the overall heat generated is the sum of heat generated by the birds, the surrounding environment and biodegradation of fecal material. Thus, the type of housing system to be used is a major determinant factor in the type of management to be adopted in the poultry farm. The housing systems used in the tropical region that is, naturally ventilated open housing system and mechanically ventilated open housing system are discussed here.

Depending upon the materials used in the construction of the floors, the poultry houses can be broadly classified as:

1. Wire floored poultry houses.
2. Deep litter poultry houses.
3. Cage houses.

Wire Floored Poultry Houses

These houses may be laying houses for hens or a brooder house for chicks. Wire floored houses use of 12-14-gauge expended metal or welded wire mesh for making their floors. The floor is placed about 45 cm above the ground level having raising slope of 15 per cent. There are series of nest placed along the posts throughout the entire length of the houses. The floored of nest may be made of either wooden or hard cloth with 12-15 per cent slope towards the central service alley of the house. Feed and water trough are suitable located to facilitate the work. The ground floor on which the dropping falls is rammed smooth but the floor of the service alley may or may not be smooth. The roof is made of galvanized iron sheets.

Deep Litter Poultry Houses

In this type of poultry houses birds are always kept inside a shed all the time. The birds live on the floor which is covered with suitable litter of about 15 to 20 cm depth. The materials of litter usually consist of chopped paddy straw, dry grasses or dry stalks of maize and bajara. Litter helps the birds to regulate their body temperature in summer as well as winter season. Litter should always be kept dry. Birds often keep busy in scratching and searching in the litter and hence refrain from feather picking. Whenever there is hot temperature outside the birds hides themselves inside the litter to make them cool and vice versa. This arrangement saves labour involves in frequent cleaning of the floor. It needs only periodic attention like stirring up the litter. Since birds are always confined inside the house so crowding of the birds should be avoided. Litter which gets decomposed after some time can remove and used as good quality manure. A floor area of 0.36 sq. m per bird is usually provided.

Cage Poultry Houses

This type of houses is generally built in the warm regions where birds need no protection from the cold winds. Depending upon the width rows of cages may vary from one to four. Cages are made of welded steel wires and are provided with the slopping floor and egg retainer from where eggs can be collected. The dimension of cages to house one bird may be 60 cm length 20 cm width and 45 cm height. The cages are placed at a height between 75 and 90 cm from the floor. Feeding and watering trough is placed outside the cages so that operator can easily supply the material. Dropping are allowed to fall on the concrete floor so that they can be easily cleaned. In two tire cages dropping of the top cages has to be collected on a sliding receiver placed in between the two cages.

Conclusion

From the above discussion we can conclude that in the present scenario, the demand for healthy and nutritional food has increased. Poultry birds are good source of the proteins and various other nutrition but for taking optimum benefits from poultry birds proper poultry housing and all other environmental condition should be maintained inside the poultry house. Heat loss in birds through convection, radiation and conduction is only effective if the environmental temperature is below or within the bird's thermo neutral zone. Naturally ventilated open housing system should be explored in the different regions according to their climatic condition to improve the environment for optimum production in birds. Studies show that when the volume and velocity of air is increased heat loss is enhanced in birds through convection. Also, the proper consideration of architectural elements such as building orientation, roof slope, roof overhang, landscape, building height, building width, building length, etc. have been reported to enhance naturally ventilated buildings for optimum production in chicken. In addition, the incorporation of cooling systems such as fogging system, sprinkling system and circulation fan in naturally ventilated design house systems have proven positive in optimizing birds' performances in general.

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Insect Pests of Cauliflower and their Management

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Introduction

Cauliflower, Brassica oleracea L. var. botrytis, is an herbaceous annual or biennial vegetable plant in the family Brassicaceae grown for its edible head. Cauliflower plants are shallow rooted with a small, thickened stem. The plant can reach a height of 1–1.5 m and is most commonly grown as an annual, harvested between 60 and 100 days after planting. Cauliflower is grown for consumption as a vegetable, either fresh or cooked. It is consumed as vegetables in curries, soups and pickles and low in fat and rich source of dietary fibres. Cauliflower is a cool season crop and grows best in well-draining, organic soil at a pH of 6.5 or above. A high amount of organic matter in the soil will help to hold moisture. Cauliflower requires consistent moisture during the growing season in order to produce large, tender heads. Cauliflower heads are ready for harvest when the head reaches 15 to 20 cm in diameter, usually about 7 to 12 days after blanching begins. Insect pests are prime important as it cause serious economic damage to cauliflower crop. Diamondback moth and tobacco caterpillar are the most serious pests of cauliflower.

Diamondback Moth, *Plutella xylostella*

The moth is grayish brown having typical white patches which form diamond like appearance in the wings while at rest. The larvae is greenish with hairs on the body and it pupates by making a silken web. The eggs are laid singly on under surface of leaves vein. Young larvae feed between upper and lower leaf surface and may be visible when they emerge from small holes on the underside of the leaf; older larvae leave large, irregularly shaped shot holes on leaf undersides, may leave the upper surface intact; larvae may drop from the plant on silk threads if the leaf is disturbed; larvae are small (1 cm/0.3 in) and tapered at both ends; larvae have to prolegs at the rear end that are arranged in a distinctive V-shape. Larvae take between 10 and 14 days to mature and spin a loose, gauze like cocoon on leaves or stems to pupate.

Management:

1. Applications of Bacillus thuringiensis,
2. Application of appropriate chemical insecticide is only necessary if larvae are damaging the growing tips of the plants.
3. Planting mustard as trap crop.
4. Application of NSKE @ 4% at head initiation stage.

Tobacco Caterpillar, *Spodoptera litura*

The moth is grey in colour having white strip lines on forewings and the larvae are dark green in colour. The eggs are laid in clusters on under surface of leaves. Young larvae feed gregariously and skeletonize the leaves while large larvae bore into heads. The infestation starts in the nursery stage while preparing the nursery beds.

Management:

1. Soil solarisation.
2. Application of NSKE @ 4% in early stage of larvae.
3. Collection and destruction of egg masses.

4. Collection and destruction of larvae.
5. Treat the nursery soil with neem cake @ 1 kg/m^2

Flea Beetles, *Phyllotreta cruciferae*

Small holes or pits in leaves that give the foliage a characteristic "shothole" appearance. Young plants and seedlings are particularly susceptible. Plant growth may be reduced and if damage is severe the plant may be killed. The pest responsible for the damage is a small dark coloured shiny beetle which jumps when disturbed. Flea beetles may overwinter on nearby weed species, in plant debris or in the soil. The insects may go through a two or three generation in one year.

Management:

1. Floating row covers may have to be used prior to the emergence of the beetles to provide a physical barrier to protect young plants.
2. Early planting of seeds to allow establishment before the beetles become a problem as mature plants are less susceptible to damage.
3. Planting of crucifers as trap crops may provide a measure of control.
4. Application of a thick layer of mulch may help prevent beetles reaching surface.
5. Application on diamotecoeus earth or oils such as neem oil are effective control methods for organic growers.
6. Application of insecticides containing carbaryl, spinosad, bifenthrin and permethrin can provide adequate control of beetles for up to a week and then it should be applied at frequent interval.

Thrips, *Thrips tabaci*

The leaves may be distorted if population is high and are covered in coarse stippling and may appear silvery speckled with black feces. The insect is small and slender and best viewed using a hand lens. Adult thrips are pale yellow to light brown and the nymphs are smaller and lighter in color. Transmit viruses such as Tomato spotted wilt virus. Once acquired the insect retains the ability to transmit the virus for the remainder of its life.

Management:

1. Avoid planting next to onions, garlic or cereals where very large numbers of thrips can build up.
2. Use reflective mulches early in growing season to deter thrips.
3. Application of appropriate insecticide if thrips become problematic.

Aphids, *Lipaphis erisimi*

The aphid sucks the plant sap from the under surface of the leaves and infested leaves shows whitish mealy covering. In severe cases it affects the quality of curd.

Management:

1. Planting mustard as trap crop.
2. Application of NSKE @ 4%.

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Microgreens- A Super Business for Young Farmers

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Microgreens, also called vegetable confetti are a new class of specialty crops that are defined as young, tender, lively green seedlings of vegetables and herbs containing high levels of biofortified phytonutrients and have potential bioactive value. Irrespective of their small size, the microgreens have a diversity of impressive colours, fine texture, unique favours, varieties and shapes and are increasingly popping up in the top-end restaurants, urban and peri-urban farmers, greenhouse farmers, and upscale markets. Due to their enormous potential as superfood, these baby shoots are tremendously exploited to garnish an array of main dishes, sandwiches, sandwiches, soups, mocktails and desserts etc. in order to enhance their texture, colour and flavour. They are typically harvested 7-14 days after germination depending upon different species at the cotyledon stage i.e., first true leaf stage and are consumed immature. Microgreens are different from sprouts and baby-greens. Sprouts are the germinated seeds consumed as a whole plant (root, stem, shoot) and are the youngest. The microgreens, 2 inches tall are larger than sprouts while the baby-greens are the largest having height of 3-4 inches. The phytochemical composition of microgreens is always greater than their mature counterparts on the basis of fresh weight. They are full of bioactive compounds like tocopherol, ascorbic acid, phylloquinone, beta-carotenoids, polyphenols, phytoestrogens, xanthophylls, glucosinolates, carotenoids (lutein, zeaxanthin) and minerals like iron, calcium, zinc, magnesium, manganese, molybdenum, selenium. The nitrate content is lower and the antioxidant activity is quite high. Therefore, due to high density in terms of phytonutrients, these foods are recognized as fresh and functional food package against various human health associated risks.

Source- https://www.ice.edu/blog/tiny-delicate-flavorful-microgreens

Cultivation of Microgreens

1. Seeds: A wide variety of seeds including kale, cabbage, carrot, beet, mustard, basil, onion, fennel, broccoli, lemongrass, popcorn, buckwheat, spinach, coriander, pea, radish, amaranth celery etc. are grown as microgreens. Among all, cauliflower cabbage, broccoli, sunflower, mustard, buckwheat is the easiest to grow. Soaking of seeds in water prior to sowing is important for effective germination. Matrix priming and Osmo-priming are also helpful in advancing seed germination. Organic seeds should be selected to get nutritious as well as healthy yields. Seed treatment or sanitization is carryout out before sowing to get rid of propagules of disease-causing pathogens viz. fungal spores, bacteria etc. Seed treatment can be done with 3% solution of hydrogen peroxide, which is a diluted solution and does not harm the seeds. After treatment, seeds are rinsed properly under tap water to wash the excess solution. Further, preliminary germination tests are advisable for adjustments in sowing rate. Pre-sowing treatments are essential for standardizing and abridging the production cycle. Seed rate primarily depends upon the type of crop, seed weight and population density.

Source- https://growherbsgarden.com/what-are-microgreens/

2. Fertilizer: Microgreens do not need fertilizers when grown in high quality soil because the soil has an innate potential of supplying enough nutrients to the microgreens strong and healthy. But in case of hydroponic or soilless medium, fertilizer application is must to provide all the essential plant nutrients to the young shoots. Many chemical fertilizers are suggested that include ammonium nitrate, urea, calcium chloride, calcium nitrate, etc. However, the chemical fertilizers can also be substituted by compost. Other important commercial fertilizers highly recommended for microgreen cultivation encompasses:

a. Azomite: It is a powdered fertilizer obtained from volcanic ash and is overloaded with earth elements and minerals. The degradation of azomite makes the mineral nutrients immediately available to the plants.

b. Liquid kelp: It is a sea weed extract which contains high amounts of plant nutrients along with high levels of cytokinin.

c. Floragro: It contains multitude of minerals. It is a water-soluble fertilizer which is dissolved in water before its application.

3. Growing Media: There are plenty of alternatives for the growing media to cultivate microgreens. The media used to grow microgreens should have electrical conductivity less than 500µS/cm, pH ranging from 5.5 to 6.5, aeration, 20-30% v/v and water holding capacity (WHC) of about 50-70% v/v. Various types of growing media commonly used are:

a. Soil: It is pivotal to utilize superior quality soil rich in plant nutrients particularly N, P and K. The three important physical and fertility properties that must be exhibited by any quality soil include richness of nutrients, water holding capacity and proper aeration. Adequate supply of nutrients improves the seedling growth, without which, the stems will be thin and weak. Water retention is crucial for seed germination and prevention of shoot wilting. The container used to grow microgreens should be porous enough to prevent overwatering. Furthermore, an adequate airflow throughout the soil augments root respiration and drainage of excess water. Additives like, perlite, peat moss, vermiculite, compost or worm castings are mixed to make a good quality soil. Well degraded compost is tremendously important in case of homemade soil. It provides available nutrients to the plants.

b. Coconut Coir: It is a fibrous material synthesized from coconut husks which is cleaner and convenient than soil. It's high thickness and porosity makes the water retention capacity, comparatively less and thereby, overwatering is obstructed.

c. Hemp mat: It is a super sustainable, biodegradable medium obtained from 100% natural hemp fibre. Hemp mats are clean growing medium with high water and nutrient holding capacity.

d. Hydroponic medium: Microgreens are grown in water medium supplied with adequate mineral nutrient to augment its overall growth. The pH between 5.5-6.5 is most favourable for microgreens. A growing pad is placed above the water to buttress the germinating seeds and is gently pressed to saturate it with water. Fertilizers are added to the water in case the plant shows wilting or yellowing symptoms.

e. Vermiculite: It is a natural clay mineral used as growing media for microgreens. It uplifts the airflow, balance the pH and is resistant to mould. The thin layer of vermiculite helps to maintain adequate moisture and facilitates seed germination.

In addition to these, synthetic fibrous mediums like polyethylene terephthalate (PET) and rockwool, natural fibre made mediums like recycled jute fibre, cellulose pulp, cotton fibre, kenaf and other admixtures of medium are commonly used as potential growing media. However, such medias are either fortified to enhance nutritional value of microgreens or inoculated with friendly microorganisms to control pathogens and to induce plant growth and development.

4. Environment: Microgreens adapt to a wide range of environments like indoor (e.g. window panes), protected environment (e.g. glasshouses), open air etc. depending upon the production scale. Containerization is possible at both micro and macro level production for selling in markets. Light conditions predominantly interfere in the biosynthesis of phytochemicals and morphology of microgreens particularly in controlled atmospheric (CA) conditions like greenhouse. Auxiliary light sources include LED, metal halide, high pressure sodium etc. Photoperiod and light intensity play a considerable role in modulating physiological metabolism of microgreens.

5. Harvesting: It is the most laborious and time-consuming part that directly affects the production cost. Harvesting is undertaken at first true leaves stage with fully expanded cotyledons having a height of around 5-10 cm. Manual or mechanical cutting a few millimetres above the growing media is carried out for attaining well developed and turgid stems. Mechanical injuries during cutting and handling, temperature abuse, desiccation, compact packing can decline the shelf life of microgreens and therefore, standardized precautionary measures should be considered to avoid maximum damage. After harvesting, immediate washing with chilled water should be to avoid microbial growth via nutrient rich exudates released from cut ends. Time of harvesting is species specific and influences the bioactive composition and shelf life.

6. Commercialization: Due to high consumer acceptance for functional and nutritious, there is an upsurge in the commercialization of wide range of varieties, species and mixtures of microgreens. The cost of production is relatively less and the farmers are able to obtain high returns.

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Puddling Behaviour in Butterflies

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Introduction

Adult Lepidoptera (butterflies and moths) of many species frequently visits moist ground, perspiration, tears, excrements, or animal carcasses to suck water and dissolved nutrients, a behaviour conventionally termed 'mud-puddling'. Although this behaviour is known from temperate-zone as well as tropical habitats, it is far more common in tropical regions. Large numbers of individuals may congregate at puddles, often neatly arrayed in groups of con-specifics or of butterflies of similar external appearance. Use their proboscis to obtain moisture and also other nutrients and salts. Mud-puddling is thought to serve as a means of acquiring essential adult resources, particularly sodium (Adler and Pearson, 1982).

Puddling Sites

1. Mud, dung, fermenting fruit, carrion, urine etc, typically wet soil. But even sweat on human skin may be attractive to butterflies such as species of Halpe.
2. More unusual sources include blood and tears.
3. The key is the chemical make-up of the site: salts, minerals and amino acids that play various roles in their physiology and ecology.

In most lepidopterons, the males pass complex spermatophores to their mates which are used to transfer, besides sperm, various types of nuptial gifts. These gifts may consist of minerals such as sodium or calcium phosphate, they may contain toxic secondary plant metabolites or they contribute nutrients such as amino acids.

Due to the low sodium content of land plants, many terrestrial herbivores, including humans are expected to crave sodium. In part, this behaviour in Lepidoptera appears to have evolved due to a shortage of sodium in the diets of many adults.

Insects with herbaceous diets, such as caterpillars, are often sodium-deficient due to the low levels of sodium ions produced in photosynthetic pathways of terrestrial plants. Among the Lepidoptera with their herbivorous caterpillar stages, mineral reserves assembled during the larval phase may often be limited, and there should be strong selection of strategies to replenish mineral stocks (Arms et al., 1974).

Toxic plant metabolites which serve as pheromone precursors and nuptial gifts by male butterflies are collected through a special, sexually selected behavioural repertoire. Mud puddling might be seen as the analogous case with regard to minerals. This idea is supported by the fact that most individuals engaged in puddling behaviour are males.

Puddling behaviour has probably evolved from the drinking of water, and in dry habitats the need for water may be a prime reason for visiting puddles. In the Californian Checkerspot butterfly *Euphydryas editha bayensis*, puddling only occurred in years of extreme drought.

Sodium gathered by an adult male butterfly while mud-puddling is transferred to his mate in the spermatophores during copulation, which can result in an increase in egg production and sometimes in offspring fitness.

Therefore, mud-puddling not only benefits the male nutritionally, but also the female and in some cases their offspring and sodium, therefore constitutes a nuptial gift from the male to the female. The importance of sodium to Lepidoptera is suggested by the widespread occurrence of receptors for sodium ions on the tarsi of adults of many species.

Conclusion

Sodium and amino acids along with spermatophore are passed by the males to the females during mating enhances reproductive success and enhances the survival rate of the eggs.

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Best Farm Machinery Package to Avoid Burning of Straw

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Summary

In absence of adequate sustainable management practices, approximately 92 metric tons of crops burned every year in India, causing excessive particulate matter emissions and air pollution. Crop residues burning creates soil nutrient losses, destroy soil properties and increases global warming Mechanization is one of the effective sustainable techniques that a help to curtail the issues while retaining the nutrients present in the crops residues in the soil. Capacity building and awareness about farm machinery packages to avoid crop burning residues can help to settle this issue.

Introduction

India accounts for about 2.4% of the world's geographical area and 4.2% of its water resources, but supports about 17.6% of its population which highlights the fact that our natural resources are under strain. The need of providing food grains for the growing population, while sustaining the natural resources base, has emerged as one of our main challenges. Food grains are a major source of the energy and thus vital for food and nutritional security. As such, food grains would continue to be the main pillar of the of food security and out of the various crops grown, rice wheat, and pulses are still part of the staple diet of the most of the rural population. Harvesting of the crops generates large volumes of the residues on and off farm.

According to the Indian Ministry of New and Renewable Energy (MNRE), India generates on an average 500 million ton of crop residues per year (NPMCR, 2019). The same report shows that the majority of this crop residues is in fact used as fodder, fuel for other domestic and industrial purpose. However, there is still a surplus of 140 Mt out of which 92 Mt is burned each year (NPMCR, 2019). The data related to residue generated, residue surplus and burned in Major states are given in table.1. The main Challenges to handle the crop residues are high volume of crop residues, collection & storage, time between harvesting and sowing of two (next) crops, cost effective mechanization, availability of appropriate machinery, utilization of crop residue, and technology up-gradation

This topic is important to the wider audience beyond India for two reasons: First, Crop residues are an important constituent of agricultural waste that can actually be used for the benefit of the society due to its organic composition. The other important reason is that the volume of the crop residue, with unsustainable management practices create high adverse environmental impacts that go far beyond India.

Table.1. Residue generated, residue surplus and burned in Major States:

SN	States	Residue generation	Residue Surplus	Residue Burned
1	Andhra Pradesh	43.89	6.96	2.73
2	Bihar	25.29	5.08	3.19
3	Chhattisgarh	11.25	2.12	0.83
4	Gujarat	28.73	8.90	3.81
5	Hariyana	27.83	11.22	9.08
6	Karnataka	33.94	8.98	5.66
7	Madhya Pradesh	33.18	10.22	6.91
8	Maharashtra	46.45	14.67	7.42
9	Orissa	20.07	3.68	1.34
10	Punjab	50.75	24.83	19.65

11	Rajasthan	29.32	8.52	1.78
12	Tamil Nadu	19.93	7V.05	4.08
13	Uttar Pradesh	59.97	13.53	11.92
14	West Bengal	35.93	4.29	4.96

(Crop residues in metric tonne)

Adverse Effects of Crops Residues Burning

1. Loss of nutrients: According to NPMCR, burning of one tone of rice straw losses 5.5 kg nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides organic carbon.

2. Impact on soil properties: Due to crop burning beneficial soil organism dies and regular practice of crop burning leads complete destruction of beneficial soil organism which reduce nitrogen and carbon in top soil.

3. Emission of green houses and other gases: Crop residue burning emits greenhouse gases. It was estimated that upon burning, Carbon (C) present in rice straw was emitted as CO_2 (70% of carbon present), CO (7%) and CH_4 (0.66%) while 2.09% of Nitrogen (N) in straw was emitted as N_2O.

Farm Machinery Package to Avoid Crop Residue Burning

1. Straw Reaper: Straw reaper (Fig.1) cut and collects the stubbles left behind the field after combine harvesting. Bhusa is collected in an enclosed trailer behind the machine.

Fig.1 Straw reaper

Fig.2 Zero Till seed cum fertilizer drill

Advantages:

a. Recover Wheat straw after combine operation which is used as cattle feed
b. This have a field capacity of 0.4 ha/h or 1-5-2.5 tonnes of bhusa/ha.

2. Zero-Till seed cum fertilizer drill: Though this machine (Fig.2) wheat and other crops is grown without tillage or disturbing the soil in paddy/other crop harvested fields. The zero-till drill is operated in the field when the soil moisture is about 24-27% and the stubble height of previous harvested crop is not more than 150mm-200 mm.

Advantages:

a. The field capacity of the machine is 0.3-0.4 ha/h with about 75% efficiency.
b. It save 50-60% in time and 40-50% saving in cost of sowing wheat as compared to the conventional practice of wheat sowing.
c. The machine saves about Rs 1000-1500/ha.

3. Happy seeder: The happy seeder (Fig.3) is direct drilling of seeds into heavy stubbles, enabling the stubble, to be retained on the surface as mulch. In the machine a rotor unit is attached at the front of seeding unit that cuts & spread straw in between the rows, as mulch.

Advantages:

a. Remove the need to burn rice stubble before planting wheat, therefore reducing air pollution
b. Direct sowing also reduces it to retain more nutrients, moisture and organic content.
c. Saves money as less time is needed on carrying out field operations which in turn reduces fuel and labour costs.

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4. Mulcher Machine: Mulcher Machine (Fig.4) is used for mulching of straws of crops such as rice, maize, sunflower and tobacco residues easily. These machines have knives which are jointed on the rollers, rotates vertically. This machine also sheds the weeds and stocks of rows crops in orchards.

5. Baler: Baler (Fig.5) is used to compress raked residues of rice, wheat, fodders, sugarcane, legumes etc. into compact bales that are easy to handle, transport and store.

Advantages:

a. Crops residues are turned into bales which is used for animal's feedings as well as bio fuels.
b. Creates alternative business for farmers to sell bales to power plants.
c. Save the environment from the air pollution.

		
Fig. 1 Happy Seeder	**Fig. 2 Mulcher**	**Fig. Baler**

Conclusion

Crop burning is hazardous for soil health. To avoid crop burning and its harmful effect there is need of capacity building and awareness for farmers. For capacity building and awareness generation following steps can be followed:

1. Organizing training of farmers for awareness generation through mass and print media.
2. Establishment of custom hiring centres through self-help groups of unemployed youth by providing subsidy.
3. Demonstration of crop residue management technologies.

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Conventional & Biotechnological Approaches to the Crop Adaptation to Climate Change

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Introduction

Climate change is aggravating the challenges faced by the agriculture sector. Climate change is expected to negatively affect both crop and livestock production systems in most regions, although some countries may actually benefit from the changing conditions. Agriculture is also contributing a significant share of the greenhouse gas (GHG) emissions that are causing climate change – 17% directly through agricultural activities and an additional 7% to 14% through changes in land use. Existing technical practices that mitigate GHG emissions underscore the potential of the agriculture sector to be part of the fight against climate change.

Methods for Climate Change Mitigation

1. Conventional Methods.
2. Biotechnological Methods.

Conventional Methods for Climate Change Mitigation

1. Greenhouse gas reduction: Agricultural practices such as deforestation, inorganic fertilizer use and overgrazing currently account for about 25% of greenhouse gases (CO_2, CH_4 and N_2O) emission.

2. Use of environmentally friendly fuels: Production of biofuels, both from traditional crops will help to reduce the adverse effects of CO_2 emission by the transport sector.

3. Less fuel consumptions: Organic farming uses less fuel by the application of compost and mulching techniques which reduce weeds and herbicides spraying due to less ploughing.

4. Carbon sequestration: The capture or uptake of carbon containing substances, in particular carbon dioxide (CO_2), is often called carbon sequestration. Reducing the amount of conventional tillage is one way of enhancing carbon sequestration. By leaving at least 30% of residue on the soil surface, no-till agriculture reduces loss of CO_2 from agricultural systems and may also play a role in reducing water loss through evaporation, increase soil stability and creation of cooler soil microclimate. Conservation practices that help prevent soil erosion, may also sequester soil carbon and enhance methane.

5. Reduced artificial fertilizer use: Reduced fertilizer use also means less nitrogen pollution of ground and surface waters.

6. Bio fertilizers: Organic farming technologies utilizing bio-based fertilizers (composted humus and animal manure), or crop rotation and intercropping with leguminous plants with nitrogen-fixing abilities are some of the conventional biotechnological options for reducing artificial fertilizer use.

7. Biotechnology for increased yield per unit area of land: Utilizing organic residues as a source of nutrients for plants, good agronomical practices such as landscape management, crop rotation or mixed farming, and Use of traditional and indigenous knowledge on non-chemical pests and diseases control are some of conventional options.

8. Adaptation to biotic stresses: Conventional landscape management practices and breeding initiatives have contributed significantly to crop adaptations through the development of strains that are resistant to biotic stresses such as insects, fungi, bacteria and viruses.

Biotechnology for Climate Change Mitigation

1. Various initiatives under the banner of green biotechnology, may offer solution to decrease greenhouse gases and mitigate climate change by giving farmers opportunities to use less and environmentally friendly energy, carbon sequestration and reduce fertilizer usage.

2. Production of biofuels, both from traditional and GMO crops such as sugarcane, oilseed, rapeseed, and jatropha will help to reduce the adverse effects of CO_2 emission by the transport sector.

3. Using modern biotechnology such as GMOs and other related technologies facilitate less fuel usage by decreasing necessity and frequency of spraying and reducing tillage or excluding the tillage practice. For example, insect-resistant GM crops reduce fuel usage and CO_2 production by reducing insecticides application.

4. In modern agricultural practices, genetically modified Roundup Ready TM (herbicide resistant) soybean technology has accounted for up to 95% of no-till area in the United States of America (USA) and Argentina, and led to sequestration of 63,859 million tons of CO_2 (Fawcett and Towery, 2003; Brimner et al., 2004; Kleter et al., 2008).

5. The dependency on agricultural chemicals to sustain productivity in marginal landscapes has led to a global-scale contamination of the environment with toxins that change the course of biogeochemical cycles.

6. Bio fertilizers: Organic farming technologies utilizing bio-based fertilizers (composted humus and animal manure), or crop rotation and intercropping with leguminous plants with nitrogen-fixing abilities are some of the conventional biotechnological options for reducing artificial fertilizer use. In modern biotechnology, the use of mutation or genetic engineering techniques to improve Rhizobium inoculants have resulted to strains with improved nitrogen-fixing characteristics.

Biotechnology for Crop Adaptation

1. Adaptation to biotic stresses: In modern biotechnology, the ability of a soil bacterium (Bacillus thuringiensis, Bt) gene to be transformed into maize, cotton and other crops to impart internal protection against insects significantly contributes to agricultural pest control strategies.

2. Adaptation to abiotic stresses:

a. Abiotic stresses including salinity, drought, extreme temperatures, chemical toxicity and oxidative stress have negative impacts on agriculture and natural status of the environment.

b. Molecular control mechanisms for abiotic stress tolerance are based on activation and regulation of specific stress-related genes. Transgenic plants are engineered based on different stress mechanisms: metabolism, regulatory controls, ion transport, antioxidants and detoxification, late embryogenesis abundance, heat shock processes and heat proteins.

3. Agro ecology and agroforestry:

a. Fungal applications in biotechnology, termed mycobiotechnology, are part of a larger trend toward using living systems to solve environmental problems and restore degraded ecosystems.

b. The sciences of mycoforestry and mycorestoration are part of an emerging field of research and application for regeneration of degraded forest ecosystems.

c. Mycorestoration attempts to use fungi to help repair or restore ecologically harmed habitats.

What should Policymakers do?

1. At the national level: The signals sent by the wider social, economic and environmental policy settings should consistently support sustainable productivity growth in combination with adaptation and mitigation efforts

2. At the sector level: Policies in the agriculture sector should be internally consistent. This requires reforming misaligned and distortive policies which encourage intensification and the overuse of natural resources and potentially damaging inputs. Further investment in research and development on sustainable productivity is also required.

3. At the farmer level: The emphasis should be on targeted initiatives – such as outcome-based farmer incentives and knowledge transfer systems – that enhance farmer capacity to achieve sustainable productivity growth through mitigating and adaptive practices.

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National Nutrition Month During Lockdown: Eat Healthy, Eat Right to Unlock Your Body Potential

Article ID: 32238

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Abstract

From March 2020, the situation of crisis arisen more like unemployment, food unavailability due to transportation and the rate of poverty increases the hidden hunger and different form of malnutrition among the major poor population also affected our lifestyle badly. The National Nutrition Month 2020 during lockdown is all about the right choice and proper diet, hygiene and sanitation and physical involvement in Yoga, Panayam, Arobics, zumba and various other activities for the wellbeing. The intake of green leafy vegetable, green vegetable, fruits, milk and milk product and the millets was highly demanded for immunity boosting response across the country. Many people at this time tried to adopt the idea of farming at home because of viral transmission and some of the citizens started farming at their houses to fulfil their own daily demand of fruits and vegetables. Low Budget Superfood like Fennel seeds, Turmeric, Eggs, Guava, Soya chunks, Yogurt, Fresh chillies, Peanuts are available in Indian Market which are cheap and possible to consume for Citizen's budget along with it the government has made various effort to regulate these principles among societies. USAID helps partner countries reach the poor and underserved to end open defecation, gain first-time or improved access to basic sanitation services, move progressively toward safely managed services, and create hygiene behaviour change that lasts. As the various researches indicated that the mortality rate was found much lower and the rate of recovery is getting higher day by day rather than the other countries like USA, France and Italy by the adoption of tradition herbs and spices with the medical treatment finalized by the Ministry of AYUSH, Government of India. So, through this way, India can become of the leading countries that can export the herbs and spices to fulfil the demands across globe and can exchange the foreign currency. The Physical activity like, Yoga, panayam brings a lot of desirable changes and make person free from metabolic issues and diseases along with that children from the growing age group should give emphasis on daily cycling outdoor games and various kids exercise so that overall growth can not affected poorly and promote whole fitness of the body.

Keywords: COVID, Hidden Hunger, National Nutrition Month, USAID, Ministry of AYUSH, Ayurveda.

Introduction

In India, during pandemic from March, some essential services staffs and personals were working at their place while Most of the citizens are doing work from home as we all have concerned about the serious illness and health issues of COVID 19. The COVID 19 urges emergency call for public awareness and preventive measure so that everyone could prevent their selves from this hazardous infective virus illness. From March 2020, the situation of crisis arisen more like unemployment, food unavailability due to transportation and the rate of poverty increases the hidden hunger and different form of malnutrition among the major poor population also affected our lifestyle badly. If we look on positive outcomes, India is a dynamic country full of an uncountable number of cultures, languages and food habits and during lockdown Prime Minister enforcement on 'BE INDIAN BUY INDIAN' and 'VOCAL FOR THE LOCAL', as many of us working from home, humans made conscious choice now for the consumption of food, another one was India's traditional immunotherapy approach and adopted globally, lockdown brings positive outcomes in changing the air quality also.

The National Nutrition Month 2020 during lockdown is all about the right choice and proper diet, hygiene and sanitation and physical involvement in Yoga, Panayam, Arobics, zumba and various other activities for the well-being. The Nutrition and physical exercise can lead a healthy lifestyle for every age group during whole life at the same time, the most devastating factors is increasing cost of food day by day and unemployment and poverty affects the food consumption of Indian population thus the focus should be on making the right choice of food at low cost and by product should be used to attained the food sustainability also insure the nutrition and overall immune response of the body.

The term "maternal nutrition" focuses attention on the nutritional status of the women as mothers for the bearing and nurturing of children. Maternal and child malnutrition and micronutrient deficiencies affect approximately half of the world's population with the conditions include intrauterine growth restriction (IUGR), low birth weight, protein energy malnutrition, chronic energy deficit of women, and micronutrient deficiencies. The stunted children ratio is much higher in Asia. The four common micronutrient deficiencies include those of iron, iodine, vitamin A, and zinc. (Ahmed et al., 2012) As it is prevailed by the Global hunger index 2018 report, Country India ranks 103rd out of 119 qualifying countries with a score of 31.1, which indicate India suffers from a serious level of hunger. (Global Hunger Index, 2019)

The intake of green leafy vegetable, green vegetable, fruits, milk and milk product and the millets was highly demanded for immunity boosting response across the country. Many people at this time tried to adopt the idea of farming at home because of viral transmission and some of the citizens started farming at their houses to fulfil their own daily demand of fruits and vegetables. So here is an attempt needed to provide knowledge and awareness regarding the low-cost fruits and vegetables which could be included as well as grown in kitchen garden, hygiene and sanitation and suitable cooking methods to be used to preserve the nutrient content in diet are as follows.

Low Budget Superfood Available in Indian Market

1. Fennel seeds: Fennel seeds not only help in digestion but are also packed with iron, phosphorous, calcium, magnesium and zinc

2. Peanuts: peanuts are packed with fibre, v.itamin, niacin, folate, protein and manganese. Eating peanuts twice a week reduces the likeliness of gaining weight and is good for the heart. A handul of peanuts keeps away the cardiac issues.

3. Turmeric: This spice is one of the most effective ways to fight infections. Curcumin, the compound that gives turmeric its canary- yellow colour, is known for its antioxidant and anti-inflammatory properties.

4. Yoghurt: contains good bacteria that help us digest food and keep us healthy. It also contains large amounts of calcium, potassium and vitamin B. It's known for containing a lot of calcium, a mineral necessary for healthy teeth and bones. Just one cup provides 49% of your daily calcium needs. Yogurt provides an impressive amount of proteins. Some types of yogurt contain live bacteria, or probiotics, that were either a part of the starter culture or added after pasteurisation. Consuming yogurt — especially if it contains probiotics — on a regular basis may strengthen your immune system and reduce your likelihood of contracting an illness.

5. Eggs: Eggs are a very good source of inexpensive, high quality protein. Giving young children just one egg a day for six months, alongside a diet with reduced sugar-sweetened foods, may help them achieve a healthy height and prevent stunting. Eggs Are high in cholesterol, but they don't adversely affect blood cholesterol. Eggs are rich in several nutrients that promote heart health such as betaine and choline.

6. Fresh chillies: They are an excellent source of vitamin C, much more than most fruits. If you like spicy food, you are in luck here. For those averse to hot spicy recipes, there are plenty of less "hot" chillies available that can provide the same benefits without the burning sensation. Fresh chillies also boost metabolism. Chilli contains up to seven times the vitamin C level of an orange and has a range of health benefits, including fighting sinus congestion, aiding digestion and helping to relieve migraines and muscle, joint and nerve pain. Chilli has long been used to reduce food micro-contamination and is also considered a potential metabolism booster for weight loss. It may also play a role in treating lung and prostate cancer and leukaemia.

7. Guava: popularly known as Poor's apple. "This humble fruit is extraordinarily rich in vitamin C, lycopene and antioxidants that are beneficial for skin. Guavas are also rich in manganese which helps the body to absorb other key nutrients from the food that we eat. Guavas benefits are credited due to the presence of folate, a mineral which helps promote fertility. The potassium in guavas helps normalise blood pressure levels as well. In fact, a banana and a guava contain almost the same amount of potassium. Since it contains about 80% of water it helps keep your skin hydrated", A 100 gm serving of the fruit contains just 68 calories and 8.92 gm sugar, according to the data of United States Department of Agriculture (USDA). Guavas are also rich in calcium as they contain 18 gm of the mineral per 100 gm of the fruit. It also contains 22 gm of magnesium per 100 gm of the fruit, as well as significant amounts of phosphorus and potassium- 40 and 417 gm per 100 gm, respectively.

8. Sattu: Considered as a staple of Bihar and Jharkhand, sattu is now a global superfood that people have started consuming. Rich in iron, manganese, and magnesium, and low on sodium, sattu provides instant energy and also works as a cooling agent that further keeps the internal organs at ease and has several other health benefits.

9. Moringa: commonly referred as Super plant whose seeds, leaves, stems, flowers, fruits are full of various minerals like calcium, iron, magnesium, potassium which can be used to prevent various forms of malnutrition as well as Anaemia. The stems of moringa plant is used to prepare bakery products to provide protein and minerals.

10. Nutrela Soya chunks: They are commonly known as Poor's meat. Nutrela Soya chunks has 52% Dhaakad Protein - which is the highest source of protein. This is equal to having 16 bowls of cooked daal, 17 boiled eggs, and 18 glasses of cow's milk!

Soya Chunks Nutrition Facts

Serving Size	1 Can
Amount Per Serving	**100g**
Calories 70	
Energy, (Kcal)	345.0
Protein, g	52.0
Fat, g	0.50
Carbohydrates, g	33.0
Crude Fibre, g	1.0
Dietary Fibre, g	13.0
Calcium, mg	350.0
Iron, mg	20.0

Not a significant source of fat calories, saturated fat, trans fat, cholesterol, fibre, vitamin A, vitamin C, calcium and iron. (Source: Nutrela Health).

WASH and COVID 19: Hygiene and Sanitation Awareness Among the Society

Investing in water, sanitation, and hygiene (WASH) is a no-regret policy for developing countries in the fight against COVID-19. Sanitation is more than just toilets, it encompasses the facilities, behaviours, and services that prevent diseases caused by contact with human waste. Hygiene refers to behaviours that can improve cleanliness and lead to good health. Why it Matters. Globally, one in three people lack a hygienic toilet in their homes. In covid times, the hygiene and sanitation of the food product, fruits and vegetables are necessary to prevent infection. The government has made various effort to regulate these principles among societies. USAID helps partner countries reach the poor and underserved to end open defecation, gain first-time or improved access to basic sanitation services, move progressively toward safely managed services, and create hygiene behaviour change that lasts. USAID's sanitation objectives include:

1. Reducing the number of people practicing open defecation.

2. Increasing the number of people with access to basic sanitation facilities.
3. Improving the affordability and availability of sanitation products and services.
4. Increasing the amount of fecal waste effectively captured and treated on-site, or collected, transported, and treated offsite.
5. Improving the ability of educational and health systems to manage sanitation and hygiene facilities in institutions.
6. Increasing the number of people with safely managed sanitation services.
7. Increasing handwashing with soap at critical times.
8. Increasing the rate of safe management of household drinking water.

India's Traditional immunotherapy Approach and Adopted Globally

This was the golden opportunity for the Indians when globally traditional immunotherapy used to treat COVID patient. As the various researches indicated that the mortality rate was found much lower and the rate of recovery is getting higher day by day rather than the other countries like USA, France and Italy by the adoption of tradition herbs and spices with the medical treatment finalized by the Ministry of AYUSH, Government of India. So, through this way, India can become of the leading countries that can export the herbs and spices to fulfil the demands across globe and can exchange the foreign currency. The Physical activity like, Yoga, panayam brings a lot of desirable changes and make person free from metabolic issues and diseases along with that children from the growing age group should give emphasis on daily cycling outdoor games and various kids exercise so that overall growth can not affected poorly and promote whole fitness of the body.

Conclusion

It can be summarized that During COVID times, the regular intake of above listed food and adopting hygiene and sanitation practices with the physical activity like yoga, pranayam the Indian population can lead the healthy life. The Secret of success is primarily depend on the great health and healthy mind and as we are aware about the national Nutriton Mponthe 2020 themes "Eat Right, Bite By Bite" focused on the locally available low cost fruits and vegetables and food grains that every person can eat in his budget and make wiser choice for her families' overall health and wealth besides this every citizen should involve in some entertainment activities to reduce stress, increasing their healthy sleeping times and should be physical active by any kind of exercise, Yoga, pranayam.

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Information and Communication Technology for Water Management in Agriculture

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Introduction

In spite of the global availability of water, and its renewable character, one-fifth of the world's population lives under conditions of water scarcity (Hering and Ingold, 2012). Hence, around 783 million people do not have access to a clean and adequate water supply. Water scarcity become increasingly important topics in global population growth. Due to a general lack of water resources, water is largely the limiting factor for agricultural production and development. Hence, a solution toward these increased threats is the integrated water resources management (IWRM) approach. Without accurate, intensive, and long-term data acquisition and exchange, it becomes difficult to access the state of the world's water resources (Glasglow et al. 2004). The continuous emergence of the information-communication technologies (ICTs), nevertheless, has put new standards in the collection, management, and dissemination of water related data. Information and Communications technologies (ICT) includes all technologies for the manipulation and communication of information. ICT encompasses any medium to record information, technology for broadcasting information and technology for communicating through voice. Some of major ICT interventions include use of websites/portals, use of drones, sensors, GIS based technology and other revolutionary technologies.

Information and Communication Technology Tools in Water Sector

Both water and ICT experts have begun to explore the vast new ICT applications and their impact on the water sector.

Sensors and meters: Meters and sensors are currently being intensively applied to regulate different activities of water distribution systems such as hydraulic pressure and flow, water quality, head losses, and water and energy consumptions. Sensors are used as a basic tool for monitoring the pressure and flow of water, which enable advanced management. Some of the different types of meters and sensors are pressure management sensor, flow sensors, energy consumption sensors, SCADA, water quality sensor and water consumption meter.

Communication Infrastructure: Currently, the water utility networks provide an opportunity to adopt an existing infrastructure into a more flexible IP-based monitoring system. SCADA systems are applied to control geographically distributed resources where centralized data acquisition and control are important to the system operation. The method works using the combination of radio and direct-wired connection systems (Keith et al. 2006). The general packet radio services (GPRS) and global system for mobile communication (GSM) are the common wireless technologies applied to cellular networks to be used as water metering infrastructure.

Information System

In the water sector, information system and knowledge management are recognized as important attributes for efficient and effective water work.

1. Geographic Information System (GIS): GIS is a technology that integrates hardware, software, and data required to capture, manage, analyse, and display all forms of geographically referenced information. GIS allows the user to view, visualize, question, interpret, and understand data in different circumstances that clarify patterns, trends, and relationships in the form of reports, maps, and charts.

2. Enterprise Resource Planning (ERP) Systems: Enterprise resource planning (ERP) systems integrate internal and external management information across an entire organization, embracing finance/accounting, manufacturing, sales and service, customer relationship management, etc. The purpose of ERP is to facilitate the flow of information between all business functions within the organization and to manage the connections to external stakeholders (ERP, 2008).

3. AQUAkNOW Information System: AquaKnow is an active web-based platform for sharing knowledge related to water issues. The platform is intended for practitioners and experts of different institutions involved in the water sector as a space for gathering and providing productive tools to manage technical and scientific information. It also enables to share documents, data and information (such as, news and events), ideas, experiences and to find help and work with other members involved in the water sector (AquaKnow, 2014).

4. EUWI Communication and Information System: The European Union water initiative (EUWI) communication and information system (CIS) is a web-based communication and information system that contains comprehensive information about the water initiative activities.

Some Innovations in Water Management Using ICT

1. Agricultural Drones: Drone technology is a phenomenal innovation that continues to have far-reaching effects across today's society, transforming our lives and the way we do business. Agricultural drones help to achieve and improve what's known as precision agriculture. This approach to farming management is based on observing, measuring, and taking action based on real-time crop. Koparan et al 2012 in USA carried out a study for insitu water quality measurement using unmanned aerial vehicle system. In this study a UAMS i.e unmanned ariel vehicle assisted with water quality measurement system was used. The authors also pointed out the main advantages of ability for conducting measurements in remote and inaccessible waterbodies, and limitations, such as limited flight duration, of this new system.

2. Water Productivity Open-Access Portal (WaPOR): The WaPOR monitors and reports on agriculture water productivity over Africa and the Near East. The database uses satellite data to help farmers achieve more reliable agricultural yields. This tool provides open access to the water database over underlying maps - the tool allows querying of data; time series analyses, area statistics related to water and land use assessments.

3. AQUASTAT: AQUASTAT is the FAO global information system on water resources and agricultural water management. It collects, analyses and provides free access to over 180 variables and indicators by country from 1960. The country can be selected and the required variable for which needed to access information on along with the time period of that and the required information will be provided.

4. Nano Ganesh: Nano Ganesh is an irrigation automation system from Indian company which allows farmers to use mobile phones to remotely control the irrigation pumps located in distant hazardous locations. After installing the Nano Ganesh unit at the pump end, a farmer can switch it on or off with the help of a mobile phone from any distance.

5. ZigBee Technology: Information of technology can be utilized to let farmers be updated continuously about the status of sprinklers. Information from different sensors like temp, humidity, soil sensor is detected and continuously updated on the web page as well as an android app using ZigBee module which a farmer can verify whether the sprinklers are on or off at any given time. ZigBee is a low-cost, low-power, wireless network measure.

6. Variable rate technology saving water for agriculture: For water-saving irrigation, variable rate spray technology (VRST) is defined as "a process of collecting, processing and analysing the data from field and soil with different conditions by using advanced information techniques and equipment's in order to give the instructions to actuator for variable rate application to control the volume of spray nozzles in real-time."

ICTs Challenges

1. Lack of standardization: In spite of the efforts carried out by ITU in this field, there still need for further standardization.

2. Lack of policies: Generally, in most countries there is no coherent multi-sectors and or multi-stakeholder coordinated policy on water management and /or conservation. For those countries, it is needed to have an integrated policy formulation approach.

3. Lack of awareness: Many Countries are not necessary conscious on the role of ITCs can play in water management or of it is usefulness, with little attention on how ICTs can act as an enabler of SWM on large scale

4. Proper ICTs governance: Lack of ICTs governance impacts investments as well as prevents stable coordinated and comprehensive planning to address future requirements and proper integration.

Conclusion

ICT provide reliable real-time information needed for monitoring, measuring, modelling, and managing of water resources. Reliable data leads to better decision making and consequently clearer projection to cope with water scarcity and water stress problems. With the help of crop management using IOT & data analytics farmers can increase their production to meet current socio-economic demand. The integration and implementation of new ICT into the existing implemented water management systems remains one of the most challenging tasks faced by technology and water experts.

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Compatibility of Chemicals, its Utility and Method of Compatibility

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Chemical compatibility measures that how stable a substance is when it gets mixed with another substance. In pest control treatment, two or more pesticides, fungicides or even fertilizers are sprayed or applied in the same operation to minimize cost of labour. Before mixing two different chemicals, their physical and chemical properties should be well understood. Incompatible pesticides should not be mixed. Only compatible pesticides should be mixed. If two substances are mixed together and it undergo a chemical reaction then they are considered as incompatible. Need for tests of compatibility arise when pesticides are combined with insecticides, fungicides, micronutrients for enhanced action or multitude effects. Combination may either prove phytotonic or phytotoxic sometimes. Physical and chemical tests undertaken for testing of insecticide quality and formulation viz.., acidity and alkanity test, emulsion stability test, wettability test, sieve test, bulk density test, suspensibility test etc. are use in testing for the compounds used in the mixture.

The Possible Effects of Mixing Incompatible Chemicals are Many and Include

1. Reduced effectiveness of one or both compounds.
2. Precipitate in the tank, clogging screens and nozzles in the sprayer.
3. Plant phytotoxicity, stunting or reducing seed germination.
4. Excessive residues.
5. Excessive runoff.

Types of Incompatibility

1. Chemical incompatibility: Chemical compounds in the two pesticides react with the another producing a different compound, reducing the pesticidal activity of the pesticides (Degradation of active ingredient). Deactivation of active ingredient due to pH, temperature, pesticide chemistries.

2. Biological incompatibility (Phytotoxic incompatibility): The mixed product exhibit phytotoxic action, which independently is not phytotoxic.

3. Physical incompatibility: The physical form of the pesticides change, and one of them become unstable or hazardous for application. E.g. EC with WP, oil-based surfactant and WP.

Importance

It is required to have a knowledge on the interaction between various chemicals and it is helpful in the formulation and adoption of a sound and effective plant protection program. It can also help to exploit the synergistic and antagonistic interactions between various pesticides for an effective eradication of weed and other pest problems. Nowadays, mixture of chemicals is applied for saving time, labour, money, equipment cost and alteration of plant absorption and translocation as well as metabolism and toxicity at the site of action.

Disadvantages

Negative effects can occur such as reduced pest control, increased damage to non-target plants, phytotoxicity and in compatibility problems. Fungicides are often combined as co-formulations or tank mixes for several reasons. These can be conveniently divided into three categories:

1. Improved disease control: Mixtures can be used to broaden the spectrum of disease control of a product, to combine the specific characteristics of the components of the mixture to increase the effectiveness of the product or to take advantage of additive or synergistic interactions leading to more potent disease control and greater flexibility.

2. Disease control security when resistance is present: Resistance to fungicides can develop rapidly in plant pathogen populations and it is possible that the fungicide user may not be aware of the resistance status of the population to be controlled. The use of a mixture in these cases is better than an alternative strategy as the application programme would be more robust in terms of disease control.

3. Resistance management: When used for resistance management it is necessary for at least two components of the mixture to have activity against the field populations of the target pathogen when used alone. In addition, the activity profiles of these components should be combined in such a way that effective disease management is achieved. There are basically four types of interactions that change the efficacy of chemical combinations and can have responses that are classified as additive, synergistic, antagonistic, and enhancement effects (Srivastava and Dhaliwal, 2010).

Additive Effect

It occurs when mixing two pesticide provide the same response as the combined effects of each material when applied alone. It neither hurt nor enhance each other. Such mixes save time, labour and equipment use. It is equal to the sum of the effects of the components taken independently. Eg. Glyphosate+ Pre-emergence herbicides.

Synergist Effect

Synergism comes from the Greek word “Synergos" meaning working together. It occurs when two pesticide provide a greater response than the added effects of each material when applied separately or it is the result of two or more processes interacting together to produce an effect that is greater than the cumulative effect that those processes produce when used individually. All the synergists appear to work by preventing the detoxification of the pesticides with which they are applied. They may also help in penetration and stabilization of the pesticides.

Eg. Methyl parathion + Carbaryl (1:4), Atrazine + Alachlor (control of weeds in corn) etc. Synergists which prevent detoxification of pesticides are of two types:

1. Analogue Synergists: Which bear a structural resemblance to the pesticide and compete with it for detoxifying the enzyme site. Such synergists have no commercial importance.

2. Microsomal inhibitors: Which inhibit or reduce the activity of microsomal enzyme as a result the rate of detoxification of pesticides is reduced.

Co-Toxicity or Co-Efficient or Synergistic Ratio

The effect of synergist is measured by dividing the LD_{50} value for the pesticide by the LD_{50} value obtained for the pesticide synergist mixture and is known as co-toxicity or synergistic ratio and is expressed by: $LD_{50}I$ / $LD_{50}M$. Where, I am the pesticide and M is mixture of pesticide and synergist. If value is greater than one, synergism occurred. If less than one, then antagonism has occurred.

Antagonistic Effect

When two insecticide applied together produce less control as compared to when applied separately is called antagonism. It may also cause phytotoxicity to plants. Chemical antagonists impede the normal function of a system. They function to invert the effects of other molecules. Eg. When simazine or atrazine is added to glyphosate solution the activity of latter is reduced, Hoelon (diclofop) + Sencor (metribuzin), Parathion + Malathion etc.

Enhancement Effect

It occurs when a pesticide is mixed with an additive to provide a greater response than if you applied the pesticide alone. The effect of a pesticide and non-toxic adjuvant applied in combination on a plant is said to have an enhancement effect if the response is greater than that obtained when the herbicide is used at the same rates without the adjuvant. E.g. mixing ammonium sulphate with glyphosate, adjuvants with pesticides, crop safeners etc.

Assessment of Chemical Interactions (Gupta, 2001)

1. Toxic Unit Approach (Sprague, 1970):

$$\text{Toxic Unit} = \frac{[\text{Toxicant}]}{\text{Toxicity Endpoint}}$$

where [Toxicant] is the observed concentration of the chemical, and "Toxicity Endpoint" is a measurement of endpoint (usually use LC_{50}, expressed in same units as toxicant concentration). Therefore, for a binary chemical mixture of compounds "A" and "B":

Additive-Effect-- TUA + (1-x) TUB = 1
Synergistic-Effect-- TUA + (1-x) TUB > 1
Antagonistic-Effect-- TUA + (1-x) TUB < 1

2. Toxic Interaction Scale (S) (Marking and Dawson, 1975):

Toxic interaction scale is useful for binary mixtures of chemicals. The raw scale is non-linear, and calculated as:

$$S = \frac{LC50(a|b)}{LC50(a)} + \frac{LC50(b|a)}{LC50(b)}$$

where LC_{50} (a) and LC_{50} (b) are the LC_{50} values for chemicals "a" and "b", respectively, LC_{50} (a|b) is the LC_{50} value of chemical "a" in the presence of "b" and LC_{50} (b/a) is the LC_{50}value of chemical "b" in the presence of "a".

S=1-----additive
S<1------synergistic
S > ------antagonistic.

Tank Mixing

A pesticide can be tank mixed if the label does not prohibit its application with other products and the pesticides in the mix must be registered individually on the crop you are treating. In this case the applicator assumes all responsibility for the application.

Mixing Order

Pesticide labels usually provide directions for mixing different materials, often describing the sequence of mixing. Whenever a label provides such directions, you should follow them. In general, follow the W-A-L-E-S plan when adding pesticides to a tank mix:

1. Wettable powders (WP) then Flowables.
2. Agitate and then add adjuvants such as anti-forming compounds, buffers.
3. Liquid and Soluble products.
4. Emulsifiable concentrates (EC).
5. Surfactants.

General Rules for Tank Mixing

1. Fill the spray tank with 1/4 to 3/4 of the water required and turn on the agitation. Leave it on until the tank is emptied. The add any fertilizer or pH adjuster additives.
2. Add any wettable powders, water dispersible granules or flowable liquid suspensions to the tank. Add dry products slowly to prevent clogged return lines. Allow sprayer to agitate for a few minutes before adding the next component.

3. Shake any liquid containers thoroughly before adding.
4. Add any pesticides that are solutions (i.e. amines and salts).
5. Add emulsifiable concentrates (i.e. esters).
6. Add any surfactants or other adjuvants.
7. Use registered rates with tank mixes. Putting a cut rate of pesticide into a tank mix may do more harm than good.

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Importance of Sericulture: Brief Overview

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Introduction

Sericulture is an agro-based industry. It involves rearing of silkworms for the production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. The major activities of sericulture comprise of food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving. Sericulture has important socio-cultural implications (Gopalachar, 1978). Studies have established large scale employment and income generation potential of sericulture. Female labour is quite dominant in all sericultural activities, to an extent of nearly 50%. In the indoor activity of silkworm rearing, women participation is as high as 94.67 % and that except for the peak period the entire sericultural activity is conducted using family labour. Most of the activities in silk production are in the informal sector and menial in nature. Thus about 90% of the employment goes either to the landless or to the marginal farming families that hire out labour, or to the sericulture families. While considering the price spread in the whole industry, it can be seen that 48% of it goes to farming sector.

High Employment Potential

60 lakh persons are engaged in various sericulture activities in the country. It is estimated that sericulture can generate employment @ 11-man days per kg of raw silk production (in on-farm and off-farm activities) throughout the year. This potential is par-excellence and no other industry generates this kind of employment, especially in rural areas, hence, sericulture is used as a tool for rural reconstruction.

Provides Vibrancy to Village Economies

A large chunk of income goes back to the villages from the cities in the following ways:

1. About 57 % of the gross value of silk fabrics flows back to the cocoon growers with share of income to different groups.
2. 56.8 % to cocoon grower.
3. 6.8% to the reeler.
4. 9.1% to the twister.
5. 10.7% to the weaver.
6. 16.6% to the trader.

Low Gestation, High Returns

Estimated investments of Rs.12,000 to 15,000 is sufficient for undertaking mulberry cultivation and silkworm rearing in one acre of irrigated land. Mulberry takes only six months to grow for commencement of silkworm rearing. Mulberry once planted will go on supporting silkworm rearing year after year for 15-20 years depending on inputs and management provided. Five crops can be taken in one year under tropical conditions. By adopting stipulated package of practices, a farmer can attain net income levels up to Rs.30000/acre/annum.

Women Friendly Occupation

Women constitute over 60% of those employed in down-stream activities of sericulture in the country. This is possible because sericulture activities starting from mulberry garden management, leaf harvesting and silkworm rearing is more effectively taken up by the women folk. Even silk reeling industry including weaving is largely supported by them.

Ideal Programme for Weaker Sections of the Society

Sericulture can be practiced even with very low land holding. Acre of mulberry garden and silkworm rearing can support a family of three without hiring labour. Features such as low gestation, high returns make sericulture an ideal programme for weaker sections of the society. Vast tracts of forest based tasar food plantations available in the country, if judiciously exploited for rearing tasar silkworms, can offer supplementary gainful employment for tribals (Dewangan, 2013).

Eco-Friendly Activity

As a perennial crop with good foliage and root-spread, mulberry contributes to soil conservation and provides green cover. Waste from silkworm rearing can be recycled as inputs to garden. Dried mulberry twigs and branches are used as fuel in place of firewood and therefore reduce the pressure on vegetation/forest. Being a labour intensive and predominantly agro-based activity, involvement of smoke-emitting machinery is minimal. Developmental programmes initiated for mulberry plantation are mainly in upland areas where un-used cultivable land is made productive. Mulberry can also be cultivated as intercrop with numerous plantations. Mulberry being a deep-rooted perennial plant can be raised in vacant lands, hill slopes and watershed areas. Currently, only about 0.1 % of the arable land in the country is under mulberry cultivation.

Satisfies Equity Concerns

Benefits of sectoral value-addition primarily accrue to rural households. As the end-product users are mostly from the higher economic groups, the money flows from high end groups to low end groups. Cases of landless families engaged in cocoon production using mulberry contracted from local farmers are common in some states.

Importance of Sericulture

Sericulture is an eco-friendly, agro-based and labour-intensive rural cottage industry subsidiary employment and supplementing the income of rural farmers especially the economically weaker section of the society. Sericulture occupies the place of pride in the rural economy. Sericulture can be practiced even with very low land holding. Low gestation, high returns make sericulture an ideal programme for weaker section of the society. 60 lakh persons are engaged in various sericulture activities in India. Tropical Tasar culture is an agro forestry of growing wild silk insect for unique Vanya silk, which provides livelihood and employment to 2.5 lakh rural aboriginal families of the country.

Sericulture and its Components

There are three main components of sericulture. These are:

1. Cultivation of food plants of the worms.
2. Rearing of silkworm.
3. Reeling and spinning of silk.

Silk Worm – Types

1. Mulberry: The bulk of the commercial silk produced in the world comes from this. Mulberry silk comes from the silkworm, *Bombyx mori* L. This is completely domesticated and reared indoors.

2. Tasar: Tasar (Tussah) is copperish colour. Produced by the silkworm, *Antheraea mylitta.* The rearings are conducted in nature on the trees in the open. This is mainly in Jharkhand, Chattisgarh and Orissa, Maharashtra, West Bengal and A.P.

3. Oak Tasar: Finer variety of tasar generated by the silkworm, *Antheraea proyeli* J. Found in abundance in the sub-Himalayan belt of India covering the states of Manipur, H. P., U. P., Assam, Meghalaya and J & K.

4. Eri: Eri is a multivoltine silk spun from open-ended cocoons. Product of the domesticated silkworm, *Philosamia ricini* that feeds mainly on castor leaves. In India, this culture is practiced mainly in the north-eastern states and Assam. It is also found in Bihar, West Bengal and Orissa.

5. Muga: This golden yellow colour silk is prerogative of India and the pride of Assam state. Obtained from semi-domesticated multivoltine silkworm, *Antheraea assamensis.* Feed on the aromatic leaves of Som and Soalu plants.

Future Prospective of Sericulture

India & H.P offers very rich potential for the development of sericulture because of vast area under forest and agriculture. Unfortunately, this industry has not made any significant progress so far, possibly due to lack of technical know-how and non-adoption of modern sericulture practices.

1. Silkworm Genetic resources: At present there are all four species of silkworm present in India. These are:

a. Mulberry silkworm (*Bombyx mori* L.)
b. Eri silkworm (*Samia cynthia ricini,* Boisduval)
c. Muga silkworm (*Antheraea assama* Westwood)
d. Tasar silkworm (*Antheraea mylitta* D.).

Antheraea proylei J. and *A. pernyi,* GM which have been introduced in H.P. recently for oak tasar culture.

2. Silk Plant resources: Mulberry leaf is the main food of *Bombyx mori*. But there is continuous decrease in the area. Efforts are being made presently to increase the area under mulberry cultivation.

3. Pest and diseases of mulberry: Many insect species act as pest of mulberry in different parts of country (Sharma and Sharma, 1989) and these are Beetles, cutworm, thrips and termites. Among the mulberry diseases, both fungal and bacterial diseases have been reported. There are four major diseases: Pebrine, Flacherie, Grasserie and Muscardine.

These problems are being controlled by adopting different pest and disease management practices (Suriyanarayanan and Tamilselvi, 2007).

4. Sericulture practices: Sericulture management has to be dealt on purely zonal basis. In the temperate zone, winter are severe and summer are pleasant, whereas in plains, summer are severe and winters are pleasant (Anonymous, 1989). Due to extreme climatic conditions in Kinnour and L & S districts, sericulture activities have not established. Two major seasons of silkworm rearing in H.P are Spring and autumn.

Development Strategies

1. Development of Productive silkworm strains.
2. Improvement in Sericulture Management Technologies.
3. Conservation of mulberry and other silk plant resources.
4. Control of pests and diseases of mulberry and silkworm.
5. Checking the Indiscriminate use of pesticides.
6. Solution of marketing problems.
7. Sericulture research and extension.

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Integrated Pest Management in Oats

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Introduction

Damage from field insects is not generally a major factor for oat crops. Mites can be a threat when oats are at the seedling stage and aphids are able to transmit viruses. Damage from other pests can occur if populations builds up easily. Grain insects are not permitted in export or grain for sale, and there is a zero tolerance for insects in export hay. Protecting against field and stored grain pests is therefore critical. Low infestations of certain pests in cereals may stimulate growth and tillers, and actually increase yields (Southwood and Norton, 1973). Pests of oats are either polyphagous (damaging a wide range of plants) or oligophagous (feeding on only a few plant species) and it is very rare, any insect found to be monophagous to oats crop. Some of the major pests attacking oats are presented in table 1.

Table 1. Insect/Nematode pests of Oat:

S.no.	Common name	Scientific name	Family:Order	Part attacked/nature of damage
1.	Army worm	*Mythimna separata*	Noctuidae: Lepidoptera	Leaves seedling, on tender grains
2.	Cut worm	*Agrotis ipsilon*	Noctuidae: Lepidoptera	Young seedling, foliage
3.	Wheat aphid	*Schizaphis graminum*	Aphididae: Homopterans	Nymphs infesting foliage, sucking sap
4.	Plant bugs	*Lecanium viride*	Pentatomidae: Heteroptera	Adults infesting foliage, leaves, ears and grains
5.	Grasshoppers	*Heiroglypus banian*	Acrididae: Orthoptera	Leaves and stem
6.	Oat thrips	*Stenothrips-graminum*	Thripidae: Thysanoptera	Adults and nymphs infesting foliage.
7.	Wire worms	*Agriotes spp.*	Elateridae: Coleoptera	Damaging roots inside soil.
8.	Cock chafers	*Melolantha spp.*	Scarabeidae: Coleoptera	White grubs in soil eating roots, destroying seedling.
9.	Fruit fly	*Oscinella fruit*	Chloropidae: Diptera	Eating stem, popu. On leaves, mostly apical part
10.	Cyst nematodes	*Heterodera specie*	Heteroderidae: Tylenchida	Little popu. found in root rhizosphere

(Lone et. al., 2009)

Integrated Pest Management in Oats

1. Cultural pest control:

a. Use treated seed of improved varieties, resistant to disease/pest.
b. Timely planting/sowing of crops and follow proper crop rotations.
c. Fallowing of field and destruction/burning of old crop debris.
d. Removal of weeds from field boundaries and deep ploughing during summer.

2. Physical and mechanical control:

a. Manual destroying of insect pest eggs, larvae and pupa etc.

b. Pheromone trap is a type of insect trap that uses pheromones to lure insects. Sex pheromones and Aggregating pheromones are the most common types used.

c. Insect light trap is also one of the very effective tools of insect pest management in organic agriculture. The ordinary light trap consists of an electric bulb emitting yellow light as attractant and a funnel to direct lured insects into a container containing water.

3. Biological control:

a. Rearing biological control agents for their field use and conservation of naturally occurring bio-agents such as *Trichogramma* spp., Lady bird beetle and *Chrysopa.*

b. Installation of bird perches @ 15 per hectare for attracting predatory birds.

4. Organic pesticides:

a. Promotion of bio-pesticides such as Neem seed kernel extract @ 5 per cent as alternative to chemical pesticides.

b. Spray of nuclear polyhedrosis virus (NPV) suspension @ 2.5 ml/10 litre of water is recommended for the control of foliage eating *Spodoptera* and *Heliothis* spp. larvae.

c. For the effective management of *Helicoverpa armigera* larvae spraying of *Bacillus thuringiensis* @ 1 kg/ha at flowering stage is recommended.

d. Soil application @ 1.25 kg/ha or seed treatment with 5g/kg of seed of different fodder crops before sowing by bio-fungicide like *Trichoderma viride, Verticillium* sp., *Aspergillus* spp., etc. that attack and suppress the growth of harmful soil borne plant pathogens causing root decay.

5. Chemical control: When above mentioned efforts fail to control pests, recommended chemicals may be used at proper stage.

Disease Management in Oats

Main control measures for rusts: Rust is the most important disease of oat and its control measures are thus explained here. Attempts to breed oat cultivars resistant to crown rust have been frustrated in most countries by the rapid appearance of new virulent races of *Puccinia coronata*, often within a few years of the release of cultivars, with new types of race-specific resistance. According to Federizzi and Stuthman (1998), the rapid breakdown of resistance observed in South America is due to the large population of *P. coronata* maintained in the uredinial stage throughout the year and the large numbers of mutations to virulence that occur annually in the pathogen population.

Table 2. Diseases of Oat

Disease	Causal organism
Crown rust	*Puccinia coronata* f.sp. *avenae*
Stem rust	*Puccinia graminis* f.sp. *avenae*
Pyrenophora leaf blotch	*Pyrenophora chaetomioides*
Scab	*Fusarium graminearum*
Smut	*Ustilago avenae* and *Ustilago*
Barley Yellow Dwarf Virus (BYDV)	Luteovirus
Halo Blight	*Pseudomonas coronafaciens*
Septoria blotch	*Septoria avenae* f.sp. *avenae*
Powdery mildew	*Blumeria graminis* f.sp. *avenae*
Ergot	*Claviceps purpurea*
Cereal cyst nematode	*Heterodera avenae*
Stem nematode	*Ditylenchus dipsaci*

Although a large number of genes for race-specific resistance to crown rust are available to oat breeders, information on occurrence of virulence to these genes in the South American populations of *P. coronata* has been largely lacking. Recently, efforts have been made to search for a more stable, quantitative, non-specific resistance to crown rust, such as the one provided by the A. sativa genotype MN841801 from the University of Minnesota breeding program. There is a much more limited reservoir of resistance to stem rust, but known genes can provide effective and long-term resistance when used in appropriate combinations. In Argentina, the only oat variety currently in use that is resistant to stem rust is the genotype UFRGS-16, bred by the oat breeding programme of the Federal University of Rio Grande do Sul State. Eradication of the alternate Rhamnus and Berberis hosts has been an important factor in reducing crown and stem rust epidemics in areas where these hosts play a major role as sources of inoculum and genetic variability for the pathogen. Berberis now plays a minor role in most of North America. Rhamnus is difficult to control and extensive infestations still remain, particularly in Ontario, Canada (Harder and Haber, 1992). Escape is another important factor in reducing damage by the rusts. This can be achieved by advancing the planting dates or by using early maturing cultivars. Typically, no chemical control is used for crown or stem rusts on oats destined for pasture.

Viral Disease Control

The best control is based on varietal resistance or tolerance. Resistance or tolerance is available in barley and oats. The oat cultivars Bates, Hazel, Noble, Otee and Pierce are resistant to BYD; Don, Lang, Larry, Ogle, Starter and Steele are moderately resistant. Late-planted spring oats in the North Hemisphere and early-planted oats in South America are most susceptible to infection. Younger plants are more attractive to aphids than older ones. To minimize outbreaks, sowing of winter cereals should be delayed until aphid populations decline. Proper sowing date allows the plants to develop when aphid populations are lowest. In addition, seed treatment with insecticides, such as Imidacloprid (for *Schizaphis graminum*) or Thiamethoxam (for *Metopolophium dirhodum*), or both, may contribute to reduce the levels of aphids at early stages of development of the plant (up to 60 days after germination).

Bacterial Disease control

In most temperate regions, specific measures are not usually necessary as little further spread of bacteria occurs with the advent of higher summer temperatures. In circumstances where the disease may cause economic losses, cultural methods, such as use of clean seed and avoidance of infected oat debris, should reduce disease levels. Resistance to halo blight is effective and simply inherited. Thus, it should not be difficult to breed resistant cultivars (Harder and Haber, 1992).

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Agriculture: A Fructuous Ground for Digitization

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Introduction

Agriculture is the backbone of India's economy as it not only provides the food security but makes a large contribution in employment sector, nearly 48 per cent of rural household depends on it (FAO, 2018). 21st century is an era of globalization and information and communication (ICT) revolution, every sector is reaping the benefit of digitization. Digitization can go a long way in helping agriculture to revive from distress by enabling them informed decision making. Digitization is the process of converting information into digital format. Digital agriculture can be defined as 'Information and communication technology (ICT) and data ecosystems to support the development and delivery of timely, targeted (localized) information and services to make farming profitable and sustainable (socially, economically and environmentally) while delivering safe, nutritious and affordable food for all' (FAO, 2018). Digital agriculture is extensively applied in areas of precision agriculture, prescription agriculture and enterprise agriculture.

Digital Agriculture Platforms

1. Precision Agriculture: The use of new tools that give farmers better operational control, e.g., auto-steer, yield monitors, variable rate applicators and planters. These are the hardware and software tools developed over the last two decades for key farming tasks.

2. Prescription Agriculture: Detailed prescription of agronomic practices to maximize yield and profit per acre using computer algorithms

3. Enterprise Agriculture: An integrated computer platform including planning, agronomy, human resource management, work orders, purchasing systems, risk management, inventory management, logistics control, machinery maintenance, marketing, and profit per acre.

Framework of Digital Agriculture

The framework of Digital Agriculture is composed of basic information databases of agriculture, real time (or quasi real time) information collecting system, digital network transmission system, central processing system and digitized agricultural machinery. The various data collection and analysis technologies includes remote sensing, geographic information system (GIS), global positioning system (GPS), sensors, robotics, drones (unmanned aerial vehicles) and internet of things (IoT's).

Application of Digital Technologies in Agriculture

1. Weather forecasting and climate monitoring: Remote sensors and ground-based sensors helps in collecting and predicting the weather and climate. 'Accuweather' and 'Weather channel' are some examples of weather forecasting platforms widely used in agriculture.

2. Land preparation: Laser land levelling which uses tractor and soil movers that are equipped with GPS or laser guided instrumentation provides smoother soil surface, reduction in time and water required to irrigate the field, more uniform distribution of water in the field, more uniform germination and growth of crops, reduction in seed weight, fertilizer, chemicals and fuel used in cultivation, and improved field traffic ability (Asif et. al., 2003).

3. Seed mapping: Highly accurate seed map would allow several automatically controlled field operations such as guidance of vehicles (e.g. parallel to crop rows), guidance of implements or tools (e.g. inter-row and intra-row weeding), application of fluids or granules to individual crop plants and measuring health and growth status of individual plants (Griepentrog et. al., 2005).

4. Crop monitoring and damage assessment: Remote sensing can be used in crop area estimation, crop growth monitoring, and crop yield prediction.

a. Plant phenotyping: Phenotyping allows the measurement of the morphometric and physiological parameters of plants in a rapid, non-destructive, accurate, and high-throughput manner. It can help breeders analyze and screen salt resistance, drought resistance, and insect resistance of different varieties (Sankaran et. al., 2015).

b. Irrigation management: GSM (Global System for Mobile Communication) is used to inform the user about the exact field condition. The information is passed onto the user request in the form of SMS. GSM can be used for irrigation control and the data collected from analysing the different conditions allows the farmer to micromanage the application of water to best address differing soil conditions and vegetation (Kansara et. al., 2015).

c. Crop health monitoring: Remote sensing can be a useful tool to monitor the heterogeneity of crop vigour and could be useful to reduce agrochemical application by aiding decisions on the position, timing, and dose of spray application. VEGSCAPE (vegetation condition explorer) is the satellite-based assessment of plant health across the United States (USDA, 2014).

5. Weed monitoring and management: For weed management, GPS is used for guidance (point guidance and swath guidance), control (variable rate application) and mapping (weed mapping).

6. Yield mapping: Hyper spectral images were acquired using an airborne imaging system from two cotton fields during the 2001 growing season, and yield data were collected from the fields using a cotton yield monitor (Yang et. al., 2004).

7. Soil monitoring: Remote sensing and GIS are useful tools in generating spatial and quantitative information on land degradation status and risk assessment mapping of an area (Abdelrahman et. al., 2015).

8. Flood monitoring: Flooded areas were detected using satellite data and moisture classes in flood plain areas were investigated in relation to water changes, accumulation of sediments and silts for different land-use classes and erosive impacts of floods.

9. Watershed delineation: Watersheds can be delineated in Geographical Information Systems (GIS) by keeping track of flow direction and number of upstream points for each grid point in a digital elevation model (DEM).

Potential of Digital Agriculture in India

1. Digitization of land records: The major components of the programme are computerization of all land records, digitization of maps and integration of textual and spatial data, survey/resurvey and updation of all survey and settlement records, computerization of registration and its integration with the land records maintenance system, development of core GIS and capacity building.

2. Pradhan Mantri Fasal Bima Yojana (PMFBY): PMFBY is aimed at reducing agricultural distress and farmers welfare without having to affect hefty hikes in the minimum support prices (MSP) of agricultural products prices. The status of crop needs to be uploaded in central data base for later claims.

3. Soil Health Card repository and Kissan credit card: Under this programme, the Government Issue soil health cards to farmers to help them get a good harvest by studying the quality of soil. The results and suggestions are displayed in the soil health cards. In order to make the scheme more successful, the Government of India, along with the Agriculture Department of India, has launched a soil health card agriculture portal. Mobile-enabled kissan card system helps the agricultural community engage in cashless transactions. It uses ICT to provide affordable credit for farmers in India.

4. eNAM and easy financial transactions: National Agriculture Market or eNAM is an online trading platform for agricultural commodities in India. The market facilitates farmers, traders and buyers with online trading in commodities. On the eNAM platform, farmers can opt to trade directly on their own through mobile app or through registered commission agents.

Conclusion

The conception of digital agriculture is helpful to determine the current object of agricultural development, and make it possible for relevant departments to make a reasonable development planning of agriculture. Digital agriculture has the potential to make agriculture more productive, more consistent and using time and resources more efficiently. But the approach is still very new, costs are high and the details of the long-term benefits are rarely available. Digitization can help agriculture in making decisions regarding sowing seeds, management of fertilizers and pesticides, farm produce management, better price recognition and better estimation for government. Digitization is necessary for agriculture as it ensures transparency, effective implementation of schemes, curb corrupt practices and "win-win" opportunity for both customers and farmers.

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Carotenoid Biofortification: Understanding the Balance Between Activity, Stability, and Bioavailability

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Introduction

Carotenoids are lipid-soluble pigments. These are responsible for the red, orange, and yellow colours of fruits and flowers. It plays an essential role in photosynthesis and acts as a precursor for the biosynthesis of strigolactones and abscisic acid (ABA). Several carotenoids, including β-carotene, β-cryptoxanthin, and α-carotene, provide provitamin A activity. Apart from provitamin A carotenoids; Non-provitamin A carotenoids are also equally important e.g. Lutein.

Need of Carotenoid Biofortification

1. Majority of developing countries dependent on many staple foods, such as rice, wheat, potato, and white maize, which are low in provitamin A carotenoids. Therefore, Vitamin A deficiency (VAD) is prevalent in these countries.

2. The breeding strategies for carotenoid biofortification are limited to some crops. However, many crop species such as rice do not have the variation in provitamin A content or the genetic diversity required for breeding strategies. Therefore, there is a need for the search of other strategies.

Carotenoid Biofortification Strategies

The strategies for carotenoid biofortification can be applied to three stages as mentioned above.

Synthesis → Storage → Turnover

1. Synthesis:

a. Manipulating biosynthesis genes such as PDS, phytoene desaturase; DXR, 1-deoxy-D-xylulose-5-phosphate reductoisomerase; IPI, Isopentenyl diphosphate isomerize; GGPS, geranylgeranyl diphosphate synthase; ZISO, ζ-carotene isomerase; ZDS, ζ-carotene desaturase; CRTISO, carotenoid isomerase; LYCB, β-lycopene cyclase; LYCE, ε-lycopene cyclase; BCH, β-carotene hydroxylase; CYP97C, carotene ε-hydroxylase; ZEP, zeaxanthin epoxidase; VDE, violaxanthin deepoxidase; NXS, neoxanthin synthase.

b. Manipulating genes deciding turnover such as CCD, carotenoid cleavage dioxygenase; NCED, 9-cis-epoxy carotenoid dioxygenase.

c. Manipulating genes involved in sequestration such as OR, orange.

2. Storage: Carotenoids are often found esterified to fatty acids. This process increases carotenoid sequestration, accumulation, and stability.

3. Turnover:

a. Attenuating the activity of carotenoid cleavage dioxygenases and lipoxygenases, enzymes.

b. Increasing the vitamin E content of crops.

Strategy 1. Targeting the Biosynthetic Genes

The best example is the development of "Golden Rice"

1. Golden Rice: psy gene encoding for phytoene synthase from Daffodil and the crtI gene encoding for carotene/phytoene desaturase from the bacterium, Erwinia uredovora, were introduced in the japonica rice cultivar. 1.6 µg/g total carotenoid accumulation was reported. But it was not enough to combat VAD. (Ye et al., 2000)

2. Golden Rice 1: Further efforts lead to the development of Golden Rice 1 with improved nutritional quality. Syngenta introduced the two transgenes- psy and crtI under the control of an endosperm-specific promoter in the American rice variety Cocodrie and developed Golden Rice 1 (GR1) which accumulates up to 6 µg/g carotenoid in the endosperm. (Al-Babili and Beyer 2005).

3. Golden Rice 2: In 2005 Syngenta developed 'Golden Rice 2' (GR2) by introducing the maize psy gene (which has much higher activity than its daffodil orthologue) along with the bacterial crtI gene into the American rice variety (Paine et al., 2005). It accumulates up to 37 µg/g (9–37 µg/g) total carotenoid which is about 23 times more than the Golden rice.

Strategy 2. Targeting Carotenoid Accumulation

The Orange (OR) gene produces OR protein. OR is a plastid-localized protein and carries a cysteine-rich zinc finger domain, which acts as molecular chaperones and essential for protein binding (Lu et al., 2006). OR proteins reported in Arabidopsis as the posttranscriptional regulators of phytoene synthase and thus having an important regulatory role in carotenoid biosynthesis in plants (Zhou et al., 2014).

Strategy 3. Reducing Carotenoid Degradation

Higher expression of CCD (Carotenoid cleavage dioxygenase) gene was observed in the white petals of chrysanthemums (Ohmiya et al., 2006). Non-CCD mediate cleavage is mediated by lipoxygenases (LOXs) activity reported in wheat by Leenhardt et al., in 2006. LOXs do not act directly on carotenoids, the hyperperoxides produced during intermediate states of peroxidation are responsible for the degradation, termed as cooxidation, of carotenoids. Targeting these genes can be fruitful in the carotenoid biofortification.

Emerging Strategies

1. Increasing Carotenoid bio-accessibility.
2. Esterification: A new target for increasing carotenoid retention.
3. Need to proceed for the combined strategies.

Increasing Carotenoid Bio-Accessibility

In mango, carotenoids are deposited in lipid-dissolved and liquid-crystalline tubular elements of mesocarp chromoplasts. However, papaya chromoplasts also contain lycopene crystalloids. These lycopene crystalloids might better protect the papaya chromoplast against breakdown during digestion due to their ‘‘nutshell-like’’ peripherical coverage. These results show that there is an influence of chromoplast morphology on carotenoid bio-accessibility (Schweiggert et al., 2012).

Esterification: A New Target for Increasing Carotenoid Retention

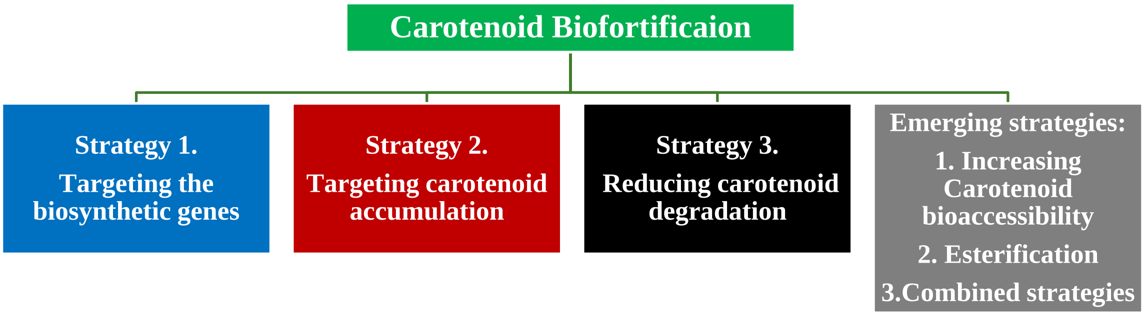
In nature, carotenoids can either be present in their free form or esterified to fatty acids. Esterification influences the chemical properties of a carotenoid by increasing its lipophilicity. This in turn affects how the pigments interact with other molecules, which may influence sequestration, accumulation, and bioavailability.

Need to Proceed for the Combined Strategies

In a recent work by Zeng et al., 2015, the combined strategies were applied for increasing wheat provitamin A by simultaneously overexpressing CrtB and silencing carotenoid hydroxylase (TaHYD).

Conclusion

There are limited examples of combined metabolic strategies to increase carotenoid content. The knowledge of the factors involved in sequestration and decay will help to proceed for combining strategies to yield greater accumulation and retention of carotenoids.



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Phytoremediation

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Introduction

Phytoremediation is a bioremediation process that uses various types of plants to remove, transfer, stabilize, and/or destroy contaminants in the soil and groundwater.

Phytoremediation is use of plants for accumulation, removal or conversion of pollutants. Phytoremediation involves Phytostabilization, Phytovolatilization, Phytostimulation, Phytotransformation and Phytoextraction. An ideal phytoremediator would have: high tolerance to the pollutant; the ability to either degrade or concentrate the contaminant at high levels in the biomass; extensive root systems; the capacity to absorb large amounts of water from the soil; and fast growth rates and high levels of biomass.

There are several different types of phytoremediation mechanisms. These are:

1. Rhizosphere biodegradation: In this process, the plant releases natural substances through its roots, supplying nutrients to microorganisms in the soil. The microorganisms enhance biological degradation.

2. Phyto-stabilization: In this process, chemical compounds produced by the plant immobilize contaminants, rather than degrade them.

3. Phyto-accumulation (also called phyto-extraction): In this process, plant roots sorb the contaminants along with other nutrients and water. The contaminant mass is not destroyed but ends up in the plant shoots and leaves. This method is used primarily for wastes containing metals.

At one demonstration site, water-soluble metals are taken up by plant species selected for their ability to take up large quantities of lead (Pb). The metals are stored in the plant aerial shoots, which are harvested and either smelted for potential metal recycling/recovery or are disposed of as a hazardous waste.

As a general rule, readily bioavailable metals for plant uptake include cadmium, nickel, zinc, arsenic, selenium, and copper. Moderately bioavailable metals are cobalt, manganese, and iron. Lead, chromium, and uranium are not very bioavailable.

Lead can be made much more bioavailable by the addition of chelating agents to soils. Similarly, the availability of uranium and radio-caesium 137 can be enhanced using citric acid and ammonium nitrate, respectively.

4. Hydroponic Systems for Treating Water Streams (Rhizofiltration): Rhizofiltration is similar to phyto-accumulation, but the plants used for cleanup are raised in greenhouses with their roots in water. This system can be used for ex-situ groundwater treatment.

That is, groundwater is pumped to the surface to irrigate these plants. Typically, hydroponic systems utilize an artificial soil medium, such as sand mixed with perlite or vermiculite. As the roots become saturated with contaminants, they are harvested and disposed of.

5. Phyto-volatilization: In this process, plants take up water containing organic contaminants and release the contaminants into the air through their leaves.

6. Phyto-degradation: In this process, plants actually metabolize and destroy contaminants within plant tissues.

7. Hydraulic Control: In this process, trees indirectly remediate by controlling groundwater movement. Trees act as natural pumps when their roots reach down towards the water table and establish a dense root mass that takes up large quantities of water. A poplar tree, for example, pulls out of the ground 30 gallons of water per day, and a cottonwood can absorb up to 350 gallons per day.

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Conclusion

Thus Phyto-remediation is effective, low cost and environmentally friendly technique. Soil also gets clean-up of heavy metals and organic compounds by this technique. Approximately 400 plant species have been classified as hyper accumulators of heavy metals, such as grasses, sunflower, corn, hemp, flax, alfalfa, tobacco, willow, Indian mustard, poplar, water hyacinth, etc. The root exudates of these plants play an important role in phytoremediation as it activates the surrounded microorganisms.

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Submerged Soils- Characteristics and Management

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Introduction

Submerged soils are soils that are saturated with water for a sufficient long time in a year. The soil is intermittently saturated with water, oxidation of organic matter is slow and it accumulates in the in "A" horizon.

In the second horizon Fe and Mn are deposited as rusty mantels or streaks if the diffusion is rapid, they are deposited as concretions.

Characteristic of Submerged Soil

1. Greater amount of soil solution.
2. Reduced oxygen level.
3. Reduced aerobic microbial activity.
4. An altered chemical status of the soil.

Properties of Submerged Soils

1. Physical- O_2 depletion, CO_2 accumulation, compaction – high bulk density, puddling, gaseous exchange and movement of water.
2. Chemical – changes in reduction and transformation process.
3. Electro- chemical – changes in soil pH, Specific conductance, Eh as against normal soils.
4. Biological- Changes in decomposition and mineralization of organic matter.

Nitrogen

1. Mineralization of N restricted to ammonification stage.
2. Ammonification of organic matter also proceeds at a low rate.
3. Intermediate products of decomposition.
4. Methane and organic acids accumulation and incomplete breakdown of carbohydrates.
5. Release of ammonia at much wider C: N ratio (Low N requirement of anaerobic).

Phosphorus

1. The mobility of P is higher (diffusion process gets increased).
2. The P mobility is restricted to the top 30 cm layer of the soil even in submerged conditions.
3. The P fixation is more (fixation/ chemisorption's of P on colloids will be more).
4. At the same time, when the colloidal fractions of P get mineralized, it results in more availability.
5. The solubility of P compounds gets increased due to the presence of CO2 and decrease in Eh.
6. Hydrolysis of P compounds and its solubility of will be more leading to the higher solution P (available P).
7. The mineralization of organic P will be higher.

Potassium

1. Increase in K availability due to Fe^{2+}
2. Release from micas.
3. However the availability of applied K decreases due to the formation of sparingly soluble Fe-K complex.

Sulphur

SO_4^{2-} reduced to H_2S and then to FeS. It has three implications. They are S supply may become insufficient:

a. Zn & Cu may be immobilized.

b. H_2S toxicity may arise in soils low in Fe.

Manganese

In submerged soils:

1. $MnO_2 + 4\ H^+ + 2e^-$ (reduction) $Mn^{2+} + 2H_2O$
2. (Insoluble) (Water soluble, available to plant)
3. The above reaction occurs almost coincident with the disappearance of molecular oxygen and NO_3-N resulting in the formation of manganous compounds.
4. Water soluble and exchangeable ion increases on submergence and ensures a better supply of Mn in flooded soils to rice.

Iron

In waterlogged conditions, Fe^{3+} is reduced to Fe^{2+} with concomitant increase in Fe solubility by anaerobic bacteria, which uses iron oxides as electron acceptors in respiration. It produces toxic effect in rice plants called 'bronzing disease'.

Under anaerobic conditions, owing to the reducing process, hydrous iron oxides give rise to Fe^{2+} according to the following equation.

$Fe(OH)_3 + e^- + 3H^+$ -----> $Fe^{2+} + 3H_2O$.

Zinc

1. Zn deficiency in flooded soils thought to be related to high pH or the presence of $CaCO_3$. However, Zn deficiency also occurs in acid soils.
2. When soils are submerged, the concentration of many nutrients increases, but not Zn.
3. In acid soils, Zn deficiency may be attributed to the increases in pH under reducing conditions and subsequent precipitation of franklinite or sphalerite.
4. However, higher soil pH - poorer the aeration and greater the Zn deficiency.

Management of Water-Logged Soils

1. Levelling of land: Levelling of land in many wetlands removes water by run off.

2. Drainage: Drainage removes excess water from the root zone that is harmful for plant growth. Land can be drained by surface drainage, sub-surface drainage and drainage well methods.

3. Controlled irrigation: Excess use of water in the irrigation results in water-logged area.

4. To check the seepage in the canals and irrigation channels: Due to seepage, land becomes water-logging.

5. Flood control measures: Construction of bunds may check water flow from the rivers to the cultivable lands.

6. Plantation of tree having high transpiration rate: Transpiration rate in certain tree like Eucalyptus, acacia, zyzyphus is very high. In transpiration process the underground water is consumed by trees, thus, lowering the ground water table.

7. Selection of crops and their proper varieties: Certain crops like rice, jute and sesbania can tolerate water-logging upto same extent. In rice crop submergence tolerance varies from one variety to another. Generally, lowland and deep-water varieties.

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Microgreens: Bunch of Nutrients

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Microgreens are vegetable greens do not confuse with sprouts or shoots, which harvested just after the cotyledon leaves have developed possibly with one set of true leaves. They are used as a nutrition supplement, a visual enhancement, and a flavor enhancement for many people focused on improving nutrition. For example, some chefs use microgreens to enhance the attractiveness and taste of food with distinct textures and flavors. Many microgreens combine flavor sensations, such as sweetness and spiciness. Microgreens used in salads, sandwich, soups. They can be used to garnish Italian and Chinese fast food. It can also be suitable material for stuffing parantha. Microgreens are smaller than “baby greens” because they are consumed very soon after sprouting, rather than after the plant have matured to produce multiple leaves. Among upscale grocers, they are now considered a specialty genre of greens, good for garnishing salads, soups, sandwiches, and plates. Edible young greens are produced from various kinds of vegetables, herbs, or other plants. They range in size from 1 to 3 inches (2.5 to 7.6 cm), including the stem and leaves. The stem is cut just above the soil line during harvesting. Microgreens have fully developed cotyledon leaves and usually one pair of very small, partially developed true leaves.

Microgreens are a tiny form of young edible greens produced from various kinds of vegetables, herbs and plants, harvested as seedling which rich in flavour and nutrition. It has three basic parts; a central stem, two cotyledon leaves, and typically the first pair of very young true leaves which are not more than 4 to 14 days old depending on the species. Microgreens firsts became popular in the middle of 1990s in California, USA. However, the word “microgreens” was first documented in 1998. Later it gained popularity among different upscale market and restaurants as new culinary greens.

Microgreens are richer sources of various micronutrient especially vitamins and minerals. Some of the lipophilic vitamins are much higher in microgreens than mature parts. Like vitamin E content of microgreens up to 40 times higher compare to mature parts.

Some of the recent report reveals that some of the micronutrient like is higher in microgreens. It is very interesting that antinutritional factor like nitrate and nitrite content also low in microgreens. In addition to these microgreens are dense sources of various bioactive compounds. Beside this, it can be easily produced using limited input which will be useful for the person especially in urban or peri-urban area where land is often a limiting factor. Furthermore, they can be produced throughout the year since at young stages, generally the seedling does not require any specific weather condition.

Given their short growth cycle, they can be grown without soil and without external inputs like fertilizers and pesticides, around or inside residential areas. Thus, they are practically chemicals free produce. Moreover, they are usually consumed raw; hence there is no loss or degradation of thermolabile micronutrients through food processing.

Varieties of Microgreens

Microgreens can be grown from many different types of seeds. The most popular varieties are produced using seeds from the following plant families:

Brassicaceae family: Cauliflower, broccoli, cabbage, watercress, radish and arugula.
Asteraceae family: Lettuce, endive, chicory and radicchio.
Apiaceae family: Dill, carrot, fennel and celery.
Amaryllidaceae family: Garlic, onion, leek.
Amaranthaceae family: Amaranth, quinoa swiss chard, beet and spinach.
Cucurbitaceae family: Melon, cucumber and squash.

Cereals such as rice, oats, wheat, corn and barley, as well as legumes like chickpeas, beans and lentils, are also sometimes grown into microgreens.

Microgreens are usually harvested at 7−14 days after germination in tropical climate and slightly longer (14-28 days) in cold weather or temperate region with a height of 2.5−7.6 cm (1−3 inch) in height that varies from crop to crop and variety to variety and other environmental conditions. These are cut along with the stem and attached cotyledons/seed leaves with the help of scissor.

If left for longer, they will begin to rapidly elongate and lose color and flavor. At the stage of harvest, sorting and delivery good hygiene practices are important. Harvesters will need gloves and the harvesting equipment such as cutters, containers and other instruments cleansed with proprietary cleanser before and after coming into contact with the microgreens.

In addition to gloves, people coming into contact with the produce should be supplied with washable or disposable clothing and hair/beard nets. This will cut down on the risk of contamination. Microgreens are highly perishable due to their high respiration rate. After harvesting, rapid senescence make it very short shelf life, usually 3 to 5 days at ambient temperature.

Thus, proper post-harvest care is essential. After harvest, microgreens are thoroughly precooled which extend the shelf life. Hydro-cooling could be cheapest methods of pre-cooling for microgreens. After that moisture are removed and produced are packed in plastic container. Modified atmospheric packaging can extend the shelf life. Precautions must be taken to avoid any microbial contamination during hydro-cooling and packaging of microgreens. All packaging, containers need labelling to show where the product came from and when it needs to be used by.

Microgreens gather an immense potential for adapting leafy vegetable production to a micro-scale, for improving nutritional value in human diet and for influencing gastronomical trends. Progress in the understanding of pre-harvest factors affecting their production and quality, and postharvest factors commanding shelf life have been examined in the current review along with challenges lying ahead.

Effective and sustainable, non-chemical treatments for seed surface sterilization and antimicrobial action, pre-sowing treatments and seed pre-germination to standardize and shorten the production cycle, as well as crop-specific information on the interaction of sowing rate or growing media with yield and quality deserve further attention. Future demand for microgreens is unknown. They have been available on the market for about twenty years but have never been available for mainstream consumption.

Microgreens are flavourful and can easily be incorporated into your diet in a variety of ways. They're also generally very nutritious and may even reduce your risk of certain diseases. Given that they're easy to grow at home, they're an especially cost-effective way to boost nutrient intake without having to purchase large quantities of vegetables. As such, they're a worthwhile addition to your diet.

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Ornamental Sunflower: A Potential Cut Flower for Summer Season

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Introduction

Scientifically ornamental sunflower is known as *Helianthus annuus* L. and it belongs to family Asteraceae. Generally, sunflower has been an important field crop for oil production and antioxidants use. With the development of Floriculture, it is gaining importance ornamental plant in garden, as pot plant and cut flower in the floriculture industry due to its beautiful inflorescence. It is also used in flower arrangements and bouquets.

The name *Helianthus* was derived from *helios* (the sun) and *anthos* (a flower). The ornamental sunflower follows the sun by day and always turns towards its direct rays. It is also believed that its name is derived from the shape of flower, which is often used to describe the sun. Due to easy cultivation practices of the crop, short growing cycle and the adaptability of the plant to various climatic conditions, it has become an important ornamental crop in home gardens.

Flower heads comprise two types of florets such as disc and ray florets. The ray florets are arranged around the outer portion of the head and sterile in nature whereas; disc flowers comprise center of the flower head, fertile and do not exhibit petals. The *Helianthus* genus comprises 65 different species of which 14 are annual plants.

Climate

This crop has advantages of short cycle, high profitable, easy propagation and management, high photosynthetic efficiency and adaptability to various environmental conditions. Sunflower is tolerant to both low and high temperatures however, highly tolerant to low temperatures.

Ornamental sunflower may be cultivated in semiarid regions due to tolerance to high temperatures and light. A temperature range of 7-10^{o}C is required for good germination of seeds. Cold (vernalization) does not affect seedlings of sunflower at early germination stage. Seedlings in the cotyledon stage survive at temperatures at -5^{o}C but at later stages chilled temperatures may damage the crop.

Optimum temperature for growth of sunflower plants ranges from 21-25^{o}C, however, a wide range of temperature from 17-35^{o}C exhibited a slight effect on productivity.

Soils

Sunflower can be cultivated to a variety of soils, however, grows best on well-drained, high water-holding capacity soils having nearly neutral pH (pH 6.5-7.5). Loam, silty loam and silty clay loam soils are suitable for sunflower cultivation.

Varieties

Sunflower has wide range of flower colours such as creamy white, mahogany, rusty red, bronze, burgundy and orange, however, brilliant yellow colours are very popular. Double type cultivars such as Teddy Bear produce flowers full of petals with no central disk. Varieties such as Sunbeam and Sunbright used for cut flower production. Other varieties are Greenburst, Moulin Rouge, Double Dandy, Velvet Queen, Ruby Eclipse, Apricot Twist, Peach Passion, Ikarus, Pacino Gold, Teddy Bear, Sunrich Lemon, Moonbright, Valentine, Soraya, Greystripe, Zebulon, Big Smile, Sundance Kid, Sonja, Junior, Prado, Red Shades, Starburst Lemon, Aura, Jade, Ring of Fire, Autumn Beaut, Panache. Sunrich Orange.

Planting

Ornamental sunflower is commercially propagated through seeds. Seeds are either sown directly in main field or transplant to the field. Sowing depth in the seed beds should be 3-10 cm for better germination whereas deep sowing reduces the germination and yield. In silt loam or clay soils, shallow depth is recommended. For dwarf types, plant to plant spacing of 50-60 cm is allowed, while tall type should be planted at 75 cm. Seeds can be sown successfully from January to June for flowering during summer and the rainy season. A light fertilizer application at the time of planting encourages the strong root growth which further protects the plants from blowing over in the wind. Staggered planting over 5-6 weeks is recommended for continuous blooming. The plants initiate flowering within 2-3 months of seed sowing.

Growing Sunflower in Pots

Sow seeds 10-12 cm apart and 1.5 cm deep directly into pots which are filled with well moistened, good quality potting mix. Generally, seeds take 8-10 days for germination. Mature seedlings may be transplanted to larger pots 30-45 cm deep. Seedlings may be sown at 15 cm apart. Keep soil moist and well weeded. Protect seedlings from hungry or nesting birds with netting or plastic berry baskets. Place container in an area with plenty of direct sunlight.

Watering

Drip irrigation is recommended for flower cultivation as it saves water and place the water where it is required. It is considered as drought tolerant due to deep root system which can extract water at a depth of 6 feet. Withholding water may reduce stem length and decrease flower diameter. The amount and frequency of irrigation will vary with weather and maturity of the crop. Insufficient water reduces crop production and quality, whereas a saturated soil reduces growth and promotes development of root rot. In sunflower, 20 days before and 20 days after flowering is the critical period for water stress.

Fertilization

Soil testing for nutrient content before initiating a fertilizer application is very important. The enhanced water requirement of cut flowers leads to more requirement of fertilizers. A fertilizers doses of 60:80:60 and 30:40:30 kg of N, P_2O_5, K_2O/ha along with FYM at the rate 5 t/ha are suggested for hybrids and varieties, respectively. Full dose of Phosphorous and potassium along with 50% Nitrogen as basal application in the seed rows at a depth of 7.5-10.0 cm should be applied and cover it with the FYM before sowing. Rest of the 25% Nitrogen should be applied at button stage and 25% Nitrogen at flowering stage.

Weed Control

Weeds reduce the flower yield and flower quality of sunflower. Weedy field also enhance the time for harvesting and raise labour cost. Hoeing, weeding, top dressing and earthing up should be done at 3-4 weeks and 6-7 weeks stage. Afterwards, apply irrigation. Pre-emergence application of Pendimethalin at the rate of 1.0 kg/ha is effective for controlling weed.

Harvesting

Main stem should be cut just before the flower buds fully opened early in the morning. Harvesting flowers in the middle of the day may lead to wilting of flowers. Periodic harvesting enhances the production of flower heads. Cut the stems diagonally and remove leaves from the bottom half of the stem. Grade the cut stems by stem length and flower size and make bunches as per buyer's specifications. Re-cut stems under water to a uniform length and then store at 12-13° C and 90-95% relative humidity. Market the flowers at the earliest due to 6-10 days vase life. Avoid direct sunlight on the flowers. Maintain the sanitation while handling of cut flowers for reduction of bacterial and fungal growth that block the xylem. Always use clean containers and demineralized water during the harvesting of flowers and post-harvest management.

Pests and Diseases

1. Insect-pests: Sunflower crop is attacked by a number of insect pests at various stages of crop development. Several species of soil dwelling insects attack seeds and seedlings of sunflowers and cause thinning or complete destruction of plants. Common insect-pests are described hereunder.

2. False wireworms: Both adults and larvae attack sunflower. Larvae feed on decaying crop residues in the soil and also feed on newly germinating seeds and the growing tips of seedlings resulting in patchy stands. It can be controlled by clean cultivation practices during summer which dries out topsoil and eradicates weeds that provide food for adults.

3. True wireworms (***Agrypnus*** spp): Larvae make bores into germinating seed and chew on roots and shoots of seedlings which results in reduced vigour or even seedling death. It can be controlled by seed dressing with insecticides.

4. Cutworms (*Agrotis* spp): Larvae attack on stems of young seedlings at or near ground level, hence cause collapsing of the plant. Cutworm infestations can be reduced by controlling weeds before planting.

5. Black scarab beetles/black sunflower scarab (*Pseudoheteronyx* spp.): Larvae feed on tap roots causing wilting and death of seedlings. Adult beetles defoliate and kill plants even up to 40 cm tall. Since *Parthenium* weed is the host for this insect, hence it is advised to remove.

6. Thrips: These are most abundant during a hot and dry spring. Both adults and nymphs feed on the leaves by sucking the sap exuded from tissue. High infestation of thrips causes distortion and browning of cotyledons and leaves.

7. Greenhouse whitefly: (*Trialeurodes vaporariorum*): Nymphs and adults suck sap from tissues and ooze out honeydew. Due to honeydew, a black sooty mould fungus grows on the infested part. Plants lose vigour under heavy infestations. Damage is more under severe moisture stress, causing leaf wilting and failure to set seed.

Disease

1. Alternaria leaf blight (*Alternaria helianthi*)*:* Dark brown lesions surrounded by a yellow halo are present on leaves. On heavy infection, lesions become irregularly shaped and cause blighten leaves resulting in defoliation and plant dies. It can be controlled by pruning out infected leaves, keeping adequate plant spacing to reduce humidity around plants and enhance good air circulation

2.Downy mildew *(Plasmopara halstedi)*: White cottony growth is used to present on undersides of leaf and then become chlorotic. Heavy infection causes stunted plant growth and reduced seed production. Bye use of resistant varieties, treating seeds with suitable fungicide prior to planting may control the disease.

3. Phoma blight (*Phoma macdonaldii*): Large black lesions appear on leaves, stem and flowers. Early infection causes drying of flowers and infected plants die prematurely. Rotate the crop to a non-host crop for a period of 4 years. Use tolerant hybrids.

4. Powdery mildew (*Erysiphe cichoracearum):* Initially white powdery patches appear on lower leaves but later spread to whole plant parts. White patches become gray, then black fungal fruiting bodies become visible. Severely infected leaves turn yellow and dry up. Keep adequate spacing between plants to promote good air circulation around foliage. Plant sunflowers in sunny area. Remove and destroy crop debris after harvest. Spray with foliar fungicides to control the disease.

5. Septoria leaf spot *(Septoria helianthi):* Water-soaked circular or angular spots with a greasy, greenish appearance are present on lower leaves. Use disease free planting material and follow crop rotation for a period of 3 years.

Conclusion

Ornamental sunflower is summer and rainy season annual flower and is used for various purposes such as cut flower, garden plant, suitable for pot purposes. It has huge potential for use in Landscaping of any area during summer season.

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Eastern Rajasthan Canal Project

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Introduction

Rajasthan being the arid region faces an acute shortage of water for drinking and irrigation purposes. The desert state, where water does not lose its scarcity warning tag even in normal monsoon years, has endured droughts 60 times in the past 72 years. The western Rajasthan is already blessed with the pioneering IGNP coming from the Satluj River. While the eastern state still faces water stress problems due to uneven rainfall and non-uniformity of the water resources and distribution facilities.

Why ERCP?

Rajasthan is a state of the large geographical extent with large variations of water resources spatially and temporally. The majority of rivers and streams flow in the monsoon season and remain dry for the rest of the year. The total cultivated area of the state is about 24 million hectares and out of this only 25% of the land is irrigated. Rajasthan farmers have to depend on different sources of irrigation that include tube wells, wells and tanks. Regulation of the water resources is essential for their optimum utilization for various purposes and prevention from the adverse climatic conditions in the region.

Through ERCP, the state govt. intends to formulate a scheme for intra-basin water transfer within the Chambal basin to optimally utilize the surplus water of Kalisindh and Parbati sub-basins. The scheme intends to ensure to fulfill water demands for various purposes and to mitigate drought in water deficit sub-basins of the river catchment area.

About ERCP

This is a long-dreamt project of Rajasthan which got the attention of different ruling governments of the time in the state. ERCP is a project to be executed on the Chambal River and its tributaries Kalisindh, Banas, Parbati etc. The objective of the project is to provide safe drinking and irrigation water to 13 districts of eastern Rajasthan and en-route towns, tanks and villages as well as nearby command area. The project is expected to benefit 40% of the State’s population with the supply of drinking and irrigation water. The project aims to ensure water quality and environmentally sustainable development for the Chambal River basin.

According to the detailed project report of the ERCP, the project is to carry the surplus water of sub-basins of Kunu, Kul, Parvati, Kalisindh and Mej rivers during monsoon to the sub-basins of Banas, Morel, Banganga, Gambhir, and Parbati rivers.

The purpose is to develop irrigation water supplies to about 10 Lakh ha culturable command area by 2051 spread over 13 districts viz. Alwar, Bharatpur, Dholpur, Karauli, Sawai Madhopur, Dausa, Jaipur, Ajmer, Tonk, Bundi, Kota, Baran and Jhalawar to improve the irrigation system by supplementing limited and erratic rainfall. Spread over a length of about 1000 Km, the project is to be completed in three phases keeping the area facing maximum water stress in the first phase. The state has surface water availability of about 10000 MCM at 50% dependability. Under the present project, it is proposed to utilize about 5000 MCM. The provision of more than 600 MCM for future industrial demands will propel industrial development in this area.

The project includes the identification of the required structures to be constructed across sub-basins of the Chambal River and suggestions for water diversion routs from water surplus to water deficit sub-basins. It will also supply water to the Delhi-Mumbai Industrial Corridor and take care of the flood and drought situation in the area. It will facilitate the restoration of the dependable yield of the existing 26 major and medium irrigation projects.

Expected Benefits

1. Increasing availability and reliability of water supplies.
2. Improving water use efficiency.
3. Eliminating unsustainable land-use practices.
4. Expanding the irrigated command area.
5. Improving health and living condition.
6. Increasing sustainable agricultural production.
7. Improving the reliability of water supply scheme.
8. Increase in Employment.
9. Reduction of migration of rural people.

Salient Features of the Project

1. The maximum Discharge of the feeder is expected to be 830 Cumecs with a Power Requirement of 2178 MW.
2. 6 barrages, 1 dam, and a network of water conductor systems are proposed to be constructed in the project.
3. The conventional B-C Ratio as per CWC guidelines is to be 1.16.

Recent Update

The cost of water delivery is growing up in Rajasthan due to dispersed human habitations and there are limited financial resources to provide water to every segment of society. Moreover, the Centre has given a national status to drinking water and irrigation projects in 16 areas in the past. But no multipurpose irrigation water project in Rajasthan has received this status. So, the government of Rajasthan has urged the center to declare the ERCP a national venture to ensure its early implementation.

Conclusion

ERCP is a river interlinking project to be implemented in the Chambal river basin connecting its tributaries for optimum utilization of resources. If implemented successfully, ERCP will benefit 13 districts of the state by providing water for irrigation drinking and other purposes by 2051. The project is proposed to be an umbrella scheme carrying other existing schemes together for the sustainable development of the region.

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Post-Harvest Technology in Horticultural Crops

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Fresh horticultural crops are diverse in morphological structure, composition, and general physiology. Thus, commodity requirements and recommendations for maximum postharvest technology life vary among the commodities. All fresh horticultural crops are high in water content and are subject to desiccation and mechanical injury. They are also susceptible to attack by bacteria and fungi, with pathological breakdown and biological deterioration. The rate of biological deterioration depends on several environmental factors, including temperature, relative humidity, air velocity, and atmospheric composition and sanitation procedures. Fresh fruits and vegetables play a very significant role in human nutrition, especially as sources of vitamins, minerals, and dietary fibre. Postharvest losses in nutritional quality, particularly Vitamin C content, can be substantial and are enhanced by physical damage, extended storage duration, high temperatures, low relative humidity, and chilling injury of chilling-sensitive commodities. Here are some points to give a brief about post-harvest technology.

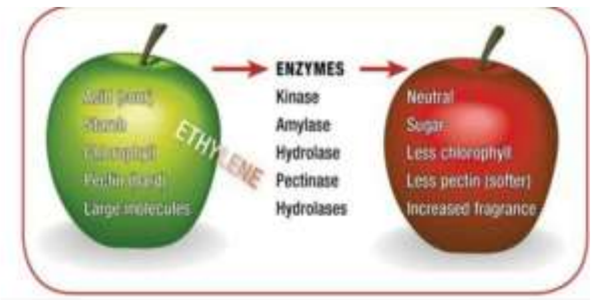
Importance of Post-Harvest Technology in Horticultural Crops

1. Fruits and vegetables are important supplement to the human diet, as they provide essential minerals, vitamins and fibres (roughage) required for maintaining health.
2. Improper harvesting, handling, transportation and distribution of fruits and vegetables result in the significant losses which cause ultimately economic loss.
3. It is estimated that total loss of vegetables and fruits in India due to inadequate post-harvest handling transportation and storage at less 20-25%.
4. Fruits and vegetables (excluding potato) processing industries uses only 2.0% of the total production.
5. After production and before consumption to prevent all types of food materials and their qualitative and quantitative losses and to prepare food for immediate or future use, some processing, prevention and storage practices are required.

Scope of Fruits and Vegetables Preservation in India

1. To avoid the post-harvest loss and to increase substantial returns to processors for off season consumption.
2. Availability of cheap labour, Government Subsidy for cold storage and processing units, convenience of roads in case for marketing and transport.
3. Availability of cans, bottles, and other equipment's at cheap rate, there is tremendous for export of processed products like Jam, jelly, marmalade, pickles, etc. dehydrated and dried vegetables in addition to domestic demand in India.
4. Processing improve the nutritional quality and digestibility of some food, add variety and taste to diet.

Fruit Maturity



Packaging of Fruits and Vegetables

1. Properly designed containers for transporting and marketing of vegetables can reduce their losses and maintain their freshness succulence and quality for longer period.
2. Packaging also provides protection from mechanical damage and undesirable physiological changes and pathological deterioration during storage, transportation and marketing.
3. Polythene films, paper boars, and boxes lived with polythene and other materials can effectively prolong the shelf life of vegetables.
4. Polythene packaging, provides modified atmosphere and consequently reduces decay, softening, and loss of solids. The thickness and permeability to CO2, O2 and water vapour of films needs to be standardized for each vegetable.
5. Wooden boxes, baskets woven from bamboo or trees, hessian sack, earthen pots and Coregulated Fibre Board (CFB) boxes are important package forms used in transportation and distribution of fruits in most of the developing countries.

Importance of Fruits and Vegetables Preservation in India

1. India is next to Brazil in fruits and next to China in vegetables.
2. Perishable in nature 35 to 40% losses due to deterioration. Therefore, preserve them for storage. The total estimated annual production is 70 million tonnes.
3. Due to inadequate facilities for processing nearly 35 to 40% produce of the total production is wasted amounting to Rs. 3000 crores annually.
4. Fruits and vegetables have immense food value in Vitamins and minerals which are main source of nourishment and body building.
5. Storage of food material in perfect consumable condition for a longer time without undergoing any spoilage is an important necessity.
6. Due to heavy glut in the market fruits and vegetables get spoiled due to lack of storage facilities.
7. India is an ideal country that all the important fruits and vegetables can be produced due to varied soils of climatic conditions.
8. Fruits and vegetables are cheap in the season and wasted due to spoilage at greater extent. Losses also occur due to improper handling transportation and lack of processing and preservation units.
9. By using various methods shelf –life of fruits and vegetables can be extended and used as material for processing units.

Methods of Preservation of Fruits and Vegetables

1. Temporary Preservation.
2. Permanent Preservation.

Temporary Preservation of Fruits and Vegetables

The products prepared by this method can be retained from a few days to a month because the spoiling organisms are partially killed or their growth is inhibited for a short period.

1. Asepsis or Absence of Infection: Cleanliness while picking, grading, packing, and transportation of raw material increases the keeping quality of fruits and vegetables. Washing or wiping of the fruit and vegetables before using in manufacture.

2. Exclusion of Moisture: Save the product from moisture and should be stored in a dry atmosphere.

3. Mild Antiseptics: Light sugar syrup is used in canning of fruits which retains the colour, flavour, and shape of the fruit products. Vinegar and spices check the spoilage of tomato sauce for few weeks after opening of the bottle.

4. Pasteurization: The product is subjected to a temperature that kills many microorganisms, but not all. The heat not only kills many organisms but greatly weakens and delays the development of those not killed. Used for fruit juices so, all the microorganism which can grow in liquid are killed by heat.

Permanent Preservation of Fruit and Vegetable

The principle used in permanent preservation is to eliminate complete or to prevent the activities of the organisms capable for destroying the product.

1. Sterilization or Processing:

a. Fruits which are naturally acidic and the more acid vegetables like tomatoes could be satisfactory preserved at boiling water temperature 100 0C for 30 minutes.

b. Vegetable products require high temperature to kill the spore farming organisms being not acidic and containing more starch than sugar. Continuous heating for 30 – 90 minutes at 240 0F is essential for their sterilization.

2. Preservation by Antiseptics: Food may be preserved permanently by addition of antiseptics like sugar, salt and vinegar and chemicals in sufficient concentration to prevent the growth of microorganisms either by osmosis or by poison or by both.

3. Sugar and Salt: If the concentration of sugar in the preserved material is increased about 66 %, Ex. Jellies, Preserves etc. A brine solution of 10 to 15 % is sufficient for permanent preservation of most of the products. Ex. Pickles and Canned Vegetables

4. Vinegar: A solution of about 2% of acetic acid prevents most of the products from spoilage. Ex. Pickles, Sauces.

Conclusion

Procedures for increasing food security by reducing postharvest losses and waste include use of Cultivars with longer postharvest life, use of an integrated crop management system that maximizes yield and quality, and use of proper harvesting and postharvest handling procedures to maintain quality and safety of horticultural crops and their products.

The postharvest handling systems for fresh produce begin with harvesting and involve preparation for fresh market or for processing, cooling, transportation, storage, and handling at destination. In all these steps, proper procedures for providing the optimum ranges of temperature and relative humidity are essential for maintaining produce quality and safety and for minimizing postharvest losses between production and consumption sites.

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Renewable Energy Technologies and Opportunities for Rural Youth in India

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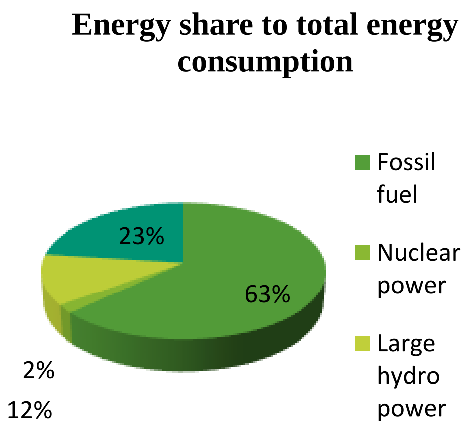
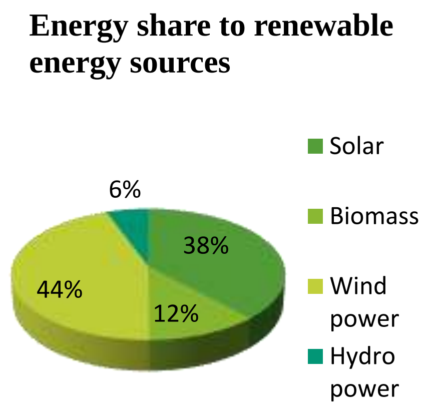
Abstract
An ever-growing population means an ever-growing requirement for energy. Sensibility to the undeniable fact that non-renewable sources are eventually depleting, the importance of renewable sources cannot be underestimated. To reach the requirement of energy, India requires 3–4 times more energy than the energy consumed every day, which paves a way towards exploitation of substitute sources of non-conventional energy sources and is inevitable. Today, renewable accounts for about 33% of India's primary energy consumptions. This article discloses about the major technical and commercial developments in renewable sector in our country and relevant government Policies and programmes on renewable energy which provides a platform for rural youth to adopt the present-day developing technologies which are feasible and energy efficient.

Introduction
Energy is the primary and most universal measure of all kinds of work by human beings and nature and being the indispensable input in all sectors of our country's economy. The energy requirement of any country is signified by per capita energy consumption, for India it is 150 kWh and it consumes only 1 % of total energy consumed in the world. (G. D. Rai, 2017).

These available sources of energy are grouped into three major types:
1. Primary energy sources: primary energy sources are the sources which furnish full supply of energy with high energy yield ratio. Even though these primary sources accelerate the growth but limited their supply.
2. Secondary energy sources: are these which produce no net energy.
3. Supplementary sources: are these which yield zero net energy but this consuming highest energy input for energy insulation. Coal natural gas, oil and nuclear energy are the primary sources of energy which yield net energy using breeder reactor. Solar energy, wind energy, water energy etc belong to Secondary sources.





Present day, each and every country withdraws its energy requisite from a variety of sources which are broadly categorized as commercial and non-commercial sources. The commercial sources include the fossil fuel (coal, oil and natural gas), hydroelectric power and nuclear power. While the non- commercial sources include wood, animal waste and agricultural waste. The exhaustion of natural resources and the accelerated demand of conventional energy have forced planners and policy makers to look for alternate sources.

Renewable energy supplies 22 % of the world's final energy consumption, counting traditional biomass, hydropower, and ''new'' renewable (wind, solar, geothermal, and bio fuels). The promising prospect for the future is adoptability of non-conventional energy resources is as a substitute to conventional energy. Hence, an attempt has been made through this paper to presents the information about the major technical and commercial developments in this sector in our country.

Renewable Energy in India

The population of India is more than 1028 million and is growing immensely at an annual rate of 1.58%. As fossil fuel energy becomes scarcer, it is inevitable to face energy shortages significantly due to increase in its cost and energy insecurity within the next few decades. India is determined to becoming one of the world's leading clean energy producers. The Government of India has already made various provisions, and entrenched many agencies that will help it to reach its goal. The country has an entrenched renewable energy potential of around 85,000 MW from commercially exploitable sources, i.e., wind, 45,000 MW; small hydro, 15,000 MW and biomass/bio energy, 25,000 MW. In addition, India has the potential to generate electricity using photovoltaic cells. (Ashwini et al, 2010)

1. Solar energy: it is the vital power source with the potential of 178 billion which is about 20,000 times the world's demand. The solar power where sun hits atmosphere is 1017 watts, whereas the solar power on earth is 1016 watts. The total world-wide power demand is 1013 watts. The sun provides us 1000 times more power than it is required. If we use only 5 % of this energy, it will be 50 times what the world is in need of. The energy radiated by the sun on a bright sunny day is approximately 1 kW/m2. As India lies in a temperature climate of the region of the world, where sun light in abundant for a major part of the year. It is necessitated to plan for proper utilization of solar energy.

The applications of solar energy as follows:

a. Heating and cooling of residential building
b. Solar water heater
c. Solar drying of agricultural and animal products
d. Solar distillation on a small community scale
e. Salt production by evaporation of seawater or inland brines
f. Solar cookers
g. Solar furnaces
h. Solar photovoltaic cells etc.

2.Wind energy: it is used for power generation and pumping of the water. About 0.7 million wind pumps are in operation in different countries. A minimum wind speed of 3m/s is needed. Potential in India is estimated between 20,000 and 25,000 MW. The maximum power generated from any single unit is about 1MW. The energy available in the winds over the earth's surface is estimated to be 1.6 × 107 MW which is of the same order of magnitude as the present energy consumption on the earth. Wind energy which is the indirect source of solar energy conversion can be utilized to run wind mill, which in turn drives a generator to produce mechanical power, such as for water pumping. In India generally wind speeds obtainable are in the lower ranges. The developments are being mainly concentrated on water pumping wind mills suitable for operation in the wind speed of 8 to 36 km per hour.

3. Biomass energy: The potential for application of biomass as alternative sources of energy in India is very great. We have plenty of agricultural and forest resources for production of biomass. Biomass is produced in nature through photosynthesis achieved by solar energy conservation. The biomass is used directly by burning or is further processed to produce more convenient liquid and gaseous fuels.

Biomass resources fall into three categories:

a. Biomass in its traditional solid mass (wood and agricultural residue)
b. Biomass in its non-traditional form converted into liquid forms.
c. Ferment the biomass anaerobically to obtain a gaseous fuel called biogas.

The production of biogas is of particular significant for India because of its large cattle production as the main source of biogas production is wet dung. The total cattle production the country is about 250 million. Some other sources of biogas are sewage, crop residue, vegetable waste, water hyacinth, poultry droppings, pig manure, algae and ocean kelp. In rural sector biogas finds great applications in cooking, lighting, mechanical power and generation of small electricity. Biogas can be used solely or with diesel engine in I.C. engines, for production of power. During seventh plan period more than 7.3 lakh families based on biogas plants were installed.

Future of Renewable Energy in India

India, faced with twin challenges on energy and environmental front, has no option but to work towards increasing the role of renewable in the future energy systems. Renewable energy technologies vary widely in their technological maturity and commercial status. In India, renewable energy is at the take-off stage and businesses, industry, government and customers have a several issues to address before these technologies could make a real penetration. India bearing with massive renewable energy resources (solar PV, wind, solar heating, small hydro and biomass) is to set to have large-scale development and deployment of renewable energy projects. India would also have to look for international cooperation in renewable energy through well defined R&D projects with proper division of labour and responsibilities for specific tasks with equitable financial burden and credit sharing arrangements. Renewable energy development is considered in India to be of great importance from the point of view of long-term energy supply security, environmental benefit sand climate change mitigation. A number of government and private organizations such as MNRE, Centre for Wind Energy Technology, Universities, IITs, NITs, Indian Oil Corporation Ltd. (IOCL) and The Energy Resource Institute (TERI) are involved in R&D of renewable energy sources.

Conclusion

Energy security, economic growth and environment protection are the national energy policy drivers of any country of the world. The increased prices of crude oil boosted up the efforts for further evolution and advancement of renewable energy sources. A censorious part of the solution to the problem lies in encouraging renewable energy technologies as a response to concern about security of energy, economic growth against rising energy prices, competitiveness, health costs and environmental degradation. The focus has to be increased towards the deployment of renewable power which accounts for around 5% in the electricity-mix by 2032. Finally, renewable energy provides enormous benefits and can contribute significantly in the national energy mix at least economic, environmental and social costs and it is expected that the share of renewable energy in the total generation capacity will increase in future.

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Ethnobotanical Medicinal Uses of Kalmegh *(Andrographis paniculata)*

Article ID: 32252

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Introduction

Kalmegh is a commonly known plant of India and has been used in the Indian system of medicine since time immemorial. It is also known of the king as bitters' & chiretta. The fresh and dried leaves of this plant and juice extracted from the herb are official drugs in Indian pharmacopeia. Sometimes, it is substituted for Swertia chirata for its bitter principles. The whole plant is the source of various diterpenoids, of which the bitter water-soluble lactose Andrographolide is important and is distributed in all the plant parts in various proportions.

Vernacular Names

Sanskrit: Bhunimbah, Kirta, Hindi: Kalmegh Gujrati: Kariyatu, Marathi: Olikiryata, Oriya: Bhuinimba, Bengali: Kalmegh, Telgu: Neelaveemu, Malyalam: Kiriyattu, Nelaveppu, Kannad: Nelaberuvayahullu, Tamil: Nilavemba, English: King of Bitters, Chiretta, Trade: Kalmegh.

Botanical Description

Kalmegh is an annual erect herb with 1.0-meter height. The branches are sharp; quadrangular, often narrowly winged towards the apical region. The leaves are petiolate; lanceolate; oblong alternate at both ends, glabrous and acute. The flowers are small, solitary, in panicles with a rose- coloured corolla which is hairy externally. The seeds are numerous, yellowish-brown and glabrous.

Varieties

AK-1 (Anand Kalmegh -1), CIM-Megha, KI-5, IC-111286, IC-111287I, C-111289.

Habit and Habitats

The herb grows abundantly in wild as are under a shrub in the tropical moist, deciduous forest. It is distributed in the plains throughout India and Srilanka. In India, it is found in Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh and West Bengal.

Agrotechnology

Soil and climate: Kalmegh are a hardy plant and can easily be grown on a variety of soils from clay to sandy loam but sandy loam soil rich in organic matter is good for its growth, development and yield. It is a tropical and subtropical crop and prefers cooler climates, moist, shady places with well-distributed rainfall.

Soil preparation: The soil is prepared by repeated ploughing and planking and brought to a fine tilth. The soil is mixed with FYM @ 25 t/ha at the time of the last ploughing. The field is laid out in plots of convenient size along with irrigation channels for easy management.

Mode of propagation: Kalmegh can be propagated by seeds.

Direct sowing: In the well-prepared field the furrows are mode at a distance of 30 cm and about 3-4 seeds are sown in each spot maintaining a distance of 15 cm between two plants. 3-4 kg seeds are required for direct sowing in a hectare field.

Nursery raising: The seeds are sown on nursery beds of 3×1.5× 0.15m size filled with a mixture of soil, sand and farmyard manure in equal proportion. The best season for sowing is during the month, May and June. About 400-500 g seeds are required for raising nursery to Transplant in a one-hectare field area. The seeds germinate in about 8-10 days and the seedling will ready for transplanting in 45-50 days.

Transplanting: The seedlings are transplanted at a spacing of 30×30 and 30×45 cm in the main field. The 15th June to 15th July is the best time for transplanting.

Manures and fertilizers: The FYM@ 25t/ha shall be mixed well into the soil at the time of the last ploughing is recommended. A fertilizer dose of 20:30:20 kg N: P_2O_5: K_2O is required for a crop of one hectare. Of this 50% nitrogen and the entire dose of phosphorus and potash is given as basal dose and the remaining 50% nitrogen is applied as topdressing 30 days after sowing /transplanting.

Irrigation: Kalmegh grows as a *Kharif* crop and needs no irrigation in the areas with well-distributed rainfall however, in the case of long dry spells the crop is irrigated initially at 3-4 days interval and later on it is increased to one week depending as the local weather conditions.

Intercultural operations: It is a small herbaceous herb. The field should keep weed-free during initial crop growth stages. The first weeding is done after about one month of planting. After this one or two weedings are recommended after 60 days of sowing or transplanting to keep the weeds under control.

Pest and Diseases: Being a hardy crop no attack of pest and disease are reported.

Harvesting: The Kalmegh crop is ready for harvest after about 3 to 4 months after sowing when the plants start flowering, at this stage, the plants are harvested by cutting the plants at the base; leaving about 10-15 cm of the stem for regeneration. The regenerated plants are ready for harvest in about 60 days of the previous harvest 2 to 3 harvests can be made in a year. At the flower initiation, active principle andrographilide is high in the leaves. After harvesting the plants are dried in shade for, 3-4 days before storages.

Chemical Constituents: The Kalmegh leaves contain diterpene lactose Andrographolide (about 2.5%) and stem (2.0%) Besides; the plants are also an important source of flavonoids, Sesquiterpene, Phenyle propanoids. The roots contain the flavonoids, andrographin, panicotin, aplegenin-4', 7- dimethylether, mono-o-methyl wightin and hydroxy-7, 8, 2, 3, - trimethoxy flavone and betasitosterol.

Medicinal Uses: Kalmegh has several Medicinal Properties like Antibacterial, Antifungal, Antiviral, antipyretic, adaptogenic, anti-inflammatory, improves immunity, liver protecting, caraminative, diuretic, gastric and liver tonic, choleretic, hypoglycaemic, hypochlolesterolemic, Bitter tonic, blood purifying etc. Kalmegh is one of the most important herbs that are a **"Sarvaroganivarani"** meaning cure for all diseases.

a. The Kalmegh forms the principal ingredient of household medicine called 'Alui', extensively used in west Bengal for general debility and certain forms of dyspepsia amongst adults and infants.

b. The expressed juice of the leaves as prescribed with cardamon; cloves and cinnamon in the form of globules to infants for relief from bowel complaints, irregular stools and loss of appetite.

c. Kalmegh is also considered as highly efficacious against malaria, snake bite; The hot water extract of the whole plant is used for acute jaundice, fever, dysentery, and stomach worm.

d. Kalmegh decreases blood sugar levels and is excellent for treating diabetic patients.

e. Kalmegh prevents cancer cells from forming and it is a powerful cancer preventive medicine.

f. Kalmegh has got anti-inflammatory properties making it ideal for treating arthritis and gout.

g. It has a blood purifying property. It removes toxins from the blood and helps in the treatment of skin diseases.

h. The fresh leaf juice along with leaf juice of *Azadiracta indica* and *Tinospora cordi folia* are used to cure cholera.

i. The roots are used as antipyretic, alternative and cholagogue agents. The common ayurvedic drugs are 'Kalmeghasava' and Kalmeghana mayas Haub' the main constituents of which are *Andrographis paniculata* besides Trikatu (Viz. *Piper longum*, *P. nigrum* and *Zingiber officinalis*) *Cyperus scariosus*, *Triphala, Embellia ribes, Plumbago Zelynica* and lauh Bhasm (organometallic salt of iron).

Used as insect control in agriculture: The crude leaf extracts of Kalmegh used against for the control of leaf-eating caterpillars, borers, sucking pests and beetles in vegetables and other crops.

Conclusion

Kalmegh is native of India which contains several medicinal properties used to cure various diseases like leprosy, paralysis, rheumatism, diabetes, debility etc. Also, it is used for insect pest control in agricultural and horticultural crops. Because of its over-exploitation for medicinal use, its population continues to decline in nature. So, it needs to conserve for future use.

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Mechanization in Agriculture

Article ID: 32253

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Abstract

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.

With the global population project 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 or world's ever-increasing population.

Introduction

Farm automation, often associated with "smart farming", is technology that makes farms more efficient and automates the crop or livestock production cycle .It involves the integration of advanced technologies into existing farming practices in order to increase the production efficiency and quality of agricultural products. As an added benefit, they also improve the quality of life for farm workers by reducing heavy labour and tedious tasks.

An increasing number of companies are working on 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.

Technologies Used in Farm Automation

The major technologies used in farm automation are driverless tractors, seeding and planting, automatic watering, drones, weeding, harvest automation etc.

Autonomous Tractors

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Autonomous tractors are driverless tractors which use modern technology to provide higher efficiency and minimize human intervention. Autonomous vehicles are touted as the next big thing in the farm equipment industry. They come with many benefits such as safety, fuel efficiency, sharing, and many others.

The most advantageous aspect of the autonomous tractor would be enhanced productivity of the machines. Doing more in less time and fuel. The initial cost would be high compared to the diesel models but over a period, the profitability that would be gained from an autonomous tractor is unmatched.

India being one of the largest markets for agro products and machinery, has also demonstrated traction in the field of autonomous tractors. Market leaders like Mahindra & Mahindra, John Deere, and Escorts have taken steps to develop and launch autonomous tractors.

Seeding and Planting

Sowing seeds was once a laborious manual process. Modern agriculture improved on that with seeding machines, which can cover more ground much faster than a human. However, these often use a scatter method that can be inaccurate and wasteful when seeds fall outside of the optimal location.

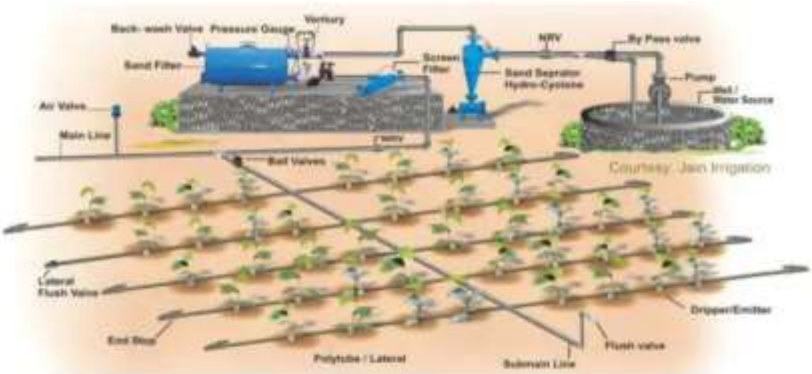
Precision seeding equipment is designed to maximize these variables like planting seeds at the correct depth, and spacing plants at the appropriate distance every time. Combining geo-mapping and sensor data detailing soil quality, density, moisture and nutrient levels takes a lot of guesswork out of the seedling process. Seeds have the best chance to sprout and grow and the overall crop will have a greater harvest.

As farming moves into future, an entire field could be planted this way, with only a single human monitoring the process over a video feed or digital control dashboard on a computer or tablet, while multiple machines roll across the field.

Seeding and Planting

(Image courtesy of CEMA.)

Automatic Watering and Irrigation



Example of an SDI system for agriculture. While current systems often require the farmer to manually check lines and monitor the pumps, filters and gauges, future farms can connect all this equipment to sensors that stream monitoring data directly to a computer or smartphone. (Image courtesy of Jain Irrigation.)

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Subsurface Drip Irrigation (SDI) is already a prevalent irrigation method that allows farmers to control when and how much water their crops receive. By pairing these SDI systems with increasingly sophisticated Iota –enabled sensors to continuously monitor moisture levels and plant health, farmers will be able to intervene only when necessary, otherwise allowing the system to operate autonomously.

Drones for Imaging, Planting and More

Drones can be used to monitor conditions remotely and even apply fertilizers, pesticides, and other treatments from above using a combination of GPS, laser measurement and ultrasonic positioning, crop spraying drones can adapt to altitude and location easily. They can also quickly and cost-effectively identify problems areas with imagery and infrared analysis to help farmers diagnose issues early on. Prototype drones are being built and tested for use in seeding and planting to replace the need for manual labour. DRONESEED and BIOCARBON are two companies, both of which are developing drones that can carry a module that fires tree seeds into the ground at optimal locations. American Robotics is developing a fully autonomous drone, base station, and analytics platform that provides insights to growers at resolutions, frequencies, and speeds never before possible.

DJI Agras MG-1 crop spraying drone. (Image courtesy of DJI.)

Example of a drone for tree planting. (Image courtesy of BioCarbon.)

Harvest Automation

Harvest Automations flagship product is designed to perform material handling tasks in unstructured, outdoor environments such as those typically found in commercial growing operations. The robots work safely alongside humans and require minimal training to operate, while vastly reducing production costs and improving productivity. They will reduce direct labour headcount and costs while enabling efficiency initiatives such as resource management, just in time production, and inventory control. The principle features and functions offered in the first product release include.

Vegetable Harvester

Fruit Harvester

AGROBOT has successfully developed the first robot for gently harvesting strawberries, no matter where and how they are grown. From a flexible mobile platform, up to 24 robotics manipulators work together to pick the fruit which meets the farmers quality standard.

Conclusion

Agriculture automation is the much necessitate reducing human interventions in practice. Day by day demand for the food is reaching its high peak and the without execution of the modern methods in agriculture it is very hard to achieve the increasing demand. Agriculture automation is the prime concern as it helps to reduce labour and increase the production. Artificial Intelligence has been implemented in crop selection and to help the farmer in the selection of the fertilizers. With the help of the database which the user has gathered and specified to the system, the machine communicates among them to decide which crop is suitable for harvesting and also the fertilizers which promote the maximum growth. Farmers are at anytime and anywhere in the world. Some disadvantages in communication must be overcome by advancing the technology to consume the less energy and also by making user interface ease of use.

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Carbon Sequestration Potential on Agricultural Lands

Article ID: 32254

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Summary

Carbon sequestration on agricultural lands is possible through a range of soil management strategies and could be substantial with widespread implementation. Sequestration of historic carbon emissions is now essential as mitigation alone is unlikely to stabilize our atmosphere. There are numerous management strategies for drawing carbon out of the atmosphere and holding it in the soil. These strategies vary in effectiveness across different climates, soil types, and geographies. There are still debates about the durability of sequestration in soil and about the precise conditions that maximize drawdown of carbon emissions.

Recent reports from the Intergovernmental Panel on Climate Change (IPCC) suggest that even if substantial reductions in anthropogenic carbon emissions are achieved in the near future, efforts to sequester previously emitted carbon will be necessary to ensure safe levels of atmospheric carbon and to mitigate climate change. Research on sequestration has focused primarily on Carbon Capture and Storage and reforestation with less attention to the role of soils as carbon sinks. Recent news reports of melting glaciers and ice sheets coupled with a decade of record-breaking heat underscores the importance of aggressive exploration of all possible sequestration strategies.

Soils have the potential to sequester carbon from the atmosphere with proper management. Based on global estimates of historic carbon stocks and projections of rising emissions, soil's usefulness as a carbon sink and drawdown solution appear essential (Lal, 2004). Since over one third of arable land is in agriculture globally (World Bank, 2015a), finding ways to increase soil carbon in agricultural systems will be a major component of using soils as a sink. A number of agricultural management strategies appear to sequester soil carbon by increasing carbon inputs to the soil and enhancing various soil processes that protect carbon from microbial turnover. Uncertainties about the extent and permanence of carbon sequestration in these systems do still remain, but existing evidence is sufficient to warrant a greater global focus on agricultural soils as a potential climate stability wedge and drawdown solution. Furthermore, the ancillary benefits of increasing soil carbon, including improvements to soil structure, fertility, and water-holding capacity, outweigh potential costs.

How is Carbon Sequestered in Soils?

Since the size of the stable pool is generally static, soil carbon is effectively increased in the labile and slow pools by increasing the net balance of carbon that enters the soil every year relative to what is lost. Agricultural managers can strongly influence this dynamic in four ways:

1. Decreasing the level of soil disturbance (i.e. tillage) to enhance the physical protection of soil carbon in aggregates.
2. Increasing the mass and quality of plant and animal inputs to soils.
3. Improving soil microbial diversity and abundance.
4. Maintaining continuous living plant cover on soils year-round. Managing these processes can quickly lead to increases in soil carbon that may be highly useful in drawing down atmospheric CO_2.

Agricultural Systems to Sequester Carbon

1. Conventional No-Till and Conservation Tillage.
2. Organic No-Till.
3. Cover Crops and Crop Rotations.
4. Rotational Grazing.

5. Perennial Cropping Systems.

Co-Benefits

In addition to mitigating carbon emissions, increasing soil carbon can have profound effects on soil quality and agroecosystem productivity. Soil carbon plays important roles in maintaining soil structure (Bronick and Lal, 2005), improving soil water retention (Rawls et al., 2003), fostering healthy soil microbial communities (Wilson et al., 2009), and providing fertility for crops. These improvements are well documented and have generated a consensus that improvements to soil carbon are key to improving agricultural systems as a whole. While uncertainties may remain about the potential of agricultural soils to act as a carbon sink, the vast number of co-benefits should remain an incentive to modify agricultural practices to increase soil carbon in their own right.

Conclusions

Soil carbon sequestration involves transferring atmospheric carbon into the soil via plant photosynthesis and keeping those soil-based carbon pools protected as effectively as possible from microbial activity that will release the carbon back to the air. There are agricultural management practices that show promise for restoring soils and sequestering a very significant portion of atmospheric carbon. The need for drawdown strategies is increasingly urgent and soil carbon sequestration through agriculture warrants far greater attention from policymakers, climate negotiators, farmers, ranchers, and scientists. Most, if not all, of the management regimes that promote carbon sequestration also improve soil aggregation, water retention, soil fertility, and food security.

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Agricultural Marketing: A Risk Mitigation Tool

Article ID: 32255

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Introduction

Risk is the uncertainty which is concerning with the occurrence of a loss & it is always associated with agriculture & it includes various kinds of uncertainties which is concern with climate, diseases, market prices, yield realisation, domestic and international markets, government policies and various other factors. Continuously famers are more exposed to various kinds of uncertainties associated with agriculture and developed extension system regularly help to farmers for reduce variation in yield and profitability through proper management against risk. Market orientation of farming and diversification towards high value horticultural crops has further made agriculture increasingly risky. Farmers are required to have an understanding of different kinds of risks and risk management skills to anticipate problems by adopting different component to mitigate market and price risk in agril marketing.

Types of Risk

1. Production Risk: Production risk relates to possibilities of not harvesting the crops as expected in terms of quality and quantity. This may be for factors like weather, inputs, diseases and insect and pests.

2. Financial Risk: It refers to a situation where sufficient cash is not being generated to meet the expected obligations due to factors associated with production, market, increased input costs, higher interest rate, borrowing and limited availability of credit.

3. Institutional Risk: Such risk is associated with uncertainties arising due to action and policies of the government in terms of taxes, marketing structure, use of inputs, certification requirement, etc.

4. Human or personal risk: It refers to risks associated with human health and relationships between different players having an impact on the farm-business.

5. Market and Price Risk: It refers to the uncertainties associated with receiving price less than expected and possibilities of losing market. Market risk may also arise if a product fails to meet the standards as per the requirement of market. The nature and degree of market and price risk may vary from commodity to commodity.

Component to Mitigate Market and Price Risk in Agril Marketing

1. Direct Marketing: Direct contact between producer and consumer without any compulsion in route of transaction in wholesale regulated market. This enables farmers, processors and bulk buyers to economize on transportation costs and to improve price realization. Direct marketing by farmers to the consumers has also been experimented through farmers market in different parts of the country.

2. Contract Farming: It is an agreement between farmers and contract company. The basis of such arrangements is a commitment on the part of the farmer to provide a specific commodity in quantities and at quality standards determined by the purchaser and a commitment on the part of the sponsor to support the farmer's production and purchase the commodity. Benefit of contract farming reduced capital investment, risk of price fluctuation, guaranteed returns and provision of technical assistance to the farmer.

3. Group Marketing: Farmers form a group for marketing of their produce to take Benefit of common transportation, storage, access to information, improved bargaining power, etc. Group can go in for backward linkage and forward linkage, directly sell to hotels, hostels, restaurants, etc and take advantage of Government schemes. Various successful examples are there under cooperatives and FPCs.

4. Alternatives Marketing Model: Government Policies helped to develop various alternative marketing models like national agricultural market, organized retail, trade outside regulated wholesale market, integration of warehouses with markets, etc.

5. National Agricultural Market: The national agricultural market is a virtual market is operated on an electronic trading portal but supported by physical markets (APMCs and other yards) at the backend. The common market has a benefit of market information, transparency, competition, efficiency, risk, price signal, etc due to operation on e-portal, it may lead large number of trader's participation and integration of various services. It is envisaged to facilitate smooth, speedy and efficient movement of agricultural commodities and information at national level.

6. Minimum Support Price (MSP): Government procure wide range of commodities on Minimum Support Price.

7. Price Stabilization Fund (PSF): The fund is used to check the volatility in prices of commodities like onion and tomato by procurement of such products during bumper supply and distribution of the same during period of short supply.

8. Agri-warehousing: Government has taken various steps to integrate warehouses with the markets and make warehouse receipt negotiable to improve liquidity in rural areas through pledge finance against warehouse receipt. Warehousing (Development & Regulation) Act 2007 has various provisions to strengthen agri-warehousing system in the country.

Conclusion

Mitigate price and market risk in agril. marketing especially government of India has taken various policy initiatives with provisions like direct marketing, contract farming, group marketing, alternative marketing model, private market, farming agreement, eNAM, MSP, PSF and warehousing to help create an excellent platform with good environment where farmers is made available with various alternatives and tools to reduce the risk associated with market and prices of agricultural commodities.

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Impact of Covid-19 on Agriculture Sector in India

Article ID: 32256

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Introduction

"Corona virus disease (COVID-19) is a communicable disease caused by a newly discovered corona virus. A novel corona virus outbreak was first documented in Wuhan, Hubei Province, China in December 2019. The COVID-19 pandemic has epic impact to India's economy and has caused enormous hardships to working people of the country. This has led to a fall in the world economy especially in developing countries like India. India with its suitable control has however tried its best to battle this crisis with a country wide lockdown to prevent the health implications. But agriculture being the backbone of the country and the GDP has been impacted in a negative way with massive faction in the provide series and cropping decisions for imminent agricultural seasons. All these have a negative implication in farming community and it will be undergoing deep losses.

Agriculture plays a crucial role in India's economy as it accounts for 16.5% of the country's Gross Value Added (GVA) for the year 2019-20. A total workforce of 54.6% is engaged in agricultural and allied activities [Census 2011]. As per the importance of agriculture sector, Government of India has taken several steps for its development in a sustainable manner. But recently, COVID-19 has put a serious challenge in front of agriculture sector. Outbreak of novel corona virus in India and the consequent lockdown, unfortunately, also coincided with the country's peak harvesting time of a variety of crops of the season and other activities related to agriculture.

Governments has taken a several action against the Corona virus. The central government on 17 May 2020 extended the nationwide lockdown, first imposed on 24 March 2020, for the fourth time till 31 May 2020 while giving considerable flexibility to the States in deciding red, green and orange zones of COVID-19 intensity. After that in the month of June Government Started "Unlock" it include Mission begin again i.e. Gradual opening of activities. The global pandemic of Covid-19 affecting so many sector & their financial system. During these challenging phases, how does Indian Agriculture respond to the crisis and how do government measures affect 140 million farm households across the country and then impact the economy of a very important country in the developing world. So, this article mainly focusses on major impact of COVID-19 on farm sector what steps taken in to action to make a sustainable food system after COVID-19.

Major Impact Due to COVID-19 on Indian Agriculture

1. Migrant Labours:

a. April is the month when India's rabi crops, especially wheat and pulses, are harvested. Farming in India is less mechanized than in the west, and harvest is a peak season of labour demand.

b. Even when a farmer is using a mechanical harvester, three or four skilled labourers are needed to operate the harvesters and service the machines.

c. In Punjab, Haryana and western Uttar Pradesh, migrant labourers from Bihar, Uttarakhand, and eastern Uttar Pradesh are regularly employed in large numbers

d. In many northern states, labour shortage forced farmers to delay or stagger harvests that led to economic Losses.

e. In the rice mills in some southern states, the shortage of migrant workers resulted in the inability of mills to procure adequate quantities of paddy from the farmers.

f. Labour shortages were also experienced in Milk processing plants, cold storage units and warehouses. According to the officials of the milk cooperative AMUL, most milk processing plants in the country were operating with half the regular labour force. (Pandya 2020).

2. Vegetables / fruit production:

a. Fruits and vegetables are extremely perishable and need to get to the market as quickly as possible. But trade opportunities are limited because everything in the value chain got disrupted, markets closed, countries restricted border crossings, ports shut down, transportation costs increased.

b. Farmers who produce fruits, such as mangoes, litchis, melons and watermelons, have suffered massive losses because of disruption of exports and collapse of domestic demand.

c. In Latur wadi (Latur district), a farmer who managed to take a truckload of cucumber to the market was turned back by the police and had to dump the entire produce on the road-side (Source: India's Villages during the COVID-19 Pandemic).

3. Disruption of food supply chains:

a. Shortage of workers to harvest the rabi crops.

b. Disruptions in the collection of harvests from farms by traders.

c. Shortage of truck drivers.

4. Reduction in market arrivals:

a. Due to limited operations of APMC mandis.

b. Shutdowns the retail markets.

5. Harvesting of Rabi crops:

a. Unplanned and sudden imposition of the lockdown resulted in a massive and unprecedented disruption to agricultural activities such as harvesting, sale of agricultural produce, and purchase of inputs

b. The lockdown caused major disruption to the harvesting of wheat. Combine harvesters were not available in villages since the government took weeks to allow inter-state movement of harvesters. Consequently, a large part of the crop was harvested manually by farmers themselves or by using whatever labour was locally available.

c. The post-harvest operations, such as threshing, winnowing, loading and storage were also very slow because of lack of workers in most of the places.

Steps Taken to Prevent Spread of COVID-19

1. Central government announced first a nation-wide lockdown, from Mar. 25, to Apr. 14, 2020. The announcement came in the backdrop of the Covid-19 outbreak and is intended to enable the concept of "social distancing" to constrain the spread of the virus.

2. Public transport is restricted strictly during lockdown also all the shops except essential services are shut down from 25 march 2020.

3. Immediately after the nation-wide lockdown was announced, the Indian Finance Minister declared an INR 1.7 trillion package, mostly to protect the vulnerable sections (including farmers) from any adverse impacts of the Corona pandemic.

4. The announcement, among a slew of benefits, contained advance release of INR 2000 to bank accounts of farmers as income support under PM-KISAN Scheme.

5. The Government also raised the wage rate for workers engaged under the NREGS, world's largest wage guarantee scheme.

6. Under the special scheme to take care of the vulnerable population, Pradhan Mantri Garib Kalyan Yojana (Prime Minister's scheme for welfare of the poor), has been announced (Extended up to November 2020). Additional grain allotments to registered beneficiaries were also announced for the next three months. Cash

and food assistance to persons engaged in the informal sector, mostly migrant laborers, have also been announced for which a separate PM-CARES (Prime Minister Citizen Assistance and Relief in Emergency Situations) fund has been created.

7. On 12 May, the Prime Minister, in an address to the nation, said that the coronavirus crisis should be seen as an opportunity, laying emphasis on domestic products and "economic self-reliance", a Atmanirbhar Bharat) through a Atmanirbhar Bharat Abhiyan.

Conclusion

The outbreak of Corona virus now becomes a global pandemic and it has been largely disruptive impact economic on indian economy. Mostly due to lockdown the limitation on the movement of agriculture commodities from its production place to the ultimate consumer has been impeded. So many problems are arising i.e. shortage of labour force due to COVID-19 which is leads to the wastage of harvested commodities, mainly fruits and vegetables which are perishable in nature, in the farmer's field itself. also, the arranging of the Kharif crop and post-harvest management of Rabi crops produce, which will cause a significant effect in the upcoming seasons.

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Nutrients & Stress Management

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"Eat a healthy meal to help your body heal"

What is Stress?

Stress is a diverse, complex phenomenon with various components initiating the triggering events and processing the brain to response. The responses may be emotional, biological or physical which varies from individual to individual because of both genetic and environmental factors and it often affects eating behaviour. The stress response is an adaptive mechanism. When stress levels are low, the body is often in a state of homeostasis: All body systems are operating smoothly to maintain equilibrium. Stressors trigger a "crisis-mode" physiological response, after which the body attempts to return to homeostasis by means of an adaptive response.

The internal fight to restore homeostasis in the face of a stressor is known as the general adaptation syndrome, or GAS. The GAS has three distinct phases: alarm, resistance, and exhaustion.
1. The first is an initial state of alarm (fight or flight response), which produces an increase of adrenaline. Living organisms can withstand occasional extreme stress and still survive.
2. The second stage is a short-term resistance mechanism that the body sets up to cope with the problem.
3. The final stage is a state of exhaustion. The exhaustion stage occurs when the body has used up all its available resources. If the situation is not taken care of, stress can produce long-term damage to the body, including heart problems, high blood pressure, the immune system problems (susceptibility to infections and allergies), skin problems (acne, itchy rashes, psoriasis, and eczema), pain (neck, shoulder and back), diabetes, and infertility

Stress and Body Response

Exposure to stressors results in a series of coordinated responses organized to enhance the probability of survival. These coordinated responses, often referred to as 'stress responses' which are composed of series of reactions in the body which includes alterations in behaviour, autonomic function and the secretion of multiple hormones like adrenocorticotropic hormone (ACTH) and cortisol/corticosterone, adrenal catecholamine, oxytocin, prolactin and renin etc.

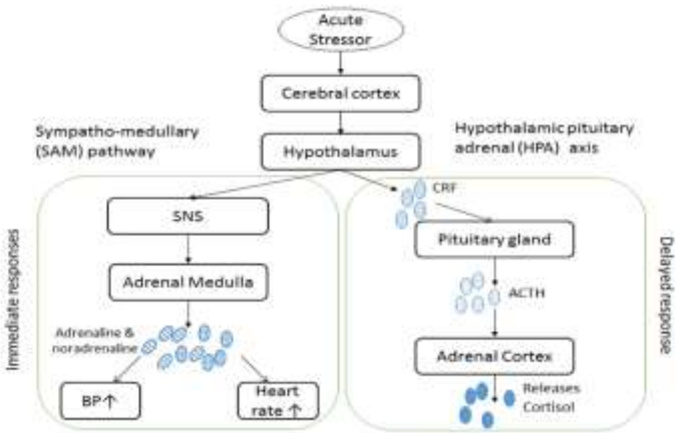

Fig.1 Acute stress response pathways

Abbreviations: ACTH = Adrenocorticotropic hormone; BP = blood pressure; CRF = Corticotropin releasing factor; SNS = sympathetic nervous system; TPR = total peripheral

Management of Stress Through Nutrients

Stress creates greater physiological demands. More energy, oxygen, circulation, and therefore more metabolic cofactors are needed (e.g. vitamins and minerals). The irony of stress is that people suffering stress need a more nutritionally dense diet but often opt for comfort foods (like sugary and fatty foods) lacking in the necessary nutrients, consequently inducing a situation of nutrient depletion that further compromises the metabolic systems. Stress not only influences the choice of food of a person but also the quantity of the food eaten.

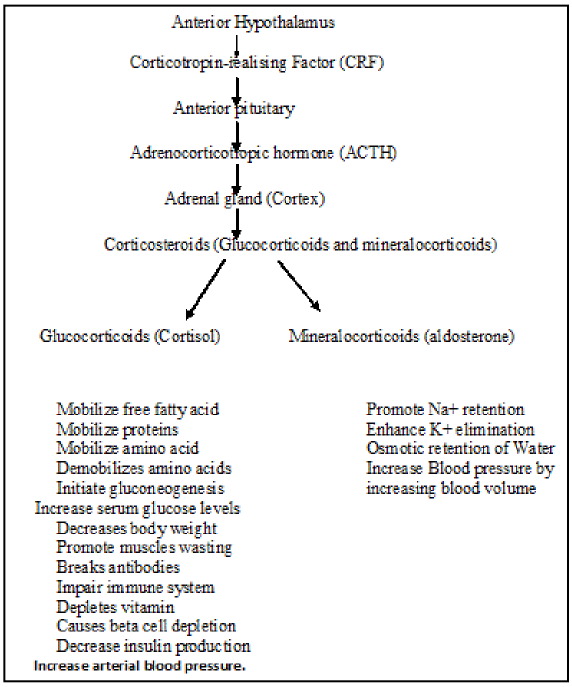

Fig.2 The physiological response to stress.

Role of specific nutrient in regulation of food intake, in the maintenance of homeostatic mechanisms and emotional processes is very dense. Serotonin (5-hydroxytryptamin or 5-HT) is synthesized from the dietary amino-acid tryptophan (TRP). Likewise, tyrosine is a precursor of noradrenaline (NA). Psychosocial and physical stress increases the rate of release of noradrenaline (NA) in both the periphery and the central nervous system hence more protein especially tyrosine is required. Likewise, various other nutrients are required to reduce the levels of the stress chemicals (cortisol and adrenaline) that activate fight and flight response in the body. A detail description of various nutrients and role in coping with stress is mentioned in fig.2.

Omega 3 Fatty Acids

The brain needs omega 3 fatty acids for the formation of healthy nerve cells. Flaxseed, hemp, canola and walnut oils are all generally rich sources of the parent omega-3, alpha linolenic acid (ALA). Dietary ALA can be metabolized in the liver to the longer-chain omega-3 eicosapentaenoic (EPA) and docosahexaenoic acid (DHA). This conversion is limited in human beings, it is estimated that only 5-15% of ALA is ultimately converted to DHA. Stress compromise this conversion. DHA (Docosahexaenoic acid) an essential component of the membrane of brain cells, enhances brain to utilize various chemicals and can turn on the genes that make serotonin. It is a good natural anti-depressant.

Proteins

Tryptophan: Tryptophan is an amino acid found in milk as well as in many proteins' rich foods like whole grains. Serotonin is synthesized from tryptophan. Tryptophan works with vitamin B6, niacin and magnesium to synthesize serotonin.

Phenylalanine and tyrosine: Phenylalanine and tyrosine promote alertness, vitality and help in increasing the rate at which brain neurons produce antidepressants-dopamine and norepinephrine. Vitamin C is required to metabolize phenylalanine and tyrosine effectively. This show, rich source of vitamin C like citrus fruits may help in metabolism of phenylalanine and tyrosine.

Vitamin C: Both emotional and physical stress may affect a person's Vitamin C status. It can increase requirement for vitamin C to maintain normal blood levels. When stress depletes vitamin C levels in the body, it reduces the body's resistance to infection and disease and increases the likelihood of further stress. When vitamin C intake is increased, the harmful effects of the stress hormones are reduced and the body's ability to cope with the stress response improves.

Vitamin B: The majority of the B-vitamins function in the development and maintenance of the nervous system. The harmful effects of vitamin-B-deficiencies on the nervous system might increase the risk of developing stress-related symptoms such as irritability, lethargy and depression. They also help maintain regular blood-sugar levels to help keep your energy and mood stable. Among B-vitamins, most important is vitamin B5 (pantothenic acid) which is often called anti-stress vitamin B5 helps support the adrenal glands and improves coping mechanisms.

Magnesium: Magnesium is needed for a variety of tasks such as muscle relaxation, fatty acid formation, making new cells and heartbeat regulation. Stress and magnesium are said to be interrelated. Both physical and psychological stress may stimulate the stress hormones. This, in turn, increases magnesium loss from the cells (especially from the heart and other vital organs), stimulate urinary excretion and increase dietary requirements for the magnesium.

Stress-Busting Foods

Foods can elicit an emotional response when eaten. Foods can help tame stress in several ways. Comfort foods, like a bowl of warm oatmeal, boost levels of serotonin, a calming brain chemical. Other foods can cut levels of cortisol and adrenaline, stress hormones that take a toll on the body over time. A healthy diet can help counter the impact of stress by shoring up the immune system and lowering blood pressure. Few stresses busting food is as follows:

Walnuts: Walnuts have long been thought of as a ‘brain food’ because of their wrinkled, bi-lobed (brain like) appearance. They are an excellent source of omega 3 essential fatty acids and uridine. The combination of omega 3 fatty acids and uridine is thought to be a natural antidepressant. Walnuts also contain some other compounds like vitamin B6, tryptophan, protein, and folic acid which contribute to stress releasing. Higher blood levels of omega 3 fatty acids have been linked with better mood and lower rates of depression.

Blueberries: Blueberries are full of antioxidants and vitamin C. These nutrients are said to be great stress busters. The antioxidants fight the free radicals which adversely affect the memory. Vitamin C along with antioxidants helps to combat stress hormone cortisol.

Broccoli: One of the good mood foods is broccoli which has stress-relieving vitamin B6. It also contains folic acid which is important in fighting depression.

Spinach: Spinach is considered to be a magic cocktail of all the greens. Being a rich source of magnesium (three cups of spinach supply about 40% of daily magnesium), it helps to lower stress level by keeping a person in a calm state and by preventing blood pressure from spiking.

Chocolate: Cocoa beans are also one of the nature’s most concentrated sources of theobromine, a molecular cousin of caffeine and theophylline, present in coffee and tea. Phenyl ethyl amine (PEA) present in cocoa increases the activity of neurotransmitters. It also contains high level of epicatechin. Cocoa beans contain nutrients essential to human mental and physical health such as iron, magnesium, potassium, phosphorus, zinc and polyphenols mainly flavonoids. Chocolates are also rich in tryptophan, which forms a rate-limiting step in the production of the mood-modulating neurotransmitter serotonin known to diminish anxiety. It has also found use in the treatment of pre-menstrual syndrome (PMS) due to its rich content of magnesium that lowers progesterone levels. Chocolate also contains amino acid gamma-aminobutyric acid (GABA) that is said to reduce anxiety.

Oranges: Oranges are rich source of vitamin C stressed body are more prone to free radical formations. Vitamin C helps to keep free radicals in check and repairs the body. Vitamin C lowers blood pressure and stress hormone cortisol. Orange juice contains folic acid which helps to relieve stress. Drinking plenty of orange juice will help in production of dopamine in the body and make the person feel relaxation.

Other foods like: Coffee, Fish, Banana, Eggs, Tea, Flax seeds, Whole grains and Probiotics also plays an important role in relieving stress.

Conclusion

Stress is a common problem that we all have to deal with in our lives, some more than others. There are many factors that bring stress upon the human body, in the surroundings and day to day life. The food a person consumes as part of their daily lifestyle can be utilized as a tool to overcome or to reduce the effect of stress on the body. One of the key ingredients to good health, and probably most important is having a well-balanced nutritional eating plan. A balanced nutrition plays an important role when we are under stress. When stress occurs, a well-balanced nutrition and good mood food will boost our resistance against the effects that stress brings upon the body.

Stress is going to happen at some point in a person's life and will most defiantly happen more than the once. However, as unavoidable as stress can sometimes be, it is always a choice. One can either let the body suffer from the effects of stress, or we can choose to do something about it. Thus, to keep the body and mind healthy, every individual should know the stress management and nutrition play a key role in stress management.

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Garlic: A Potential Source for Plant Disease and Insect Pest Management

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Introduction

Plant disease and insect pests have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Synthetic fungicides and insecticides are not eco-friendly for their potentially hazardous toxic effect. For the development of alternative control strategies to reduce dependency on synthetic fungicides, a number of botanicals have been tested against different plant diseases and insect pests for their management.

Garlic is an important aromatic plant with a wide spectrum of pharmacological effects. It is also used as a spice and food additive. European standards specify that garlic supplements contain not less than 0.45% allicin (www.globalherbalsupplies.com) and also contains 65% water, 28% carbohydrate, 2.3% organ sulphur compound, 2% proteins, 1.2% free amino acid (mainly arginine), 1.5% fibre, 0.15% lipids, 0.08% phytic acid and 0.07% saponins (Tyagi et al., 2013). This article focuses on the best use of garlic as a potential source for plant disease and insect pest management.

Effect of Garlic Extract Against Plant Diseases

Garlic extracts have shown to be inhibitory on the growth of a number of fungi (Tansey and Appleton, 1975; Sumbali and Mehrotra, 1980). Patel (1995) recorded bio-efficacy of 29 phytoextracts tested *in vitro* against *Fusarium solani* causing wilt of Pigeonpea, among these, garlic clove extract (A*. sativum*) proved strongly inhibitory to the growth of the fungus. Garlic has been found to be effective against *Phytophthora infestans* on tomato seedlings (Curtis *et al*., 2004). The crude extracts of garlic completely inhibited (100%) the mycelial growth of *Rhizoctonia solani* causing root rot of cotton (Kshirsagar *et al.*, 2004). Upadhyaya and Gupta (1990) found ethanol extracts of garlic to be effective against the growth of *Curvularia lunata.*

Bioactive Compounds of Garlic Responsible for Plant Disease Management

The inhibitory action of garlic juice was suggested to be due to the presence of volatile sulphur compounds garlicin, phytocides, allicin, which act as an inhibitor of respiratory- SH group enzymes, ajoene which destroys the integrity of cell wall (Yoshida et al., 1987; Focke et al., 1990). The antimicrobial substance, allicin, which is produced in garlic is active against a wide range of pathogens (bacteria and fungi) both in vitro and in vivo, and is responsible for bursting the young hyphae of fungus (Shekhawat and Prasad, 1971; Durbin and Uchytil, 1971). Flavonoids and saponins of red garlic exhibited antibacterial properties against *Bacillus subtilis* (Locke, 2006).

Effect of Garlic Extract Against Insect Pests

Garlic extracts have shown considerable toxicity to a number of pest species, across all life stages; susceptible orders include the Coleoptera, Lepidoptera, Heteroptera and the Diptera. Aqueous garlic extracts have been shown to inhibit egg hatch of mosquitoes (Jarial, 2001). Garlic extracts and steam distillates are reported as having toxic and antifeedant effects on both coleopteran stored product pests (Chiam *et al*., 1999) and Lepidoptera (Gurusubramanian & Krishna, 1996). Repellent and toxic effects upon Hemiptera have also been reported by Flint *et al*., (1995). Garlic essential oil is used for control of arthropod pests mainly Japanese termite, *Reticulitermes speratus* Kolbe at very low concentration 3.5 µL/L of volatile garlic oil in fumigation assay (Cloyd *et. al*., 2009). DADS and p-anisaldehyde isolated from garlic oil exhibited very high insecticidal potential against larvae of *Lycoriella ingenue* at very low LC (50) values. Methyl allyl disulfide and Garlic organosulfide diallyl trisulfide (DATS), two of the major constituents of the essential oil of garlic, were found active against *Sitophilus zeamais* and *Tribolium castaneum* (Park *et. al*., 2006).

Bioactive Compounds of Garlic Responsible for Insect Pest Management

Of all the Allium species, garlic is the most important because of the presence of sulphur compounds like Allicin (diallyl-dithiosulfinate), diallyl disulphide (DADS), S-allylcysteine (SAC), diallyl trisulfide (DATS) etc. (Tariq et. al., 1988). The two major constituents of the essential oil of garlic, Methyl allyl disulfide and Garlic organosulfide diallyl trisulfide (DATS), show contact toxicity, fumigant toxicity, and antifeedant activity.

Conclusion

Extracts and oils from garlic have been formulated into a range of pest control products marketed as crop protection products for use against many plant diseases and insect pests.

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Exploring the Antimicrobial and Insecticidal Activities of Allamanda in Crop Protection

Article ID: 32259

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Introduction

Use of synthetic pesticides imbalances our ecology, interferes our food chain and causes many abnormalities to the environment as it usually takes a long time to degrade completely (Damalas and Eleftherohorinos, 2011). Therefore, plant-based pesticides appear to be one of the better alternatives for the control of plant diseases and insect pests, as they are known to have minimal environmental problems and less danger to consumers in contrast to synthetic pesticides (Varma and Dubey, 1999).

So, efforts have been made to control these harmful pests, and in today's date, research on natural biodegradable source of plant-based pesticides is the need of the hour. Plant extracts of many higher plants have been reported to exhibit antibacterial, antifungal and insecticidal properties under laboratories trials (Bhatnagar *et al*. 1990; Mohana and Raveesha, 2006). Therefore, the present study is to explore the antimicrobial and insecticidal activities of *Allamanda* extract against plant disease and insect pests and to explore the main active components responsible for the purpose.

Allamanda cathartica Linn. (Family Apocynaceae) is a widely growing imperishable ornamental shrub, notable for its medicinal properties. All parts of the plant (leaves, flower, root, and stem) contain allamandin, a toxic iridoid lactone (Abdel-Kader, 1997) and are used in traditional medicine for giving protection to human from ancient time. Different ethno pharmacological reports suggest that the roots are used against jaundice, malaria, and an enlarged spleen. The flowers act as a laxative, and also used as an antibiotic against *Staphylococcus* spp.

Effect of Allamanda Extract Against Plant Diseases

Kirtiker *et al.* (1975) found that Allamanda contains anti-fungal activity and the leaf extract has anti-pathogenic action against fungus and bacteria. Allamanda extract in water was found inhibitory to vegetative growth of nursery disease causing plant pathogens like *Phomopsis vexans, Phytophthora capsici, Fusarium oxysporum, Rhizoctonia solani* and *Sclerotium rolfsii* etc. (Masuduzzaman, 2006; Tania, 2007).

Mishra and Dixit (1979) reported that leaf extracts *A. cathartica* completely inhibited the spore germination of *Ustilago tritici* and *Ustilago hordei*. Islam (2004) also found 76-100% inhibition of mycelial growth of *P. vexans* by Allamanda leaf extracts. On the other hand, Ahmed *et al.* (2012) reported that ethyl acetate extract of Allamanda at 0.2% and 0.3% concentration resulted 100% inhibition of mycelial growth of *Phomopsis vexans*.

Effect of Allamanda Extract Against Insect Pests

Radhakrishnan and Prabhakaran (2014) found that aqueous extracts of leaves and flowers from A. *catharitica* showed significant 100.0 % adult mortality against red spider mite, *Oligonychus coffeae* infesting tea with 20 % significant reduction in adult emergence compared to the control.

Mannen *et al.* (2017) also found that the petroleum ether fraction of *A. cathertica* showed strong toxic effect against stored gain pest, Red flour beetle, *Tribolium castaneum* for 72 hours exposure. Extraction of A. *cathartica* leaves using chloroform and methanol also showed pesticidal effects on *T. castaneum*. Petroleum ether and chloroform extraction of its stem bark showed dose mortality effects against stored gain pests, *T. castaneum, Sitophilis oryzae* and *Callosobruchus chinensis.*

Feng *et al*. (2013) studied the insecticidal activity of *A. cathartica* extract against *Aleurodicus disperses* in the laboratory and field conditions, where results showed that the extract possessed a strong toxicity against the larvae of A. *disperses* but has no activity against the pupae of the insect.

Bioactive Compounds of Allamanda Responsible for Crop Protection

The whole plant parts possess various medicinal properties such as anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, antipyretic, and analgesic activity (Ghosh and Banerjee, 2018). Savithramma *et al*. (2013) also found that aqueous leaves extract of *A. cathartica* showed highest amount of phenol followed by lipids, saponins, proteins, carbohydrates, flavonoids, tannins and alkaloids.

Presence of phenol in plant products is considered to be potentially toxic to the growth and development of fungal pathogens and thereby reduces plant diseases (Okwu and Okwu, 2004). Several researchers in India isolated compounds like plumericin, isoplumericin, plumieride, long chain esters, etc. from different parts of Allamanda which were reported to be antimicrobials (Abdel-Kader *et al*., 1997; Tiwari *et al*., 2002).

Plumieride separated from Allamanda leaf extract completely inhibited the mycelial growth of *Phomopsis vexans, Phytophthora capsici,* and *Fusarium oxysporum* and 83.33% in *Rhizoctonia solani* and 88.63% in *Sclerotium rolfsii* (Mone *et al.,* 2013).

Conclusion

Though *Allamanda cathertica* has many ethnomedical, phytochemical, pharmacological, toxicological, and biotechnological uses, this article focuses on the anti-microbial and insecticidal activities of *A. cathartica as a* potential source of biopesticide in crop protection.

Knowledge on the medicinal properties of Allamanda with their proper methods of extraction and standardization is of utmost importance and efforts should be made to produce new commercial formulations from this plant for use as better alternative instead of synthetic pesticides for the control of plant diseases and insect pests.

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Conservation Agriculture: Present Scenario, Strategy and Policy for Rice Fallow Management in Eastern India

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Introduction

The conservation agriculture (CA) promotes minimum soil disturbance, permanent soil cover and crop rotations for achieving higher productivity while maintaining environmental sustainability. Over last three decades, efforts have been made to develop, improve and disseminate CA technologies to match the needs of diverse agro-ecologies. Significant progress has been made over the years; still there are several constraints that affect its large-scale adoption. The technology of CA has the potential to reduce the cost of production, save water and nutrients, increase yields, improve resource use efficiency and helps in achieving ecological balance.

Apart from inadequate knowledge on CA, lack of CA compatible machinery, competitive users for crop residues, burning of crop residues, delayed harvest of paddy, lack of irrigation infrastructure, uncontrolled grazing and affinity for conventional tillage are some of the constraints that preclude the farmers from large-scale adoption of CA. This technology offers opportunities in rice fallow areas of Eastern India. About 80% of rice-fallow area of South Asia is in India, mostly in the undulating to Hilly Eastern Plateau Region comprising the states of Jharkhand, Chhattisgarh and parts of Bihar, Odisha and West Bengal. Efficient utilization of these fallow lands may improve productivity and sustainability of the region (Singh et al., 2019). In this context, there is urgent need to develop the policies and strategies to promote CA in the Eastern region for Rice-fallow ecosystem.

Harvesting of Rice

After harvest, Rice fallow areas

Rice–fallow areas are those Kharif paddy grown areas that are kept fallow in Rabi season due to lack of irrigation, late harvesting of long–duration high yielding rice varieties, moistures stress at sowing during the Rabi crops, water logging and excessive moistures in November/December and social issues like grazing. There is great scope in converting rice fallow area into productive agro-ecosystems through appropriate crop-based interventions involving suitable varieties and appropriate conservation agriculture technologies. Pulses such as chickpea, lentil, lathyrus, black gram and oilseeds such as safflower and linseed, through rotation or relay with rice, can efficiently utilize the residual soil moisture and can strengthen the livelihood of resource poor farmers of the region.

It is therefore, important to develop package of practices for CA to increase food production sustainably and enhance the farm income for farming community in the eastern plateau region while protecting natural resources and minimizing environmental footprints. In most part of India, the crop yields enhanced through widespread adoption of CA. The CA technology has been proved to be cost effective, reduce environmental pollution, promote conjunctive use of organics (avoids residue burning), improve soil health and help adapting to climate risks. Over past two decades, efforts have been made on research, development, adaptation and up scaling of CA under various programs of ICAR, State Agricultural Universities, CIMMYT and other CGIAR Centres.

Besides, some good success stories around CA based technologies, the potential impact of CA is yet to be achieved in India. About 79% (11.65 m ha) of the total rice fallows of South Asia (15.0 m ha) lies in India (NAAS 2013) which can benefit from wider adoption of CA technologies. The maximum rice fallow area is reported in Madhya Pradesh and Chhattisgarh (4.38 m ha) followed by Bihar and Jharkhand (2.20 m ha), West Bengal (1.72 m ha), Odisha (1.22 m ha) and rest of Maharashtra, Assam, UP and AP (2.13 m ha).

A holistic system-based approach and multi-disciplinary team effort is required to refine and improve the location specific CA practices and its components (variety, machine, water, nutrient, weed, pest, etc.) to match the context of its three principles. The CA research has evolved over time and is still evolving in view of benefits that CA can provide to address the growing social, technical and environmental challenges.

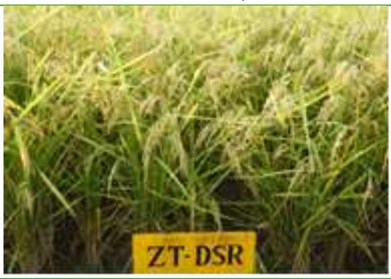
Various organizations conducted number of studies to improve the productivity and profitability of rice-fallows. Despite of efforts made in the past; the uptake of CA in India has been slow. Presently, CA has emerged as one of the major frontiers of future farming. However, scaling CA based management practices in diversity of farm typologies and production ecologies for impact scale, it needs a collaborative approach of consortium of projects/programs/institutions involved in CA research for development in India. So, there is need to examine the pros and cons of CA to answer the questions like 'why the adoption is slow', 'what are new research aspects' to make synergies and complementarities of the on-going CA research in India by Institutions like ICAR, CIMMYT, BISA and other Centres.

ICAR initiated a Consortia Research Platform (CRP) on CA with broad objectives of development, adaptation and refinement of location specific CA practices for enhancing the productivity of rice-fallow eco-systems in Eastern India. The project is being implemented at ICAR-RCER, Patna, KVK, Buxar (Bihar), Ranchi (Jharkhand) and Jashpur (Chhattisgarh) with major objective to develop, demonstrate and validate CA-based crop management technologies for improving the productivity of rice-fallows in rain fed ecosystems of Eastern region. Major focus was on selection of appropriate varieties of rice and suitable rabi and summer crops in rice-fallow system under CA practices. The project evaluated the CA practices like zero tillage direct seeded rice (ZTDSR) and zero tillage transplanted rice (ZTTR) and compared the results with farmers puddle transplanted Rice (FPTR).

Research Outcomes

At all the project sites, the CA practice was evaluated. Analysis carried out at ICAR-RCER, Patna revealed that during initial years and under Bihar condition, FPTR recorded highest grain yield (5.18 t/ha) as compared to ZTDSR (3.58 t/ha) and ZTTR (2.53 t/ha). The yield analysis revealed that, during initial years, farmers practice (FPTR) produced higher grain yield of 5.35 t ha-1, which was 28.60 % higher yield than ZTDSR.

This may be attributed to high tillers, high vegetative biomass production and high numbers of filled grains per panicle. The economic analysis of CA revealed that farmers practice (FPTR) recorded higher gross return of Rs. 81,855 ha-1 with a B: C ratio of 2.72 and net return of Rs.51, 785 ha-1 as compared to the ZTDSR which resulted in net return of Rs.38, 128 ha-1 with B: C ratio (2.49).




Experimental Site of CA at Bihar

The yield analysis revealed that farmers practice (FPTR) produced higher grain yield of 5.35 t ha^{-1}, which was 28.60 % higher yield than ZTDSR. This may be attributed to higher number of tillers, high vegetative biomass production and high numbers of filled grains per panicle. The economic analysis of CA revealed that farmers practice (FPTR) recorded higher gross return of Rs. 81,855 ha-1 with a B: C ratio of 2.72 and net return of Rs.51, 785 ha-1 as compared to the ZTDSR, which gave the net return (Rs.38, 128 ha^{-1}) with B: C ratio (2.49).

Similarly, under Jharkhand condition, the farmers practice of puddled transplanted rice (FPTR) recorded highest grain yield of 5.35 t ha-1 followed by zero tillage transplanted rice (ZTTR) of 4.23 t ha-1 (Jha et al., 2019). Among the genotypes, Lalat recorded consecutively maximum grain yield of 4.78 t ha-1 followed by Naveen (4.67 t ha-1).

At, Chhattisgarh, FPTR recorded highest yield (3.1 t ha^{-1}) followed by ZTDSR (2.4 t ha^{-1}) and ZTTR (2.1 t ha-1).The Rice genotypes IR -64 yielded grain yield of 2.8 t ha-1 was significantly highest in FPTR.

Experimental site of CA at Jharkhand

Experimental site of CA at Chhattisgarh

After the harvest of paddy, by minimum disturbance of soil by cleavage opening manually by hand driven or bullock driven implement or mechanically by tractor drawn zero till seed cum fertilizer drill. Rabi crops of mustard, lentil, chickpea, safflower, linseed, etc. can be sown immediately to utilize the residual soil moisture. In mustard, the effect of straw mulch was insignificant while the yield was highest in ZTDSR (0.3 t ha^{-1}) over farmer's practice (FPTR). In rabi, linseed seed yield (0.2 t ha^{-1}) was higher under mulch and recorded 5.0 and 16.7% higher yields under ZTT-M and DSR-M, respectively. Among the CA practices the soil organic carbon varied from 0.49 to 0.55 % which was slightly higher than farmers' practice (0.42%).

Also, during initial years at Patna experimental site, no significant effect of residue was recorded in paddy and succeeding winter crops like chickpea (3.88 t ha^{-1}) and safflower (3.85 t/ha). The yield of chickpea (2.5 t ha^{-1}) was higher after ZTTR, while safflower yield (1.7 t ha-1) was higher in ZTDSR. Comparatively higher seed yields of Rabi crops were recorded in the treatments having 30% residues retention as compared to no-residue. The annual system productivity in terms of rice equivalent yield (REY) was higher in rice-chickpea (12.2 t ha^{-1}) followed by rice-lentil (11.6 t ha-1) under the FPTR. The Utera system effectively used the soil moisture (121 mm) and recorded higher SREY (6.4 t ha^{-1}) as compared to ZT with straw mulch @ 5 t ha-1 (5.8 t ha^{-1}) and ZT (5.6 t ha^{-1}).

Economic Appraisal of CA in Rice-Fallows

In rice-fallows, reduced tillage has increased the yield of pulses (lathyrus, greengram, black gram, field pea) by 33–44% over conventional tillage (Kar and Kumar, 2009). Similarly, retention of rice stubble/mulching and ZT sowing of pulses significantly enhanced productivity of pulses in rice fallows (Ghosh et al., 2016). Retaining 30% rice residues on soil surface and ZT sowing with Happy Seeder increased yields of succeeding lentil, chickpea, safflower, linseed and mustard by 3.1, 11.7, 19.1, 14.4 and 12.3%, respectively. Similarly, Utera cropping performed better than ZT (with or without mulch), and produced the maximum seed yield due to advantage of early sowing and better utilization of residual soil moistures. Among different crops, lathyrus followed by linseed and lentil recorded the maximum yields and profits (Mishra et al., 2016). ZT after rice harvest also facilities timely planting of winter pulses, and helps to escape negative effects of terminal drought and rising temperature in spring-summer in rice–fallows. Results of the farmers participatory trials on ZT lentil and chickpea in Eastern–IGPs during 2009–10 showed that using ZT with reduced seed rate (30 kg ha-1 for lentil and 80–100 kg ha-1 for chickpea), deeper seed placement (5–6 cm for lentil) improved crop establishment, crop productivity and reduced wilt incidence (Singh et al., 2012).

A survey on farmers' participatory adoption of ZT seeded lentils in rice–fallows (200 ha) of Nawada, Bihar showed that ZT planting of lentils together with the suitable improved agronomic packages resulted in higher yields (13 %) and a reduced cultivation cost by` Rs. 3800/ha, thereby increasing farm profitability of Rs. 10,000/ha (Singh et al., 2012). In lowlands having high moistures after rice harvest, draining excess water at physiological maturity of rice by providing drainage channels at appropriate intervals creates a favourable soil condition for ZT of winter pulses (Layek et al., 2014). But in case of a dry soil at rice harvest, NT along with standing stubbles/residue retention @ 5 t/ha along with lifesaving irrigations could give a reasonable lentil yields (Das et al., 2013). Mulching with paddy straw/ water hyacinth was found to increase productivity of groundnut sown after rice harvest (Chaudhary et al., 2014). At Indian Institutes of Pulse Research Kanpur, ZT–drill for small farmers having low purchasing power was developed for line sowing in rice–fallow, which helped in moisture retention as least disturbances of soil occurred. Use of NT drill, seeding was performed timely at reduced cost. Experiences from several location in IGPs showed that farmers adopting ZT can save the cost incurred on preparatory operation by Rs. 2500/ha and reduced diesel consumption by 50–60 l/ha (Sharma et al., 2005).

Promotion of CA at Jharkhand and Chhattisgarh

		
Lentil	**Linseed**	**Mustard**
Winter season crops under CA		

Three cropping patterns viz. Rice-mustard-cowpea, Rice-lentil-Black gram and Rice-linseed-green gram were evaluated at Jharkhand and Chhattisgarh sites by constructing the water harvesting structures. These structures were used to supplement the critical irrigation during rabi and summer seasons.

Among the three cropping systems, Rice-mustard-cowpea performed better in all CA practices at Jharkhand and Chhattisgarh. The outcome of the experimental reveals that CA technology can be promoted in management of rice-fallow areas of Jharkhand and Chhattisgarh for its wide scale adoption in the Eastern region to enhance the cropping intensity.

		
Black gram	**Cowpea**	**Green gram**
Summer season crops under CA		

A successful attempt of rice fallow management by adopting Rice-Cucurbits system was found satisfactory and can be considered as better viable option for livelihood support. The cucurbit crops like bottle gourd, bitter gourd, cucumber, etc. grown in portray and seedlings were transplanted in the paddy fields just after its harvest by minimum disturbance of soil. The paddy and bottle gourd tried at farmers' field yielded 2.8 t and 23.4 t ha^{-1}.

Strategy and Policy for Promotion of CA

The concrete strategy and policy on CA would be very effective for confronting agriculture in India including the climate change, water scarcity, soil health deterioration, low farm profitability, environmental pollution and its adverse impacts on ecosystem and human health. The policy paper on CA by Jat et al., (2018), outlined that the research programs have generated significant knowledge of CA performance over past 2 decades. However, they emphasized the need for aggregating and mapping of CA knowledge across the sites in order to define domains that consider soil, climate, cropping systems and socio-economic conditions of different regions of the country. There is an urgent need to strengthen the ongoing long-term CA research platforms, while the lessons learnt and consideration should be given to new scientific insights. The on-farm research-cum-demonstration with farmers' in participatory mode involving KVKs, SAUs, NGOs, State functionaries, etc., is essential for validating CA performance on a wider scale. The major critical factor for success of CA is the access of appropriate machinery to farmers for its wide adoption and promotion of CA in eastern India. Therefore, special emphasis should be made on establishing CA mechanization hubs in rain-fed region. There is need of thorough investigation on biotic and a-biotic stress under CA to conceptualize carbon and nutrient regimes of the soil in presence of crop residue cover, non-disturbance of soil and crop rotations to harness benefit in CA. Further, the evidences generated on CA across the diversity of production system and ecologies over past 2 decades, a strong strategy and policy of promotion of CA in India to be taken in account by Ministry of Agriculture & Farmers Welfare, GOI. So, there is need to establish strategic sites also as demonstrative units on CA under deficit, limited and saturated water availability situations for irrigation with a provision of both in-situ and ex-situ water harvesting structure. These sites should represent diverse soil types and climatic conditions for a major production system of the region. Micro irrigation has been proved to be the most efficient way water application and need to be combined with CA practices (Jha et al., 2017; Mali et al., 2016). The research outcomes may be converted to scalable and sustainable business models for promoting the adoption of CA in larger scales through motivating and attracting youth in agriculture and empowering women for creating effective custom hiring centres as well as manufacturing hubs.

The strategy for effective penetration of CA in farmer's domain, the course curriculum in UG and PG of Agricultural Universities, CA is to be incorporated (Jat et al., 2018). In all the SAUs/ICAR research institutions and KVK farms, there should be large-scale demonstrations of CA based systems for training of young researchers. Also, the practical crop production program at undergraduate level by the students should be mandated for CA-based production system. Besides, these strategies, there is a special need to establish a learning platform with a mechanism for regular interactions, knowledge sharing and capacity building. There is also need of holistic efforts by coordinating the key researchers from ICAR, SAUs, CG Centres, etc., working on CA should be established with defined roles and responsibilities to promote the CA in India (Jat et al., 2018).

The institutes engaged in research and development on CA should work out the CA-based management systems, identifying research gaps and address pertinent questions and concerns related to CA. These institutes should act as knowledge repository and sharing centre, serving as catalyst for capacity development of stakeholders. Such institutes should work on development of science-driven policy guidelines and advisories for out scaling CA and should develop a collaborative framework for tracking adoption and social impact of CA.

Conclusion, Constraints & Research Gaps in CA

During initial years the farmers' traditional practices of crop cultivation may prove to be better than CA, however in long-term CA practices are known to perform better in terms of reduced costs, increased returns and environmental gains. Among CA practices, ZTDSR proved to be more productive and remunerative than ZTTR system. However, it was felt that major constraint in wider adoption of CA is the pre occupied mindset of the farmers that tillage has direct relation with crop production and the seeding or sowing is not possible without tillage practice. Farmers generally opined that intensive tillage operations for seeding or transplanting with a greater number of plowing leads to high yield and a smaller number of ploughing are responsible for low yields. In modern technology, the researchers are emphasizing more on minimum disturbance to soil, accordingly, the concept of ZT technology having minimum soil disturbance was introduced among farmers. In recent past, due to globalization, it is necessary to reduce the cost of agricultural produce, in this context CA offers great potential and should be adopted on wider scale. The CA technology is known for its potential in saving fuel, time, seeds, water, fertilizer and labour requirements in crop production. However, for promotion of CA, the lack of improved suitable varieties, poor plant stand (low moisture), weed menace, limited fertilizer use, terminal drought, prevalence of diseases, delayed planting (late harvest of rice), poor crop management, lack of mechanization in CA practices, inadequate capacity building cum awareness and socio-economic constraints (animal grazing) are the major constraints. Government should also focus developing promotional schemes viz. incentives, subsidy programs etc. for wider adoption of CA in eastern region of India. Provision of funds should be made to take up the more detailed and specific research programs to fine tune the CA technology. Government can promote the developed CA technologies through its developmental programs for reducing the extent rice-fallow area in eastern India.

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Mushroom: A Major Source of Vitamin-D (Nutraceuticals)

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Introduction

A mushroom or toadstool is the fleshy, spore-bearing fruiting body of a fungus, typically produced above ground, on soil, or on its food source. The standard name "mushroom" is the cultivated white button mushroom, *Agaricus bisporus*; hence the word "mushroom" is most often applied to those fungi (Basidiomycota, Agaricomycetes) that have a stem, a cap, and gills on the underside of the cap. "Mushroom" also describes a variety of other gilled fungi, with or without stems, therefore the term is used to describe the fleshy fruiting bodies of some Ascomycota. These gills produce microscopic spores that help the fungus spread across the ground or its occupant surface. In fact, mushrooms are the only significant source of vitamin D in the produce department, as no other fruits and vegetables contain enough of the nutrient to be considered significant (Khatun et al., 2012). But not all mushrooms contain vitamin D, only those that were exposed to sunlight or ultraviolet prior to packing. Worldwide mushroom consumption has increased markedly in the past four decades, and mushrooms have the potential to be the only non-animal, unfortified food source of vitamin D that can provide a substantial amount of vitamin D2 in a single serve.

Status of Mushroom in High Vitamin D Content

Instead of taking supplements, some prefer to receive vitamin D “naturally,” through their diet. But very few foods contain this nutrient, and not all mushrooms have an opportunity to produce vitamin D, as few are exposed to light when commercially grown. A wild harvested mushroom contains high levels of vitamin D, but very few mushrooms are available at grocery store. Mushrooms utilize the power of ultraviolet light, therefore, producing vitamin D-rich mushrooms. The most common form of vitamin D in mushrooms is D2 (ergocalciferol), with lesser amounts of vitamins D3 (cholecalciferol) and D4, while vitamin D3 (cholecalciferol) is the most common form in animal foods (Glenn et al., 2018).

Importance of Vitamin D in Human Consumption

The two main dietary forms of vitamin D are D_2, found in fungi and yeast, and D_3, found in animals; lesser amounts of vitamin D_3 and D_4 are also found in fungi. Vitamin D is a highly impactful nutrient for people of all ages and it has earned its incredible reputation. This special vitamin has been linked to numerous health benefits, from enhancing the immune system to improving bone resilience (Maria et al., 2015). Vitamin D stimulates the synthesis of the calcium transport proteins in the small intestine, enhancing the absorption of dietary calcium and thereby reducing the risk of osteomalacia in adults and rickets in children. Vitamin D deficiency has been connected with ailments including multiple sclerosis, certain cancers, diabetes, etc., with new associations being discovered to this very day. That’s a real problem, as nearly 42% of Americans lack adequate vitamin D.

Mushroom and UV Light Relation

Humans produce vitamin D when the sun’s rays touch our skin. Unlike other fruits and vegetables, the penetrable tissue of mushrooms responds to light similarly to the way people and increase vitamin D content when exposed to sunlight. When commonly consumed mushroom species are exposed to a source of ultraviolet (UV) radiation, such as sunlight or a UV lamp, they can generate nutritionally relevant amounts of vitamin D. Although the levels of vitamin D2 (ergocalciferol) in UV-exposed mushrooms may decrease with storage and cooking, if they are consumed before the ‘best-before’ date, vitamin D2 (ergocalciferol) level is likely to remain

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above 10 µg/100 g fresh weight, which is higher than the level in most vitamin D-containing foods and similar to the daily requirement of vitamin D recommended (Stamets, P., 2005).

Categories of mushroom

1. Cultivated Mushrooms: Cultivated mushrooms are ones that are grown commercially. Cultivated mushrooms include button mushrooms, portobello, cremini, oyster mushrooms, enoki, and others.

2. Wild mushroom: Wild mushrooms are those harvested by mushroom hunters and foragers from nature. It includes truffles, morels, and chanterelle mushrooms.

3. Medicinal mushroom: These types of mushroom have medicinal properties in treating cancer, reducing cholesterol, as antibacterial and antifungal agents. They are reishi, chaga, and turkey tail mushrooms.

4. Psychoactive Mushrooms: Psychoactive mushrooms are commonly referred to as “magic mushrooms.” These mushrooms have psychotropic effects. Most contain a psychoactive ingredient called psilocybin.

5. Poisonous mushroom: This type of mushroom is poisonous for human consumption and causes toxicity in humans. The most poisonous species, like the Amanita bisporigera (aptly named the “destroying angel”) look very similar to edible mushrooms.

6. Useful mushroom: Some varieties of mushrooms aren’t ingested at all, but are used for other purposes instead. People in Europe traditionally used Amanita muscaria mushrooms as fly traps and named it “fly agaric.” This type of mushrooms is also used for bioremediation, or cleaning up the environment.

Categories of Mushroom Based on Growth Habit

1. Saprotrophic Mushrooms: These kinds of mushrooms grow on dead matter. They release enzymes and acids that break tissue down into smaller pieces that they can absorb and get nutrients from it.

2. Mycorrhizal Mushrooms: These types of mushroom have a symbiotic relationship with trees and other plants. The mycelium (basically the roots of mushrooms) weave themselves into the roots of other plants.

3. Parasitic Mushrooms: These types of mushroom depend on their host and remain on the for the several months to grow and feed on them. Some parasitic mushrooms include chaga, lion’s mane, and honey fungus.

4. Endophytes: They invade plant tissue like a parasitic mushroom. But the plant stays healthy and seems to gain an increased immunity to disease and absorbs nutrients more easily. Some endophytes produce mushrooms, while others never emerge from their host until it dies.

		
Shiitake Mushroom	**Oyster Mushroom**	**Button Mushroom**
		
Portobello	**Morell Mushroom**	**Reishi Mushroom**

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Conclusion

Mushroom consumption is increasing rapidly worldwide and hence we focussed on the three most commonly consumed mushrooms worldwide i.e. the button mushroom (*Agaricus bisporus*, 30% of worldwide consumption), oyster mushrooms (*Pleurotus*, 27% of worldwide consumption), and shiitake mushrooms (*Lentinula edodes*, 17% of worldwide consumption), together comprising approximately three-quarters of all mushrooms consumed in the world. Consumption of vitamin D enhanced mushrooms could substantially contribute to alleviating the global public health issue of vitamin D deficiency.

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Role of Technology in Horticultural Crops

Article ID: 32262

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Introduction

Agriculture has seen its most dramatic advancements in the past few decades. Recognizing the transformation in agricultural mechanization was ranked as one of the greatest engineering achievements of the 20th century. However, horticultural crops such as fruits and vegetables have not yet benefited fully from a number of the technologies which have been successful in row crops.

Beside this, some technologies have been successfully applied in various countries crop production systems over the past 2-3 decades. Mechanization of horticulture can provide a better opportunity to improve the efficiency of horticulture production systems, especially for high-value crops such as fresh grapes, apple, kiwifruit, strawberry etc. and reducing labour demand. Early applications of these technologies focused on yield monitors and global positioning satellite (GPS) system for annual row crops. Recent advances in crop sensing, soil sensing and data analytics have set the stage for the next wave of mechanization.

However, the adoption of advanced horticultural technologies has generally lagged behind other horticultural technology advancement, with relatively some producers using, soil sensing, remote sensing and variable rate application technologies. Lagged adoption has been due to several factors such as capital requirements, insufficient agronomic research tailored to mechanized horticulture and lack of grower time and technical expertise for information intensive management.

However, various commercial firms recognize that these agricultural technologies have the potential for use in tree fruit production. A number of technological services are available for agriculture, including remotely sensed canopy maps, precision soil mapping and pre-planting nutrient management, and sensor-based irrigation management. Although high value fruit industries invested substantial capital in expensive horticultural technologies such as engineered trellis systems, high density orchard plantings and high capacity sorting and storage equipment and facilities.

Tools and Equipment

1. Global Positioning System (GPS): It is a navigation system based on a network of satellites which helps users to record positional information such as longitude, latitude and elevation with an accuracy of between 100 and 0.01 m. Global Positioning System allows farmers to locate the exact position of field information, including soil type, weed invasion, pest occurrence, water holes, boundaries and obstructions. There is an automatic controlling system that have light or sound guiding panel (DGPS), antenna and receiver. GPS satellites broadcast signals which allow GPS receivers to calculate their position. The system allows farmers to reliably identify field locations so that inputs like herbicides, pesticides, fertilizers and irrigation water can be applied to an individual field, based on performance criteria and previous input applications.

2. Sensor technologies: Various technologies including electromagnetic, photoelectricity, conductivity and ultra sound are used to measure humidity, temperature, vegetation, texture, structure, physical character, vapour, air, nutrient level etc. Generally, remote sensing data are applied to distinguish crop species, identify pests and weeds, locate stress conditions and monitor drought, soil & plant conditions. These sensors enable the collection of immense quantities of data without any laboratory analysis. Further sensors presumable for remote sensing are light detection and ranging, ultra sound and texture-based image analysis. In citrus orchards in Florida, volume of tree canopy was measured by laser or ultrasonic scanner. Consequently, remote sensing can be applied for analysing variation of canopy considering spectrophotometric properties and morphology, in spite of we need proximal measurements to acquire information on the quality of the product.

3. Geographic information system (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. Generally, GIS links information in one place so that it can be extrapolated when required. Computerized GIS maps are different from conventional maps and contain various layers of information for example yield, crops, soil survey maps, rainfall, soil nutrient levels and pests). Geographic information system is a type of computerized map, but its main role is using statistics and spatial methods to analyse characters and geography. A farming GIS database can provide information about the filed topography, soil types, subsurface drainage, irrigation, chemical application rates, crop yield *etc*. Once analysed, this information helped to understand the relationships between the different elements affecting a crop on a specific site.

4. Grid soil sampling and variable-rate fertilizer application: Variable-rate technologies (VRT) are automatic and may be applied to various farming operations. This system set the rate of application of farm inputs on the basis of soil type noted in a soil map. Generally, information extrapolated from the geographic information system can control processes such as seeding, pesticide, fertilizer and herbicide selection and application at a variable quantity in the right place at the right time. Variable-rate technologies is the most widely used PFS technology in the United States. The goal of grid soil sampling (GSS) is a map of nutrient needs, called an application map. Samples should be collected for more than one place of a field which comes under the same range of yield, soil colour, etc. and thus the same zone. These samples are analysed in the laboratory, and an interpretation of crop nutrient needs is made for each soil sample. Then the fertilizer application map is plotted with the help of entire set of soil samples. The application map is loaded into a computer mounted on a VRT spreader. The computer uses the application map and a GPS receiver to direct a product-delivery controller which modified the amount and kind of fertilizer product, according to the application map.

5. Soil and plant sensors: The sensor technology is a very important component of agriculture technology and their use has been reported to provide information on soil properties, plant fertility and water status. A number of current sensors as well as desirable features for new sensors to be developed in the future. It is the one of the most popular ways to characterize soil variability is surveying the field with soil apparent electrical conductivity sensors which collect information continuously when applied over the field surface. Because electrical conductivity is sensitive to changes in soil texture and salinity. These sensors provide a very important baseline to implement site-specific management.

6. Rate controllers: Rate controllers are devices designed to control or mange the delivery rate of chemical inputs including fertilizers and pesticides, either granular or liquid. These rate controllers regulate the speed of the tractor or sprayer traveling across the field and also the flow rate and pressure (if liquid) of the material, which making delivery adjustments in real-time to achieved a target rate.

7. Precision irrigation in pressurized systems: Recent developments in sprinkler irrigation by controlling the irrigation machines motion with GPS based controllers are being released for commercial use. In addition to motion control, wireless communication and sensor technologies are being developed to monitor soil and ambient conditions, along with operation parameters of the irrigation machines such as flow and pressure to gain higher water application efficiency and utilization by the crop. These technologies show the huge potential but further development is needed until they become commercially available.

8. Software: Application of mechanization in horticulture, technologies will frequently require the use of software to carry out different tasks such as display-controller interfacing, information layers mapping, pre as well as post processing data analysis and interpretation, farm accounting of inputs per field, and many others. The most common are software to generate maps like yield and soil, software to generate variable rate applications maps for chemicals, fertilizer and lime, software to filtering collected data, software to overlay different maps and software to provide advanced geostatistical features. All are better options for mechanized horticulture farm management and record keeping to keep up with the needs of modern, information-intensive farming systems.

9. Yield monitor: Yield monitors are a combination of several components. They typically include various sensors and other components including a data storage device, user interface like display and key pad, and a task computer located in the combine cab, that controls the integration and interaction of such components. The sensors measure the mass or the volume, colour changes in fruits. In all yield monitors, Global Positioning System (GPS) receivers are used to record the location of yield data and create the yield maps. A yield monitor combining harvester and digital camera system was approached in blueberries by counting blue pixels in the images and also estimated apple yield by means of digital photography. RGB camera pictures in mid-July, after thinning and after the initiation of colour changing to red, to estimate yield of Gala apples with reasonable success.

10. Mechanical Harvester: A number of robotic pickers have been developed for high value row crops especially in Japan. These usually use machine vision to sense the colour, shape and location of the product before directing a robotic arm with a specialised end-effecter to pick the product. Mechanical harvesting of wine grapes has produced direct benefits and spin-offs for the industry. These include reduced harvest costs compared to hand picking, particularly of the key premium small bunched cultivars, capacity to harvest large quantities of grapes at night at low fruit temperature to preserve quality, capacity to harvest large areas and quantities of a single cultivar at optimal maturity, establishment of new orchard in areas where labour is not readily available and adoption of tall trellises and light pruning systems for mechanical pruning.

11. Mechanical Pruner: Adoption of mechanical pruning by hedging and minimal pruning was rapid in Australia in the 1970s. About 65% of wine grape vineyards are mechanically pruned leading to substantial savings in production costs. Hedging is also used for pre- pruning of spur-pruned vines where detailed hand pruning is required. In general, adoption of mechanical pruning systems across a wide range of environments has not had a negative impact on wine quality, except where cropping levels have exceeded the vine's capacity to adequately mature the crop or where the harvested fruit sample contains excessive amounts of debris causing difficulties in processing.

Challenges and Opportunity

There are some challenges for successfully applying technologies in horticulture crops such as complex plant structures, inconsistency in product shape and size, the delicacy of the products, and smaller economies of scale. But there are good opportunities, too. New mechanization-friendly orchard architectures are opening up the better possibilities for automation. For example, the SNAP architecture (Simple, Accessible, Narrow and Productive) represents these types of training systems that create a narrow two-dimensional canopy in which most of the branches and fruits are visible and accessible to machines. Besides, the availability of low-cost computational power, the recent development in robotics, and new sensor technologies show good promise in automating specialty horticultural crop production operations. These ongoing efforts such as automatic weeding in vegetable crops, mechanical fruits harvesting, mechanical blossom thinning and auto-guidance in orchards.

Advantage of Mechanization

1. Reduction in labour costs.
2. Saving of timer.
3. The more efficient centralized processing of the crops i.e. efficient use of production factors and reduction of emissions.
4. Improvement of working conditions.
5. Monitoring, grading, tracking and tracing during the production process for optimal product quality and safety.

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Conclusion

In conclusion, it can be seen that there are many factors that need to be taken into account when specifying a new technology. Generally, establishment and management costs are similarly high for fruit crops. Additionally, the lack of availability of seasonal labour in some area places further pressure on orchard profitability. Given such high management costs and value for high-quality products, there is substantial potential for horticultural technologies to improve labour and resource efficiency, horticultural practices, fruit quality, and profits.

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Tissue Culture Practices in Horticulture

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Background

Technological revolutions have changed m our lives in every field of life from livelihood, communications, and food habits. An important filed of life which has not seen technological revolutions to the extent as that of others in agriculture and now it's a time to innovate in these fields also. Scientist, Researchers, Agriculturists, Horticulturists, and Farmers have come up with innovative ways and ideas to bring some phenomenal changes in the field of agriculture but even there were some massive changes as that of the reputed Green Revolution, it has not been simple enough to meet the increasing demand of the growing world. Today's agriculture is on the edge of the agriculture revolution that was never witnessed before in the decades. The beginning of agriculture technologies with the advancement in genetic research and other biotechnological programs has bought new opportunities to mankind. Many of the uncontrolled problems have come to the human reach. Biotechnology is the broad area of biology that helps to manipulate the living cells and their molecules and that can be used to improve the crop production and other abiotic and biotic resistance of crops. The major techniques used in biotechnology are Tissue culture (one of the most widely used techniques) PCR (polymerase chain reaction), gel electrophoresis, cell culture, protein engineering, etc.

Introduction

Plant Tissue Culture, Cell Culture, or Micropropagation is a collection of biotechnological techniques used to grow the plant cells in the sterilized conditions to get the desirable traits or qualities in a short period. Nowadays it is the widely used method to produce clones through micropropagation in the controlled sterilized conditions. A single specimen plant is capable of producing the entire crop population. The parts taken from the mother plant is capable of producing a quick mature plant. The method greatly reduces the chances of transmitting disease and other pathogens. The explants can be taken from the shot tip, leaf, stem, flower bud, lateral bud, root tissues, etc. the technique relies on the ability that many plant cells can regenerate into the whole plant. This ability of plants is known as totipotency. In -vitro conditions are provided to get the optimum pre-requisite plant growth. The regeneration ability of the ex-plants helps it to initiate multiply and root thus producing a cell into a mature plant. The prepared plantlets are later on hardened in the climatically controlled conditions that are in greenhouse or polyhouse etc. depending upon the type of plant species become ready for planting in the varying time frame. This technique of plant propagation is easy and reliable also reduces the labour requirement and the time-space. The new varieties used by this method can help to increase production rates.

Scientists have been experimenting to make evolution in the micropropagation technological program. The experiments have been conducted by scientists in various horticultural crops such as coconut, palms. Mango, orange, etc. tissue culture has also bought a scope to propagate fine varieties of flowers and other fruit trees. The plants that are sterile or do not propagate easily can be multiplied by tissue culture techniques. Commercialization by this method has already taken place. In crops such as Ornamental crops Orchids, Gladiolus, Gerbera, Carnation, etc. have been grown commercially. And in the case of fruit crops such as Bananas are propagated by tissue culture method. Eucalyptus and teak among forest trees are also grown commercially by the tissue culture method. The technological advancement has also reached to the medicinal plants. Biotechnology is the area with huge potential and is expanded to the diverse sciences of health and agriculture and has tremendous potential for food, fibre medicine, etc.

Micropropagation

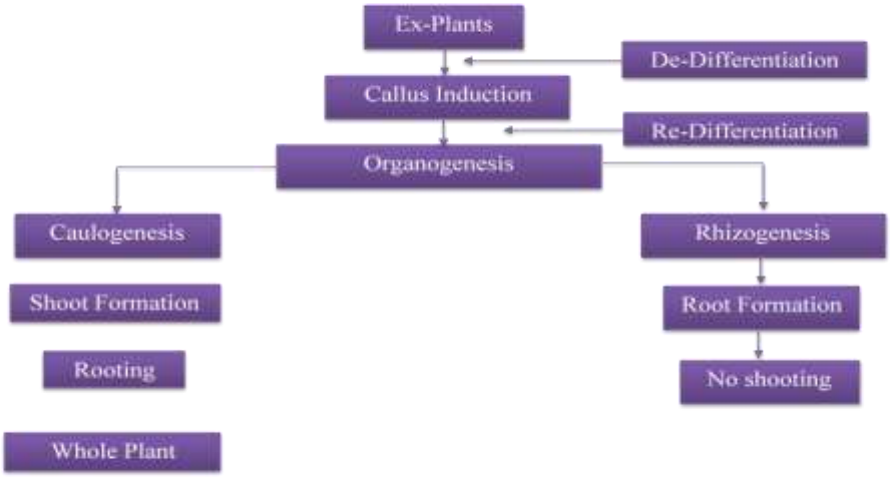
Micropropagation is the method of producing numerous progeny plants from a single plant. The single cell of the plant by providing the optimum conditions can be grown into the full-fledged plant. The whole process takes place with many metabolic events and facilitates the production of a new plant from a single cell of the old plant. The events that take place during the whole process are:

Differentiation: In biological terms, differentiation can be used in various senses. The differentiation can be defined as the process in which a distinct type of cells arises from the precursor cell and mature or become different from one another. The meristematic cells get converted into more types of cells, tissues, and organs are later differentiated from each other to form a new plant.

De-differentiation: It refers to the transformation of cells into the highly organized tissue or the unorganized tissues into the organized tissues.

Re-differentiation: It is the process of differentiation occurring in the undifferentiated tissues.

Regeneration: The plants can regenerate or can form into the entire new plant from the single callus culture known as regeneration. The plant part that is removed physiologically or is isolated has this ability to regenerate. It is the genesis of the plant to develop from the single callus culture is called regeneration.



Morphogenesis: It is defined as the biological process that causes the organization of cells, tissue, or organism to develop its shape or form is referred to as morphogenesis. The morphogenesis under in vitro environment can be achieved by two routes: de novo origin of the organ primordia is differentiated to form the shoots or roots from the cultured tissue is termed as organogenesis. and de novo and formation of the embryos with the distinct roots and shoot poles lie on the opposite ends formed by somatic cells cultured in vitro known as somatic embryogenesis. The seed coat or endosperm is not formed in somatic embryogenesis.

Organogenesis: It is defined as the means of development or formation of adventitious organs or primordia from the undifferentiated mass of cells. Organs in plants such as root, shoot, leave flowers, etc. The first report of induction in shoot organogenesis in vitro was by White (1939) utilizing a tobacco hybrid; and the first root formation in carrot callus was observed by Nobecourt (1939). The regulatory mechanism behind the science of organogenesis was not identified until the late 1950s. Skoog and Miller (1957) experimented on the chemical that controls the new shoot formation in the pieces of tobacco stems grown in culture. They recognized the regulatory mechanism of the balance between auxin and cytokinin. In their research, they concluded that a high level of auxin with as compared to cytokinin favored the root formation whereas the reverse favoured the shoot formation in plants. Utilizing this concept, it has now become easy to achieve organogenesis in a large number of plant species by culturing the explants, calli, and cell suspension in the definite medium. In organogenesis, the shoot or root may form first reliant upon the nature of growth hormones in the basal medium. The start of shoot and root from the explants or callii is termed as caulogenesis (caulm = stem) and rhizogenesis (Rhizo = root) respectively.

Type of Culture

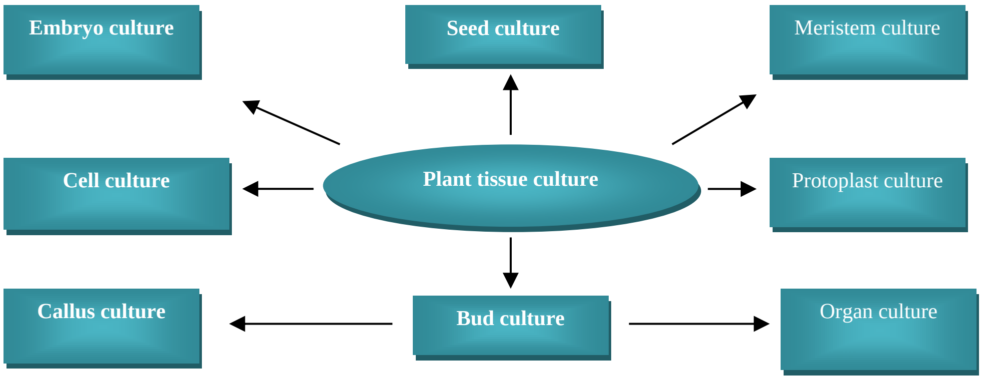


Fig.1 Various types of plant tissue cultures

Callus Culture

A callus is an undifferentiated mass of mainly unorganized plant cells. The callus culture is composed of parenchymatous cells that undergo division. When the media of explants is cultured with a sufficient number of auxins it results in a culture that produces a mass of cells in the explant's surface. Auxin concentration varies with the type of explant. It mainly depends on the physiological state of the explant tissues. Callus can be maintained for a very long time by alternating sub-culturing to a new medium. Callus cultures can be used for different purposes by changing the hormone concentrations in the media be it for the regeneration of plantlets, preparation of single cells or suspension cultures, or for protoplasts preparation and genetic transformation studies. In various cases, it becomes a compulsion to go through a callus phase before regeneration via somatic embryogenesis or organogenesis. Cultures are also suitable for somaclonal variants generation (genetic or epigenetic) and can also be used in the case of in vitro selection of cells and tissue variants. The callus is grown after that on a new medium which is known as subculturing. An S-shaped or sigmoid pattern of growth of callus culture is obtained when subculture regularly on agar medium.

There are five phases of callus growth:
1. Preparation of cell division (Lag Phase).
2. Highest cell division stage (Exponential Phase).
3. The rate of cell division gets slow but the rate of cell expansion gets increased (Linear phase).
4. A decrease in rates of cell division and elongation (Deceleration phase).
5. Constant number and size of cells (Stationary phase).

The growth of the callus can be monitored by various fresh weight measurements, which are more convenient while observing the growth of cultures over time in a non-destructive manner. Generally, weight measurements based on dry weight give more accuracy than fresh weight measurements, but at the same time, this method requires the sacrifice of various sets of samples. Measurement-based on the mitotic index of cell division rates requires an extensive sampling for reducing error in sampling and at the same time are not feasible to perform.

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Production Technology of Radish (*Raphanus sativus* Linn.)

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Botanical name: *Raphanus sativus* Linn.
Family: Cruciferae.
Chromosome number: 2n= 18.
Origin: Probably China and India.

Introduction

Radish is a quick growing vegetable. It is very easy to cultivate and best suited to grow as inter-crop and catch crop. It can be grown even on ridges of the beds; this way vacant area can be utilized profitably. The tops (leaves) and roots are used as salad or cooked as vegetable in various ways. The leaves are rich in minerals and vitamins A and C. The pods of radish are also used as vegetable which is favourite vegetable in U.P. and Punjab states of India. Seeds are used for non-drying fatty oil which is suitable for soap making, illuminating and also for edible purpose. Radish increases appetite. It has cooling effects. It prevents constipation. It is good for patients suffering from piles, liver trouble, enlarged spleen and jaundice. Pungency in radish is due to volatile isothiocyanates. Pink colour is due to anthocyanin. The fleshy root of radish is modified root (fusiform) develop from both the primary root and the hypocotyl.

Climate

Radish is a cool season crop; suitable temperature is between 10^{o} C and 15^{o} C. However, different range of temperature that is why varieties are grouped as temperate and tropical types.

Soil

Radish can be grown on a wide range of soil but a light, friable, moist soil is the best. Heavy soil produce roots of poor quality i.e. roots become rough, misshapen with a greater number of fibrous roots. Radish is moderately tolerant to acid soil (pH 6.8-5.5). Soil should be well prepared by digging deeply and making friable. It is better if there is no clod, stone, weed plant in soil. In case if it is essential to grow radish on heavy soils, then an adequate amount of sandy soil should be added during the land preparation. In order to provide equal distribution of irrigation water and to avoid water stagnation in the field, levelling seems to be an essential operation.

Improved Varieties

Radish varieties are of mainly two types.
1. Temperate types: White Icicle, Scarlet Globe, French Breakfast, Rapid Red, White Tipped, Pusa Himani.
2. Tropical types: Japanese White, Pusa Mridula, Pusa Desi, Pusa Chetki, Pusa Rashmi, Arka Nishant.

Besides, there are several other varieties under cultivation. They are: Newari, Jaunpuri Giant (root may grow more than one metre long and weight up to 5-15 kg or so), Kannauji, Long White, Long Rose, Baramasi, Black Spanish, Yellow Gold, Bombay Red, Chinese Rose, Contai.

Baramasi is suitable for growing throughout the year, though yield varies with the season. In order to use long thin, immature radish pods as vegetable which is a delicious dish in Punjab and Haryana, the rat-tail radish (Sengri or Mongri) (Raphanus sativus var. caudatus) is cultivated.

Manure and Fertilizer

Well rotten compost or leaf mould should be incorporated at least 3 weeks before sowing the seeds. It should be remembered that undecomposed organic matter should never be applied because it may result in forking of the radish roots. Fertilizer mixture should be applied before sowing and raked/mixed in the soil. Nitrogen 80-100 kg, phosphorus 40-60 kg and potassium 80-100 kg per hectare should be applied depending upon initial fertility of soil, climatic condition, variety etc.

Method of Sowing

Radish is sown directly in the field. The seeds are drilled 1.25 cm deep at 6 to 8 cm between the plant and 30 to 45 cm between rows on well levelled field. The temperate types are early and having less growth, therefore, they should be sown closely whereas tropical types take longer duration and having more foliage and root growth should be planted at wider spacing. Seeds are sown thinly overcrowding leads to foliage rather that roots growth. After sowing, cover the seed properly with rake and if necessary, tamp down the soil with the head of a rake, so that the seeds become in the contact with the soil.

Time of the Sowing

Radish can be grown throughout the year except during very hot season and heavy rainfall. However, sowing of winter crop is done in the month of August-September and for spring season crop, it is done in December-January.

Seed Rate

In order to sow one-hectare area about 8 to 10 kg healthy seed of tropical types and 10-12 kg seed of temperate types is required.

Irrigation

Adequate soil moisture will enhance quick germination of seeds. Seed germinate within 4-5 days under normal condition. Pre sowing irrigation is better for rapid germination. Irrigation can also be given immediately after sowing. This can only be done when soil is light. It is not advisable to do irrigation in heavy soil after sowing because the soil surface becomes dry with hard soil crust which hinders in coming out the sprouts. Subsequent irrigations should be done at frequent intervals as radish requires moist soil for its proper development of roots.

Thinning
In order to provide proper plant spacing additional plants should be thinned as soon as they are large enough to handle.

Weeding and Earthing Up
Shallow hoeing will keep down the weeds and will provide good condition for root development. Radish crop is quick growing and competes with weeds due to its shading effects of canopy many weeds do not grow, if somehow other weeds grow by that time radish becomes ready for harvesting. Sometimes, large verities need earthing up which will help to prevent radish root from greening effect.

Harvesting
The method of harvesting is very easy. Prior to harvesting, light irrigation is given, it will soften the soil. The roots are pulled out along with the tops and washed in running water. After cleaning they are packed for the market. Tropical types are ready in 25-30 days after sowing and mostly temperate types are ready for harvesting from 45-60 days. The harvesting of radish should be done when the roots are still tender. Delayed harvesting may cause pithiness and such roots become unfit for consumptions.

Yield
Yield varies according to the types. European varieties (temperate types) yield about 60 to 80 quintals per hectare, whereas the Asiatic varieties (tropical types) yield about 150-350 quintals per hectare. Besides types of cultivar, the yield may very due to soil types, climatic conditions management practices etc.

Storage
Radish roots can be stored under ordinary conditions for 3 to 4 days. However, under cold storage at 00C and 90 to 95 percent relative humidity for about two months.

Insect-Pest
1. Aphid: Aphids are the most important insects harming radish crop.
Control measures: Remove and destroy the affected plants parts. Spray with Nicotine sulphate or Malathion (0.01%) or Yellow sticky trap. Harvesting should be done after 7-10 days of insecticides application.

2. Flea beetle: Flea beetle attack leaves and makes small circular holes until they are skeletonised and lack like. They are active in sunny weather during spring.
Control measures: Remove weed hosts. Fallow phytosanitary measures. Spray Malathion (0.15%) or sevin (0.4%) at 10 to 15 days intervals.

3. Mustard sawfly: The affected leaves and fruits show holes. It appears late during the crop season.
Control measures: Follow hand picking in kitchen garden. BHC dusting at the rate of 20 to 25 kg per hectare. Spray carbaryl (0.2%) or Malathion (0.05%).

Diseases
1. Dumping off:
Control measures: Sow the seed thinly. Thin out the seedlings it they are crowded. Avoid sowing in very wet condition. Sown the seed after treatment with thiram or captan at @ 2g/kg of seed.

2. White rust:
Control measures: Avoid crowding of plants by the seeds sparsely and by thinning out the week seedlings. Remove the weeds and spray Dithane M-45 at 0.2 % or Bordeaux mixture at 0.8 percent.

3. Alternaria blight:

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Control measures: Use disease free seed. Treat the seed with hot water at 500C for 30 minutes. Spray with Blitox 50 or Copper Oxychloride (0.5%) and follow crop rotation.

4. Radish mosaic virus (RMV):

Control measures: Remove weeds plants. Spray Rogor 30EC at 0.06% at regular intervals to control aphids which are vector of the disease.

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NGS Technologies for Crop Improvement

Article ID: 32265

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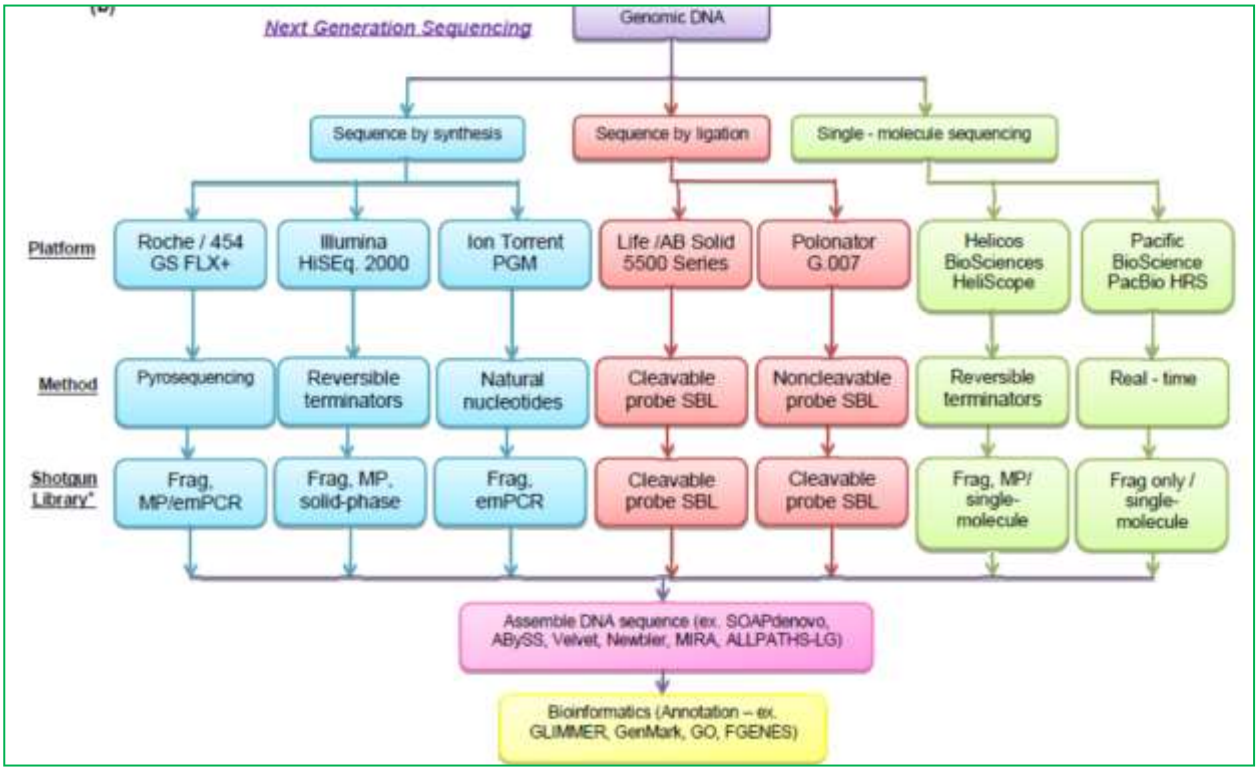
Introduction

Sanger-based methods are not suitable for analyzing massive numbers of samples, also has limitations. Next-generation sequencing tools developed to sequence large numbers of samples at a lowest cost with lower time. Genome Sequencer was the first commercially available next-generation equipment introduced by Roche Company. Next, Genome Analyzer introduced by Solexa Company. The third NGS instrument was invented by Applied Biosystems company i.e., SOLiD (Sequencing by Oligo Ligation and Detection). Unlike next-generation sequencing, third-generation sequencing devices do not require the amplification of a DNA sample. While next-generation sequencing generates short reads a few hundred base pairs long, but, the third-generation equipments can produce over 10 000 bp reads, generates highly accurate de novo assemblies and more contiguous reconstruction of the genomes with a high content of repetitive elements (David and Jana 2017). The most advanced sequencing technologies till to date included Ion Torrent and nano ¬pore sequencing by Oxford Nanopore Technologies. These NGS tools utilizing diagnosis of genes involving human diseases, metagenomics, epigenetics forensic purpose. In crop improvement NGS techniques serve for crop reference genomes, transcriptome studies to know the gene expression, development of whole-genome molecular marker and identification of markers for known-functional genes.



Development of Molecular Markers

There are many types of molecular markers, but single-nucleotide polymorphisms (SNP) and simple sequence repeats (SSR) are the most widely used in plant breeding. Mining of molecular markers through NGS was originally limited to model species of *Arabidopsis* and rice. Molecular markers have been gradually discovered even in species without reference genomes, for example in durum wheat, common bean etc. A new approach to searching SNPs in crops like chickpea called as coverage-based consensus calling (CbCC).

It consists of four freely available tools for local alignment: Maq, BowTie, Novoalign, and SOAP2. NGS offers several approaches that are capable of simultaneously performing genome-wide SNP discovery and genotyping in a single step. A new technique known as genotyping-by-sequencing has been developed as a rapid and robust approach to sequencing of multiplexed samples. It combines genome-wide molecular marker discovery and genotyping. Its cost-effective nature makes GBS an excellent tool for many applications in breeding in as much as it can genotype thousands and even hundreds of thousands of SNPs in crop genomes and populations and then identify SNPs correlated with traits of interest. Thus, marker-assisted selection widely applied to enhance crop yield, quality and tolerance to biotic or abiotic stresses.

Construction of Reference Genome

A reference genome sequence is an important tool to study genome structure and function, to guide the genome assembly of closely related species. The reference genome sequences provide the mining of large amounts of molecular markers and candidate genes. Resequencing projects are useful for pre-breeding activities and to identifying genomic variations. Nearly more than 100 plant species have been sequenced into reference genome sequences. The plant genomes consist of high content of repetitive elements due to the high copy number and amplifying nature of transposable elements. This complexity of the genomes had been a problem for a long time and it needed to be reduced involving sequencing library with partial representation of the genome using capturing sequences without enzyme digestion (Ray & Satya 2014).

Transcriptome Studies

RNA-sequencing (RNA-seq) is consists of converting RNA molecules to a library of cDNA fragments with adaptors, these fragments are sequenced and the resulting reads are either aligned to a reference genome, or assembled de novo (Wang et al. 2009b). RNA-seq is used to obtain expressed sequence data in a specific tissue within a defined time. To study large and complex genomes De novo transcriptome assembly by using NGS data is a boon . Roche technology was successfully used in sequencing a series of non-model plants, like bread wheat cultivar Yunong 201 (Zhang et al. 2016). In addition to Sanger sequencing technique associated with the identification of expressed sequence tags. Data acquired by RNA-seq are universal. Furthermore, they can be used in gene characterization (Dassanayake et al. 2009) and molecular marker development.

Identification of Functional Expressed Genes

NGS technologies and RNA-seq aids in study of gene expression, which is becoming an important tool for plant breeding and identification of genes of interest controlling defence mechanisms against biotic and abiotic stresses. A study focused upon the pathogen *Puccinia striiformis*, which causes extensive damage in wheat, used RNA-seq to find genes encoding proteins and which may be useful in breeding wheat varieties resistant to this pathogen (Garnica et al. 2013). Soil salinity is becoming a major problem, several studies to discovering a molecular mechanism of salt tolerance in plants. Such a mechanism was ascertained for example in soybean, cotton.

Epigenetic Regulation

Epigenetic changes are responsible for alternations in gene regulation. Epigenetics includes some stable changes in the structure of proteins (prions), expression of small RNAs and modification of chromatins i.e. DNA methylation and adjustment of histone tails like in the cases of acetylation, methylation, ubiquitination, and phosphorylation. The NGS technologies made a breakthrough in studying epigenetics, and these technologies have become important tools for ChIP-seq when high coverage of sequence reads is required. Illumina technology was used in an extensive study of organ-specific epigenetic modifications and their impacts on mRNA and sRNA in maize.

Conclusion

In the recent years, NGS has provided the development of methods to genotype large numbers of single-nucleotide polymorphisms. Genotyping- by-sequencing and whole-genome resequencing can aids in the mining of molecular markers for studies of genetic relationships among breeding materials, construction of genetic mapping of targeted genes and genome-wide association studies. Next -generation sequencing (NGS) technologies have changed the pattern of sequencing of crop genomes and gene regulation. Now adays, NGS techniques gaining popularity in metagenomic and agrigenomic research due to their utilization in plant breeding. RNA-sequencing and subsequent expression analyses reveals beneficial information about gene regulation on the cellular and whole-plant level through this we can obtain the genes involving in plant defence mechanism to biotic and in abiotic stress tolerance. Plant genotyping through NGS can help in plant breeding through selection of individuals resistant to climatic stress and to biotic agents.

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Mealy Bug of Brinjal and their Management

Article ID: 32266

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Introduction

Mealy Bugs *(Coccidohystrix Insolita)* is a very common pest of families Malvaceae and Solanaceae as well. The insect is polyphagous in nature and they feed on wide range of host plants of Malvaceae, Solanaceae and Leguminosae families. It is a sucking type pest and they suck the plant sap by inserting their mouth parts in the tender foliages of the plant. They are wingless, soft, small pests and covered by a white waxy material. They can also see as in clusters of white cotton aggregates below the leaf surface. Generally, they do not cause in plants but they ground the curling and yellowing of leaves due to their sap sucking habits.

Biology

1. Mealy Bugs can be easily identified by the presence as of white cotton with soft bodied.
2. The females bugs lay about 200-300 eggs and incubates it for about 4 to 5 days Fig. A.
3. Groups of bugs can be seen below the surface of leaves Fig. B.
4. They are covered by white mealy wax.
5. After 22 to 25 days they become adult; passing through three nymphal instars stages.
6. The first instar nymph are light yellow in colour which turns greenish and then darker with next instar stages.
7. The adults are soft and covered by white or greyish waxy like substances.

Fig.: A.

Fig.: B.

Damage Symptoms

1. They suck the sap of plant leaves, tender shoots, and the fruits at both nymphal and adult stage.
2. They cause discoloration as well curling of leaves Fig. 1.
3. At initial stage they are found in large groups of white cottony bugs aggregated below the leaf surface and later they spread to entire plant Fig. 2.
4. If the insect attacked on flower blooms, the fruit set of plant is affected and the production can also be affected Fig. 3.
5. Generally they secrete waxy like sticky & sweet substances which results in growth of black sooty mould fungus.

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Fig.: 1.

Fig.: 2.

Fig.: 3.

Management

1. If the small area gets affected by this insect then remove the affected leaves and either burn them or burry them in soil.
2. Natural predators like ladybirds' beetles can be released in infested plant as biological control.
3. By using forceful stream of water on the leaf surface can also helpful to remove the bugs from the leaf surfaces.
4. Spray of insecticides like Monocrotophos @ 1.5ml/liter or Methyldemeton 25 EC @2ml/liter at 15 days intervals.

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Crop Doctor-Efficient Component of Agri Expert System for Crop Protection

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Introduction

An Expert System is a computer program that stimulates the judgment and behaviour of a human (or) an organization that has expert knowledge and experience in a particular field. It is program that emulates the interaction a user might have with a human expert to solve a problem. An Expert System is a problem solving and decision-making system based on knowledge of its task and logical rules or procedure for using knowledge. Both the knowledge and the logic are obtained from the experiences of a specialist in the area. Expert System are recognized as an appropriate technology because they address the problem of transferring knowledge and expertise from highly qualified specialists to less knowledgeable personnel. In agriculture, this transfer is always taking place from research to extension, from extension to farmers, and even from farmers to farmers. Expert system present excellent tools for relieving the increasing pressure on the limited expertise available in developing nations.

Expert System for Agriculture

The complexity of problems faced by the farmers are yield loses, soil erosion, selection of crop, increasing chemical pesticides cost, pest resistance, diminishing market prices from international competition and economic barriers hindering adoption of farming strategies. Expert System are computer program that are different from conventional computer programs as they solve problems by mimicking human reasoning process, relying on logic, belief, rules of thumb opinion and experience. In agriculture Expert System are capable of integrating the perspectives of individual disciplines such as plant pathology, entomology, horticulture and agricultural meteorology into a framework that best address the type of ad hoc decision making required of modern farmers. Expert system can be one of the most useful tools for accomplishing the task of providing growers with day to day integrated decision support needed to grow their crops.

Components of the Expert System

The home page of the expert system has three important components viz., Information System, Decision Support System, Diagnosing System (Crop Doctor):

1. Information System: Information system is web based static information wherein all the technological and complementary information from A to Z about the crop are pooled and loaded in this component. It is a ready reckoner and user-friendly navigation with image-based presentation, up scaling and updating the content at any time. The static information system is highly useful for the extension officials, scientists, policy makers and administers.

2. Decision Support System: Decision support system is a computer-based information system including knowledge-based system that support decision making activities. A decision is a choice between alternatives based on estimates of the values of those alternatives.

Accordingly, the DSS has been contemplated and designed to get best possible options and decision by farmer themselves for the day today agriculture operation. Customized tools such as Menus, Popup Windows, drop down Boxes or inter-related Multiple Combo Boxes, Video Plug-ins etc., were incorporated using Dot net programme.

The Decision Support System is consisting of details about Season, Climate, Variety, Nursery Management, Cultivation Practices, Irrigation Management, Nutrient Management, Crop Protection, Farm Implements, Post-Harvest Technology, Marketing, Institutions, Schemes and FAQ‟s.

Crop Doctor (Diagnosing System)

Crop doctor is a vital component in the Expert system which acts as artificial intelligence. It is picture and image based „if and then rule‟ based programme which has written using Dot net programme. It deals with diagnosing the pest, disease and nutritional disorders affecting the selected crops. The first obvious sign is given as thumbnail images in the Key Visual Symptoms (Primary Symptom) with multiple sub levels (Secondary Symptoms). Farmers by selecting the symptoms, they will make a conclusion on the causes for the damage, identification of pest or pathogens, nutritional disorders and control measures to be taken in the field. ¨ In crop doctor component of expert system, major pests, diseases and deficiency disorders were included. ¨ Regarding management, different control methods like cultural, Biological, Physical and IPM.

Segments of Crop Doctor

In crop doctor component of Expert System, three segments such as:
1.Symptoms of damage
2. Identification of pest or pathogen
3. Control measures are given after diagnosing the problem.

Identification of Pest or Pathogen: In crop doctor component, after diagnosing the reason behind the problem, user may want to know the details about the causal agent. For this reason, morphological descriptions about pest or pathogen, its life stages, conditions favouring its multiplication, longevity, its resistance or susceptibility to a particular problem are documented both in words and as visuals.

Management of Pest or Pathogen

This is the most valuable part of crop doctor. While developing management strategy, user has to select different methods that are readily available, economical and applicable at field level. To cater the needs of different critical stage of affected crop, various methods like cultural method, chemical method, biological methods, trap method, preventive method and eco-friendly methods are given in detail with relevant and suitable visuals. User can select a method according to the situation. By having the choices for control measures, selection of method may be decided by pest economic status. This will help to reduce the cost of cultivation and thereby increase the farm income. Real videos and visuals for management of pest or pathogen were added with specific video icon buttons.

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Genesis and Characteristics of Acid Soil

Article ID: 32268

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Introduction

Acid soil is a base unsaturated soil which has got enough of adsorbed exchangeable H+ ions so as to give soil a pH lower than 7.0.

Genesis of Acid Soils

1. Leaching due to heavy rainfall: Acid soils are common in all regions where rainfall or precipitation is high enough to leach appreciable amounts of exchangeable bases (Ca^{2+}, Mg^{2+}, Na^+ and K^+) from the surface soils and relatively insoluble compounds of Al and Fe remains in the soil. The nature of these soils is acidic and its oxides and hydroxides react with water (H_2O) and release hydrogen ions in solution and soil becomes acidic. As the soil gets gradually depleted of its exchangeable bases through constant leaching, it gets desaturated and the exchange complex is saturated with H+ ions of the carbonic acid.

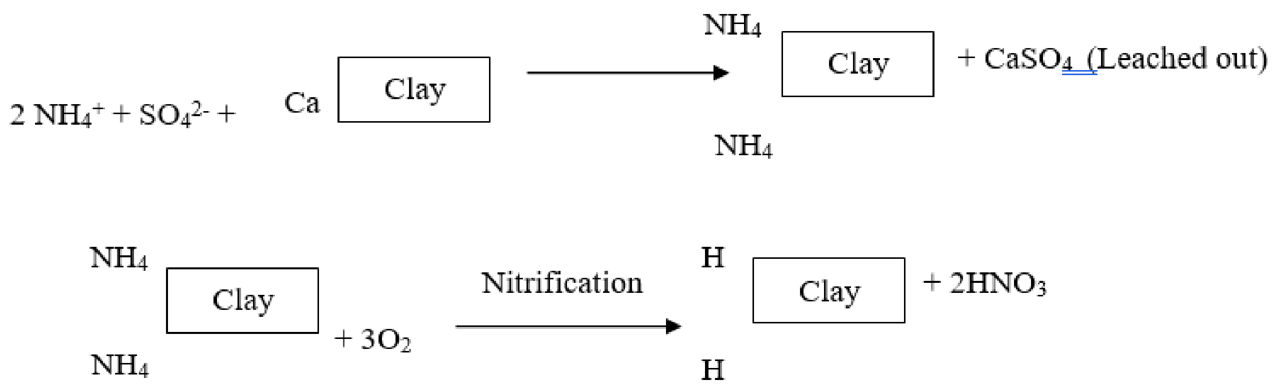
$$CO_2 + H_2O \longrightarrow H_2CO_3$$

$$H_2CO_3 + CaCO_3 \longrightarrow Ca(HCO_3)_2 \text{ (Leachable)}$$

2. Acidic parent material: Some soils developed from acidic parent materials like granite and gneiss may develop soil acidity.

3. Acid forming fertilizers and soluble salts: The use of acid forming fertilizers like ammonium sulphate $(NH_4)_2SO_4$ and ammonium nitrate NH_4NO_3 increases soil acidity. Ammonium ions from (NH4)2SO4 when applied to the soil replaces calcium (Ca^{2+}) ions from the exchange complex and the calcium sulphate formed is finally leached out.

$$(NH_4)_2SO_4 \rightleftharpoons 2\,NH_4^+ + SO_4^{2-}$$



Acid soil

Similarly sulphur also produces acid forming sulphate ion through oxidation. Divalent cations of soluble salts have a greater effect on lowering soil pH than the monovalent cations.

4. Humus and other organic acids: Decomposition of organic matter releases weak organic acids, which is capable of solubilizing bases resulting in increased acidity.

5. Aluminosilicate minerals: At low pH values most of the aluminium (Al) is present as the hydrated aluminium ions (Al^{3+}) which undergoes hydrolysis and release hydrogen (H^+) ions in soil solution.

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$$Al^{3+} + H_2O \rightleftharpoons Al(OH)^{2+} + H^+$$

$$Al(OH)^{2+} + H_2O \rightleftharpoons Al(OH)_2^{+} + H^+$$

$$Al(OH)_2^{3+} + H_2O \rightleftharpoons Al(OH)_3^{+} + H^+$$

$$Al(OH)_3^{4+} + H_2O \rightleftharpoons Al(OH)_4^{+} + H^+$$

6. Carbon dioxide (CO_2): CO_2 evolved from root activity and microbial metabolism combines with H_2O to form H_2CO_3 resulting in soil acidity.

7. Hydrous oxides: The oxides of iron and aluminium under favourable conditions undergo stepwise hydrolysis with the release of hydrogen (H^+) ions in the soil solution and develop soil acidity.

8. Aluminium and iron polymers: The Al^{3+} ions displaced from clay minerals by cations are hydrolysed to monomeric and polymeric hydroxyl aluminium complexes.

Kinds of Soil Acidity

1. Active acidity: It is defined as the acidity that develops due to hydrogen (H^+) and aluminium (Al^{3+}) ions in the soil solution. The magnitude of this acidity is limited.

2. Exchange acidity: It is defined as the acidity that develops due to adsorbed hydrogen (H^+) and Aluminium (Al^{3+}) ions on the soil colloids. The magnitude of this acidity is very high. It is also called potential / reserve acidity.

3. Total acidity:

The summation of active and exchange acidity is called total acidity.

Total acidity = Active acidity + Exchange acidity.

Distribution of Acid Soils

Out of 157 m.ha of cultivable land in India, 49 m.ha are acidic, if which 36 m.ha have soil pH less than 5.6 and the rest 13 m.ha have soil pH in the range of 5.6 to 6.5. In Tamil Nadu, acid soil occupies nearly 2.6 M.ha, predominantly found in the hilly areas of Nilgris and Kodaikanal, high rainfall zone of Kanyakumari districts and parts of Pudukottai, Sivagangai, Cuddalore and Vilupuram districts.

Broadly acid soils of India can be classified into seven distinct groups viz.,
1. Laterite.
2. Laterite and Lateritic red.
3. Mixed red, black and yellow.
4. Ferruginous red.
5. Podsolic brown forest and forest soil.
6. Foot hill soils.
7. Peat soils.

Problems of Soil Acidity

1. Acid toxicity: The acid toxicity includes toxicities of acidic anions as well as H^+ ions.

2. Toxicity of nutrient elements:

a. Iron and Manganese: The concentration of these two ions (Fe^{2+} and Al^{3+}) in soil solution depends upon the soil reaction. The nutrient elements viz., Mn^{4+} and Fe^{3+} reduce to Mn^{2+} and Fe^{2+} respectively and their concentration is increased to toxicity levels. Due to such toxic effects, a physiological disease of rice is found in submerged soils which is popularly known as *browning disease*.

b. Aluminium: The toxicity of aluminium tends to decrease with an increase in concentration of other cations such as calcium. Aluminium toxicity is a problem in both upland and lowland soils.

3. Nutrient availability:

a. Non-specific effects: It causes inhibition of root growth and thereby affects the nutrient availability.

b. Specific effects:

i. Exchangeable bases: Due to complementary ion effect, exchangeable bases are released preferentially in a fractional exchange. Deficiency of bases like Ca^{2+} and Mg^{2+} are found in acid soils.

ii. Nutrient imbalance:

- Phosphorus reacts with iron, aluminium and manganese and produces insoluble phosphatic compounds rendering phosphorus unavailable to plants.
- Availability of phosphorus is reduced due to fixation of phosphorus by hydrous oxides of iron and aluminium or by adsorption.
- Molybdenum is very limited and is unavailable to plants.
- Availability of boron is also reduced due to adsorption on sesquioxides, iron and aluminium hydroxyl compounds.
- Nitrogen, potassium and sulphur become less available in a soil with pH less than 5.5.

4. Microbial availability: Bacteria and Actinomycetes function better in soils having moderate to high pH values. They cannot function at a pH below 5.5. Nitrogen fixation in acid soils is greatly affected by lowering the activity of *Azotobacter* spp. Besides these, soil acidity also inhibits the symbiotic nitrogen fixation by affecting the activity of Rhizobium sp. Fungi can grow well under very acidic conditions and causes various diseases like root rot of tobacco, blight of potato etc., However potato scab (caused by Actinomycetes) is not prevalent under acidic environment.

Use of Plastic Mulch in Agriculture and Strategies

Article ID: 32269

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Abstract
The excessive use of plastic in modern agriculture is threatening the overall sustainability of our ecosystem due to persistency of residual plastic residues in both terrestrial and aquatic environments. A key components of crop production (including crops, soil and water) and even human beings are all extremely vulnerable to this menace of plastic pollution. Lack of viable alternatives for conventional polyethylene (PE) film which is the predominant type currently used as mulch; has made the scenario even worst. Biodegradable mulch (BDM) films have the potential to ameliorate the problem of residue accumulation of PE plastic film in soil. But non-affordable price and lower reliability of consumers coupled with lack of aesthetic value in the field are some of the main hindrances, hampering wider acceptability of BDMs. various options that could possibly unravel the underlying mechanism of biodegradation and help in developing cost effective BDMs as complete replacement for the extensive use of PE film in current production systems.

Introduction
Plastics have become one of the most ubiquitous materials used globally since their production started in 1930s and 1940s (Jambeck et al., 2015; Heidbreder et al., 2019). Currently, there is no other alternative which possesses such a wide range of useful traits and can be as efficiently brought into so many conceivable and plausible forms. The biggest producer of plastic is Asia; contributing more than half of the world's plastic production. While the shares of Europe, North America, Middle East, Africa, Latin America and CIS (The Commonwealth of Independent States) are 18.5%, 17.7%, 7.1%, 7.1%, 4% and 2.6%, respectively. China is by far the main plastic producing country, occupying nearly 29% of the total global plastic production (Fig. 1), which may remarkably surpass 500 million Mt. by 2050 (Sardon and Dove, 2018). Plastic itself is not a problem, neither is its use, but the end products can have devastating effects.

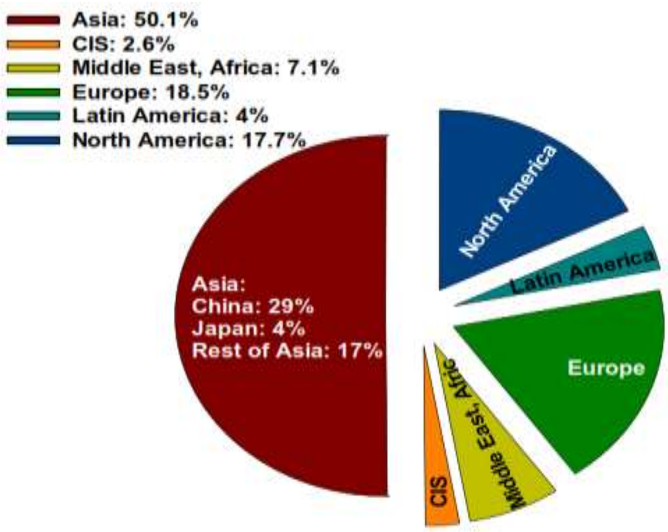

Fig. 1 Global plastic production from 1950 to 2017 and distribution of global plastic production among Asia, CIS (The Commonwealth of Independent States), Middle East, Africa, Europe, Latin America and North America in 2017.

The increasing trend of plastic production worldwide can be attributed to the increasing demand across several key sectors such as packing, automobiles, health and agriculture. Considering the large-scale use of plastic in agriculture a term "plasticulture" has been coined which refers to the use of plastic products in agriculture. A wide range of plastics are used in agriculture currently, including, Polyolefin, PE, Polypropylene (PP), Ethylene-vinyl acetate copolymer (EVA) and Poly-vinyl chloride (PVC), etc.

Plastic Film Mulch

Anything that is applied to or grown on the surface of soil, in contrast to amendments (which are substances mixed in the soil profile) is known as mulch. Mulch can improve the environment around a crop by regulating solar radiations on surface of soil and hydrothermal status of the soil which in turn increase crop productivity, water use efficiency (WUE) and economic returns (Yang et al., 2015). Conversely, soil without mulch is prone to serious problems such as particle detachment, surface sealing, crusting, and compaction.

Advantages of Plastic Mulch

1. Protection against weeds, pests and diseases.
2. Water conservation and high WUE.
3. Soil conservation.
4. Microbial diversity.
5. Better micro-environment for the crop.
6. Higher yield and better quality.
7. Reduced GHGs emissions.
8. Economic returns of plastic film mulch.

Limitations and Concerns of Plastic Film Mulch

The effects of plastic pollution have already become apparent as plastic debris can be seen everywhere. Reuse of plastic products is generally encouraged and considered quite effective in minimizing the potential risk associated with its residues.

1. Environmental concerns: Polyethylene film mulch is made of non-renewable, petroleum-based materials, and has an operational lifetime span of usually one growing season before it is disposed. Plastics debris obtained from degradation of such film mulches are not eco-friendly at all, and have already started deteriorating the environment of the current farming systems. Within just a short period of several decades since large scale plastic products production commenced in the 1950s, plastic debris has accumulated in terrestrial environments, on shorelines of even the most remote islands, in the open oceans and even in the deep sea (Barnes et al., 2009)

2. Health risk: Plastic-associated health risks arise right from the production of plastic and last till its degradation. Manufacturing plastic on large scale discharges a large number of toxic compounds into the surrounding such as CO, dioxin, and hydrogen cyanide (Proshad et al., 2018). The occurrence of steady-state concentrations of residual plastic in humans has been demonstrated in bio-monitoring studies, that unravels the fate of these compounds from exposure to metabolism and ultimate excretion. An accurate assessment of the impact of currently used plastic additives on human is still difficult, as not only production procedures and uses of plastics and its additives vary too much, but the confidential nature of industrial specifications also adds to the challenge of assessing the exposure still a challenge.

3. Yield reduction: When the residual plastic film is present in lower than 240 kgha-1, it does not exhibit any pronounce effect on crop yield, but a higher amount than this level can significantly reduce yield of different crops (Gao et al., 2019).

4. Soil physical and chemical properties: Some chemical attributes of soil including pH and availability of certain essential nutrients in the form of anions or cations are directly influenced by residues of PFM. When the density of soil plastic film residue reaches 2000kg ha-1, pH increases by 10.1%, and organic matter, alkaline hydrolysis of N, available P, and available K decrease by 16.7%, 55.0%, 60.3%, and 17.9%, respectively (Dong et al., 2013). Such residues can also negatively influence the microbial activity in soil by releasing additives like PAE. These are toxic to the soil microorganisms and reduce their activity thus impacting soil quality and ultimately affecting the yield and quality of crops (Wang et al., 2016). Even a continuous application of biodegradable mulch (BDM) film that passes the ASTM D6400–12 a standard developed by "American Society for Testing and Materials" for composting, would theoretically, allow the accumulation of:

1. Plastic particles less than 2.0 mm in size.
2. 10% of organic carbon left after 180 days.
3. Up to 5% original weight of untested organic constituents (at up to 1% for each component).
4. Up to 49% of the concentration of regulated metals allowed for sludge, fertilizers, and composts.

Alternate Options for Plastic Film

1. Photo-degradable film mulch.
2. Straw or crop residues mulch.
3. Paper mulch.
4. Double cropping.
5. Ridge furrow with plastic-film mulch.
6. Biodegradable plastic.

Future Challenges and Strategies

A continuing challenge in plasticulture is ensuring that performance of the material is not affected during its use, whereas rapid degradability is desired in nature after use (Albertsson and Hakkarainen, 2017).

1. Strengthening the understanding of key mechanisms.
2. Technological changes.
3. Recycling of plastic film.
4. Role of government, policy makers and other stakeholders.

Conclusion

Use of Plastic film mulch (PFM) in crop production has increased remarkably during the last few decades because of its distinct advantages. Lack of proper infrastructure for recycling and disposal coupled with slow degradation of the fragments have led to excessive accumulation of PFM residues in the soil. Consequently, it not only interferes with soil physical, mechanical and biological properties but also affects crop growth and even human health.

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Antibiotics: A Boon or Bane in Aquaculture Industry

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Introduction

Aquaculture is known to be the most progressive sector in the 21st century, by surpassing the capture fishery numbers since 2014, it is still rowing towards more and more production. By 2030, it is estimated to have a 59% increment in its production levels. But to meet the set goals, the sector has to encounter challenges widely faced in this field. The most common challenge faced is the aquatic animal health management, with daily discoveries of deadly pathogens affecting the health of the animal, the farmer has no choice left but to use prophylactic measures to save the production. In aquatic animal health management, the main concern is to prevent the finfishes and shellfishes from diseases. Pathogens causing disease are a diverse group of microorganisms, which tend to evolve and become intense over time. For preventing these infectious diseases, the prophylactic measure also needs to evolve; hence, third-generation antibiotics are mostly employed in aquaculture, and livestock production, also with the further development and efficient application of antibiotics and improvements in urban sanitation and water quality results in a drastic decrease in death from infectious diseases. Like every coin has two sides, so the excessive use of the antibiotics have adversely affected the environment, produce and ultimately the human consumers. Moreover, this development has been accompanied by an increase in antibiotic resistance in fish pathogens.

Antibiotics Used in Aquaculture

The term antibiotic means "opposing life", from the Greek roots ἀντι anti, "against" and βίος bios, "life", which is broadly a substance used against microbes. The antibiotics are natural or synthetic in origin with following pre-requisite; safe to the host, permitting their use as chemotherapeutic agents for the treatment. Employment of antibiotics in the sector of aquaculture is mainly associated with two prime functions; anti-infectious agents and growth promoters. The feeding of antibiotics is related to decreases in animal gut mass, increased intestinal absorption of nutrients and energy sparing. That results in a reduction in the nutrient cost for maintenance so that a larger portion of consumed nutrients can be used for growth and production, thereby improving the efficiency of nutrient use. Antibiotics alter the non-pathogenic microorganism, producing beneficial effects on digestive processes and more efficient utilization of nutrients in feeds. Studies have also shown that antibiotics may prevent irritation of the intestinal lining and may enhance the uptake of nutrients from the intestine by thinning of the mucosal layer. Fish are provided antibiotics with their food, and sometimes in baths and injections. Some of the antibiotics authorized for use in aquaculture are; Oxytetracycline (in medicated feed), Florfenicol Premix, Sarafloxacin and Sulphonamides potentiated with trimethoprim or ormethoprim. All these antibiotics have potentially improved the life span of the species but, their excessive use and malpractices have led to alter their beneficial role to a hazardous one.

Abuse of Antibiotics and its Effects

Applications of antibiotics are mostly carried out through medicated feed, bath treatments, which is a sort of metaphylactic use not a prophylactic as the entire population of fish is treated orally, whereas the infected percentage is comparatively small. The significance is to protect the healthy ones instead of the infected ones, and as a result, the infection is rarely eradicated. The unconsumed medicated feed, and fish faeces, antibiotics are leached from the feed and faeces and diffuse into the sediment which can be washed by currents to distant sites. These residual antibiotics will remain in the sediment, exerting selective pressure, thereby changing the composition of the microflora of the sediment and resulting for antibiotic-resistant bacteria. The determinants of antibiotic resistance that have emerged during this aquatic environment have the potential of being transmitted by horizontal gene transfer to bacteria of the terrestrial environment, including human and animal pathogens and viz-versa. In many aquaculture settings in developing countries, the possibilities of these exchanges have been intensified by the high level of contamination of seawater and freshwater with untreated sewage and agricultural and industrial wastewater containing normal intestinal flora and pathogens of animals and humans usually resistant to antibiotics.

When antibiotic treatment begins (usually via medicated feed) the gut microflora and environmental bacteria can come in contact with the antibiotics present in fish farm and hatchery wastes. Oxytetracycline, one of the most commonly used antibiotics in fish farms and hatcheries, is very poorly absorbed through the intestinal tract of fish. It has to be administered at a high dosage rate of 100–150 mg per kg fish per day for 10–15 days. This treatment consequently causes the slow excretion of large amounts of this antibiotic, thus increasing the selective pressure, which might lead to the presence of oxytetracycline-resistant bacteria in the gut. An increase in antibiotic-resistance genes in the absence of the antibiotic itself has also been recognized to co-selection with other antibiotics. Though the use of a wide range of antibiotics in aquaculture has well-known positive effects on the control of bacterial infections; however, some side effects that affect both the fish and the environment are linked with excessive use. The effects of antibiotics on the environment are mainly caused due to the overuse of those drugs by the aquaculture industry and therefore, the presence of drug residues in fish products. The excessive use of antibiotics results in the presence of residual antibiotics in commercialized fish and shellfish products. This problem has led to invisible consumption of antibiotics by consumers of fish with the added potential variation of their normal microflora that enhances their susceptibility to bacterial infections and also more antibiotic-resistance. Besides, undetected consumption of antibiotics in food can create problems of allergy and toxicity, which are difficult to diagnose because of a lack of previous information on antibiotic ingestion.

Responsible Use of Antibiotics and Alternatives

The use of antibiotics in aquaculture depends on the local regulations that vary widely between different countries. In some countries, regulations on the use of antibiotics are strict, and only a few antibiotics are licensed for use in aquaculture. However, a large proportion of global aquaculture production takes place in countries that have permissive regulations. Many policies of antibiotic use in aquaculture with the possible restriction on their use have implemented. Restrictions include; increased control of the prescription of therapeutic antibiotics, almost total elimination of the use of antibiotic prophylaxis in this setting and prohibition of the use of antibiotics in therapeutics that are still very useful in the therapy of human infections. The former steps for responsible use of antibiotics with increased control of antibiotic use, accompanied with sanitary measures including the use of vaccines has not only drastically reduced the use of antibiotics in the aquaculture industry of developed countries but is economically feasible to develop a productive aquaculture industry. Vaccination is an ideal method for preventing infectious diseases which is a booming sector in aquatic health management. Several other alternatives to the use of antibiotics have been used successfully in aquaculture. The use of innocuous microorganisms to avoid bacterial infection, instead of improving the growth of beneficial bacteria in aquatic organisms has been tested in aquaculture, which is said to be probiotics. Another source of alternative treatments is essential oils, which are natural components from plants that are generally recognized as safe substances, with their antimicrobial properties, these oils may constitute alternative prophylactic and therapeutic agents in aquaculture.

Conclusion

The public health risk related to antibiotic residues depends on the quantity of the antibiotic encountered or consumed or the exposure. The appearance of acquired resistance in fish pathogens and other aquatic bacteria means that such resistant bacteria can work as a reservoir of resistance genes from which genes can be further distributed and may ultimately end up in human pathogens. It is essential to consider that most antibiotics used for treating infections are produced by environmental microorganisms, meaning that the genes for antibiotic resistance must also have emerged in nonclinical/artificial habitats. A better understanding of the ecological role of antibiotics and antibiotic resistance in natural environments may eventually help to predict and counteract the emergence and evolution of resistance. With everlasting problems with new inventions, so are the many problems associated with the use of antibiotics in aquaculture. Taking into account the rapid growth and importance of the aquaculture industry in many regions of the world there is widespread, intensive, and often unregulated use of antibiotics for fish and shellfish production; hence, additional efforts are required with judicious use of antibiotics in aquaculture systems. Fish farmers must ensure that fish are kept in the best state of health and welfare. The invention of novel drugs or the use of alternatives to antibiotics should also be encouraged. With the increased awareness of the scientific community and the stakeholders, in general, which is both alarming and promising at the same time can further aid to betterment of the aquatic environments by ensuring upliftment of living standards of the farmers.

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An Ecological Engineering-based Integrated Viral Disease Management Module for King Chilli (U-Morok)

Article ID: 32271

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King Chilli (*Capsicum chinense* Jacq) belonging to the family Solanaceae is an important spice crop which is known for its culinary preparations as well as medicinal value. It has been reported to be highly rich in capsaicin content with a reported Scoville Heat Units (SHUs) rating of 1,001,304 (Ngasepam et al., 2016). It is cultivated as an important horticultural crop in the North-Eastern (NE) states.

However, the farmers in NE states face faces major constraints of biotic stresses in king chilli production, out of which infection of viruses is of major concern. The prevailing conditions of high humidity and favourable environmental conditions trigger the high incidence of viral infections and insect-vectors responsible for their spread. Aphid-transmitted viruses are of major concern in the king chilli plantations. In the view of this, an ecological engineering-based virus disease management module was developed for management of aphid-transmitted viruses in king chilli.

Introduction

Ecological engineering-based integrated viral disease management is a method for analysis of agro-ecosystem with the management of its different elements to control diseases or to maintain an acceptable level for the economic, health, and environmental necessities. There has been a shift to more ecologically sustainable strategies and bio-intensive integrated disease management (IDM) viz., Agro-Eco system analysis (AESA) based IDM, and ecological engineering-based integrated disease management.

AESA is a process in which farmers observe the crop, evaluate the field situation, and take crop management decisions based on field observations. Ecological engineering-based integrated viral disease management is a model to enhance the natural enemies of pests in an agroecosystem and relies on the use of cultural techniques to bring about habitat manipulation and enhance natural enemies of pests in the crop micro and macro environment.

Ecological engineering-based integrated viral disease management of King chilli is a system approach relying primarily on biological knowledge of insect pests and their interaction with the host King chilli. King Chilli is being cultivated in the North East states, since time immemorial, especially in the states of Manipur, Nagaland, and some parts of Assam and Arunachal Pradesh. In Assam, Manipur, and Nagaland it is known as Bhut Jolokia, Umorok, and Raja Mirch, respectively. It is cultivated as an important horticultural crop in the North-Eastern states by the farmers.

The farmers continually face numerous constraints in carrying out the production of king chilli and amongst the constraints, the high incidence of viral diseases that are carried through infected planting materials is the major constraint being perceived. It is further propounded by the existing high humidity and favourable environmental conditions, which favours and triggers the prevalence of insect-vectors up to a very high level which thereby leads to the spread of viral diseases.

One of the explanations for the high infection of viral diseases under field conditions is the unavailability of disease-free/virus-free quality planting material of the crop. To reduce the incidence of insect-vectors in king chilli, farmers tend to adopt chemical control as a solution that comes with unwanted harm to the ecology and environment in the long run.

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Principles of Ecological Engineering-Based Integrated Viral Disease Management Module for King Chilli

1. Production of virus-free planting materials.
2. Incorporation of biopesticides as seed and soil treatments along with chemicals.
3. Incorporation of barrier and border crops to check insect activities.
4. Application of scientific techniques to hinder the insect pest activity such as the use of mulching through the straw mulch and silver mulch.
5. Keen observation of the plantation, decision making and use of biochemical and biopesticides to reduce the toll on chemical dependencies.

The Methodology of Ecological Engineering-Based Integrated Viral Disease Management Module for King Chilli

1. Raising of seedlings under insect-free protected conditions (treated seed with *Trichoderma*)
2. Grow maize in border row of the plots 20-25 days prior to transplanting of king chilli
3. Dipping the bare-rooted seedlings dipped in insecticides (Thiamethoxam 5s @ 2g/Litre) for 6 hours to overnight before transplanting
4. Transplant the seedlings in plots where maize was sown as barrier crop around 20-25 days earlier to transplanting
5. Mulching of the inter-row spaces with paddy straw and silver plastic mulch as shown in fig 1 and 2.
6. After 20-25 days post-transplanting, a foliar spray of insecticide (thiamethoxam 25WP @ 6g/10 Litre of water) and micronutrient mixture (@2g/Litre) to the king chilli was given.

Fig 1: Straw mulching with maize border

Fig 2: Silver mulching with maize border

Data Recording

The following data is to be recorded in order to analyze the efficiency of ecological engineering based viral disease management module:

Crop situation:	
a	Health of plants
b	Pests, diseases, weeds infesting the crop
c	Natural enemies present in the field
d	Soil condition of the field
e	Irrigation
f	Weather conditions of that area
g	Input Cost: Seeds, fertilizer, pesticides, and labour cost
h	Harvest: Yield (kg/acre) and price of produce (Rs./kg)

i	B:C ratio

Conclusion

Dependency on chemical pesticides for control of insect-vectors is the major cause of ecological imbalance and environmental degradation resulting in serious problems of insecticide resistance, pest resurgence, and pesticide residue. Ecological engineering-based integrated management of viral disease relies on biological knowledge of insect pests and on their interaction with the host and incorporation of eco-friendly elements of disease management which shall benefit the farmers in particular and offer constructive conduct of the ecology and environment in general.

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Advances in Production Technology of Crossandra

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Introduction

Crossandra is one of the important commercial, traditional loose flower crops of South India. It is mostly cultivated in Tamil Nadu, Karnataka and Andhra Pradesh. Crossandra is commonly called as Firecracker flower belongs to the family Acanthaceae and botanically known as *Crossandra infundibuliformis*. It is a tropical, evergreen shrubs producing flowers in dense sessile spikes oval, deep green leaves, about 5 cm long compact spikes of orange, red, yellow, blue funnel shaped flowers with prominent bracts. Plant height ranges from 2 to 3 feet. The flowers are highly priced for its attractive bright deep orange colour, light weight, good keeping quality and availability round the year. It is extremely popular in southern states of India where the flowers are immensely used for hair adornments, religious ceremonies and for making gajras and venis. Owing to their attractive colours, light weight and good keeping quality, crossandra flowers are ideal for garland making. Even though the flowers lack fragrance, they are widely used in garlands either alone or along with jasmine to produce charming colour contrasts

Species and Cultivars

There are 20-25 species but only few like *Crossandra infundibuliformis, Crossandra undulaefolia, C. guineensis, C. mucronata* and *C. subacaulis* are cultivated. The species grown for commercial flower production is *Crossandra undulaefolia*. These are small, evergreen shrubs freely producing flowers in dense sessile spikes. Orange, Delhi, Lutea Yellow and Sebaculis Red are four different cultivars of the species.

1. Orange Crossandra is tetraploid (2n=40), sets seeds profusely, breeds true and produces bright orange coloured flowers.
2. The cultivar Delhi is triploid (2n=30) and produces more attractive flower colour.
3. Lutea Yellow is tetraploid (2n=40) and the flowers are orange yellow colour.
4. Sebaculis Red is tetraploid (2n=40) and hardy cultivar, which possesses high degree of tolerance to nematodes.

			
Orange crossandra	**Delhi crossandra**	**Lutea Yellow**	**Sebaculis Red**

Cultivars

Madurai Local and Nilakottai Local are also mainly cultivated in the farmers' fields.

Varieties Developed at IIHR, Bangalore

1. Arka Soundarya.
2. Arka Shreya.
3. Arka Shravya.
4. Arka Kanaka (yellow colour flowers; Yield - 5.01 tonnes/acre).
5. Arka Ambara (Orange red colour flowers;Yield - 5.9 tonnes/acre).

6. Arka Chenna.

Flower of this variety is medium sized, 20 per cent bigger than the local. Petal colour is orange. Yield is 4 times higher than the local variety i.e., 40 kg/ week per 1000 plants. The shelf life is 3.4 days. The stalk strength is 0.82kg/cm2 which is 20 per cent more than the local variety.

Climate

It requires a temperature of 30 - 35°C for growth. It is tolerant to shade some extent but susceptible to low temperature and frost.

Soil

Well drained sandy loam and red soil and rich in organic matter with pH of 6 - 7.5 are ideal. Soil is to be tested for nematodes before planting.

Propagation

Tetraploids: Propagated through seeds. Seed rate is 5kg/ha. 60-day old seedlings are transplanted in the main field. In case of seedlings, they are raised in the month of April – May and Aug – Sep. The seedlings are raised in poly bags.

Triploids: Propagated through terminal cuttings of 10 - 15 cm length (41,700 cuttings/ha).

Seeds and Sowing

Fresh seeds are sown during July - October in raised beds at 15 cm apart in lines. Watering should be done daily. The seedlings will be ready for transplanting in 60 days.

Seed Rate

The required seed rate is 5 kg/ha for optimum plant population. For Delhi Crossandra, rooted cuttings have to be used for planting.

Preparation of Field and Planting

Land is ploughed thrice and FYM at 25 t/ha is incorporated. Ridges are formed 60 cm apart. Dip the roots of seedlings in Carbendazim (1 g/lit of water) and plant on one side of the ridge at 30 cm spacing. For seed production the spacing may be 60 x 60 cm. For Delhi Crossandra a spacing of 60 x 40 cm is to be followed. Planting should be done in moist soil. Providing partial shade is beneficial to maintain the health of plants and obtain higher yield of flowers. In case of seedlings they are transplanted at 4- 6 leaves stage i.e., 8-10 days old seedlings.

After Cultivation

Spray Diuron (pre-emergence) 2.5 kg a.i/ha for controlling the weeds.

Manuring

Tetraploids: Apply FYM 25 t/ha as basal and N, P, K at 75, 50 and 125 Kg/ha as top dressing three months after planting. Repeat NPK application at the same dose at half yearly intervals for two more years (Instead of applying N at 75 Kg/ha, N at 60 Kg/ha + Azospirillum 2 Kg/ha can also be applied).

Delhi Crossandra: Apply FYM 25 t/ha, Gypsum 100 Kg/ha and P & K at 50 and 100 Kg/ha respectively as basal dose. Top dressing is done 30 days after planting with neem cake 250 kg and N 40 Kg/ha. Apply N P K @ 40:20:60 Kg/ha at 90 days after planting and repeat this dose at quarterly intervals for a period of two years.

For Both Tetraploids & Delhi Crossandra

Bio fertilizers: Soil application of 2 kg each of Azospirillum and Phosphobacteria per ha at the time of planting. It is to be mixed with 100 Kg of FYM and applied.

Growth regulators: Spray Ascorbic acid 1000 ppm (1 g/lit of water) before flowering.

Top Dressing

On 30 days after planting, apply neem cake 250 kg and N 40 kg/ha. Again on 90 days after planting apply N, P, K of 40:20:60 Kg and repeat this dose at quarterly intervals for a time period of two years.

Flowering

Crossandra comes to flowering 2-3 months after planting and continues to bear flowers throughout the year with a drop in production during the rainy season. The flowers open in sequence from the base of the spike. Two flowers which are diagonally opposite in the spike, open at the same time. It takes about two days for complete opening of the flower.

Irrigation

Irrigation is done once in a week. Adequate irrigation helps in rapid growth of the plant and also to obtain regular flower yield. At the time of planting, the soil should have optimum moisture for initial growth. During dry period irrigation should be given at shorter intervals and also during the flowering stages which results in more flower and also encourage better plant development.

Pests

Nematode: Avoid planting crossandra in nematode infested fields. To control nematodes, apply Phorate or Carbofuran 3 G at 1 kg a.i./ha, a week after planting and the same may be repeated six months after planting.
Aphids: To control aphids, spray Dimethoate 30 EC 2 ml/lit.

Disease

Wilt: Soil drenching with Carbendazim 1 g/lit or Triflooxystrobin + Tebuconazole @ 0.75 g/litre.

Crop Duration

3 years including ratoon crop.

Harvest

Flowering will start a month after transplanting. Fully opened flowers are picked once in two days. Depending on the length of spike, it takes nearly 15-25 days to complete flowering on a spike. After the flowering is over, the spent spikes are removed. The fully opened flowers remain fresh on the plant for about three days but when picked they fade away in 36-48 hours.

Yield

An average yield of 2000 kg of flowers per ha/year can be obtained. In Delhi Crossandra, 2800 kg of flowers per ha per year can be obtained. It extends up to 3 years including ratoon crop in the third year.

Marketing

For marketing loose flowers, the flowers are packed in wet cloth or gunny bags and sometimes in basket.

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Biofortification In Horticultural Crops

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Introduction

Biofortification is the process of adding nutritional value to the crop. It refers to nutrient enrichment of crops to address the negative economic and health consequences of vitamin and mineral deficiencies in humans. Biofortification, the process of breeding nutrients into food crops, provides a comparatively cost-effective, sustainable, and long-term means of delivering more micronutrients.

The biofortification strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield and disease resistance. Marketed surpluses of these crops may make their way into retail outlets, reaching consumers first in rural and then urban areas. Progress to date in breeding and delivering biofortified crops is discussed.

Methods of Biofortification

1. Agronomic bio fortification.
2. Conventional plant breeding.
3. Genetic engineering.

SWOT Analysis of Bio Fortification Methods

	Agronomic Bio fortification	Conventional plant breeding	Genetic engineering
Strengths	Simple method and suitable for immediate results.	One-off cost, easier distribution, Long-term strategy	One-off cost, easier distribution, speed up conventional breeding.
Weakness	Needs regular application of nutrients, expensive and difficult to distribution.	Long development time, Success limited to minerals available in the soil.	Long development time, Success limited to minerals available in the soil.
Opportunities	Used as a compliment to other strategies	Wide public acceptance, simple legal frame work	More success rates
Threats	Negative environmental impact	Requires genetic variation	Environmental impact

(Prasad et al., 2015)

Examples for Biofortified Crops

Biofortification works have been practiced in most of the horticultural crops like Banana, Cassava, Beans, Potato, Orange sweet potato (OSP), Cowpea, Pumpkin etc. several conventional and transgenic varieties have been released.

1. Orange sweet potato (OSP): To increase targeted level of 30 ppm of provitamin A in sweet potato, International Potato Center (CIP) in south Africa and Uganda (Harvest plus) + National agriculture Research and Extension System (NARES) started project in 2002-2007 and the first variety released in 2002.This variety have ability to grater provitamin A retention more than 80% after boiling or steaming and at least 75% after solar or sun drying but also high yielding and drought tolerant.

2. Bio Cassava+: Project on Bio Cassava Plus initiative started in 2009 by Donald Danforth Plant Science Center to target Nigeria, Kenya. The scientists of Nigeria have developed three new yellow colour varieties of cassava by hybridization and selective breeding methods. The se varieties can produce higher amount of beta-carotene which helps to fight against vitamin-A malnourishment in the region and release of the varieties will be in 2017.

3. Potato: CIP (International centre for potato) started project on development of Fe rich potatoes by conventional biofortification method in 2009 and the varieties will be release in 2017.

4. Cow pea: Pioneer research on biofortifcation of cow pea has initiated G.B. Pant University of Agriculture and Technology, Pantnagar, India. Two early maturing high iron and zincfortified varieties namely Pant Lobia-1(82ppm Fe and 40ppm Zn), Pant Lobia-2(100ppm Fe and 37 ppm Zn) has been developed by conventional plant breeding and released in 2008 and 2010.

5. Nutri banana: Biofortification works on banana will be beneficial where bananas are the major staple food source and good consumer acceptance. The biofortification works on banana had been initiated at Queensland University of Technology (QUT), Australia to develop provitamin A (β- carotene), alfatocopherol and iron rich varieties.

Works initiated to transfer of specific traits in two Indian banana varieties cv. Grand Nain and Rasthali. Donald Danforth Plant Science Centre working on nutri banana to develop 20 ppm provitamin A bananas by Conventional breeding.

6. Beans: Iron (Fe) content in common bean is about 50 parts per million (ppm) and target in biofortification of bean by conventional breeding is 94 ppm, biofortified beans provide about 60% of yields in Rwanda. Non-biofortified beans produce approximately 0.8 tons/hectare (bush and climbers combined) but biofortified bush beans yield around 1.5 t/ha and biofortified climber beans 2–3 t/ha (Bouis et al., 2013).

ICAR Biofortified Varieties

Cauliflower: Pusa Beta Kesari 1 - β-carotene (8-10ppm) rich variety.
Sweet Potato: Bhu Krishna – anthocyanin (14.0mg/100g) rich variety.
Potato: Bhu Sona - β-carotene (8-10ppm) rich variety.
Pomegranate: Solapur Lal - High iron (5.6-6.1mg/100g), high zinc (0.64-0.69mg/100g) and vitamin-C (19.4-19.8mg/100g) rich variety (Yadava et al., 2017).

Strategic Advantages of Biofortification

1. One-time investment is made to develop seeds that fortify themselves, recurrent costs are low and germplasm may be shared internationally.

2. Once in place, the biofortified crop system is highly sustainable.

3. Nutritionally improved varieties will continue to be grown and consumed year after year, even if government attention and international funding for micronutrient issues fade.

4. Moreover, biofortification provides a truly feasible means of reaching malnourished populations in relatively remote rural areas, delivering naturally fortified foods to people with limited access to commercially marketed fortified foods, which are more readily available in urban areas (Singh et al., 2016).

Conclusion

Biofortification is a cost-effective, feasible means of reaching people who have limited availability and access to diverse diet, supplements or commercially fortified foods. A one-time investment in plant breeding yields micronutrient rich varieties for farmers to grow for years to come and the same varieties can be evaluated in other target geographies with similar agroecological conditions, thus multiplying the benefit of the initial investment.

Biofortification is one solution among many that are needed to solve the complex problem of micronutrient deficiency and it complements existing interventions.

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Dual Purpose Crops Can Mitigate Food and Fodder Crisis in India

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Summary

In developing countries like India due to alarming increase of human as well as livestock population and declining per capita land holding, the food grain and fodder productivity per unit area is being badly affected. To overcome this issue, it is necessary to include high yielding varieties of dual-purpose crops along with proper agronomic management that will help to provide food for human being and fodder for animals from the same crop. The dual-purpose crops like oat, barley, pearl millet and sorghum have excellent growth, biomass production and quick regeneration after their cutting that permit forage production in early season in addition to the grain yield during later stage from same crop.

Introduction

India inhabits 15 per cent of world's livestock population and 16 per cent human population on 2.4 per cent geographical area, which itself is an indication of the extent of livestock and human pressure on limited land resources (DAHD & F, 2012). Although, India has made an impressive progress in achieving food grain production with tune of 276 MT, the average productivity of some major food grain crops is very low in comparison with other countries (Directorate of Economics and Statistics, 2016). The large masses in the country are the victim of food insecurity due to very low productivity of food crops. Similarly, there is acute shortage of green and dry fodder from several decades due to having very less area i.e. 4.9 % under fodder crop cultivation that drastically affect the health as well as productivity of animals . Also, as per the report of agriculture census per capita average land holding of farmer is declining day by day from 2.28 ha to 1.15 ha with increasing trend of small and marginal farmers that accounts more than 85 per cent of the total farmers. It clearly indicates that in future also there are very few chances to bring more area under forage crops which otherwise will affect the food grain production. Hence scientists, policy makers and researchers have been developing such strategies that could sustain increasing human and animal population from meagre land by producing adequate food and fodder simultaneously from the same crop. This suggests there is future scope for growing of high yielding varieties of dual-purpose crops. It is also important for growers to select the dual-purpose variety according to environments and establish crops early to maximize forage as well as grain yield potential. The dual-purpose crops oat, barley, sorghum and pearl millet have excellent growth, biomass production and quick regeneration after cutting that permit forage production in early season in addition to the grain yield during later stage. Besides; scientific management the selection of suitable varieties of dual-purpose crops attain a paramount importance in harnessing the higher green fodder and grain yield.

Dual Purpose Oat (*Avena sativa* L.)

Oat or jai, is one of the most important dual-purpose winter season non-legume crops grown for animal food and grain production under irrigated conditions because of its excellent growth characters, quick re growth after cutting and economic source of dietary energy. It provides the succulent, nutritious and highly palatable green fodder, hay and silage for feeding the animals during lean period. Oat grain makes a good balanced concentrate in the rations for the livestock. The demand of oat as a human food has increased because of its dietary benefits of the whole grain.

Table 1 Fodder and grain yield of dual-purpose oat genotypes:

Oat Genotype	Fodder Yield (q/ha)	Grain Yield (q/ha)
OL-1709	120 – 122	12 – 14
RO-19	130 – 133	6 – 8
UPO-212	87 -89	15 – 17
OS-387	75 -77	21 -22
JO-09-504	90 – 92	18- 20
OL-1775	115 – 117	10 – 12
JHO-822	85 – 88	16 – 18

Dual Purpose Barley (*Hordeum vulgare* L.)

It is a valuable crop because it is used for food, processed food and feed for cattle. Besides these conventional uses, it is an important industrial crop which is used as raw material for preparation of beer, whisky and in brewing industries. Barley is mainly cultivated for grain which is consumed as feed and raw material in beverage industries. It is also grown as fodder for animals.

In recent past, growing of dual-purpose barley genotypes having wider adaptability and responsive to inputs has opened a new avenue for exploiting higher green fodder and subsequent grain yield potential (Singh et al., 2012). It tolerates salt and moisture stress therefore; it can grow in water deficit areas.

So, with the development of high yielding dual purpose varieties, barley can serve as alternative for augmenting the green forage demand in the arid and semi-arid areas of northern plains under limited irrigations along with satisfactory levels of grain yield from the regenerated crop, which can also be utilized as feed for cattle or for human consumption.

Table 2 Yield of dual-purpose varieties of barley:

Varieties	Fodder yield (q/ ha)	Grain yield (q /ha)
RD-2859	235- 238	24-26
RD-2715	215- 216	31-33
UPB-1034	155- 157	34-36
BH-971	184-186	40-42
RD-2858	187.-190	25-27
RD-2857	208-210	23-24
AZAD	155-157	37-39
RD-2856	190-192	24-25

Dual Purpose Sorghum (*Sorghum vulgare* L.)

It is an important staple food grain after rice and wheat for millions of poor and most food-insecure people in the semiarid tropics in India. Sorghum also offers great potential to supplement fodder requirement of the growing dairy industry in India because of its wide adaptation, rapid growth and high green-fodder yields as well as good quality.

The major sorghum growing states in India are Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh and Gujarat. The grain and fodder sorghum mainly cultivated in rainy season in north India and in both rainy and post rainy season in south India.

Table 3 Yield of dual-purpose varieties of Sorghum:

Varieties	Grain yield (q/ha)	Fodder yield (q/ha)
SPV1600	31 to 33	125 to 130
CSV 15	32-34	120-125
CSH 14	33-35	75-80
CSH 8	36-38	80-90

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Dual Purpose Pearl Millet (*Pennisetum typhoides* L.)

Pearl millet or bajra is considered as bread and butter of the large poor rural people. Recently new dual-purpose varieties of pearl millet have been released which would help in providing food and fodder security for people particularly in drought prone areas. . This crop is recently grown as dual-purpose crop because of its profused tillering, better regenerating capacity under repeated cuttings and absence of anti-nutritional factor like prussic acid or hydrocynic acid. It is mainly grown in Rajasthan followed by Maharashtra and Gujarat. The dual-purpose nature of pearl millet ensures both food and fodder security in the arid and semi-arid regions of the country. Pearl millet is rich source of energy, carbohydrate, protein, fat and ash content; besides, it is also a rich source of dietary fibre and minerals like iron, calcium, magnesium, potassium etc It is also relished by the animals and provides good quality green as well as dry fodder to the animals. Stover yield produced from this crop is also useful as dry straw for animals. Popular dual-purpose varieties of bajra are as below

Table 4 Grain and fodder yield of dual-purpose varieties of Bajra:

Variety	Grain yield (q ha $^{-1}$)	Stover yield (q ha $^{-1}$)
BAIF-Bajra-1	9-10	65-70
AVKB-19	7.5-8.5	52-55
GFB-1	6.5-7.5	45-50

Conclusion

It can be concluded that scientific cultivation of dual-purpose crop varieties of sorghum, pearl millet, barley and oat will produce good quality green fodder to the animals at early growth stage and also produce grains for human being after cutting at later growth stage from the same crop that will help to reduce food and fodder crisis at some extent.

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Integrated Nutrient Management in Fruit Crops

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Introduction

Fertilizers are usually classified, according to the source driven into two main categories. The first one is the organic source (natural) and the second is inorganic source (mineral or synthetic or manmade). Integrated nutrient management (INM) is one of the agronomic practices aiming at the usage of the harmonious properties of both sources by making a combination that can be used for decreasing the enormous use of chemical fertilizers and accreting a balance between fertilizer inputs and crop nutrient requirement options, which can maintain the soil fertility, restore the soil health and continuous supply of plant with nutrient requirements to obtain an optimum level of yield production, maximize the profitability, and subsequently reduce the environmental pollution.

Objectives

The main objective of the integrated nutrient management is to maintain economic yield for a long period with little effect on native soil fertility and environmental pollution, making some changes in farmer's awareness toward the eco-friendly technique (organic farming system) for producing healthy food free from contaminants and insuring satisfactory economic returns.

Advantages of INM

1. Systems can improve the soil nutrient natives and increase the solubility and availability of fertilizers to be used.
2. Use the harmonious behaviour of nutrient supplies and making them match with the crop requirements.
3. Offer the nutritional balance to the crops and lessen the aggressive effects resulting from the opposite impact between nutrient fractions and nutrient imbalance.
4. Advance and sustain the physiochemical and biological functions of soil properties.
5. Reduce the rate of soil degeneration, water, and ecosystem by enhancing carbon confiscation and decreasing nutrient losses to ground and surface water forms and/or to environment pollution.
6. Minimize higher total costs of production and raise the farmer's returns (increasing profitability).
7. Improve the resistance to both biotic and abiotic stresses.

Constraints of INM

Soil corrosion, mining, degradation, and also loss of fertility are the main reasons leading to irreversible decrease of plant production and huge damage for sustainable agriculture. Therefore, to sustain soil health and return soil productivity is an urgent need to overcome the problem of low soil productivity.

INM in Fruit Crops

1. Apple: Integrated nutrient combination comprising NPK sources from organic manures (FYM and vermicompost) and inorganic sources along with mulching (leaf mould and black polyethylene) were applied on apple (*Malus domestica* Borkh) cv. Starkrimson planted on high density system. The objective was to supplement NPK requirement by applying sufficient quantity of organic manures, thereby, minimizing the inorganic fertilizer requirement. Better result was obtained in treatment comprising leaf mould mulch and integrated nutrients: 50 kg/tree FYM + 10 kg/tree vermicompost + 50 g/tree N + 75 g/tree P2O5 + 250 g/tree K_2 O in 5th year; 60 kg/tree FYM + 13 kg/tree vermicompost + 30 g/tree N + 80 g/tree P_2 O_5 + 225 g/tree K2O in 6th year; 70 kg/tree FYM + 16 kg/tree vermicompost + 10 g/tree N + 85 g/tree P_2 O_5 + 250 g/tree K2O in 7th year and 70 kg/tree FYM + 19 kg/tree vermicompost + 165 g/tree N + 178 g/tree P_2O_5 + 548 g/tree K2O in both 8th and 9th year. In the 8th and 9th year, this treatment resulted comparatively higher fruit yield (31.8 and 30.6 kg/tree, respectively) and productivity (50.8 and 53.3 MT/ha, respectively) with fruit weight 200.4 and 202.4 g and diameter 8.4 and 8.2 cm, respectively. Whereas, in recommended dose, in 8th and 9th year, 27.6 and 25.6 kg/tree yield and 44.2 and 40.9 MT/ha productivity were recorded, respectively. Reduction of FYM quantity by 50% and increasing the vermicompost dose also supplemented considerable amount of NPK requirement from inorganic sources and resulted better plant growth and yield (Biswajit *et al.,* 2016).

2. Banana: Suhasini *et al*., 2018 conducted experiments with treatments consist of **T1 -** RDF 100% (200:100:300 g NPK + 20kg FYM/ plant) **T2-**RDF100% (200:100:300 g NPK + 20kg FYM per plant) + PSB (20g)+ Azospirilum (20g) **T3 -** RDF 75% + 25% , N and P through organic sources **T4 -** RDF 50%+ 50% ,N and P through organic sources **T5 -** RDF 25%+75%,N and P through organic sources **T6-**100%,N, P and K through organics sources. They concluded that, the treatment received 100% recommended dose of fertilizers (RDF) along with Vermicompost (2kg) + Neemcake (250g) + Azospirillum (50g) + PSM (50g) + VAM (250g) recorded the highest plant height, pseudostem girth, number of functional leaves, total leaf production, total leaf area and leaf area index.

3. Citrus: Anoop 2010, studied on effect of various components of INM as application of individual higher doses of farmyard manure (50 kg tree-1) and conjoint use of iron pyrites (200 g)- farmyard manure (25 kg – pressmud 2 kg ha-1) on acid lime (*Citrus aurantifolia* Swingle) on changes in soil fertility status showed much higher status of available N (196.7 to 219.2 kg ha-1), P(27.6 to 35.1 kg ha-1), K (342.4 to 361.3 kg ha-1), and S (8.4 to 17.4 kg ha-1). Application of 5 kg vermicompost and 20 kg FYM in the months of November and May under sub-humid tropical climate of central India significantly (p<0.05) improved the fruit yield and quality over either of individual effect of two, manures individually or when applied in combination with inorganic chemical fertilizers.

4. Guava: Ram *et al.,* 2007 conducted experiments on integrated nutrient management with different fertilizers, organic manures and biofertilizers on 7-yrs-old trees of Sardar (Guava) improved the vegetative growth parameters. Maximum increases in plant height (0.45m), plant spread (0.34m, E-W & 0.57m, NS) were recorded with dose of 250g N, 100g P2O5, 250g K2O, 10kg FYM and 250g *Azotobacter*. Number of fruits (1200 tree-1), yield (150.25kg tree-1and fruit quality parameters such as TSS, reducing sugars (13.50Brix & 3.50%) were also higher with same treatments.

Conclusion

Integrated nutrient management is a tool which can offer good options and economic choice to supply plants with a sufficient amount of most macro- and micronutrients and also can reduce the dose of chemical fertilizers, create favourable soil physiochemical conditions and healthy environment, eliminate the constraints, safeguard the soil nutrient balance in the long run, generate an optimum level for sustaining the desired crop productivity, and lastly find safe methods to get rid of agriculture wastes.

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The Forbidden Rice – Health Benefits

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Introduction

Rice *(Oryza sativa)* is consumed as staple food around the world from time immemorial. Among the various rice varieties observed "Black Rice" has gained importance for its nutritional benefits. Black rice has immense functional properties. Usage of rice for medicinal purposes in China can be backtracked to 2800 BC. The rice is called "Forbidden Rice" as in China, back in past, was used only by the Emperors and forbidden for commoners owing to its value. This article is to emphasize the origin and cultivation, characteristics, nutrient composition and therapeutic benefits of black rice.

Origin and Cultivation

Black rice *(Zizania aqatica)*, native to China is formed by mutation of Kala4 gene, the gene that is responsible for production of anthocyanin- black/purple pigment. Its cultivation is rich in countries of Asia like India, China, Thailand, Vietnam, Bangladesh and Indonesia. Owing to the benefits it is also grown in minor amount in Southern areas of Unites States of America.

Varieties

With fewer studies describing the genetic diversity, about 200 varieties of black rice is found throughout the globe. The most commonly utilized types are given below.

1. Black Japonica Rice – Has mild sweet spiciness and spreads an earthy flavour.
2. Black Glutinous Rice / Black Sticky Rice – In Asia used for making sweet dishes.
3. Italian Black Rice – Exhibits rich buttery aroma.
4. Thai Black Jasmine Rice – On cooking provides subtle floral (jasmine) flavour.

Characteristics

1. Thick Layer of black coloured bran.
2. Medium or long cereal grain.
3. White kernel inside black bran is observed in pre-cooked/parboiled rice.
4. Turns cooking water to brilliant purple colour.
5. Cooking changes the rice colour from black to purple.
6. Cohesive in nature.

Nutritional Content

The nutritional value is superior to other rice varieties consumed and comparable to the brown rice. The nutrients per 100 g include protein (8.5 g), fibre (4.9 g), iron (3.5 g).

Black rice is considered super-food as it contains 18 amino acids (Arginine, Alanine, Asparagine, Aspartic acid, Glutamine, Glutamic acid, Glycine, Histidine, Leucine, Isoleucine, Methionine, Phenylalanine, Lysine, Valine, Tyrosine, Thereonine, Proline & Serine), copper and other vital vitamins. It is also a rich source of anthocyanin, a phytochemical and anti-oxidant.

Health Benefits

1. Anti-oxidant Property: The oxidative stress caused by Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS) affects cells and results in cell death, tumours or ageing. Black rice with the anti-oxidant anthocyanin has been proven, to protect the cells from oxidative stress and to exhibit tumour metastasis lowering effect (anti-tumour). Additionally, presence of vitamin E aids in maintenance of skin and eyes.

2. Liver Health: In vitro and in vivo studies on bioactive components of black rice and their role on lipid peroxidation demonstrated increased fatty acid metabolism, decreased blood sugar elevation and reduced risk for high cholesterol. This directly affects liver by reducing the risk for fatty liver.

3. Control of Diabetes: Black rice extract when studied showed lower glycaemic index than wheat and another study revealed the insulin resistance promoting activity. The anti-diabetic activity of black rice makes it a better complementary medicine in the management of type 2 diabetes mellitus.

4. Miscellaneous: The influence of black rice phytochemicals on fat metabolism prevents the formation of atheroma in arteries thus positively influencing heart functions as indicated by cell line and animal studies. Clinical investigation showed that anthocyanin present in black rice despite boosting the memory helps in lowering depression and prevents the onset of Alzheimer's disease, dementia and premature cognitive ageing.

Food Products

Some of the commercially available black rice incorporated products include black rice bran oil, noodles, paste, yogurt, Thai pork sausage, bread and cookies.

Conclusion

Black rice one of the traditional rice varieties possess anti-inflammatory, anti-cancerous and other health benefits. The anti-diabetic activity exhibited by the forbidden or emperor's rice makes it a suitable substitute for white and brown rice. The rich amount of anthocyanin, fibre, iron and amino acid presence makes it a super-food with proven functional properties. Therefore, further cultivation and processing of black rice might be enhanced for better consumption by general public.

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Characteristics of Devastating Storage Pest of Pulses – Bruchids *(Callosobruchus maculatus)*

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The production of pulses is seriously threatened by many insect pests. Among the various insect pests, bruchids or seed weevils are the most dangerous storage pest. Furthermore, cowpea weevil (*Callosobruchus maculatus*) and adzuki bean weevil (*Callosobruchus chinensis*) are the most destructive, during pulse transportation and storage. The damage caused by the pest produces considerable reduction in quantity and nutritional quality of seeds and also affects the germination and viability of seeds. Bruchids attack almost all the edible legumes, including mung bean, pigeon pea, black gram, cowpea, chickpea, and lentil, and are cosmopolitan in distribution. This necessitated the study of characteristics of *Callosobruchus maculatus.*

Physical Characteristics of Callosobruchus maculatus

Callosobruchus maculatus adults are 2.0-3.5 mm long. The antennae of both sexes are slightly serrate. Females often have strong markings on the elytra with two large lateral dark patches mid-way along the elytra and smaller patches at the anterior and posterior ends, leaving a paler brown cross-shaped area covering the rest. The males are much less distinctly marked. *C. maculatus* has a pair of distinct ridges (inner and outer) on the ventral side of each hind femur, and each ridge bears a tooth near the apical end. An active- or flight-form of adult *C. maculatus* which is more active and is more strongly marked, with a white pygidium.

Ovipositional Preference of *Callosobruchus maculatus*

Ovipositing females prefers the seeds with less than the average number of eggs, in order to minimize the competition among larval progeny. Before ovipositioning the female perambulates one or several seeds, palpating the seed coat with the antennae. The egg load assessment is made using chemical and tactile stimuli and also with egg-marking pheromones/oviposition deterrents. The oviposition by *C. maculatus* reaches a peak within two days after the commencement of oviposition and declines overtime.

Life Cycle of *Callosobruchus maculatus*

Individual eggs (0.75 mm long) are oval or spindle-shaped, clear, shiny and firmly glued to the seed surface. Eggs get hatched within 5-6 days of oviposition. The grub that hatches from the egg burrows the seed starting from the seed coat and then into the seed endosperm. Soon after the grub burrows into the seed, the remaining egg (shell) becomes opaque white or speckled as it fills with frass (feces) of the grub. The grub burrows to a position just beneath the seed coat before pupation. Although the seed coat of the bean is still intact, a round 1-2mm window is visible at the location where the beetle is pupating. At 25°-30°C and 70±5% relative humidity, pupation and emergence of an adult beetle occurs 25-35 days after an egg was deposited. After 24 to 36 hours of emergence, the adults get completely matured. The adult lifetime (10-14 days) of both male and female does not require food and water.

Fecundity of *Callosobruchus maculatus*

The emerged females release a 'calling posture' and a pheromone to attract males. The process of mating (3-8 min) takes place within an hour after the emergence of male and female *C. maculatus*. The mated female can lay 80–100 eggs, depositing only one to three eggs per seed. An oily substance that attaches the eggs to the seeds also functions as an inhibitor of hatching, ensuring that only one or two eggs on each seed will hatch even if more is deposited. With 30 days of life cycle and a reproductive rate of 80 eggs per female, it is obvious that the population of bruchids will mushroom and destroy the entire seed lot when seeds are stored for several months, even with the moderate level of the initial infestation.

Conclusion

Pest management is a two-strand approach which mainly relays on the knowledge of the strategy and the pest biology. The information of pest biology helps to determine the most appropriate procedure and the right time of applying the management measures.

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Agnihotra: Homa Organic Farming

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AGNIHOTRA is the science of healing the atmosphere through pyramid fires to eliminate pollution and contamination. Agnihotra has its origin in the most ancient Vedic sciences of bio-energy, medicine, agriculture and climate engineering. When Agnihotra is applied in medicine and agriculture it is called Homa Therapy. When Homa Therapy is applied to Agriculture it is called Homa Organic Farming. With chemical fertilizers and pesticides, it becomes necessary to increase the dosage and strength or alter formulas as years go by. Then a stage comes when nothing grows unless you use them. If you do use them, they ruin the soil and subsoil water. The harmful chemicals are ingested into the body when we eat food grown under these conditions. This ancient Vedic farming technique promises an increase in crop yields with minimal input costs. The practice is used to treat the atmosphere, the soil, plants, pests and disease problems.

The Science and the Belief Behind it

Utilizing the healing fire, holy ash and vedic sounds, the sounds of natural law to awake the inner intelligence of the plant and promote a peaceful healthy life for all who eat them, the chanting of mantras removes negative energies from the environment.

What is Agnihotra?

Agnihotra is a simple healing fire from the ancient science of Ayurveda. Agnihotra is the antidote for all the problems we have created for ourselves and for the whole of Nature.

1. Agnihotra is a process of purifying the atmosphere through a specially prepared fire.
2. The process involves preparing a small fire with dried cow-dung cakes in a copper pyramid of fixed size and putting some grains of rice and ghee (clarified unsalted butter) into the fire exactly at sunrise and sunset to the accompaniment of two simple mantras.

Materials Required for Agnihotra

To perform Agnihotra you require:

1. Copper pyramid of prescribed shape and size: Copper pyramid has capacity to all the electricity and others.
2. Dried cow-dung cakes: Dried cow dung has been found to be rich in Actinomycetes and treated as medicine in all ancient culture from Indian to North and South America, Scandinavians, Asians and Africans.
3. 100% pure cow's ghee (clarified butter): It is very special medicinal substance, when used in Agnihotra fire. When cow ghee is burned with rice it purifies atmosphere and also induces rain.
4. Unpolished, unbroken rice grains: If the rice is broken the chemical analysis of both pieces may be the same but the subtle energy structure is broken and hence, it should not be used for Agnihotra healing fire.
5. Sunrise/sunset timings up to seconds accuracy.
6. Simple Sanskrit Mantra:

- a. Morning Agnihotra mantra:
  - i. *Sooryáya swáhá, sooryáya idam na mama* (add first pinch of rice).
  - ii. *Prajápataye swáhá, prajápataye idam na mama* (add second pinch of rice).
- b. Evening Agnihotra mantra:
  - i. *Agnaye swáhá, agnaye idam na mama* (add first pinch of rice).
  - ii. *Prajápataye swáhá, prajápataye idam na mama* (add second pinch of rice).

Advantages

1. It is a total and complete organic farming with assured yield.
2. Agnihotra helps to produces healthy soil, plant life and quality foods.
3. It helps to restore natural taste, colour and flavour of economic produces.
4. Improve the cooking quality of rice and other cereals.
5. Reduces incidence of insect-pest and diseases and thereby the need of peat control measure eco-friendly.
6. Cost effective.
7. Safe to handle.
8. Leads to sustainable agriculture.

Effect of Homa Farming on Soil and Crop

1. By applying the energetic ash, the soil quality is improved successively from year to year. soil structure will become very friable has good water holding capacity and contain ample essential nutrients.
2. Some scientists discovered that agnihotra ash contain 94 elements.
3. This ash acts like a catalyst on plant growth in homa atmosphere plants develop leaf vein that are cylindrical and larger than normal due to this water and nutrient be more easily assimilated by the plant.
4. Agnihotra ash increase the amount of water-soluble phosphorus available to the plant in the soil this have great effect on growth and reproductive cycle.
5. Homa atmosphere is also conductive for the production of chlorophyll. Hence, increase photosynthesis and respiration this in turn promotes the proper oxygen cycle in nature.
6. Plants that grow in homa atmosphere display a greater array of cell structure.

Plant Nutrient Solution

To make an Agnihotra plant nutrient solution, up to 4 tablespoons of Agnihotra ash and 4 tablespoons of pulverized, dried cow dung are stirred in approximately 5 lires of water and then applied to plants and repeated every 14 days, depending on how much it is needed.

Treatment of Seeds Before Sowing

Seeds are impregnated with a mixture of Agnihotra ash and cow dung urine. It is recommended to prepare a mixture of cow urine and water in a ratio of 50:50 to which up to 4 tablespoons of agnihotra as per 5 litres of solution added and stirred. Seeds should be soaked in this solution for 30-40 minutes and then dry enough. This strengthens the germinating plants and makes it more resistant to pests.

Fertilizers

Plants can be fertilized with a mixture of Agnihotra ash, stinging nettles and water. This special liquid fertilizer strengthens the plants. The stinging nettles are fermented i.e., decomposed in the water for 7-14 days, depending on weather conditions and the amount of nettled needed. this mixture should be diluted to a solution with ratio of 1:9.

Effects of Homa Farming on Environment

1. Agnihotra helps to purify the atmosphere and improve the quality of air, water and soil.
2. Cow dung contains the substance similar to penicillin which has a disinfecting effect and reduce pathogenic bacteria.
3. Hazardous effects of agrochemicals on ozone layer, forest as well as on living thing. But Homa Farming helpful in the reduction of pest, hold soil moisture better than conventional farming. HOMA is the way to save our planet from POLLUTION.

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Alteration in Rhizosphere and Phyllosphere

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Abstract

Rhizosphere is the part of soil where there is maximum microbial activity due to extensive presence of microbes. Similarly, phyllosphere is the leaf area which is occupied by the microorganisms. By altering the condition in rhizosphere as well as in phyllosphere one can improve the positive growth of microbes and can help to reduce the virulent strains. The alterations can be done at various level depending upon many physical as well as chemical factors of soil and crops. This should be done very carefully or else it will be going to damage the entire crop and sometimes the entire field which cause toxic effects to the soil of that particular area and hence lead to be temporarily hazardous condition. The alterations need to be done because after harvesting of any crop the soil will lose its nutrient for the next cycle and also another kind of crop cannot be grown easily so alterations will help for the betterment of crop and hence the output is quite favourable according to the needs.

Introduction

Rhizosphere: The rhizosphere is the dynamic region governed by complex interactions between plants and the organism that are in close association with the roots. (A.C Kenndy, L.Z de Zuna,2005).

The root exudates affect the microbial activity, and hence play an important role in the population of microorganisms in the soil. Several relationships will be established between plants, organisms, and rhizosphere which ultimately affect the root functioning and so the plant growth.

Phyllosphere: The phyllosphere is aerial region usually consider as part of leaf that are colonized by microbes. This part of leaf will be very beneficial in several ways like:

They can fix atmospheric nitrogen, have antagonistic action against fungal parasites., Degrade plant surface waxes and cuticles, produce plant growth hormones, decompose plant material after leaf fall, activate plant to produce phytalaxins (disease resistance), Influence plant growth behaviours and root exudation pattern.

The phyllosphere is considered to be a hostile environment due to rapid changes in temperature and humidity, limited nutrients, and solar irradiation. Yet, phyllosphere commensals have adapted to cope with these conditions.(A.M.Hirsch, N.A.Fujishige,2008).

Why there is need to Alter the Rhizosphere and Phyllosphere?

As we know that both rhizosphere and phyllosphere play a crucial role when it comes to the functioning of plants. The microorganisms present there helps in performing the salient features for the growth of plants as they help in circulation of nutrients from environment to soil to plants.

The growth and functioning of these microorganisms solely depend on the root exudates. The root exudates are the organic compounds release from the roots such as sugars, aminoacid, fatty acids, growth factors etc.

There immediate amount can control the growth of microflora and microfauna in soil, therefore by changing the pattern of root exudates one can achieve the amount and variety of microfauna in root as well as in leaf zone.

Alterations in Rhizosphere Microflora

There ae many ways through which we can alter the pattern of root exudates and hence the rhizosphere microflora. Some of them are:

1. Soil amendments: Soil amendments are the practices to improve biochemical as well as structure of the soil. They are of two types inorganic as well as organic, both of them directly provide the nutrients to the soil and indirectly change the root exudates pattern.

The organic amendments include biochar, organic manure, sewage manure, mulches etc. Wang et al. (2017) studied the effect of mulches and legumes for the restoration of urban abandoned land and reported a decrease in temperature from 6% to 18%.Dwivedi and Chaube (1985) showed that amendment of soil with neem-cake can stimulate the activity of actinomycetes which results into the reduction of propagules of Macrophomina phaseolina. It is also known to control phytopathogenic nematodes in soil by stimulating nematode trapping fungi.

While the inorganic amendments include coal, gypsum etc. The combination of composted sewage sludge and steel mill slag was also used as a potential amendment for afforestation in Brazil that resulted in the increase of soil fertility and plant growth (Guerrini et al., 2017).

2. Folliar application of fertilizer and agrochemicals: Foliar application is the method of spreading of chemicals over the leaf surface as during the metabolic process the photosynthates will translocate from the leaf to the root rhizomorphic area. By applying the growth regulators, plant protection chemicals etc. on the leaf it will travel to the root and alter the conditions there and hence protect the plant from toxic microbes so enhance the growth of the plants.

In actinomycetes by 2, 4-D, disodium hydrogen phosphate and sodium nitrate sprays, and in fungal population by 2, 4-D and sodium nitrate sprays were observed in sorghum rhizosphere whereas in sun hemp 2, 4-D and sodium nitrate sprays increased the bacterial, actinomycetes and fungal populations. (*A. Balasubarmanian* & G.rangaswami,1973).

3. Seed treatments with bioinoculants: Living strains of bacteria, fungus or algae are known as bio innoculants. They directly lay out on the soil/seed and inhabited there and formed a large colony in the rhizosphere and then produce specific materials and also regulate the nutrient transport.

In vertisols of maharastra, inoculation of azotobacter and PSB on blackgram, soyabean and pigeon pea increased the seed yields significantly by 150-250 kg/ha over control even at 100% RDF.

Alteration in Phyllospheric Organisms

1. Chemicals spray on foliage: The chemical should be like which have ability to modify the microhabitat in order to increase the nutrient availability on phylloplane. Biosurfactants may facilitate the movement of bacteria on the phylloplane, as was suggested for tolaasin, a toxin produced by *Pseudomonas tolaa*.

2. Cell density dependent modification: On the phyllosphere there will large amount of heterogenous variety of bacterial population exist.it is experimentally proved that the bacterial aggregates support these microbes to colonise and survive the extreme environment of the phyllosphere as it will help them to modify their immediate environment.

Given that recent results indicate that cells in aggregates are much more tolerant of desiccation stresses on leaves than are more solitary cells (Monier and Lindow,). Therefore, by increasing cell density of bacteria plant fitness will be gradually expanding.

3. By altering physical structure of soil: Cultivation practice improves soil structure and affects rhizosphere and phyllosphereic microorganisms. As better the aeration practices the better will be growth of microbes. Hence timely proper tillage and other management practices should be followed on the field.

Personal Opinion

Our ecosystem is all run due to interactions between every single creature or organisms in the world. So, when it comes to agriculture then why not we must take advantage of that relationship. Plants rhizosphere and phyllospheric area provide the zone of the interaction through which organisms will relate to plants and help them to perform in a preferable way. Also, they help to fix the nutrients from the environment to the plants which will reduce the synthetic use of fertilizers so there will be less loss of fertility from soil after every crop also it reduces the amount of money spend by farmers. So, it will help them financially and economically in a better way. Therefore, if we learn that how to alter the rhizosphere and phyllospheric area we can control the major part of practices which enhance the growth and fertility of the soil and as well of the crop.

Summary / Conclusions

Alterations in rhizosphere and phyllospheric region leads to the growth and development of plants or crops in a very systematic and in a progress way. For that there are very economic methods which will help farmers and support them. These methods are not only for the farmers benefit but also enrich our environment and lead our agriculture into a sustainable way.

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Mycorrhizae - A Gracious Gift to Mankind

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Introduction

Mycorrhizal fungi are fungi that closely associate with plant roots and forming a symbiotic relationship, with the plants provide carbohydrate for the fungi and the fungi provide nutrients such as phosphorus, to the plants. Mycorrhizal fungi can take up, collect and transport significant quantities of phosphate within the fungi and liberate in root tissue of plants. Mycorrhizae are biotrophic, endophitic and mutualistic symbiont prevalent in many cultivated and natural ecosystems. Ectomycorrhiza, Ectendomycorrhiza and Endomycorrhiza are the three major groups of mycorrhizae. Among them Ectomycorrhiza and endomycorrhiza are vital in agriculture and forestry.

Endomycorrhiza (AM- Arbuscular mycorrhiza) play a significant position on enhancing the plant growth and yield due to rise in supply of phosphorus to the plant. Mycorrhizal plants can absorb and accumulate several times more phosphate from the soil or solution than non–mycorrhizal plants. Plants inoculated with Arbuscular Mycorrhizal fungi have been shown to be more resistant to some root diseases.

Arbuscular Mycorrhizal (AM) Fungi

Arbuscular Mycorrhizal (AM) fungi [previously Vesicular Arbuscular Mycorrhizal fungi (VAM)], are symbionts with terrestrial plant roots. In recent times, mycorrhizae recognized not only for increasing phosphorus nutrition of the host plant but also its growth, which may lead to an increase in drought stress resistance and resistance to some diseases. Hence, AM fungi put forward an immense potential for sustainable agriculture, and the application of AM fungi in agriculture has been developed.

Mycorrhiza increases root surface area for water and nutrients uptake. The use of mycorrhizal biofertilizer helps to improve higher branching of plant roots, and the mycorrhizal hyphae grow from the root to soil enabling the plant roots to contact with wider area of soil surface. One kilometer of hypae may be associated with a plant in a one liter pot and it can access water and nutrients in the smallest pores in the soil, hence, increasing the absorbing area for water and nutrients absorption of the plant root system. Therefore, plants with mycorrhizal association will have higher efficiency for nutrients absorption, such as nitrogen, phosphorus, potassium, calcium, magnesium, zinc, and copper; and also increase plant resistance to drought.

Benefits of Mycorrhizal Biofertilizer

1. Mycorrhizae can symbiotically associate with more than 90% of plant species. Mycorrhiza is the only known fungal system, which is considered as a biofertilizer.

2. Mycorrhizae allow plants to take up nutrients in unavailable forms or nutrients that are fixed to the soil. In acidic or basic soil, phosphorus is usually bound to iron, aluminum, calcium, or magnesium, leading to water insolubility, which is not useful for plants. Mycorrhiza plays an important role in phosphorus absorption for plant via cell wall of mycorrhiza to the cell wall of plant root.

3. Mycorrhiza help to absorb other organic substances that are not fully soluble for plants to use, and also help to absorb and dissolve other nutrients for plants by storage in the root it is associated with.

4. Mycorrhiza helps to produce more vigorous and healthy plants. They enhance plant growth, improve crop yield, and increase income for the farmers. Arising from improved water and essential nutrients absorption for plant growth by mycorrhiza, it leads to improvement in plant photosynthesis, nutrients translocation, and plant

metabolism processes. Therefore, the plant has better growth and yield, reduce the use of chemical fertilizer, sometimes up to half of the suggested amount, which in turn increases income for the farmers.

5. Mycorrhiza improves plant resistance to root rot and collar rot diseases. Mycorrhizal association in plant roots will help plant to resist root rot and collar rot diseases caused by other fungi.

6. They utilize photosynthetically produced carbohydrates for their growth and synthesize and excrete molecules like glomalin (glycoprotein). The release of glomalin in the soil environment results in better soil structure and higher organic matter content.

7. Mycorrhiza helps in soil conservation and soil structure stabilization, thus restoring land productivity. These fungi have a key role in soil aggregation process and stimulate microbial activity. Soil structure refers to soil particle aggregation as well as pore spaces. Mycorrhiza plays an important role in maintaining soil quality and nutrient cycling and leads to greater water infiltration and water holding capacity. Also shows Better resistance to surface sealing (crusts) and Better resistance to compaction.

8. It can be used together with other agricultural chemicals. Mycorrhiza are endurable to several chemical substances; for example; pesticide such as endrin, chlordane, methyl parathion, methomyl carbofuran; herbicide such as glyphosate, fuazifopbutyl; chemical agents for plant disease elimination such as captan, benomyl, maneb triforine, mancozed and zineb.

9. They are better equipped for combating the unfavourable conditions and have longer shelf lives as compared to the bacteria-based product.

10. Mycorrhiza offers tolerance against a range of soil stresses like heavy metal toxicity, salinity, drought, and high soil temperatures. This enhances the chances of plant survival immensely.

Summary

Mycorrhizal fungi are fungi beneficially associated with plant roots. Mycorrhizae can symbiotically associate with more than 90% of plant species. Mycorrhiza is the only known fungal biofertilizer. Mycorrhizal fungi can take up, collect and transport significant quantities of phosphate and other nutrients within the fungi and liberate in root tissue of plants. Mycorrhiza help to absorb other organic substances and water. They enhance plant growth, improve crop yield, and increase income for the farmers. It reduces the use of chemical fertilizer, improves plant resistance to diseases and unfavourable environmental conditions and also helps in soil conservation and soil structure stabilization.

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Powdery Mildew and its Management in Pea

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Introduction

Pea has advantage of qualitative as well as quantitative protein content. However, a major biotic constraint worldwide, and in India, for the production of pea includes powdery mildew, a widely distributed fungal disease of pea. It is caused by the fungus *Erysiphe pisi*. It can cause severe damage in areas where it is cultivated. The infection starts with small diffuse spots on the upper surface of leaflets or tipules and may quickly cover the plant surfaces completely. Usually, powdery fungal growth appears first on the upper leaf surface. Eventually the entire leaf may become covered with mildew.

The symptom is a white or grey, powdery growth on leaves and stem which will not usually kill a plant, however it may weaken plants. The disease then spreads to other parts of the plant such as tendrils, pods, stems etc. In the advanced stages of the disease large areas of the host get covered with white floury patches. Seed from infected pods can be discoloured and less palatable, which reduces its market value. Powdery mildew spores are carried by air and once active, will continue to spread in dry conditions. Powdery mildew is most prevalent late in the season when warm days and cool nights result in dew formation. Current powdery mildew control methods include, early sowing, the use of fungicides and of resistant varieties.

Cultural Practices

The most adopted practice to escape from powdery mildew infection is to plant early in the growing season or use early maturing cultivars. Early sowing crops and early maturing cultivars are often less affected by this disease than late harvested crops because the fungus has less time to spread and affect yield. Infection of powdery mildew disease increases with soil nitrogen availability due to its effect on host growth rate. On the contrary, phosphorous reduces the incidence of the disease (Jarvis et al. 2002). Powdery mildew is often severe in a lush pea stand. The fact that powdery mildew is more severe in conditions that favour growth and productivity of the host implies that crop management practices to create sub-optimal host growing conditions in the hope of reducing powdery mildew and severity is not an attractive proposition for farmers. Crop rotation is of limited usefulness in managing powdery mildew.

Biological Fungicides

Biological fungicides (Serenade) are commercially available beneficial microorganisms which are used to destroy fungal pathogens. The active ingredient in Serenade is a bacterium, Bacillus subtilis, that helps to prevent the powdery mildew from infecting plant while functions of this product to kill the powdery mildew organism and is nontoxic to people and beneficial insects.

How to Use

Apply protectant fungicides, such as wettable sulphur, to susceptible plants before or in the earliest stages of disease development. The protectant fungicides are only effective on contact, so applications must provide thorough coverage of all susceptible plant parts. As plants grow and produce new leaves, additional applications may be necessary at 7- to 10-day intervals as long as conditions are conducive to disease growth. If mild to moderate powdery mildew symptoms are present, the horticultural oils and plant-based oils such as neem oil and jojoba oil can be used to reduce or eliminate the infection.

Chemical Control

Spray dinocap@ 0.05per cent or wettable sulphur@ 0.2 per cent. Repeat after 10-15 days if necessary. Foliar spray of pea with hexaconazole 0.1 % two times at 15 days interval, starting at 40 days after sowing is most effective in reducing the powdery mildew of pea, thereby increasing the yield. Use of propiconazole @ 0.1 % and carbendazim @ 0.1 % are effective for the management of powdery mildew diseases of field pea (Pisum sativum L.). These fungicides also promote growth of plant by preventing disease and can be taken up for disease management of powdery mildew (Jha et.al., 2019).

Non-Chemical Approaches

1. Plant tolerant / resistance varieties like PMR-53, Palam Priya, Arka Ajeet.
2. Rotate with non-host crops such as potato, maize, wheat or other grains
3. Maintained proper spacing between plants for free air circulation
4. Early sowing is recommended because powdery mildew infection is more damaging on late-maturing pea crops.
5. Maintain field sanitation/hygiene
6. Avoid heavy application of fertilizer.
7. Minimize field movements from infected areas to non-infected areas.

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Medicinal Properties and Uses of Some Underutilized Fruit Crops

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Introduction

Southeast Asia a prime and large centre of diversity for several tropical fruits, Indian sub-continent comprises of huge vast semi-arid and arid has huge diversity number of underutilized fruit crops. A large number of many multipurpose species grow in plenty under most inhospitable and highly stressed agroclimatic conditions also as isolated trees or may be in small groups. Findings have shown that species have no systematic or organized orcharding, nutritional management and plant protection practices. Such species have indicated very high adaptation to extremely adverse conditions- drought, salt tolerance, marked resistance to major pest and diseases. High rate of exploitation from natural habitats, increased demand for land- agriculture and industry no care taken to preserve natural wealth cost extensive damage to the natural habitats.

India has wide variation in agro-climatic conditions which is evident from the fact that large number of indigenous as well as those introduced for abroad have established and formed a very sound and stable fruit industry. Pome, stone fruits are typical example, also guava, pomegranate, pineapple, have established to the Indian conditions and their massive cultivation reveal that they are indigenous to India and in turn have added and enriched fruit basket of India. Consequently, throughout the year various fruits are available in plenty. In doing so many indigenous fruits which are now designated as underutilized fruits were side lined in view of the large commercial value of other fruits. In recent times through various surveys and exploration work, several genotypes have been characterized data cultivation as built testing at advance stages for their recommendation for cultivation. Further nutritive value and their uses have been recorded although were used several centuries ago.

A small article on the said aspect (uses and nutritive value) of such crops is briefly described so that information reaches generally public and their consumption is increased with added advantage to human health which is free of many insecticide and pesticide sprays.

Protection, maintenance and extension of tree cover is also essential to support agricultural production besides meeting the requirements of local population for fodder, feed, fuel wood and timber. Time has come to think upon urgent steps to be taken to save numerous genetic resources through appropriate genetic resource management and improvement of such fruits to enable food and nutritional security of tribal and rural population associated with enhancement of income to the farmers engaged in cultivation of these fruits. Through fixing thrust and priority areas for efficient management of genetic resources by way of:-

1. Definite survey and exploration to collect specific genetic resources of natural wild or semi-domesticated types.
2. Species propagated through seeds has huge genetic variability and heterogeneity for important chracters. Their characterization, evaluation to identify quality genotypes.
3. Developed of vegetative propagation method to maintain the selected genotype for various parameters.
4. Enhancement of farmers income through selection of suitable cultivars and availability of desired planting materials with traits like:
   a. Cultivars with high and stable production potential
   b. Ability to resist/tolerate various stresses
   c. Genotypes with diverse quality character
5. In situ conservation of species to ensure their dynamic conservation by selecting identified protected areas, also on farm conservation.

6. Molecular characterization to support morphological characterization to know exact magnitude of genetic diversity and its utilization.

7. Apart from pomologiucal traits species are excellent source for heat, water, stress and salt tolerance.

Aonla *(Phyllanthus emblica)*

Important uses: Aonla is a significant fruit of Indian origin mostly taken as fresh, processed and preserved in many ways. Fruits are rich source of vitamin C as it has high content of leucoanthocanins which slow down the oxidation of vit. C. besides this fruit is known for its richness in minerals components e.g., iron, calcium and phosphorous. Several thousand plants of seedlings grow naturally throughout India which were collected and same is also being done presently from wild populations by tribals and marginal farmers, used them as vegetable/cooked, pickled or preserved with sugar/jaggery to make local preparations or are directly sold in the market to earn hard cash. Fruit has marked role in processing and pharmaceutical industry. Years of studies have shown numerous medicinal uses are fully documented in the Indian System of Medicine and Unani prescribed in various ways to increase human immunity and health. Further through processing nutritive values are retained in the products as Murabba, Chawanparash and Trifala in addition few new products are developed by value addition i.e. aonla candy, jam, herbal jam, chutney, pickle, squash, juice, sharbat, vinegar etc. Number of other processing systems have and are being developed at various institutions in India to make the fruit popular among the consumers to enhance its consumption.

Being rich in vitamin C, crop is used for pickling, almost all parts of the plant are used in one or other way to take care/cure serious ailments like jaundice, dysentery, diarrhea, cough and diabetes in tanning industry. Latex exudation used for eye ailment, known as contraceptive and has anti fertility properties. Aonla is known for its highly rated medicinal properties like anti-tumour, anti-oxidant hepato protective contain significant levels of flavonoid.

Bael *(Aegle marmelos)*

Important uses: Significance of bael is that leaves are offered as divine offering to Lord Shiva. Bael tree is native to India, has huge degree of historical importance from Indian culture point of view, its uses have been indicated in numerous famous literatures. Fruit is rich source of riboflavin (B12), pulp eaten as raw, processed to accomplish different value-added products namely murabba, jam, sharbat, squash etc. In summer fresh bael juice is sold in the market as soft drink. Fruit pulp is economically significant has number of medicinal features help to reduce/ cure stomach ailments, dysentery and diarrhoea, has number of bio active compound pectins, tannins, phenolics, terpenoids. Reports have indicated phytochemical, pharmacological activities. Chemical ingredients alkaloids, steroids and cumarins identified from wood, leaves, barks roots etc. Leaves and bark helps to restrict intermittent fever, young leaves cause sterility and abortion (woman), roots helps to control indigestion and heart palpitation. Leaf extract has anti spermatogenic activities, strong remedy for peptic ulcer, overcomes jaundice, control thyroid related disorder, poultice used in treatment of thalamic. Marmelosin has number of therapeutic properties. In nut shell leaf pulp is potential source of protein, minerals, fat crude fibre and energy.

Jamun *(Syzygium cumini)*

Important uses: Another significant fruit crop originated in India and nearby countries distributed all over in the India plains. Fruit very nutritious, consumed fresh or processed to make different preparations. Being rich in mineral matters like iron, minerals, protein and carbohydrate is processed to make high grade products like juice, sharbat, syrup, jam, jelly squash, wine and vinegar. Seeds has high contents of alkaloids i.e. jambosin and glycoside, inhibits conversion of starch to sugars, powdered seeds highly useful for sugar patients. Crop important in the Indian System of Medicine, used to overcome ailments- diabetes, heart and liver problems. Seeds widely used in Ayurveda, Unani and Chinese medicines has high content of protein, carbohydrates and calcium, used as potential cattle feed.

Karonda *(Carissa carandus, C. grandiflora)*

Important uses: An evergreen shrub, numerous white pink tinched flower highly sweet smelling in nature, crop has number of uses and medicinal properties. Usually eaten fresh or mixed with salt and sugar provide soothing experience in hot dry summer. In Rajasthan a tasty dish made by cooking immature fruits with green chills, pulp make a fine jelly, rich in iron, vitamin C used to treat anaemia, as astringent antisorbic remedy for biliousness, leaf decoction overcome ear pain, fever and diarrhea. Roots serve as a stomachic, vermifuge and remedy for itches and insect repellent.

In Chhattisgarh fruit used to treat different types of cancer, different plant parts use to dress cancerous wounds helps to kill maggots. Decoction from roots, flowers, spines, leaves in equal quantities made into aqueous paste. Paste applied on cancerous region restrict further spread of wounds.

Fruit used as food this medicinal plant has bioactive constituents, alkaloids flavonoids, saponins and large amounts of cardiac glycosides, triterpenoids, phenolic compounds and tannins. Roots rich in volatile compounds- principles being 2-acetyl phenol, lignan, carinol, sesquiterpenes (carissone, carindone), lupeol, β-sitosterol, 16β-hydroxybetulinicacid, α-amyrin, β-sitosterol glycoside, and des-N-methylnoracronycine. Leaves have triterpenoid constitutes as well as tannins, while fruits contain carisol, epimer of α-amyrin, linalool, β-caryophyllene, carissone, carissic acid, carindone, ursolic acid, carinol, ascorbic acid, lupeol, and β-sitosterol.

Ethno-pharmacological significance of the plant has been ascribed due to anti-cancer, anti-convulsant, anti-oxidant, analgesic, anti-inflammatoryAQ1, anti-ulcer, anthelmintic activity, cardiovascular, anti-nociceptive, anti-diabetic, antipyretic, hepatoprotective, neuropharmacological, and diuretic activities, antimicrobial activities and cytotoxic potentials, *in-vitro* anti-oxidant and DNA damage inhibition, and constipation and diarrheal activities. There is need to aim to provide a direction for further clinical research to promote safe and effective herbal treatments to cure a number of diseases.

Plants and their active constituents play an important role in the prevention of chronic and degenerative diseases is increasing. Origin of many therapeutic substances is due to secondary metabolites in the plants. In folk medicine, different extracts are used for the treatment of several complains like high blood pressure, chest complains, rheumatism and diabetes mellitus. The pharmacological actions of the different extracts include *in vivo* and/or *in vitro* anti-hypertensive, anti-inflammatory, anti-plasmodial, anticonvulsant and decrease blood glucose level. Appropriate use of *C. edulis* increased urinary excretion of sodium, potassium and chloride ions. Based upon the nutritional and pharmacological properties and relative safety, *C. edulis* and compounds isolated, flavonoids, sesquiterpenes and lignans are important source of therapeutically useful products.

Chironji *(Buchanania lanzan)*

Important uses: Tree bark is used for tanning. Fruit eaten raw have pleasant, sweetish, sub-acid flavour, eaten by local people sold in the nearby village markets. Fruits after harvest are washed and nuts are dried and stored properly to sell in the market. Seed collected and kernel extracted either at home or in the large quantity taken to the local market for mechanical extraction of kernel by breaking the nut using modified flour mills. Separated seed is an economically important part of the plant used as dry fruit in traditional sweet dishes. Kernel is of very high value and fetch Rs. 300-400 per Kg in market. Kernel a rich source of protein (20-30%) also has high oil content (40-50%), rated as highly nutritious.

Ker *(Capparis decidua)*

Important uses: Plant produces hard, heavy and termite resistant timber. Unripe fruits are edible and used as fresh vegetable and also pickled in various ways. Fully ripen fruits are sweet and eaten raw by local people. Fruits are rich in proteins, carbohydrates and minerals. Seeds contain about 20 per cent edible oil. Root bark and stem are reported to contain good amounts of spermidine alkaloid and isocodonocarpine helps in the treatment of asthma, inflammation and cough.

Lasora *(Cordia dichotoma)*

Important uses: Unripe fresh fruits are acrid generally used as vegetable and for pickle making, ripe fruits are eaten fresh. Fruit pulp regarded as rich in carbohydrates, extractive matter and ash. Fruit highly mucilaginous used in cough mixture to cure diseases of chest given in bilious infections as a laxative. Lasora fruits fetch Rs. 50-80/- per kg in the urban markets, always in the high demand not accomplished fully.

Pilu (*Salvadora Linn*. - *S. oleoides Decne*. and *S. persica* L.)

Important uses: Both the species are of multipurpose use as all plant parts being used in one or the way, further are medicinally important possess pharmaceutical uses. Toothbrushes made from roots and small branches of *S. persica* were in use for over 1000 years to get rid of toothache and gum diseases. Seeds of both species yield non-edible oil (30-50%) used in industrial production of soaps, cosmetics, paints, varnishes and lubricants, has medicinal properties to cure piles, rheumatism, skin diseases, etc, very good sand binder due to special root system highly suitable for culture in shelter belts especially as wind breaks in desert tracts. Fruits sweet regarded as a delicacy with the local populations, pulp hasgood amount of glucose, fructose and sucrose and high calcium content. Oil has lauric acid forms the basic raw material for industrial production of lauryl alcohol.

Phalsa *(Grewia subinaequalis)*

Important uses: Phalsa is extensively cultivated for its sweet and sour fruits, which are consumed fresh as table fruit and sold in the markets during summer months. Fruit possess astringent properties and used for several stomach ailments, fruits pulp processed to make phalsa sharbat when mixed with sugar solution and squash is prepared after adding some preservatives (generally sodium benzoate). Phalsa sharbat and squash give pleasant and cooling effect in summers and work as an astringent and stomachic agent. Fresh fruits fetch very good price of Rs. 80-100/- per Kg in urban markets and consumed fresh with some salt.

Use and cultivation of phalsa fruit has been mentioned in the ancient Indian literature and has been used for various ailments in the Indian System of Medicine. Fresh or dried fruits are suggested to cure heart and blood disorders, fever and diarrhea. The unripe fruits are removing vata, kapha and biliousness. The root bark is used by Santhal tribal population for rheumatism. The stem bark is used to make ropes by local people and mucilaginous extract used to clarifying sugar.

The major plant chemical constituents are flavonoids and terpenoids grewinol, quercetin and naringenin from flowers, taraxasterol, β-sitosterol, erythrodiol, β- amyrin, lupeol, betulin lupenone, friedelin and α-amyrin from the bark, has antioxidative, radioprotective and many other putative health benefits. The leaves are used as cattle fodder, are applied to wounds and cuts to relieve irritation and cure painful rashes due to their antibiotic effect. The root bark overcomes urinary tract problems, effective in treatment of rheumatism, stem bark used in sugar refining. The fruit is a small berry with stony seeds, flesh pulpy and consumed fresh, in desserts, or processed into refreshing fruits and soft drinks. Fruits are useful for heart, blood and liver disorders. Anorexia, indigestion, thirst, toxemia, stomatitis, hiccough, asthma, spermatorrhoea, fever, diarrhea, tuberculosis and sexual troubles are some other ailments where Phalsa fruits have been reported to be effective.

The crop has multiple uses, pruned wood is a very good source for staking vegetable crops and to make baskets, baskets are quite strong and are used for fruit and vegetable transport purposes. Shoots after sufficient wetting and bark after treatment yield strong fibre used for rope making and gunny substances. Cures fever, inflammation, heart and blood disorders and diarrhoea. Besides fruit, other plant parts are also used for one or other purposes.

Grewia asiatica is a rich of biologically active molecules, major constituents are grewinol, flavonoids, quercetin and naringenin from flowers; taraxasterol, β-sitosterol, erythrodiol, β-amyrin, lupeol, betulin lupenone, friedelin and α-amyrin from the bark, acts as antioxidative, radioprotective, anticancer, antiviral, antidiabetic, anti-inflammatory and antimalarial activities. Fruit pulp is a rich source of flavonoids, proteins and amino acids.

Tamarind *(Tamarindus indica)*

Important uses: A multipurpose tropical tree, fruits eaten fresh / processed in several ways used as seasoning or spice and the fruits and seeds are processed for non-food uses. Major constituents are tartaric acid and invert sugars, pulp rich in calcium, phosphorous, riboflavin, niacin and thiamine. Pulp used in several ways as per the locality and food habit of local inhabitants, used to prepare chutney, tamarind powder, puree, juice concentrate, jam, jelly, candies, pickles and fruit leather. Number of value-added products were recently developed by Central Food and Technological Research Institute (CFTRI), Mysore to enhance its use. Tamarind seeds being commercially significant are employed in several ways i.e. Tamarind Kernel Powder prepared by very fine grinding of kernel and used for sizing in textile industry.

Tendu *(Diospyros melanoxylon)*

Important uses: Tendu tree have very important role in the socio-economy of tribal populations of tropical dry forests of India along with other two trees Mahua and Chironji, has number of economic uses all plant part used for commercial purposes. Fruit 'timru' is eaten raw and sold commercially in the local markets by local tribals, bark burnt to "cure" small-pox, dried powdered used as carminative and astringent, tannin content about 15 - 23 per cent. Dried flowers useful in urinary, skin and blood diseases. Seeds help to cure disorders, palpitation of heart and nervous breakdown. Leaves constitute raw materials for "Bidi" industry. Indian ebony wood used to make fine quality furniture, boxes, combs, ploughs and beams.

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Coir Pith Composting - Wealth from Waste

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Introduction

The largest by product of coconut is coconut husk from which coir fibre is extracted. This extraction process generates a large quantity of dusty material called coir dust or coir pith. Large quantity of coir waste of about 7.5 million tonnes is available annually from coir industries in India.

In Tamil Nadu state alone 5 lakh tons of coir dust is available. Coir pith has gained importance owing to its properties for use as a growth medium in Horticulture. Because of wider carbon and nitrogen ratio and low biodegradability due to high lignin content, coir pith is still not considered as a good carbon source for use in agriculture.

Coir pith is composted to reduce the wider C:N ratio, to reduce the lignin and cellulose content and also to increase the manorial value of pith. Composting of coir pith reduces its' bulkiness and coverts plant nutrients to the available form.

Compost Heap Formation

Coir pith composting is an aerobic composting. So, it should be heaped above the soil. There is no need for pith or cement tub to make the compost. Coir pith should be spread to the length of 4 feet and breadth of 3 feet. Initially coir pith should be put up for 3-inch height and thoroughly moistened.

After moistening, source material should be added. The nitrogenous source may be in the form of urea or fresh poultry litter. If urea is applied, it is recommended that 5 kg urea is required for one ton of coir pith. This 5 kg is equally divided into five portions and in alternate layer of coir pith one kg of urea should be applied. If fresh poultry litter is applied, it is recommended @ 200 kg for one ton of coir pith.

One has to proportionally divide and put the required amount of poultry litter over the coir pith. For example, if one-ton coir pith is divided into 10 portions, in the first layer, 100 kg poultry litter is added. After adding, the nitrogen source, the microbial inoculums Pleurotus and TNAU Biomineralizer (2%) are to be added over the material.

Over this one portion of coir pith is added and the same input mentioned above should be added. It is advisable to make a heap up to minimum of 4 feet height. But beyond 5 feet. It requires machinery to handle the materials. The increase in height retains the temperature generated in the coir pith compost process. If the height is low, whatever the heat generated will be dissipated easily.

Turning of Material

The compost heap should be turned once in 10 days to allow the stale air trapped inside the compost material to go out and fresh air will get in.

Moisture Maintenance

Maintaining optimum moisture is the pre-requisite for uniform composting or waste material. Sixty percent moisture is to be maintained at the time of composting. The index for maintaining 60% moisture is, the compost material should be always wet. But excess water should not be drained from the waste material. The other way of assessing the moisture is to take a handful of composting material and put in between the palms and squeeze it. If no water is coming out of the material, that moisture status is ideal for composting.

Compost Maturity

The period of composting varies from substrate to substrate. If all the above said conditions are maintained in the composting, it will take sixty days (60 days) for composting. The maturity of compost will be assessed by some of the physical parameters to be observed in the compost. First observation is volume reduction of waste material. When the waste material is composted, the compost heap height will be reduced by 30%. The second observation is waste materials are turned to black in color and the waste particle size is reduced. The third observation is that composted material emits earthy odor. The chemical observation for compost maturity is to be analyzed in the laboratory. The chemical observations are narrow C:N ratio (20:1), less oxygen uptake, a smaller number of microorganisms, more amount of available nutrients and high cation exchange capacity.

Nutritive Value of Raw and Composted Coir Pith

Sl. No	Parameters	Raw coir pith(%)	Composed coir pith (%)
1	Lignin	30.00	4.80
2	Cellulose	26.52	10.10
3	Carbon	26.00	24.00
4	Nitrogen	0.26	1.24
5	Phosphorous	0.01	0.06
6	Potassium	0.78	1.20
7	Calcium	0.40	0.50
8	Magnesium	0.36	0.48
9	Iron(ppm)	0.07	0.09
10	Manganese (ppm)	12.50	25.00
11	Zinc(ppm)	7.50	15.80
12	Copper(ppm)	3.10	6.20
13	C:N ratio30.00	112:1	24:1

Benefits of Composted Coir Pith

1. The addition of composted coir dust improves soil texture, structure and tilth, sandy soil become more compact and clayey soil become more arable.
2. It improves the soil aggregation.
3. It improves the water holding capacity (more than 5 times its dry weight) contributing towards increased soil moisture.
4. The bulk density of both the surface (10-15cm) and subsurface (15-30 cm) soil is reduced to considerable extent with the application composted coir pith.
5. Composted coir dust contains all plant nutrient elements and it can provide a supplemental effect along with inorganic fertilizers.
6. There is improvement in cation exchange capacity of soils, where composted coir pith is applied.
7. Coir pith compost application increased the soil native microflora because of addition of humic materials.
8. Ammonification, nitrification and nitrogen fixation are increased due to improved microbiological activity.

Application of Coir Pith Compost

1. It is recommended that 5 tons of composted coir pith per hectare of land irrespective of the crop raised.
2. It is advised that composted coir pith should be applied basally before take up the sowing.
3. For nursery development in poly bags and in mud pots, while preparing the potting mixture 20% of composted coir pith can be mixed with the soil and sand before filling it in the poly bag or mud pot.
4. For applying to the established trees like coconut, mango, banana and other fruit bearing trees, minimum 5 kg composted coir pith is required.

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Limitations in Using Composted Coir Pith

1. It is not economical to buy composted coir pith and put in the farm for large areas. It is better to prepare compost in the own farm.
2. Before buying composted coir dust, it should be ensured that the material is composted completely and quality analysis certificate is available with the material.
3. If immature compost is applied to the soil, even after entering in to the soil, it will undergo decomposition inside the soil, by taking nutrients from the soil. Because of this, standing crop will get affected.

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Termites in Cotton: An Overview

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Between 1960 and 2006, the annual output of cotton was just 98 lakh bales (170 kg / bale), covering about 320 lakh bales in the last 14 years. Since 2002, India has become the second largest exporter of raw cotton, with the large-scale introduction of Bt cotton along with advanced production and safety technologies. The big cotton-growing states of Gujarat, Maharashtra and Telangana account for about 70 percent of the country and 67 percent of India's cotton production. Gujarat is second in the world in terms of area (26.23 lakh hectares) and first in volume (104.00 lakh bales of 170 kg). The productivity of cotton in the Gujarat (674.04 kg/ha) is higher than the national average(505.46 kg/ha) (Singh, 2019).

Because of biotic and abiotic restrictions, cotton production has remained constant over the years. Among the biotic threats in India, insect pests are important. The cotton range of the insect pest is very complicated and 1326 species of insect pests have been recorded on this crop worldwide, of which around 130 different species of insects and mites have been found to consume cotton at various stages of crop growth in India (David and Ramamurthy, 2017).

Among the various pests attacking the crop, aphid (*Aphisgossypii* Grover), leaf hopper (*Amrascabiguttulabiguttula*Ishida), thrips (*Thrips tabaci* Lindeman and *Scirtothripsdorsalis* Hood), whitefly [*Bemisiatabaci* (Gennadius)], mealybug (*Phenacoccussolenopsis* Tinsley), stem weevil[*Pempherulusaffinis* (Faust)], spotted bollworms [*Eariasinsulana* (Boisduval) and *E. vitella* (Fabricius)], pinkbollworm [*Pectinophoragossypiella* (Saunders)], Americanbollworm or gram pod borer [*Helicoverpa armigera*(Hubner)], red bollworm (*Rabila frontalis* Walker), red cottonbug [*Dysdercuscingulatus* (Fabricius)], dusky cotton bug[*Oxycarenushyalinipennis* (Costa)], budworm [*Phycitainfusella* (Meyrick)], shoot weevil [*Alcidodesaffaber*(Auriv.)], ash weevil (*Myllocerusundecimpustulatusmaculosus*Desbr.), leaf roller (*Sylleptaderogata* Fabricius),semiloopers [*Anomis flava* (Fabricius), *Pardoxiagraellsi*(Feisthamel) and *Tarachenitidula* (Fabricius)], *Spodopteralitura* (Fabricius) and termite [*Odontotermesobesus* (Rambur)and *Microtermesobesi* (Holmgren)] were found damaging tocotton crops. Of these termites is an important and destructivepest of cotton in sandy loamy soil (David and Ramamurthy, 2017).

Termites: Overview

In the animal kingdom, the most primitive social insects in the order of Isoptera are termites. A soft-bodied whitish and ant-like social insect that feeds on wood. Approximately 35 species of the 300 species of termites have been recorded to damage agricultural crops and building structures not only in India, but also in tropical and subtropical regions of the world. The termite present in a colony consists of several castes, namely, workers, soldiers, queen and king of reproduction. Three-stage termites with incomplete metamorphosis: egg, nymph, and adult. Among termites, there are two kinds of reproductive system, primary reproductive and secondary reproductive. As regard habitats, there are two kinds of termites i.e. wood dwellers (damp wood and dry wood termites) and ground dwellers (subterranean, mound builder and carton nest builder). Termites possess an enlarged sac in the hindgut which contains cellulase secreting flagellate protozoans help in digestion of cellulose of the plant materials. Termites damage the seedlings by either cut just below or above the soil surface. In mature plant, feeding root system and inside the stems, which directly kills the plant or indirectly lowers yield through decreased translocation of water and nutrients. Severally infested plant wilt, dry up and can be easily pulled up. It inflicts heavy damage to the crop cultivated in sandy loam soil, damage the crops right from sowing till harvest. Infestation is particularly serious in dry season. Problem is more predominant in rainfed areas than irrigated (Chapman, 2012).

The major mound-building species in India are *Odontotermesobesus*, *O. redemanni* and *O. wallonensis* and the subterranean species are *Heterotermesindicola*, *Coptotermesceylonicus*, *C. horni*, *Microtermesobesi*, *Trinervitermesbiformis* and *M. beesoni*. The most important species attacking cotton were *Microtermesobesi* and *Odontotermesobesus* (Roonwal, 1981).

Management of Termites

1. Digging out the termitoria to kill the queen, king and complimentary caste.
2. Collection of dead or decaying matter or dry stubbles of previous crops from the field and destroy them.
3. Use well rotten organic manure.
4. Chlorpyriphos 20 EC 450 ml or Bifenthrin 10 EC 200 ml dilute in 5 lit. of water and then give seed treatment 100 kg of seeds and sowing after 12 hours.
5. In standing crop give, chlorpyriphos 20 EC 3 lit./ha with irrigation wateror mix with 100 kg sand and broad cast/ ha and then give light irrigation.
6. Maintain moisture in field.
7. Spraying chlorpyriphos 20 EC 0.05% on bunds.
8. Use of *Calotropis procera* (Akada) leaves and seed kernels of *Azadirachta indica*.

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Trends and Economics of Pulses Production in Bihar

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Introduction

Pulses are the nature's precious gift to mankind because these crops are the rich source of plant-based protein, vitamins, minerals and also ability to tackle environmental challenges. It is extensively grown throughout the world. India ranks second position in pulses production (about 22 percent of the world production). At present, the country produces about 24.51 million tons of pulses annually. It is the fact that India is the largest pulse consumer about one third of the production in the world. Due to rapid and continuous increase in the population of country there is always a gap in production and demand. This gap was fulfilled by imported pulses from other countries. As per the recommendation of India Council of Medical Research, the requirement of pulses per capita per day was about 65 grams however the availability was only 55 gram in the year 2019. The picture was not encouraging during the past years i.e., in 1990 it was 40 g and in 2014-15 it was 30 g only per capita per day. After the year 2015-16 remarkable increase in pulses production was registered due to pulses developmental programmes, agricultural roadmaps, practice of seed replacement rate, and technological breakthrough.

Since pulse crops are mostly grown on marginal lands under rainfed conditions that cause low yields and unstable production over the years. This unstable production of pulses was not enough to supply the pulses to meet the demand for increasing population a short fall of about 3–4 million tons recorded. At present income, test, and purchasing power continuously increasing of the people in the country and people demanded more and more pulses in their diet.

Bihar state is an important pulse producing state in India. The state has been contributing about 3.0 percent pulses production of the country. Out of total production of pulses, about 18.33 percent produced during kharif season and 81.67 percent during the rabi season in the state. The details of season wise pulses production have been presented below.

Table: Season – Wise Pulses Production in Bihar During the Triennium Ending 2001-03 to 2016-18

Triennium ending	Kharif season total pulses	Rabi season total pulses	Total pulses
2001-03	88.45	486.68	575.13
2003-06	81.56	410.20	491.76
2006-09	78.25	405.67	483.92
2009-12	82.46	404.08	486.54
2012-15	92.64	433.89	526.53
2015-18	95.06	484.33	579.39
Average Production	86.40	437.47	523.87
Production Range	78.25 to 95.06	404.08 to 486.68	483.92 to 579.39
Triennium variation in production	17.68	16.97	16.48

Quantity in 000 tons. Source: - Department of Statistics and Evaluation, GOB, Patna.

The above Table showed that the kharif pulses production ranged between 78.25 thousand tons to 95.06 thousand tons during the noted period. The variation in production was 17.68 thousand tones indicated instability in production during the period. In case of rabi pulses production, the variation across the period was comparatively low i.e. 16.97 thousand tons showed slight stability mainly due to low risk involved in rabi season pulses production.

Cost and Returns

Kharif pulses: In this season mainly urad, moong, kulthi and other pulses crops were grown in the state. The average yield per hectare of total kharif pulses was 8.71 quintals, Moong was 7.10 quintals, kulthi was 9.16 quintals, and other pulses of the season was 6.66 quintals per hectare. The costs and returns per hectare of kharif season pulses were on an average of Rs 18830 as variable cost and Rs 13000 as fixed cost. The total cost incurred for cultivation of kharif pulses were worked out to Rs 31830 (about 59.15 percent variable cost & 40.85 percent fixed costs) on an average. The production of one quintal main product (grain) farmers were expenses Rs 1698.82 and for by - product (bhusha) Rs.13.18 per quintal. On an average yield in the season was 11 quintal per hectare and by product 7 quintal per hectare. The cost benefit ratio 1:1:49. This indicates return over cost is higher.

Rabi pulses: Under the season pulses crops mainly arhar, gram, lentil, pea, khesari, moong, urad and other rabi pulses were grown extensively. The average yield of total rabi pulses was 8.98 q/ha, gram 10.75 q/ha, lentil 10.63 q/ha, Pea 11.08 q/ha, khesari 10.87 q/ha. Summer moong 6.28 quintal per hectare and other rabi pulses 9.89 q/ha, The farmers expenses on an average Rs 34,854 per hectare for cultivation of rabi pulses. Out of the total costs incurred, about Rs 63.56 percent born on variable cost and rest 39.44 percent on fixed cost. The average main product (grain) yield was 14 quintals per hectare and by product 10 quintal per hectare. The per quintal production cost for grain is Rs 1556.05 and by product is Rs 25.50. The net return received from cultivation was Rs 56,146 per hectare. The cost benefit ratio was 1:1:61 which is remunerative.

Conclusions

The production of kharif pulses was found marginally increasing during the noted period. More or less same picture was observed in case of rabi pulses in the state. The benefit cost ratio proved to be the profitable but not so encouraging. Thus, in the state, there is need for the development and popularization of improved pulses varieties with better quality for increasing net returns per hectare. The main reasons for instability in the production were climatic conditions and marginal lands.

Suggestions

1. Proper supply of improved variety and seeds to the farmers.
2. Intercropping practices should be promoted for high net gains.
3. Proper processing and marketing facilities may be needed in the state.
4. Cultivation of pulses in the fertile lands.

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Different Ways of Helping Farmers in Agricultural Sector by the Students / Youth

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Introduction

India's population has been increasing day by day and land is decreasing for agriculture. So, with the increase in population and a decrease in the land, the demand for food and Agri produce is increasing, but the supply is constant due to low agricultural productivity. This is predominantly due to improper Farm Management practices and loss in post-harvest handling. There is a requirement for a specific set of skills in the field of agriculture. Students and youth play a very important role to increase the productivity of agriculture. If you're studying agriculture go and visit a farmer and ask him for a job to get your foot in the door. Then you can ask him about problem areas at which you can advise him. As a student, I think that the first thing you should do is to understand that your understanding of what farmers do and how they do and what are the techniques they were using for farming and understand about, what are the massive losses to farmers at harvest time. What makes you think that there's something that you know or can do to help the farmers understand or do something to help him make money better than they currently understand or do? These farmers have typically spent many years thinking about farming and running farms for many years. Farmers in many rural areas are still using farming in traditional ways so, students and youth are the best bridge between the farmers and technology to transfer the new technologies to the farmers. Finally, the biggest thing, give them moral support in their bad times so that we can see newspapers without farmer suicide news.

Some of the Ways to Help Farmers by the Students/Youth in Agriculture

1. field trips: Primary and higher school education should include modules on farming, from growing to the marketing of crops. This could help young people see agriculture as a potential career. Relatively only a few students choose to study agriculture, perhaps in part because the quality of agricultural training is mixed. Every youth should have some understanding of agriculture. Go to the field trips whenever you are free or Sundays, and help the farmers over there in the fields. Nowadays the labour cost has been increasing a lot, so that if the students or the youth, whenever they are free can go and help the farmers in agriculture so that the labour cost for them will be decreased and can high their income.

2. Giving scientific knowledge / innovative techniques to the farmers to increase their yield and income: You have to tell them about the latest technologies available for them and teach them about climate, effects of deforestation etc. and how to use the internet. They have to teach to illiterate farmers and tell them about the soil testing, natural fertilizers and hazards of chemical fertilizers, insecticides etc. and also about weather forecasting etc. they must also give innovative ideas to the farmers to increase their income.

3. Information about the different government schemes and various bank schemes of the government: students must explain them about the different government schemes and bank schemes that help farmers to decrease their investment in agriculture .Different banks are giving them loans with very less interest so, they even have to explain them about these benefits of bank schemes etc. some of the government schemes in India in the agriculture sector are:

a. E-NAM.
b. National Mission for Sustainable Agriculture (NMSA).
c. Pradhan Mantri Krishi Sinchai Yojana (PMKSY).

d. Paramparagat Krishi Vikas Yojana (PKVY).
e. Pradhan Mantri Fasal Bima Yojana (PMFBY).
f. Gramin Bhandaran Yojna.
g. Livestock insurance Scheme.
h. The scheme on Fisheries Training and Extension.
i. National Scheme on Welfare of Fishermen.
j. Micro Irrigation Fund (MIF).

4. Creating videos in YouTube or social media about the farmer's hard work and they need to create awareness about the farmers and motivate the youth in supporting farmers in various ways.

5. Giving training classes to the farmers: Farmers need to be educated about the schemes and grants provided by the government. They also require training in newer and more effective agricultural practices and explain them about different subsidies given by the government for start-ups.

6. Join NGO or start NGO to help farmers: Listed below are 10 partner NGOs that are working to help Indian farmers by providing them with the necessary education and help them to maintain their livelihood.

a. Haritika.
b. Manuvikasa.
c. Rajasthan Bal Kalyan Samiti (RBKS).
d. Bhagini Nivedita Gramin Vigyan Niketan (BNGVN).
e. Dreams Alive.
f. AARDE Foundation.
g. Centre for Sustainable Agriculture (CSA).
h. Centre for Dignity (CFD).
i. MUKTI.
j. VRUTTI.

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Soil Health Management in India

Article ID: 32287

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Introduction

In India, current consumption rate of NPK is 6.7:2.4:1, this is higher than the ideal ratio of 4:2:1. Optimum doses of fertilizers based on cropping system and soil test value is the first step towards smart and sustainable farming. Every year government of India is spending Rupees Seventy thousand crore to meet the farmer fertilizer need in the form fertilizer subsidy. Due to fertilizer subsidy concept, farmer is applying fertilizer in larger amount that causing water pollution. Hence, there is a need to stop excessive use fertilizer, keeping this government of India introduced Soil Health Card Scheme across India. Soil health management is one of the most important and critical issue in Indian agriculture. The main focus in soil health management is directly on deficient nutrient in soil. Organic carbon and Nitrogen content are the indicator of soil health. Carbon and Nitrogen are deficient in > 70 % of Indian soil. Apart from Carbon and Nitrogen, Deficiency of Zinc, Boron, Iron is found in all type of soil. Micronutrient deficiency can decrease yield of crop up to 100 %. (Ahlawat et al., 2007). Now a day, Micronutrient deficient soils are arising malnutrition problem. Food security of our country will be unbalanced with the poor soil health. To manage malnutrition, Food production, and other issue in agriculture, government of India launched two important programmes one is soil health card and another is soil health management.

Soil Health Card Scheme

Soil health card scheme was started in the year 2015 with objective of digital mapping of soil and assessment of soil fertility status. Soil Health card reduces fertilizer use by 8-10 %. Soil health card scheme is the first step toward precision agriculture.

The aim of soil health card scheme:
1. To reduce the wide gap between fertilizer demand and supply.
2. To studies the emerging nutrient deficiency.
3. To prepare soil fertility map.
4. To measure area of acid and saline soil.
5. Soil fertilizer recommendation to farmer.

Soil Health Management Scheme

The aim of soil health management scheme is to promote integrate nutrient management through:

1. Application of fertilizer based on soil test response to build soil fertility.
2. Use of chemical fertilizer with organic manure and biofertilizer to improve soil health and productivity.
3. To control quality and quantity of fertilizer and biofertilizer for maintenance of soil health.

Impact of Soil health Card Scheme on Agriculture

1. Soil health card is the component of doubling of farmer income (reduce cost per ha by 10 %).
2. Soil health card saved urea by 13 %, DSP/SSP by 12% and Potassium by 4 % in paddy crop (Reddy, 2017).
3. In Pigeon Pea, fertilize use reduced by 19% (Reddy, 2017).
4. Crop yield increased slightly.
5. Use of NPK in soybean reduced after SHC scheme.
6. In Wheat, Urea use, Phosphorus use and Potassium use reduced by 10, 11 and 18 % with significant increase of yield (Reddy, 2017).

History of Soil Management Related Policy Existed Before Soil Health Card Scheme

1. Soil Conservation work in India started in the year 1951 -1956 (1 st FYP).
2. Intensive Agriculture Development Program also called Package Program was started in year 1961-1966 to reclaim soil condition.
3. In 1980-85, Flood prone river and Integrated Watershed Management program started with the aim of soil and water conservation.
4. National Watershed Development Programme for Rain fed Agriculture started in the year 1985-90 with the achievement of 11.3 mt fertilizer consumption.
5. Integrated Nutrient Management (INM)/Integrated Plant Nutrient Supply (IPNS) was started in the 2002-07.
6. National Project on Management of Soil Health & Fertility' (NPMSH&F) was started in the year 2007-12 with 30 % more fertilizer consumption.
7. In 2012-17, National Mission for Sustainable Agriculture (NMSA) started.

Techniques for Soil Health Management

1. Conservation Agriculture: Conservation Agriculture is the new technique of crop production with crop stubble or crop residues. It followed in rice-based cropping system. In CA, organic matter in soil is increase in every year that improving physical and chemical properties of soil. In sense of soil health, soil fertility can be improved with the CA in legume cropping system. Biological indicators are increasing in soil with the CA practice.

2. Long term fertilizer experiment: The main aim of long-term fertilizer experiment is the uniformity of soil fertility status. In LTFE, Excessive use of chemical fertilizer is avoided which is replace by organic manure and biofertilizer. Balanced use of fertilizer is followed in LTFE.

3. Integrated Nutrient Management: Balanced use of fertilizer is a prime factor in integrated nutrient management. Application of organic manure, chemical fertilizer and biofertilizer are improve the soil fertility status. Physical, Chemical and Biological properties of soil are increased with the organic manure use and also increased the availability of NKK in soil. INM, use of organic manure will enhance the micronutrient content in soil which is reflected in grain of different crop.

4. Soil Test Crop Response: STCR Model is used for fertilizer recommendation to achieve target yield. STCR is maintaining the balanced use of fertilizer. Excessive use of fertilizer and their losses in soil are controlled by STCR model. This model will recommend fertilizer to get higher yield as well as maintain soil fertility.

5. Green Manure: Green manure is the crop can fix atmospheric nitrogen, Uptake unavailable nutrient present in lower death. Green manuring crop is harvested at flowering stage or before that. Green manure crop will add organic carbon, Nitrogen and other nutrient in soil as well as reclaim saline soil.

6. Soil Amendment: Soil amendment like lime, gypsum, tank silt, and zeolite etc can improve the soil health. Soil amendment will improve the soil productivity which loss due to salination, sodification, formation of acid, accumulation heavy metals

7. Organic Farming: Organic farming is the production of organic food or product from organic input. Organic fertilizer will enhance physical, chemical and biological properties of soil.

Conclusion

Balance use of fertilizer, application of organic manure and biofertilizer are maintain soil health. Soil health management is the saving of fertilizer, increase of crop production, increase of carbon stock in soil and reduction of greenhouse gas emission. Soil health management approach will increase cost of production and net return. Soil Health card will save subsidy money wasting in soil through the use of excessive fertilizer.

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Speed Breeding: A Breeder's Pipeline for Success

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Introduction

The ever-growing human population and its adverse changing environmental conditions leave the plant breeding community backtrack, hampering the productivity and stability of the crops. Moreover, the plant breeding methods used takes longer generations which becomes a bottleneck in applied research programs and developing new varieties. Therefore, there is a need for technologies that accelerate plant development and generation turnover. Here comes the 'speed breeding' an innovation which was inspired by NASA aiming to grow wheat and food crop in the space and started from the University of Queensland, John Innes Centre, and the University of Sydney in Australia by Dr. Lee Hickey and co-worker in wheat and peanut. Speed breeding' technology shortens the breeding cycle and accelerates crop research through rapid generation advancement. It can be carried out in numerous ways - extending the duration of plant's daily exposure to light, early seed harvest, seed to seed to cycle quickly which thereby reduces the generation times for some long-day or day-neutral crops. . It can first-hand Control all environmental conditions from seedling to maturation and from temperature to daylight time. Crop generation time can be shortened when the period of illumination is increased and accelerating the maturation of grains enables us to gain a dozen days. And increasing plant density also proved to be efficient for the crop to grow faster.

How Speed Breeding Works?

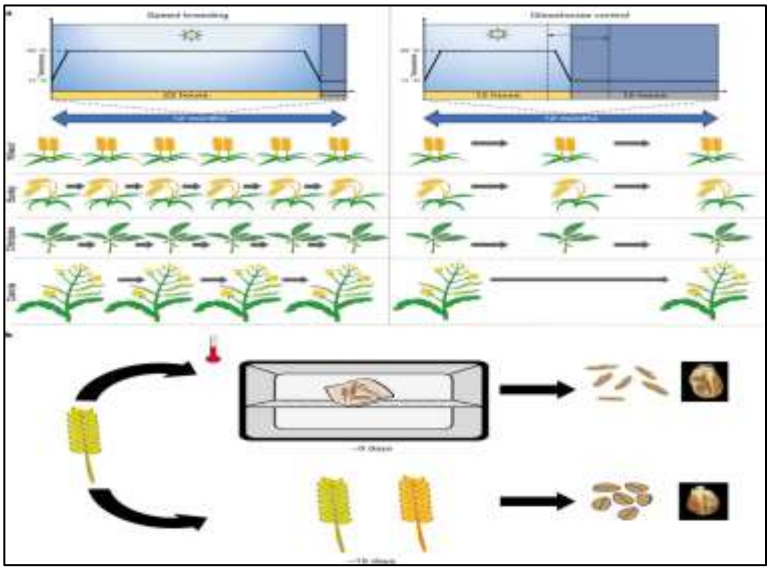
These techniques are operated in glasshouses with sodium vapour lamps (SLV) or growth chamber fitted with a mixture of metal halide and light-emitting diode (LED) lighting. The use of supplemental lighting using LEDs in a glasshouse environment allows rapid generation cycling through single seed descent (SSD) and plant density can be scaled-up for large crop improvement programs.

a. In a glasshouse with a natural variable photoperiod (10–16 hours), we can get only 2–3 generations of wheat, barley, chickpea, and canola per year (right). However, in speed breeding we get 4-6 generations of these crops.

b. b. Harvesting of immature spikes and drying them in an oven/dehydrator (~3 days) enables the faster seed to seed

In wheat, the experiment was conducted using Speed breeding techniques by using continuous light which induces early reproduction in the plants and quick growth which in turn, accelerates genetic gain in the plant breeding programs. It was observed that there was no difference in the quality and yield of the plants grown under controlled climate (extended day length) with those crops grown in regular glasshouse conditions. In these techniques, photosynthesis rate is supplemental in intensive regimes of up to 22 h per day in a glasshouse environment allowing rapid generation cycling through single seed descent and potential for adaptation to larger-scale crop improvement programs.

Speed breeding techniques used a setup in an existing plant growth chamber or CER, Light: PAR region (400-700 nm), ambient light with LED, Photoperiod: 22hours with 2 hours of darkness, Temperature: 220C for 22 hours and 2 hours dark, Humidity: Ideally 60-70%. It should also be well equipped with Benchtop growth cabinet; Hardware, cabinet structure, lighting system, temperature, and humidity system and software installation and setup.



Watson & Ghosh et.al (2018). Nature Plants. 4, 23-29

Watson & Ghosh et.al. (2018). Nature Plants. 4, 23-29

As speed breeding techniques in fully enclosed, controlled-environment growth chambers can accelerate plant development for research purposes, including phenotyping for traits such as flowering time, plant height, and disease resistance in wheat; leaf sheath glaucousness in barley; and pod shattering in canola, mutant studies and gene transformation pipelines. Different speed breeding protocols were introduced for several crop species based on their variable growth habits like growing conditions, soil media composition, lighting, temperature, and spacing.

Scope

A better and efficient outcome can be envisaged when we incorporate speed breeding with other modern crop breeding technologies, including high-throughput genotyping, marker-assisted selection, CRISPR genome editing, and genomic selection for the better and faster crop improvement program. Cost-saving through the light-emitting diode (LED) supplemental lighting is also outlined.

Challenges and Limitations

Yes, there are obstacles on the way. For instance, when different plants are exposed to extend photoperiod its responses differently and early harvesting of immature seeds interfere with phenotyping of seed traits. These techniques are not cost-efficient and it lacks a protocol for the diverse response of plant species to different photoperiod.

Implications in Crop Improvement

Speed breeding techniques have successfully achieved generation of wheat crops from seed to seed in just eight weeks. It implies the possibility of achieving six generations of wheat per year, which is a threefold increase in the shuttle-breeding techniques currently being used by plant breeders

Speed breeding has been successful in case of photosensitive crops like spring wheat (*Triticum aestivum*), durum wheat (T. durum), barley (*Hordeum vulgare*), chickpea (*Cicer arietinum*) and pea (*Pisum sativum*), and 4 generations of canola (*Brassica napus*) and found to be adapted to oat, various Brassica species, grass pea, quinoa, *Medicago truncatula*, and *Brachypodium distachyon*. However, it doesn't work well in the case of photosensitive crops like soybean, where speed breeding is not suitable to speed up the breeding cycles. Mutant transformation i,e. Waxy less mutant in barley. Multiple disease resistance in barley (*Hordeum Vulgare*), commercial breeding programs in peanut and multiple quantitative traits analysis in durum wheat (T. Durum), and harness rust resistance by developing recombinant inbred lines with desirable alleles to reduce the length and number of years.

Conclusion

Speed breeding is the best way to develop the pipeline of new crops. The traditional breeding methods are slow and tedious but with speed breeding it shortens the years. Moreover, when incorporated with other technologies the end result is faster and better. India, a country which requires more mouth to feed than the rest of the world this technique could to a boon to the breeders as well to accelerates the research scenario.

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Modern Day Asset: Vertical Farming

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Introduction

These days agriculture is fighting with one of the biggest challenges faced by agriculture all around that is the issues of decreasing in the percentage of the arable land. The concept of vertical farming is about another level of indoor farming that comes with some added benefits for the modern-age farmers.

Vertically farming is a practice of growing crops in vertical stacked layers in controlled-environment. It reduces the requirement of water along with increasing yield and ability to cultivate a larger variety of crops in significantly lesser land area. Plants can be grown indoors, with or without soil, under vertical farming, which assures the protections from unruly winds, incessant rains, dry climate. The key environmental elements such as light, temperature, humidity and micro-nutrients are controlled to optimize plant growth. The advantage of utilizing this technology is to increase the crop yield that comes with a smaller per 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.

Types of Vertical Farming

Hydroponics: Hydroponics is a technique of growing plants in nutrient solutions with or without the use of an inert medium such as gravel, vermiculite, rock wool, peat moss, saw dust, coir dust, coconut fibre, etc. to provide mechanical support.

Aeroponics: Term "aeroponics," defined as "growing plants in an air/mist environment with no soil and very little water." In aeroponic growing systems, the roots of plants are suspended in a chamber where the emitters intermittently and continually spray on the roots of plants with nutrient solution.

Aquaponics: An aquaponic system is one step further to hydroponic system in which plants are combine with fish in the same ecosystem. Fishes are grown under indoor pond that produces nutrient-rich waste which can be used as a feed source for the plants. These plants than filter this fish wastewater within this vertical farm arrangement.

Advantages of Vertical Farming

Vertical Farming is a different approach towards agriculture. There are several advantages of vertical farming, which makes it promising for the future of agriculture.

1. One of the biggest advantages of vertical farming is that 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.

2. Another advantage of this type of farming is that it allows farmers to grow more plants in lesser area.

3. It requires less water per unit area that helps farmers in avoiding problem like failure of crops during scarce rainfall period.

4. Vertical farming is not affected by weather conditions because crops are grown in controlled environment that is artificially created so that plants can grow under unfavourable conditions round the year of crop production. There is no need to worry about frosts, winds, sunny days. All you need to do is introduce a well-controlled environment and be able to supply your vertical farm with seeds, the needed soil-substitutes and nutrients.

Conclusion

Ultimately, vertical farming contributed to climate change, enhances human health and productivity, reduce the wastage of resources that enable us to portray a more positive outlook for the future of cities. This farming encourages various modern-age techniques of farming that is variable from the traditional farming practices. As it involves technology, it has the potential to revolutionize the future of agriculture.

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Intensification and Diversification in Agriculture for Doubling Farmer's Income

Article ID: 32290

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Introduction

Farming in India is still complicatedly dependent on the vagaries of monsoons and it is largely supported by small and fragmented holdings which in turn are run by resource poor farmers. Thereby, farming turns out to be a non-viable proposition and often not profitable.

Over the years, it has become an occupation marked by large-scale disguised unemployment and unending uncertainties at each and every stage of farm operation. Topping all these issues, recent NSSO survey reveals that more than 40 per cent of the Indian farmers wish to leave farming if given with some other option (NSSO, 2014). Given this background our Hon'ble Prime Minister Shri. Narendra Modi has envisioned of Doubling Farmers' Income by 2022-23, the 75th year of the country's Independence. Thereafter, Doubling Farmers' Income by 2022-23 are needed for increasing farmers profitability in India.

Doubling farmers income, a buzz word now a days. India has set a very ambitious target of doubling farmer's income by 2022. February 28, 2016- PM Narendra Modi addressing farmers rally in Bareilly, UP "It is my dream to see farmers double their income by 2022, when the country completes 75 years of its independence "Doubling real income of farmers by 2022-23 over the base year of 2015-16, requires annual growth of 10.41% in farmers income (whereas, it was at 3.80% in 2016-17).

This implies that the on-going and previously achieved rate of growth in farm income has to be sharply accelerated. Therefore, strong measures are needed to harness all possible sources of growth in farmer's income within as well as outside agriculture sector.

Why Doubling Farmers Income?

1. More than one fifth of rural households with self-employment in agriculture were having income less than poverty line.
2. Sharp increase in the number of farmers suicides due to losses from farming, shocks in farm income and low farm income.
3. Sharp slowdown in growth rate of agricultural output.
4. Low and highly fluctuating farm income is causing detrimental effect on the interest in farming and farm investments and also forcing younger age groups to leave farming.
5. To promote farmer's welfare, reduce agrarian distress and bring parity between income of farmers and those working in non-agricultural professions.

Prime Minister's 7 Point Mantra for Achieving the Goal of DFI

1. Big focus on irrigation with large budgets, with the aim of "per drop, more crop."
2. Provision of quality seeds and nutrients based on soil health of each field.
3. Large investments in warehousing and cold chains to prevent post-harvest crop losses.
4. Promotion of value addition through food processing.
5. Creation of a national farm market, removing distortions and e-platform across 585 stations.
6. Introduction of a new crop insurance scheme to mitigate risks at affordable cost.
7. Promotion of ancillary activities like poultry, bee keeping and fisheries.

Concept of Intensification

What can we do to double farmers income?

There are two sources to increase in agricultural output viz., area and productivity. Due to rising demand for land for non-agricultural uses and already high share of arable land in total geographical area of the country, further expansion in area under cultivation is not feasible. Therefore, agricultural output has to be increased through improvement in productivity per unit of land. Agricultural intensification involves.

1. Enhancing productivity:

a. Increase in yield or productivity of crops and other enterprises is the single most important factor that can increase income. Since the area cannot expand much either through increase in net sown area or through increase in cropping intensity, enhancing the productivity is the only route available to enhance production.

b. The yield gaps can be bridged with simple agronomic measures. Intercropping, crop rotation, weed and pest control, applying secondary and micronutrients, adopting HYV, high density planting are some of the strategies for bridging yield gaps.

2. Leveraging water resources: Micro Irrigation- Drip Irrigation and Fertigation.

a. Scarcity of water and heavy demand pressures on it, made farmers to focus on micro irrigation systems like drips and sprinklers.

b. Several studies have shown that the adoption of micro irrigation increases productivity and also helps resource-saving, particularly in rainfed areas.

3. Intensive cropping systems:

a. Crop intensification is essential to develop sustainable agricultural systems.

b. Intensification in sustainable agricultural systems generally refers to the fuller use of land, water and biotic resources to enhance the agronomic performance of agroecosystems and it involves system of rice intensification (SRI), Multiple cropping approach, Multi storied cropping.

c. Farmers can intensify the use of the resources available to them at different times by using more diverse rotations and optimal harvesting schedules.

4. Special focus on dryland areas:

a. Dryland areas are home to 43% of our population and receive rainfall between 150 mm to 1000 mm per annum.

b. Dryland's productivity improvement needs irrigation facility, good soil and technology.

c. There are a few options which have been successfully tried. They are watershed development and management, rainwater harvesting and storage, farm ponds, recharging depleted groundwater and aquifers.

d. Farm pond is used for storing the monsoon rainwater, which is used for irrigation. A farm pond has found significant in the rainfed cultivation. Since rain water harvesting structures namely farm-ponds are expected to have an impact on cropping pattern, productivity, employment and income of the farmers.

5. Enhancing resource use efficiency:

a. Nanotechnology.
b. Precision Farming.
c. Organic farming - Low input agriculture.
d. Conservation agriculture.
e. Mechanization.

6. Reducing post-harvest losses:

a. Post-harvest losses generally range from 5 to 10% for non-perishables and about 30% for perishables. This loss could be and must be minimized. Because, a grain saved is a grain produced.

b. The challenge is in handling of fresh produce after harvest with emphasis on reducing losses, value addition, maintaining quality and marketing.

c. Agro-processing is now regarded as the sunshine sector of the Indian economy, in view of its large potential for growth and likely socio-economic impact specifically on employment and income generation.

7. Climate change and sustainable agriculture:

a. Climate change is one of the most important areas of concern for India.

b. Significant negative impacts have been implied with medium-term (2010-2039) climate change, predicted to reduce yields by 4.5 to 9%, depending on the magnitude and distribution of warming.

c. Climate change resilience can be built in through; Stabilisation and management of the natural resources, integrating a package of climate smart agriculture practices into on-going programmes such as weather-based local specific agro-advisories, contingent crop planning, promotion of low-external input technology and promotion of local agro-biodiversity.

Concept of Diversification

Diversification of agriculture refers to the shift from the regional dominance of one crop to regional production of a number of crops/enterprises, to meet ever increasing demand for cereals, pulses, vegetables, fruits, oilseeds, spices, fibres, fodder and grasses, fuel, livestock , fish products, etc. Diversification of agriculture offers food and nutrition security, income growth, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development, and environmental improvement.

Agricultural diversification involves:

1. Integrated farming systems:

a. Promotion of Integrated farming system approach involving synergic blending of crops, horticulture, dairy, fisheries, poultry, etc. seems viable.

b. Option to provide regular income and at site employment to small land holder and decreasing cultivation cost through multiple use of resources and providing much needed resilience for predicted climate change scenario.

2. Diversification towards high value crops:

a. Diversification towards high value crops is required to improve income and resource use efficiency. Similarly, diversification towards livestock, poultry and non-farm sector activities is considered ideal especially for small holders who do not possess adequate land to generate enough income for the family.

b. Crop diversification in India is generally viewed as a shifting from traditionally grown less remunerative crop(s) to more remunerative crop(s).

c. Crop diversification and growing of large number of crops are practised in dryland areas to reduce the risk factor of crop failures due to recurring droughts.

3. Value addition and food processing:

a. Rapidly growing purchasing power, both in urban and rural centres, has affected shift in demand pattern in favour of products of allied sector, value added products, ready-to-cook and ready-to-eat products thus moving away from traditional staple food varieties.

b. The opportunities available has to be tapped with appropriate investments in dairy, poultry, sheep-goat, piggery, rabbit rearing, fishery, value addition, food processing, etc

c. In the increasingly rising share of non-agriculture activities of contemporary rural India, processing industries can play a vital role in achieving the avowed objective of 'doubling farm income'.

Conclusion

1. The low level of farmers income and year to year fluctuations in it are major sources of agrarian distress.

2. To secure future of agriculture and to improve livelihood of half of India's population, adequate attention needs to be given to improve the welfare of farmers and raise agricultural income.

3. There are several pathways that can lead to step up in income, of which intensification and diversification by increasing production through rise in yields, cost reduction, water management, stabilising income through risk coping and mitigation measures, diversification within farm sector and towards non-farm sector are a few important ones.

4. Similarly, efforts to double farmers' income do not cut much ice if work is not done for small and marginal holders that constitute 85% of the holdings.

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Use of Trap Crops in Insect-Pest Management

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Introduction

Plant stands grown to attract insects or other organisms like nematodes to protect target crops from pest attack, preventing the pests from reaching the crop or concentrating them in a certain part of the field where they can be economically destroyed. Trap crops are plants grown to attract insects or other pests that destroy the main crop. A trap crop is an attractive host plant that attracts insects away from the main crop during a critical time period.

Examples of Trap Crops

Main Crop	Trap Crop	Target Pest
Maize	Ground nut	*Atherigona sp*
Tobbaco	Castor	*Spodoptera litura*
Cabbage	Indian mustard	*Plutella xylostella*
Melon	Maize	*Bactrocera cucurbitae*
MAIN CROP	TRAP CROP	*TARGET PEST*
Cotton	Bhendi	*Boll worm*
Cabbage, Cauliflower	Sesamum	*DBM*
Groundnut	Castor/sunflower	*Leaf eating catterpillars*
Tomato	Marigold/Cucumber	*Fruit borers*
Field bean	Chrysantamum	*Leaf miner*
Maize	Ground nut	*Atherigona sp*
Tobbaco	Castor	*Spodoptera litura*
Cabbage	Indian mustard	*Plutella xylostella*
Melon	Maize	*Bactrocera cucurbitae*
MAIN CROP	TRAP CROP	*TARGET PEST*
Cotton	Bhendi	*Boll worm*
Cabbage, Cauliflower	Sesamum	*DBM*
Groundnut	Castor/sunflower	*Leaf eating catterpillars*
Tomato	Marigold/Cucumber	*Fruit borers*
Field bean	Chrysantamum	*Leaf miner*
Potato and rice	Marigold	*Nematode and snail*
Maize	Sorghum	*Corn stalk borer*
Cowpea	Gingelly	*Bihar hairy caterpillar*

Several Factors to be Considered for Trap Cropping

The feeding and egg laying habits of the pest, the trap crop must be more attractive to the pest as either a food source or egg laying site than the main crop, spatial layout of the trap crop, and proportion of trap crops needed.

Conventional trap cropping: Trap crop planted next to a higher value crop is naturally more attractive to a pest as either a food source or oviposition site than the main crop. Thus, preventing or making less likely the arrival of the pest to the main crop and or concentrating it in the trap crop where it can be economically destroyed.

Dead-end trap cropping: Plants that are highly attractive to insects but on which they or their offspring cannot survive, Dead-end trap crops serve as a sink for pests, preventing their movement from the trap crop to the main crop later in the season.

Genetically engineered trap cropping: The deliberate manipulation of genes through the use of biotechnology in trap cropping, and its importance in the development and improvement of trap crops.

Perimeter trap cropping: Perimeter trap cropping can be defined as the use of a trap crop planted around the border of the main crop.

Sequential trap cropping: This modality involves trap crops that are planted earlier and or later than the main crop to enhance the attractiveness of the trap crop to the targeted insect pest.

Multiple trap cropping: It involves, planting several plant species simultaneously as trap crops with the purpose of managing several insect pests at the same time.

Push-pull trap cropping: This strategy is based on a combination of a trap crop, (pull component) with a repellent intercrop (push component), the trap crop attracts the insect pest and combined with the repellent intercrop.

Tips for Successful Trap Cropping

Make a farm plan, learn to know and identify the pests, select a trap crop that is more attractive to the pest than the main crop, monitor your plants regularly, immediately control the pests that are found in the trap crop, and be ready to sacrifice your trap crop as an early crop, always keep farm records.

Economic Benefits

Trap cropping has indicated benefits in terms of economic returns on an average of 10-30 per cent increase in net profits mainly resulting from reduced insecticide use and pest attack, it is a useful strategy in managing several pests in various cropping systems.

Increasing the Effectiveness of Trap Cropping

Combining biological and or insecticidal control to supplement the effects of the trap crop, plant breeding can be used to develop trap crop cultivars, cultural control methods can also be used to increase the effectiveness of trap crops.

Example- Diamond back moth adults were more attracted to large groups of collard plants than to small groups, as well as to larger plants and higher planting densities.

Factors Determining the Success of Trap Cropping Systems

The insect stage targeted by the trap crop, insect's ability to direct its movement, its migratory behaviour (mobility and mode of colonization), its host-finding behaviour, the insect stage to be controlled by the trap crop is of critical importance in designing an effective trap crop strategy.

Examples

1. Adult female lepidoptera select plants for oviposition but it is the larvae, which typically have limited mobility, that are the damaging stage.
2. The adult crucifer flea beetle, Phyllotreta spp., that selects host plants and causes injury.
3. To select a successful trap crop in the first case requires knowledge of the ovipositional preference; in the second case knowledge of adult feeding preference is required.
4. The ability of insects to direct their movements as a result of the presence of the trap crop should also be considered in the deployment of trap crops.
5. Colonization patterns of the insects are largely due to passive, random, high-altitude aerial dispersal.
6. Trap crops taller than the main crop and planted in the borders could act as barrier crops.

7. Larger insects in Coleoptera and lepidoptera have an enhanced capacity for directional flight that makes them more amenable for trap cropping.

Host-Finding Behaviour

1. The strength of arrestment seems to be the most important parameter influencing the effectiveness of a trap crop in insects.
2. In insects that use olfactory or visual cues to find plants, the actual aggregation in the trap crop was a combination of attraction and the attractiveness of the trap crop and the proportion of trap crops in the field are important factors in the arrestment of the insect and in the success of a trap cropping system.

Advantages of Trap Cropping

1. Lessens the use of pesticides.
2. Lowers the pesticide cost.
3. Preserves the indigenous natural enemies.
4. Improves the crop's quality.
5. Helps to conserve the soil fertility.

Limitations of Trap Cropping

1. The trap crops tend to be relatively species specific makes them less practical compared with other alternative IPM strategies.
2. The cost of insecticide control is often low compared with the cost of setting aside land for trap cropping.
3. Agronomic practices associated with implementing trap crops, such as different planting dates and fertilizer requirements of the trap crop and main crop, are also likely to limit the practical use of trap cropping.
4. Pest management practices need to show consistent results
5. Trap cropping is also knowledge-intensive and demands information on the temporal and spatial attractiveness of potential trap crops to maximize their effectiveness. It may even require co-operation between growers.

Conclusion

1. Trap crops are plants grown to attract insects or other pests that destroy the main crops.
2. They must be more attractive to the pest than the main crop.
3. Trap cropping has indicated benefits in terms of economic returns resulting from reduced insecticide use and pest attack.
4. By combining biological, chemical and or cultural activities to increase the effectiveness of a trap crop.
5. Low pesticide cost, lessens the use of pesticides and preserves the natural enemies.

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Approaches for Mobilization of Soil Phosphorus

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Introduction

The chemistry of phosphorus in soil is complicated as it is bounded with various compounds with different range of bonding energies/strengths. When phosphatic fertilizer is added to the soil, only a fraction of phosphorus is taken up immediately by the plant roots, while the remaining fractions become adsorbed to soil particles. When the adsorption is weak, the phosphorus can transfer back into the soil solution. After the initial adsorption, further reactions lead to absorption of phosphorus which makes the bond stronger thereby reducing its further availability. The speed at which phosphorus becomes unavailable to plants depends on the type and size of the mineral particles, the presence of other elements such as aluminium, iron and calcium, soil acidity and organic matter.

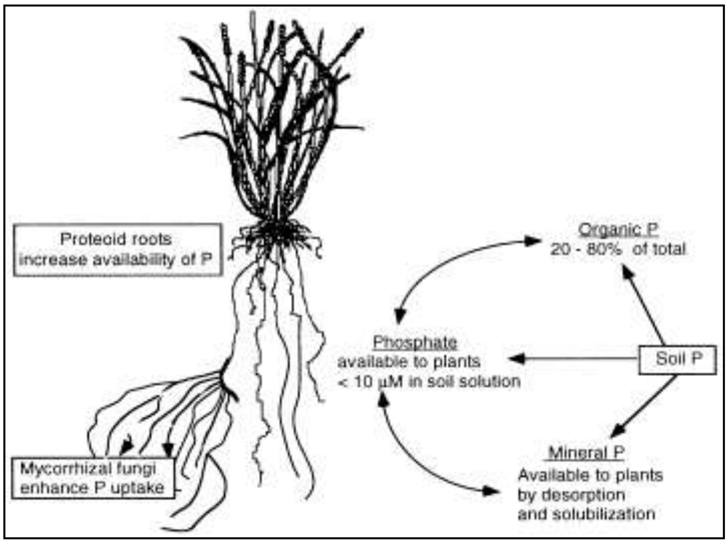

Fig. 1. Chemistry of phosphorus in soil

Organic phosphorus present in the soil can be associated either with soil organic matter or recently added organic debris coming from plants or animals. These organic molecules cannot be directly used up by the plants. They need to be broken down by soil micro-organisms to release inorganic phosphate ions which can be taken up by plants or enter into the same reactions as other fertilizer phosphate ions. Phosphorus in the soil solution is either taken up by plant roots or goes into a readily available pool, where it is held weakly. From this pool, it moves to a less readily available pool where it is held strongly.

Phosphorus Mobilization

Mobilization is defined as the starting of phosphorus movement with solubilization and detachment being the two primary processes governing it. Solubilization refers to the transfer of phosphorus from solid phase to liquid phase with chemical non-equilibrium as the driving mechanism. Physical detachment brings soil particles and colloids into suspension with attached phosphorus due to mechanical forces exerted by moving water. The reactions responsible for solubilization are dissolution/precipitation, sorption/desorption and mineralization/immobilization that controls the amount of phosphorus in soil liquid phase both in inorganic and organic forms.

Although P is abundant in the lithosphere, limited inorganic phosphorus (Pi) availability is a general phenomenon in agricultural soils. It is one of the most immobile, inaccessible and unavailable nutrient present in the soil. Soils vary widely in their capacities to supply phosphorus to crops as only a small fraction (> 1 - 3%)

of the total P in any soil is in plant available form. Thus, unless the soil contains adequate amount of plant available P (H2P04-, HP042- or P043-), crop growth will suffer.

Imbalanced and inadequate phosphorus fertilizer application, organic and inorganic fixation, and exhaust of world's reserves rock phosphate coupled with expensive phosphate fertilizer points to the need for recycling and exploitation of native plant unavailable phosphorus to improve crop production. Thereby, it looks feasible to develop strategies that can monitor soil phosphorus. The immobile properties of phosphorus can be exploited by mobilizing native plant unavailable phosphorus to available form, so that recycling the native P and minimizing the P fertilization from outside sources can be feasible. This will result in saving rock phosphate reserve and huge amount of money that is spent for importing phosphoric acid for preparation of phosphate fertilizers.

Ways to Mobilize Native Phosphorus

Native P can be mobilized by the help of:

1. Phosphate solubilizing microorganisms,
2. Phosphatase and phytase producing fungi and bacteria,
3. Arbuscular mycorrhizal (AM) fungi,
4. Organic acids, and
5. Rhizosphere manipulation through efficient P mobilizing genotypes.

Phosphate Solubilizing Microorganisms

Micro-organisms play a significant role in release of plant available inorganic phosphate into soil from unavailable inorganic P (CaP, Fe-P, AI-P) through secretion of different organic acids. Many fungi and bacteria like Aspergillus, Penicillium, Bacillus, Pseudomonas are potential solubilizers of bound phosphates. Fungi proves to be better agents in dissolution of phosphates as compared to bacteria, although bacteria have been used in the commercial preparation of phosphate-dissolving cultures to improve the growth of plants a long time ago. The important organic acids secreted by microorganisms to dissolve insoluble phosphates are formic, acetic, lactic, glycolic, oxalic, citric, fumaric, succinic and malic acids. Some of these acids (hydroxy acids) may form chelates with cations such as Ca, Fe, and Al and this results in effective solubilization of phosphates.

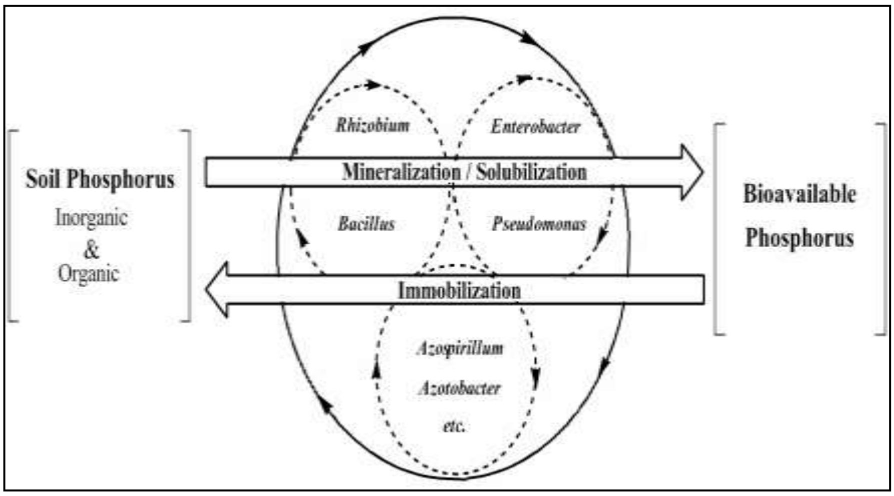

Fig.2. Microbial transformations of soil phosphorus

Possibilities which Help in Releasing the Orthophosphate

1. Microorganisms can lower the pH around them by the CO_2 given off during respiration thereby causing more phosphate to dissolve.
2. Certain bacteria release H_2S, which can react with ferric phosphate to yield ferrous sulphide and soluble orthophosphate ions.

3. Microbial-degraded plant debris (humic acid and fulvic acid) might chelate with the calcium, iron and aluminium in complex phosphates, thereby releasing orthophosphate.

Solubilization must be considered within the rhizosphere, which coincides with the zone of phosphate depletion. Beyond this region solubilization will have a little effect on the growing root because of the slow diffusion of phosphate ions in soil. Root exudates and sloughed cells provide the substrate to support the intense microbial activity of the rhizosphere.

Example- Diamond back moth adults were more attracted to large groups of collard plants than to small groups, as well as to larger plants and higher planting densities.

Phosphatase and Phytase Producing Organisms

In general, 20-90% of total P in all agricultural soils is present in organic form. Organic P is located mainly in fulvic acid fraction and generally higher in clay soils than in course-textured soils, but lower than in humus soils. Plants utilize organic P after the hydrolysis of C-O-P bond by phosphatases and phytase. Phytin P is the most difficultly hydrolysable organic P compound present in the soil. Important organisms which are found to be efficient in hydrolyzing organic phosphorus are *Aspergillus candidus, Aspergillus flavus, Aspergillus jumigatus, Aspergillus parasiticus, Aspergillus rugulosus, Aspergillus terreus, Aspergillus ustus, Chaetomium globosum, Curvularia lunata, Gliocladium catenulatum, Paecilomyces variotii, Penicillium purpurogenum, Phoma* sp., *Pseudeurotium zonatum* and *Trichoderma harzianum.* A major portion (36 to 64%) of the total P hydrolyzed by phosphatase is from NaOH extractable P fractions. Generally, between 60 and 75% of the water and $NaHC0_3$ extractable P is hydrolyzed by phosphatases. Generally, acid phosphatase is more efficient in hydrolyzing water-soluble P, bicarb-P and NaOH-P than alkaline phosphatase.

Arbuscular Mycorrhizal (AM) Fungi

The AM fungi can exploit Pi from long distances due to their long hyphae. They mobilize organic phosphorus by phosphatases and hydrolyse it. Phosphatase activities are distinctly higher in the presence of mycorrhizal plants particularly with a supply of organic P which also increases the percentage of infected root length. Phosphatase activity is strongly correlated with hyphal length which was highest within 10 mm from the root surface. Mycorrhizal inoculation increases P content and total P uptake irrespective of P sources and soils.

Role of Organic Acids

Organic acids are low-molecular weight compounds, which are characterized by the presence of one or more carboxyl groups. Depending on the dissociation properties and number of the carboxylic groups, organic acids carry varying negative charges, thereby allowing the complexion of metal cations in solution and the displacement of anions from the soil matrix. Organic anions function as organic ligands, which can increase P in solution by (i) replacing P sorbed at metal hydroxide surfaces through ligand-exchange reactions, (ii) dissolving metal oxide surfaces that sorb P and (iii) complexing metals in solution and thus preventing precipitation of metal phosphates.

Rhizosphere Manipulation through Efficient Genotypes

The rhizosphere is an active site for P transformation because of the presence of many bacteria and fungi that are actively involved in P transformations in soils. They are 20 to 50 times more abundant in the rhizosphere than in the bulk soil. The important mechanisms of plant or microbial origin that can increase the P concentration in the soil solution of the rhizosphere are:

1. Low molecular weight organic acids exuded from plant roots or micro-organisms lower the rhizosphere pH thereby accelerating the dissolution of sparingly soluble phosphate minerals by complexion with the metal cations of the mineral.

2. Organic acid anions accumulate in sufficient concentrations in the rhizosphere to compete effectively with orthophosphate for adsorption sites on Fe or Al oxides.

The plant alters the rhizosphere pH and hence modifies soil P solubility by net excretion of $HC0_{3-}$ to maintain a balance of electric charge associated with cations or anions crossing the root membrane.

Conclusion

It is important to utilize and recycle native P for plant nutrition both to reduce the cost of production and sustain the mineral reserves for longer period. Various biological and biochemical approaches have been tried in past but with limited success. Major limitation in the biological approaches is the inability of introduced microbial agent to survive in soil under low substrate availability, adverse soil moisture and temperature conditions and to compete with native flora. Moreover, utilization efficiency of phosphatic fertilizers is very low due to their inversion to insoluble forms in general and it is further aggravated by higher concentration of silicic acid in some soils.

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Autonomous Farming: Need of the Hour for Indian Agriculture

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Scope of Autonomous Farming

Robotics and mechatronics are the prima facie for real-time autonomous technologies in agriculture for the optimal and efficient management of agriculture. Agricultural robots can be used for seeding, fertilizer application, soil nutrient availability, spraying, harvesting, monitoring of crops etc., while mechatronics is applied for precision and control system management. With technological advancement, the elements of mechatronics form the building blocks of autonomous agricultural machinery to augment the efficiency in farm operations.

Applications of Autonomous Farming

1. Crop scouting: Crops have different stages of growth throughout their life cycle and it depends on varying factors such as crop variety, soil nutrients, soil moisture, root zone depth, weed density etc. Site specific management is the key for agriculture to flourish and it is possible with optimum input application at appropriate time. Continuous monitoring and data collection of various crop growth parameters is the prima facie for input optimization at different stages of crop growth. An automated system could be installed within the crop canopy for continuous monitoring as this will be less expensive for crop physical status monitoring and timely data will be available (Akhila and Srinivas, 2011). Real time management of agricultural inputs could be achieved by the information obtained from installed automated sensing systems in the field and this can be further processed using microprocessor or micro-controller. The robotic vehicle can continuously monitor the crop canopy by utilizing related data and it will be easy for robot to identify crop diseases and pest attack at an early stage, even in patches. In addition to this, it can monitor weed density and water stress at a different stage of crop growth.

2. Intercultural operation: According to research, most of the agricultural loss is with pests caused by weeds interference. Hence, it is imperative to identify the weeds from crop and spray herbicides for weed control. It is a known fact that excessive use of herbicide results in the deterioration of crop, human and animal health. Agricultural robot with machine vision systems aid in accomplishment of intercultural operation by creating weed maps of particular field. The robot appropriately decides the type of weeding technique needed based on the information sensed from the field and performs the weeding operation. Mechanical weeders available in the market can only perform the weeding operation in between the rows while for intra-row weeding there are no commercial models. Intra-row weeding requires high-speed sensing device and this can be effectively achieved by robotic systems.

3. Fertilizer application: Fertilizer is a vital supplement as nutrient for crop growth and increasing productivity. The rational use of fertilizers and its technology has a significant effect on the development of agriculture (Yueling et al., 2011). Soil nitrogen is a critical nutrient for improving productivity of crops but it also contaminates the environment. A major portion of the input fertilizer is lost by leaching which contaminates freshwater, marine ecosystems when high rates of N fertilizers are applied (Tilman, 1999). The soil nutrient content varies within small area of the field and traditional measurements of soil nutrients by laboratory method are very difficult to assess with respect to a reference point in the field. A fertilizer map of the field assists the farmer to vary the rate of fertilizer application in a field and it is possible with variable-rate fertilizer application technology. Variable rate fertilize application technology has a potential to apply the input as per need of field that enhances the economic benefits and maintain soil environmental health. Most of the Variable rate technology is GPS based but some are available on control system based without GPS on reckoning up track distance for a variable rate fertilizer applicator. Controlling unit has control over motor rpm at the time of application which is directly responsible for opening area of metering unit or its rpm that is calibrated with the input amount of fertilizer requirement at that particular grid.

Fig 1: Ag bot II

Fig 2: Crop scouting platform

Fig 3: BoniRob

Fig 4: Dino weeding robot

Ag bot II helps farmers to take decisions on the use of herbicides, pesticides, fertilizers and watering.
BoniRob aids in chemical weed control or uses a rod device to remove the weeds.

4. Harvesting: Bulk harvesting is the common trend of harvesting. In crops like cotton where the maturity of cotton ball achieves at the different time period in a single plant (Hutmacher et al., 2003), therefore in this case selective harvesting of a cotton ball is important.

Harvesting of immature crop affects its quality and even production. There is need of threshold parameter to define the range of maturity level for defining crop as mature. In some of crops, selective harvesting is required. This can be assessed with the use of sensing technology.

The information obtained with the technology is to be processed through microprocessor or microcontroller. Harvesting with the agricultural robot can be done at real-time data sensing. Such kind of precision monitoring and harvesting with the help of farm-robot could help to overcome problem of labour scarcity with quality produce.

Conclusion

Precision agriculture paves the way forward for development of autonomous robot to aid in farm operations. Autonomous robot is a superficial alternative which can be exploited to achieve its potential. This helps in real-time monitoring of different agricultural parameters using sensing systems for timely action to reduce the impacts on crops. Inevitably the farm robot compensates for shortage of agricultural labour with timely and superlative performance of farm operations. Agricultural robot can be a platform which could be integrated with various technologies like machine vision, image processing, mechatronics etc. to give an optimal solution for autonomous agricultural operations with the aims of precision, economic alternative, reduced human drudgery and environment protection.

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Study on Groundnut Diseases and their Management

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Introduction

Groundnut *(Arachis hypogaea)* is an important oilseed crop in India and is cultivated during kharif and rabi-summer. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan and Maharashtra are major groundnut growing states contributing about 80 percent area and production in India. The average yield of rabi-summer groundnut is around 1600 kg/ha, whereas kharif-groundnut is around Ghewande et al., 1983 and Subramaniyam et al., 1985). More than 55 pathogens including viruses have been reported to affect groundnut. Among diseases, stem rot, collar rot, aflaroot, leaf spots (early and late), rust and bud necrosis affect the groundnut crop both in kharif and rabi 1000 kg/ha which is lower than major groundnut growing countries. This may be attributed to the rainfed nature of cultivation of this crop coupled with attack by a variety of diseases and insect pests. The role of groundnut diseases in reducing yield has been clearly demonstrated (summer season). It has been reported to cause yield loss of up to 50% in early infected crop of groundnut in India (Ghewande et al., 1983). Besides these, in the past three years, Alternaria leaf blight had been occurring severely in summer groundnut (Kumar et al., 2012).

Symptoms

The disease occurs on all above ground parts of the plant, more severely on the leaves. The leaf symptoms produced by the two pathogens can be easily distinguished by the following characters. Both the fungi produce lesions also on petiole, stem and pegs. The lesions caused by both species coalesce as infection develops and severely spotted leaves shed prematurely. The quality and yield of nuts are drastically reduced in severe infections.

Pathogen

Early leaf spot: *C. arachidicola* (Sexual stage: *Mycosphaerella arachidis*)

The fungus is intercellular and do not produce haustoria and become intracellular when host cells die. The fungus produces abundant sporulation on the upper surface of the leaves. Conidiophores are olivaceous brown or yellowish brown in colour, short, 1 or 2 septate, unbranched and geniculate and arise in clusters. Conidia are sub hyaline or pale yellow, obclavate, often curved 3-12 septate, 35-110 x 2.5 - 5.4 um in size with rounded to distinctly truncate base and sub-acute tip. The perfect stage of the fungus produces perithecia as ascostromata. They are globose with papillate ostiole. Asci are cylindrical to clavate and contain 8 ascospores. Ascospores are hyaline, slightly curved and two celled, apical cells larger than the lower cell.

Late leaf spot: *P. personata (C. personata)* (Sexual stage: *M. berkeleyii*)

The fungus produces internal and intercellular mycelium with the production of haustoria. The conidiphores are long, continuous, 1-2 septate, geniculate, arise in clusters and olive brown in colour. The conidia are cylindrical or obclavate, short, measure 18-60 x 6-10um, hyaline to olive brown, usually straight or curved slightly with 1-9 septa, not constricted but mostly 3-4 septate. The fungus in its perfect stage produces perithecia as ascostromata which are globose or brodly ovate with papillate ostiole. Asci are cylindrical to ovate, contain 8 ascospores. Ascospores are 2 celled and constricted at septum and hyaline.

Favourable Conditions: Prolonged high relative humidity for 3 days, low temperature (20OC) with dew on leaf surface, heavy doses of nitrogen and phosporus fertilizers and deficiency of magesium in soil.

Mode of Spread and Survival: The fungi survives for a long period in the infected plant debris as conidia, dormant mycelium and perithecia in soil. The volunteer groundnut plants also harbour the pathogens. The fungi also survive on contaminated pods and seeds. The primary infection is by ascospores or conidia liberated from infected plant debris. The secondary spread is by windblown conidia. Rain splash also helps in the spread of conidia.

Management: Remove and destroy the infected plant debris. Eradicate the volunteer groundnut plants. Keep weeds under control. Treat the seeds with Carbendazim or Thiram at 2g/kg. Spray Carbendazim 250g or Mancozeb 1 kg or Chlorothalonil 1 kg/ha and if necessary, repeat after 15 days. Grow moderately resistant varieties like ALR.1.

Rust

Puccinia arachidis

Symptoms: The disease attacks all aerial parts of the plant. The disease is usually found when the plants are about 6 weeks old. Small brown to chestnut dusty pustules (uredosori) appear on the lower surface of leaves. The epidermis rupture and exposes a powdery mass of uredospores. Corresponding to the sori, small, necrotic, brown spots appear on the upper surface of leaves. The rust pustules may be seen on petioles and stem. Late in the season, brown teliosori, as dark pustules, appear among the necrotic patches. In severe infection lower leaves dry and drop prematurely. The severe infection leads to production of small and shriveled seeds.

Pathogen: The fungus produces both uredial and telial stages. Uredial stages are produced abundant in groundnut and production of telia is limited. Uredospores are pedicellate, unicellular, yellow, oval or round and echinulated with 2 or 3 germpores. Teliospores are dark brown with two cells. Pycnial and aecial stages have not been recorded and there is no information available about the role of alternate host.

Favourable Conditions: High relative humidity (above 85 per cent), heavy rainfall and low temperature (20-25^{o}C).

Mode of Spread and Survival: The pathogen survives as uredospores on volunter groundnut plants. The fungus also survives in infected plant debris in soil. The spread is mainly through wind-borne inoculum of uredospores. The uredospores also spread as contamination of seeds and pods. Rainsplash and implements also help in dissemination. The fungus also survives on the collateral hosts like Arachis marginata, A. nambyquarae and A. prostrate.

Management: Avoid monoculture of groundnut. Remove volunteer groundnut plants and reservoir hosts. Spray Mancozeb 1 kg or Wettable sulphur 2.5 kg or Tridemorph 500 ml or Chlorothalonil 1 kg/ha.

Collar Rot or Seedling Blight or Crown Rot

Aspergillus niger and *A. pulverulentum*

Symptoms: The fungus is both seed-borne and soil-borne and so the infection can be seen at any stage from sowing onwards. The disease usually appears in three phases.

a. Pre-emergence rot: Seeds are attacked by soil-borne conidia and rotten of seeds prevents the seeds to germinate. The seed are covered with black masses of spores and internal tissues of seed become soft and watery.

b. Post-emergence rot: The pathogen attacks the emerging young seedling and cause circular brown spots on the cotyledons. The symptom spreads later to the hypocotyl and stem. Brown discoloured spots appear on collar region. The affected portion become soft and rotten, resulting in the collapse of the seedling. The collar region is covered by profuse growth of fungus and conidia and affected stem also show shredding symptom.

c. Crown rot: The infection when occurs in adult plants show crown rot symptoms. Large lesions develop on the stem below the soil and spread upwards along the branches causing drooping of leaves and wilting of plant.

Pathogen: The mycelium of the fungus is hyaline to sub-hyaline. Conidiophores arise directly from the substrate and are septate, thick walled, hyaline or olive brown in colour. The vesicles are mostly globose and have two rows of hyaline phialides viz., primary and secondary phialides. The conidial head are dark brown to black. The conidia are globose, dark brown in colour and produce in long chains.

Favourable Conditions: Deep sowing of seeds, high soil temperature (30-35°C) and low soil moisture.

Mode of Spread and Survival: The pathogen survives in plant debris in the soil, not necessarily from a groundnut crop. Soil-borne conidia cause disease carry over from season to season. The other primary source is the contaminated seeds. The fungi are carried on the seed surface or under the testa.

Management: Select good quality seeds. Treat the seeds with Carbendazim 2 g or Thiram 4g/kg. Avoid deep sowing of seeds. Destroy the crop debris by burning.

Root Rot

Macrophomina phaseolina

Symptoms: In the early stages of infection, reddish brown lesion appears on the stem just above the soil level. The leaves and branches show drooping, leading to death of the whole plant. The decaying stems are covered by whitish mycelial growth. The death of the plant results in shredding of bark. The rotten tissues contain large number of black or dark brown, thick walled sclerotia. When infection spreads to underground roots, the sclerotia are formed externally as well as internally in the rotten tissue. Pod infection leads to blackening of the shells and sclerotia can be seen inside the shells.

Pathogen: The fungus produces hyaline to dull brown mycelium. The sclerotia are thick walled and dark brown in colour.

Favourable Conditions: Prolonged rainy season at seedling stage and low-lying areas.

Mode of Spread and Survival: The fungus remains dormant as sclerotia for a long period in the soil and in infected plant debris. The primary infection is through soil-borne and seed-borne sclerotia. The secondary spread of sclerotia is aided by irrigation water, human agency, implements, cattle etc.

Management: Treat the seeds with Thiram 4g or Carbendazim 2g/kg or treat the seeds with *Trichoderma viride* at 4g/kg. Spot drench with Carbendazim at 0.5 g/lit.

Rossetts Virus

Symptoms: The affected plants are characterized by the appearance of dense clump or dwarf shoots with tuft of small leaves forming in a rossette fashion. The plant exhibits chlorosis and mosaic mottling. The infected plants remain stunted and produce flowers, but only a few of the pegs may develop further to nuts but none bear seeds.

Mode of Spread and Survival: The virus can survive on the volunteer plants of groundnut and other hosts. The virus is transmitted by *Aphis craccivora* in a persistent manner.

Management: Use heavy seed rate and rogue out periodically the infected plants. Spray Monocrotophos or Methyl demeton at 500 ml/ha.

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Integrated Pest Management Under Protected Cultivation

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Introduction

Protected cultivation is the concept of growing potential crops in the modified natural environment for ensuring optimum growth of the crop plants without any or least stress (Sabir and Singh, 2013). The growing conditions within the protected environment of greenhouse/polyhouse are highly favourable to arthropod pests. Under this the warm, humid conditions and abundant food, provide an excellent, stable environment for pest development. Often, the natural enemies that keep pests under control outside are not present under protected environment. For these reasons, pest situations often develop in the indoor environment more rapidly and with greater severity than outdoors. Integrated pest management (IPM) refers to an ecological approach in PM in which all the available necessary techniques are consolidated in a unified program, so that pest populations can be managed in such a way that economic damage is avoided and adverse side effects are minimized. It is a site-specific strategy for managing pests that relies on correct pest identification and understanding the pest biology. With a long-term perspective it is easier to see that an investment in IPM can pay for itself in a higher-quality crop and a cleaner environment. In India, many arthropod pests (insect and mite pests) have been recorded to be associated with the crops under protected environment (table 1).

Table 1. Insect-pests under protected environment:

Insect pests	Scientific name	Host plant
Aphids	*Aphis gossypii*	Capsicum
	Macrosiphoniella sanborni	Chrysanthemum
	Myzus escalonicus	Strawberry
	Myzus persicae	Capsicum, gerbera
Caterpillars	*Helicoverpa armigera*	Capsicum, tomato, carnation
	Spodoptera litura	Rose, tomato, capsicum, cucumber
Leaf-miner	*Liriomyza trifolii*	Tomato, cucumber, chrysanthemum, gerbera, and many ornamentals
Thrips	*Scritothrips dorsalis*	Rose
	Thrips palmi	Gerbera
	Thrips tabaci	Gerbera
Whiteflies	*Bemisia tabaci*	Gerbera, capsicum
	Trialeurodes vaporariorum	Tomato, cucumber, capsicum, beans, gerbera, and more than 30 hosts
Mites	*Polyphagotarsonemus latus* (yellow mite)	Capsicum
	Stenotarsonemus fragariae	Strawberry
	Tetranychus cinnabarinus	Carnation
	Tetranychus neocalidonicus	Cucumber
	Tetranychus urticae (Spider mite)	Tomato, capsicum, cucumber, carnation, gerbera

Integrated Pest Management strategies

As greenhouse conditions allow rapid development of pest populations, successful control of insect pests on greenhouse vegetables and ornamentals depends on several factors. The IPM programme for protected cultivation can be described here under.

1. Avoidance of the pests: Under this, pest can be avoided by entering into the greenhouse. The following practices can be done.

a. Use of Insect-proof screens: Use of physical barriers to exclude insect-pests by screening. Screening vents and doorways can greatly limit the movement of insect pests into the greenhouse. This includes common greenhouse pests such as thrips, aphids, leaf miners and whiteflies. However, selection of proper screen size mesh and assuring adequate airflow are more important. Mesh size depends upon the targeted insect and given in the table 2. Mesh with holes less than 200 micrometres is required for complete exclusion of thrips, screening with holes as large as 600 mm is sufficient for excluding leaf-miners (Sood, 2010).

Table 2. Screen mesh sizes to avoid different insect pests under protected environment (Mandeep et al., 2018):

Mesh (number of threads per linear inch)	Hole size (micron)	Target insect-Pest
34	610	*Leafminer (L. trifoli)*
42	462	*Cotton whitefly (B. tabaci)*
52	340	*Aphid (M. persicae)*
58	290	*Greenhouse whitefly (T. vaporariorum)*
76	192	*Thrips (Thrips spp.)*

b. Ultra-violet radiation absorbing sheets: The UV part of the solar spectrum plays an important role in the ecological behaviour of insects, including orientation, navigation, feeding and interaction between the sexes. Spectrally modified sheets are produced commercially by the introduction of a UV-absorbing additive into the raw material which blocks the transmission of most wavelengths in the UV range below 370-380 nm without interfering with the transmission of photosynthetically active radiation (400-700 nm). The manipulation of the UV vision of insects by using UV-blocking greenhouse cladding materials has been shown to be effective in preventing the immigration of a wide range of insect-pests (whiteflies, aphids, thrips and leaf miners) from the external environment into the protected crop.

c. Provision of double door: Limited access to screened areas is beneficial since insects may come in the protected structure on clothing or be swept in with the wind. Building a screened foyer to create a double-door entry partially solve the problem of wind-carried insects. Special efforts must be put in for repairing holes or tears immediately, and cleaning the screens to maintain airflow.

d. Sanitation: Many of the methods incorporated in an IPM strategy are logical greenhouse operating procedures and basic horticultural practices. The following method produces a healthier crop, prevent many pest problems, and isolate pests to smaller areas in the greenhouse.

e. Pre-season clean-up: A basic component of cultural practices is sanitation. Infestations are easier to prevent than to cure. It has been observed that insects can enter the protected structure in following ways, introduction of infested seedlings/ planting material, infestation from other plants within the protected structure and infestation from host plants outside but near the protected structures. Before introducing a new crop into the greenhouse, it is extremely important to eliminate pests from the previous crop. Remove all plant debris and weeds from the greenhouse. A fallow period of two to four weeks reduces the pest load considerably.

f. Inspection upon arrival: When new plants arrive at the greenhouse, examine them closely for signs of pest infestation. If necessary, remove lower or damaged leaves to avoid spread of pests. Make the decision whether treatment is needed from the first sign of symptoms of insects or mites. It is much easier to manage a pest infestation by treating a group of small plants (in seedling stage) rather than larger plants where the dense canopy prevents thorough coverage.

g. Balanced use of fertilizer: Fertilization schedules based on balanced use of nutrients should be followed. Nitrogen should be applied only as needed for optimal growth. Periodic heavy applications set up nitrogen surpluses that cause excessive growth, which favour the population growth of aphids, and other pests. Application of potassium at desired levels has been found to reduce the incidence of insect-pests.

h. Pinching and Pruning: Pinching-off damaged plant parts, flowers, and spotted leaves (and those with insect larvae or egg deposits) can be a very effective way of reducing the spread of pests in the greenhouse. The plant debris should be placed immediately in a covered container before being disposed-off. This practice can be helpful in reducing the pest population of all the targeted pests. Pruning lower leaves after harvesting lower fruit clusters is helpful measure in removing large numbers of developing leaf miners and whiteflies.

i. Plant Quarantine: Workers in the greenhouse are frequently the mechanism for dispersal of insects and mite pests. One should try to avoid moving plants with mites or thrips and they should not be touched or moved immediately before handling clean, healthy plants.

j. Trap crop/Indicator plants: For early detection and trapping of the target pests, some of the preferred hosts of the target pests can be used. Planting border rows of Portulaca oleracea in rose can be used as a trap crop for tobacco caterpillar under protected environment.

2. Early detection: Scouting and early detection are critical to manage the insect infestation successfully. Scouting is the regular, systematic inspection of the plants and exteriors to identify and assess pest problems. It includes inspection of foliage and flowers; and the use of insect traps. Many insect infestations begin in isolated spots within the greenhouse.

a. Scouting: Scouting procedures for most greenhouse-grown crops are based on visual observations and use to provide estimates of the pest population in protected environment. Inspect the entire plant, including the soil surface, for the presence of arthropod pests. Look at the plant systematically, begin at the bottom, older leaves, young, tender leaves, and the flush growth. A majority of arthropod pests prefer the underside of a leaf, it is important to turn the leaves over to check for pests. Scout the crop on a regular basis and at least 1-2% of the total plants should be inspected at weekly interval. A thorough greenhouse inspection reveals the location and severity of any current pest problems. Use a field data sheet to record the identification, location, and severity of all pest's present, and record the effectiveness of any treatments.

b. Monitoring: It is a relative method of insect population estimation where no direct observations on the plants for the presence of insect-pests are needed. However, the pest population is estimated with the help of attractant traps. For monitoring whiteflies, aphids, thrips and leaf miner adults, yellow sticky cards (4″x12″ or 8″x12″) and blue coloured sticky traps for thrips are used in the protected environment. Hang the yellow sticky cards/ traps in the crop with the help of strings about 4″ to 6″ above the plant canopy. The traps are placed in a grid pattern and 1-2 yellow sticky cards per 100 square meter of floor area are used (Mandeep et al., 2018). Besides, sex pheromone, baited traps can also be used for detecting moths of tobacco caterpillar and tomato fruit borer. These traps allow visualizing population trends and can be used to time the application of pesticides or release of bio-agents.

3. Curative measures: Insect pests' incidence can be checked by following methods in the protected cultivation.

a. Bio-agents: Use of specific predators and parasitoids in greenhouse ecosystem to manage pests forms the basics of biological control. But to be effective, biological control must be well planned and begun when the target populations are low. In Western Europe and North America, the bioagents are commercially available and being used successfully for the management of pest problems under protected situations (Table 3).

Table 3. List of natural enemies for pest management in protected cultivation:

Biocontrol agent	Scientific name	Target pest
Parasitic wasps	*Encarsia Formosa*	Whiteflies
Parasitoid	*Dacnusca sibiriica* *Diglyphus isaea*	Serpentine leaf miner
Predatory mites	*Amblyseius californicus* *Phytoseiulus longipes Phytoseiulus persimilis*	Spider mites
Predatory mites	*Amblyseius cucumeris* *Amblyseius mckenziei*	Thrips
Lady beetles	*Cryptolaemus montrouzeri*	Various soft-bodied insects and eggs
Green lacewings	*Chrysoperla carnea*	Various soft-bodied insects and eggs

b. Chemical control: The insecticides are curative in action and are one of the important tools to check the flaring pest populations. Under protected environment, in order to avoid the contamination of produce from pesticide residues, use of pesticides having less persistence and adopting suggested waiting period between last insecticidal application and harvesting can be followed. Incorporating botanicals, microbials and others in management schedule proves better in insecticide resistance management Programme (IRM). Besides, emphasis to improve the awareness level of the growers for timely diagnosis and judicious use of insecticides need to be taken up on priority.

Table 4: Important pesticides for the management of insect pests under protected cultivation:

Insect pests	Pesticides
Mites	Fenpyroximate, Abamectin @ 0.5 ml/L
Thrips, Whiteflies, Aphids	Imidacloprid @ 0.4 g/L, Acetamiprid @ 0.2 g/L, Spinosad @ 0. 3 ml/L
Leaf miner	Spinosad @ 0.3 ml/L, Abamectin @ 0.5 ml/L
Caterpillars	Spinosad, Chlorantraniliprole @ 0.3 ml/L, Flubendiamide @ 0.1 ml/L

Future Drive

Further, research is needed to develop pest management technology under protected environment with emphasis on selective use of pesticides. Safe waiting intervals based on harvest time pesticide residues needed to be established for the crops under protected environment as this information is lacking completely.

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Management of Cluster bean Diseases (*Cyamopsis tetragonoloba* L.)

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Introduction

Cluster bean (*Cyamopsis tetragonoloba L.)* Commonly known as "Guar" is an annual *kharif* arid legume grown for green fodder, vegetable, green manuring, gum and seed purpose. India is the largest grower and producer of cluster bean in the world. It contributes 84% share in the world‟s total production. In India, cluster bean is being grown in the area of 4.30 million hectares with a production of 2.52 million tonnes of cluster bean seed with an average productivity of 467 kg/ha.In Rajasthan , about 80% area of the Gird zone, which consists of Nagaur, Ajmer, Jaipur, Jodhpur, Bikaner and Tonk Districts (Anon., 2015). Deeksha and Tripathi (2002) reported the loss in yield ranging from 24 to 67 per cent. Suryanarayana and Bhombe (1961) reported only 8 - 12 per cent seed germination due to the seed borne nature of *Colletotrichum spp*. Padaganur and Naik (1991) observed 75.5 per cent seed infection due to *Colletotrichum capsici*. In Papua, New Guinea, anthracnose infection rate ranged upto 17.2 per cent (Pearson *et al*., 1984).

Genus *Colletotrichum* was described by Corda in 1831. The conidia are one celled, hyaline, ovoid to oblong , developed in acervuli on conidiophores with setae. In 1849, has observed a closely related genus *Gloeosporium* having similar conidia in acervuli. However, Shear and Wood (1907) showed by comparing cultures of *Gloeosporium musarum* Cooke and Massee, *Colletotrichum lagenarium* (Pass.) Ellis and Halst and *Colletotrichum atramenatrium* (Berk and Br.) Taub. Rathaiah and Sharma (2004) indicated appearance of characteristic blood red ring like spots of 8 – 11 mm diameter on the upper surface of leaf. The spots on the lower surface of leaf were different from those on the upper surface, which are comparatively large (10 mm diameter) patches of bright blood red stains. The corresponding upper surface became chlorotic. Blood red stains measuring upto 2.5 cm in length appeared on the pods. Similar symptoms occurred on the petioles.

A large number of diseases and insects attack the cluster bean crop right from seedling stage to pod formation stage. Symptoms along with suitable control measures of disease and insects are as follows:

Bacterial blight: It is caused by a bacterium X*anthomonas cyamopsidis.* This disease infestation mostly occurs during *kharif* season crop at the surface of leaf. The spot of the disease is intraveinal, round and well defined on the dorsal surface of the leaf. The pathogen invades vascular tissues and causes flaccidity of the affected portion. The flaccid spots become necrotic and turn brown. The infection advances to petiole and stem. It results in blackening and cracking of stem. Resistant varieties and certified seed should be used for sowing purpose. Seed should be treated with 250 ppm of agrimycine or 200 ppm of streptocycline for 3 hours. Spray of streptocycline @ 5 g or plantomycine @ 50 g with 100 L water per hectare should be done at 35-40 days after sowing.

Alternaria leaf spot: The casual organism of alternaria leaf spot disease is a fungus *Alternaria cyamopsidis*. The symptoms of the disease appear mainly on the leaf blade of leaves as dark brown, round to irregular spots varying from 2 to 10 millimeter in diameter. The water-*soaked* spots later on turn grayish to dark brown with light brown lines inside the spots. Spray of zineb @ 2 kg in 500 L of water per hectare should be done at an interval of 15 days at least twice.

Anthracnose: This disease is caused by *Colletotrichum capsici* f. cyamopsicola. The symptoms of the disease appear on the leaves, petiole and stem in the shape of black spots. Spray of zineb @ 2 kg in 500 L of water per hectare should be done for controlling this disease.

Powdery mildew: This disease is caused by a fungus *Erysiphe polygoni.* The symptoms of the disease start with white powdery growth over the leaf surface. This white growth consists of the fungus and its spores. The disease can be controlled by spray of wettable sulphur like suffex at the rate of 2-3 kg ha-1 or dusting of sulphur powder @ 20-25 kg ha-1 or spray of dinocap @1.5 ml L-1 of water.

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Methods of Application of Biofertilizers

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Bacterial biofertilizers are generally supplied as carrier-based inoculants. Peat and lignite are used as a carrier material. These inoculants are applied by the following methods.

1. Seed treatment: The recommended dose of biofertilizers (600g – 1 kg / ha of seed) should be mixed with rice gruel to make a paste and treat the seeds in such a way to have uniform coating over the seeds. Shade dry it for 30 minutes and sow the seeds.

2. Seedling root dipping: This method is used for transplanted crops. Mix the recommended dose of biofertilizer (800g- 1kg) in 1 lit of water and make a slurry, to which dip the seeling (care should be taken that the root portion should be completely immersed in the biofertilizer slurry/solution) for 20-30 minutes then transplant the seedling.

3. Soil application: This method is applicable for all types of crop plants. Mix 2 kg of biofertilizer with 25 kgs of fully decomposed FYM or sand and broad cast before sowing or transplanting for better result.

4. Spot application: For grown up trees, 20-50 g of recommended biofertilizer (Azospirillum, Phosphobacteria &VAM) along with fully decomposed FYM and should be applied near to the root zone and cover it with soil.

Application of Bacterial Biofertilizers

Rhizobium: For all legumes Rhizobium is applied as seed treatment only.

Azospirillum: *Azospirillum* can be applied to almost all crops except Pulses. For direct sown crop, it is applied through seed treatment and soil application. In the transplanted crop, inoculated by seed treatment, seedling root dipping and soil application.

Phosphobacteria: Inoculation is done by seed treatment, seedling root dipping and soil application as in the case of *Azospirillum*.

Combined application of bacterial biofertilizers: *Phophobacteria* can be mixed with *Azospirillum* and Rhizobium. The inoculants should be mixed in equal quantities and applied as mentioned above.

Application of Liquid Biofertilizers

1. Seed treatment: or seed treatment 15 ml of liquid biofertilizer should be mixed with less quantity of rice gruel to make a paste and treat the seeds in such a way to have uniform coating over the seeds. Shade dry it for 30 minutes and sow the seeds.

2. Seedling root dipping: 250 ml liquid biofertilizer is mixed with one lit of water and make a slurry, to which dip the sealing (care should be taken that the root portion should be completely immersed in the biofertilizer slurry/solution) for 20-30 minutes then transplant the seedling.

3. Soil application: 500 ml of liquid biofertilizer is mixed with 25 kgs of fully decomposed FYM or sand and broad cast before sowing or transplanting.

4. Biofertigation: Liquid biofertilizer is applied at the rate of 1- 5 ml per lit of water and it should be mixed with the water in the fertigation tank.

Application of Arbuscular Mycorrhizal Fungi (AM fungi)

1. Nursery Application: 100g bulk inoculums is sufficient for one-meter square nursery area. The inoculums should beapplied at 2-3cm below the soil at the time of sowing. The seeds/ cuttings should be sown/ planted the AM inoculums and cause infection.

2. For poly bag raised crops (forest trees, coffee, tea etc.): 50-100g of bulk inoculums is sufficient for each packet. Mix 10kg of inoculums with 1000 kg of sand potting mixtures in polythene bag before sowing

3. AM Inoculum Required for out planting: Twenty grams of inoculums is required for planting per seedling. Apply inoculums at the time off planting.

4. AM inoculation for existing trees: Two hundred grams of inoculum is required for inoculating one tree, apply inoculums near the root surface at the time of fertilizer application.

Storage of Inoculums

AM bulk inoculums can be stored for a period of six months under room temperature. Bacterial inoculants should not be mixed with chemicals (insecticide, fungicide, herbicide and fertilizers). When seeds are to be treated with any chemical, seed treatment with bacterial inoculants should be done last, prior to sowing.

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Analysis of Soil Compaction Using Finite Element Method

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Soil compaction is an important physical limiting factor for the root growth and plant emergence, decreasing crop production worldwide (3). Soil compaction is the process through which the soil grains are rearranged to reduce void space and take them into closer contact with each other, so increasing the bulk density (7). It has adverse effects on soil structure, reduces crop production, plant height, increases runoff and erosion, accelerate potential pollution of surface water by organic waste and applied agrochemicals, and cause inefficient use of water and nutrients due to slow drainage (4). Quantitative methods of detecting compaction include measuring penetration resistance with a commercially available cone penetrometer. Finite element analysis is also another method to determine the soil compaction (1). Soil compaction was also evaluated by field traffic using a FEM with Modified Cam Clay model (2).

Numerical simulation allows the modelling of soil compaction by showing the changes in the soil's initial stress state due to external forces, such as vehicle traffic. Thus, the objective of this work was to evaluate the mechanical behavior of the soil after a sugarcane crop preparation subjected to vehicle traffic.

Numerical simulation was carried out using the Finite Element Analysis (FEA) of the compaction in the soil layer 0–100 cm subdivided into 0–20 and 20–100 cm. The Modified Cam Clay elastoplastic constitutive model (traction, shear and compression) was used in the numerical analysis. The properties of the soil samples collected in each layer assessed through oedometer tests, considering the moisture content of 10%, 15% and 20%. The vehicles used were a tractor and truck loaded with their standard loads.

The loads of tractor front and rear tire applied during the analysis was 1635 and 2452 kg, also for truck front and rear tire was 3000 and 2125 kg. Finite element meshes were generated for each scenario, with area defined in terms of types of axis configuration and covered 5m width of base. The meshes had a refinement in the region below the tires because these are zones of greater tendency to compaction. The pre-consolidation stress is the variable of the model that defines the transition from elastic to plastic deformation behavior, and indicates the soil compaction when increased in relation to its initial value.

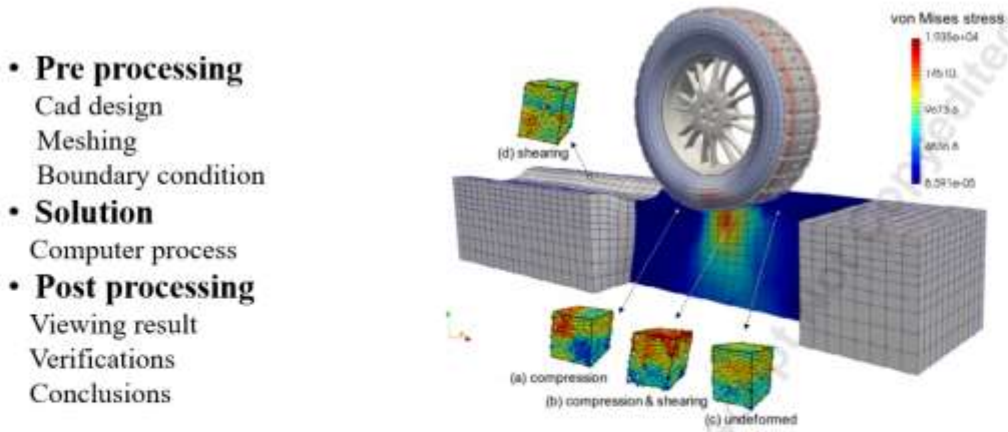

Fig: 1 Steps of Finite Element Method

Soils with higher moisture have greater propagation of stress to deeper layers and consequent compaction. The use of a numerical simulation in an elastoplastic constitutive model, such as the Modified Cam Clay, provide valuable insight into problems involving compressive stresses, and is important for soil compaction studies, since it defines the compaction region along the cross section of the soil.

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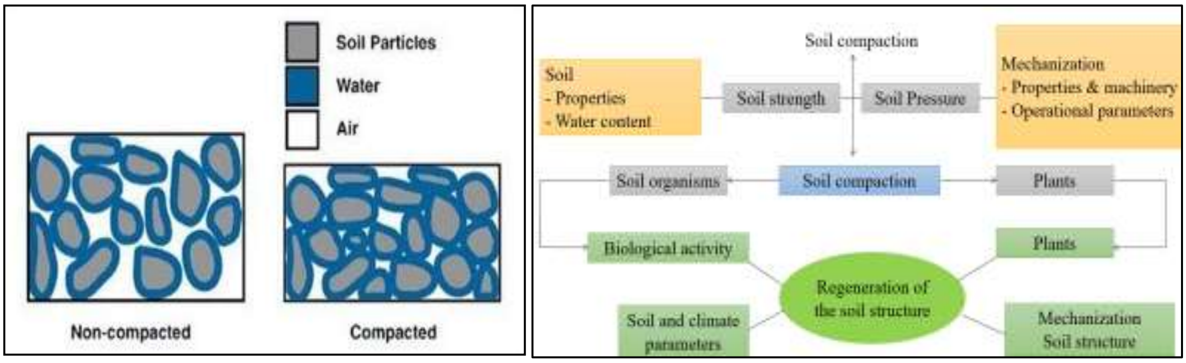

Fig: 2 Factors influencing Soil Compaction

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Grafting Techniques in Vegetables

Article ID: 32299

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Introduction

Grafting is a technology which involves joining together two living plant parts to produce a single, living plant. The upper plant parts which produces fruits is called scion and the lower root parts is known as root stock. The rootstock contributes vigour and disease resistance while the scion is chosen for fruit and its quality. In vegetable crops, it has become popular in past few decades for commercial vegetable industry. The objective of grafting is to eliminate soil born pests that infects vegetables. Grafting can be applied on a number of vegetable crops, but due to intensive labour requirement, it is mostly practiced on cucurbits, and members of the solanaceous vegetables such as brinjal and tomato. Grafting has several advantages like increased yield, disease tolerance, nematode resistance, low temperature tolerance, high temperature tolerance, enhanced nutrient uptake, enhanced water uptake, high salt tolerance, wet soil tolerance, quality changes, heavy metal and organic pollutant tolerance. Beside several beneficial manifestations, there are certain limitations associated with grafting technology such as additional seeds for rootstocks, experienced labour, high price of grafted seedlings, excessive vegetative growth and fruit harvesting may be delayed.

Basic Pre-Requisites for Vegetable Grafting

1. Selecting the right rootstock/scion: Select the desirable rootstock and scion having the same stem size (diameter). Grafting should be done at 2-3 true leaf stage. The properties of different root stock for cucurbitaceous and solanaceous vegetables are presented in Table 1.

2. Graft compatibility: Compatible rootstock and scion minimizes the mortality rate even in later stage of growth. Rapid Callus formation takes place between scion and rootstock and leads the formation of vascular bundles.

3. Grafting aids: Commonly used aids to perform grafting i.e., Grafting clips, Tubes, Pins, and Grafting Blade.

4. Screening house: Used for growing seedlings prior to grafting. It should be constructed with 60-mesh nylon net. Arrange double door, the upper half of the structure should be covered with a separate UV resistant polyethylene to prevent UV light penetration.

5. Healing of grafts: Healing is most critical to provide favourable conditions to promote callus formation of grafted seedlings. In healing chamber, temperature should be 28-29 0C with 95% relative humidity for 5-7days in partially shaded place (darkness for 1-2 days) to promotes callus formation at union. It helps in formation of better graft union by reducing transpiration, maintains high humidity, maintains optimum temperature and reduces light intensity. The main aim is to initiate environment by controlling temperature and humidity.

6. Acclimatization of the grafted plants: After the callus has formed and the wounded surfaces are healed, plants may be put under a mist system, greenhouse or placed under a clear plastic cover for acclimatization to prevent leaf burning and wilting. In general, 5 to 6-week time is sufficient for successful graft union.

Table 1. Root stocks and grafting methods used in vegetable crops:

Scion plant	Root stock	Specific features	Method
Eggplant	*Solanum torvum*	Resistant to VW, BW, FW, RKN and tolerant to abiotic stresses	Tongue and cleft method
	S. sissymbrifolium	Resistant to VW, little leaf, nematodes, fruit and shoot borer	Cleft method

	Solanum khasianum	Resistant to fruit and shoot borer	Both tongue and cleft methods
Tomato	*L. pimpinellifolium*	Color, quality, resistant to BW, LB	Only cleft method
	S. nigrum	Resistant to BW	Tongue and cleft methods
Cucumber	*C. moschata*	Low temperature tolerance, disease tolerance	Hole insertion and tongue method
	Cucurbita maxima	Low temperature tolerance, disease tolerance	Tongue method
Water melon	*Benincasa hispida*	Good disease resistance	Hole insertion and cleft method
	C. moschata	Vigorous root systems, Fusarium and low temperature tolerance	Hole insertion and cleft method
	C. moschata × C. maxima	Vigorous root systems, Fusarium and low temperature tolerance	Hole insertion method
	Lagenaria siceraria	Vigorous root systems, Fusarium and low temperature tolerance	Splice Grafting
Bottle gourd	*C. moschata,* Luffa sp.	Fusarium and low temperature tolerance	Hole insertion and tongue method

Methods of Grafting

1. Cleft grafting: This method is widely used for grafting of tomato. The seeds of rootstock are sown 5-7 days earlier than those of scion. The stem of the scion (at four-leaf stage) and rootstock seedlings (at 4-5 leaf stage) are decapitated and a longitudinal cut is made in a downward direction, 1-1.5 cm long and ¾ depth of stem diameter. The scion is pruned to 2-3 true leaves and the lower stem is cut to slant angle to make tapered wedge. After placing the scion into the split made on the rootstock, a clip is placed to hold both in position until the union is completed.

2. Tongue approach grafting: Commonly used in Cucurbitaceous crops viz., melons and cucumbers because of its high survival rates. For TAG, both scion and rootstock should be of same height. Cucurbits seeds of scion are sown 5-7 days earlier than the rootstock seeds. The growing point of rootstock removed carefully before grafting to reduce unnecessary loss of nutrients. The grafting cut for rootstock is made in a downward direction and the scion cut in an upward direction at an angle of 30-40 degrees to the perpendicular axis to allow fusion of vascular bundles. After grafting operation, specially designed clips are placed to fix the graft position and later planted in 9-12 cm diameter pot. Most widely used by farmers and small nurseries.

3. Hole insertion grafting (HIG): Commonly used for watermelon because of smaller seedling size as compared to rootstock (squash/ bottle gourd). Watermelon seeds sown 7-8 days after sowing of bottle gourd seeds (rootstock) or 3-4 days after sowing of squash rootstock seeds. Grafting is made 7-8 DAS of watermelon seeds. The true leaf including growing point should be carefully removed and a hole is made with bamboo or plastic gimlet or drill at a slant angle in longitudinal section. The hypocotyl portion of the watermelon is prepared by slant cutting to have tapered end for easy insertion. HIG requires more technical skill and suitable conditioning facility. It does not require additional labour for clipping, transplanting, cutting and clip removal.
Healthy and stronger seedlings are obtained because more of the vascular bundles can be connected.

4. One cotyledon / Slant / Splice grafting: It has recently been adopted by commercial seedling nurseries and applicable to most vegetables. In SG, one cotyledon and the growing point are removed for grafting. After placing the scion on the rootstock, grafting clips are used to fix the grafted position tightly together. This method has been developed for robotic grafting of cucurbits. The major advantage of this method is production of strong and healthy grafted seedlings.

5. Tube grafting: It is similar to slant grafting except that in this method root stock & scion joined are held with an elastic tube instead of clips. It is more popular in tomato, brinjal.

6. Pin grafting: Pin grafting is basically the same as the splice grafting. Instead of placing grafting clips, especially designed pins are used to hold the grafted position. The pins are made of natural ceramic so it can be left on the plant without any problem.

Tips for a Successful Graft Union

Scions and rootstocks should be exposed to full sun for 2 to 3 days and some water stress (2-3 days) should be imposed before grafting to keep the plants short and to increase tolerance to water stress. Before starting the process of grafting, make sure that plants have been watered and are turgid. Grafting in the greenhouse is to be carried out early or late in the day to avoid undue water stress and drying of the cut plants. Ideally, grafting should be done in a shady place, which is sheltered from the wind and bright sun. While grafting, cut both the scion and the rootstock plants at the same angle with a razor. Do not cut more plants for grafting at a time, because the process must be completed in a few minutes. Both scion and rootstock should be of similar thickness and be placed the cut surfaces together in tight contact before clipping in place. The objective is to maximize the chances for the vascular bundles of the scion to some contact with the respective vascular tissues of the rootstock.

Conclusion

Grafting is a method of plant propagation, done by utilizing selective rootstock and scion combinations for tolerance against soil borne diseases that directly influences the production of vegetable crops. It is a rapid alternative means to the moderately slow breeding methodology. In recent days, grafting application leads the limit use of harmful soil disinfectants which minimizes the toxic residues in vegetables and environmental pollution. Hence, it is suggested that, by adopting modern innovations and indigenous wild relatives, we can realize commercial use of grafting to attain the low input sustainable horticulture in future.

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Role of Tritrophic Interactions in Pest Management

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Introduction

Interactions among host plants, herbivores and their natural enemies (parasitoids and predators) are called tritrophic interaction. As well-known, plants recruit natural enemies to protect them from herbivores through herbivore-induced plant volatiles when plants are damaged by the herbivores (Arimura et al., 2005).

Natural enemies have to utilize different info chemicals to locate the appropriate host plants and host prey in their whole life span (Vinson, 1976). Floral volatiles benefit plants by attracting pollinators and benefit insects by serving as nutrition and mate location sign posts. (Wei et. al., 2006). Floral scents attract or arrest potential predators and parasitoids of herbivores. Many such natural enemies are carnivorous only as larvae; as adults they require nutrition from flowers.

Sugar rich extrafloral nectaries and protein and lipid laden food bodies are thought to attract natural enemies. (Kessler A, Baldwin IT 2001). It has been noticed that wild cherry and catalpa trees time extrafloral nectar production to coincide with susceptible periods of herbivores. Plant pollen and nectar increase the life spans and fecundities of many parasitoids and predators, fostering greater herbivores mortality. (Heil et al.,2008).

Tri-Trophic Interactions Leads to Effective Defence at Each Level

Two types of defence:
1. Intrinsic defence.
2. Extrinsic defence.

Intrinsic Defense

When the plant alone produces defence through physical, mechanical means or through production of chemicals or both it is called intrinsic defence.

Physical factors:

a. Leaf toughness slow the larval development of Pierid butterfly and thus exposing them to natural enemies for longer period.
b. High rate of parasitization is recorded to moderately resistant varieties of pigeon pea which have fine epidermal hairs.
c. The searching behaviour of Trioxys indicus (parasitoid of aphids) is influenced by pubescence of host plants.

Mechanical defences:

a. Plants have many external structural defences that discourage herbivory.
b. Depending on the herbivore’s physical characteristics (i.e. size and defensive armour), plant structural defences on stems and leaves can deter, injure, or kill the grazer.
c. Some defensive compounds are produced internally but are released onto the plant’s surface; for example, resins, lignin’s, silica, and wax cover the epidermis of terrestrial plants and alter the texture of the plant tissue.
d. A plant's leaves and stem may be covered with sharp prickles, spines, thorns, or trichome hairs on the leaf often with barbs, sometimes containing irritants or poisons.

Chemical factors: Plants have evolved many secondary metabolites involved in plant defence, which are collectively known as antiherbivore compounds and can be classified into sub-groups:

a. Alkaloids are derived from various amino acids. Over 3000 known alkaloids exist, examples include nicotine, caffeine, morphine, colchicine, ergolines, strychnine, and quinine.

b. Cyanogenic glycosides are stored in inactive forms in plant vacuoles. They become toxic when herbivores eat the plant and break cell membranes allowing the glycosides to come into contact with enzymes in the cytoplasm releasing hydrogen cyanide which blocks cellular respiration

c. Glucosinolates are activated in much the same way as cyanogenic glucosides, and the products can cause gastroenteritis, salivation, diarrhea, and irritation of the mouth.

d. Benzoxazinoids secondary defence metabolites, which are characteristic for grasses (Poaceae), are also stored as inactive glucosides in the plant vacuole. Upon tissue disruption they get into contact with β-glucosidases from the chloroplasts, which enzymatically release the toxic aglucones.

Extrinsic Defence

When the natural enemies of insect pests benefit the host plants by reducing the pest abundance is called extrinsic defence.

1. The physical, morphological and chemical characteristics of plants interact with the parasitoids and predators of insects by influencing their host seeking ability and affecting the efficacy with which they locate and utilize hosts.
2. Plants provide nutrition to the natural enemies in the form of pollen and nectar.
3. Insects such as aphids and whiteflies which secrete honey dew attract ants which also keep herbivores away.
4. Floral volatiles benefit plants by attracting pollinators and benefit insects by serving as nutrition and mate location sign posts.
5. Floral scents attract or arrest potential predators and parasitoids of herbivores.
6. Many such natural enemies are carnivorous only as larvae; as adults they require nutrition from flowers.
7. Sugar rich extrafloral nectaries and protein and lipid laden food bodies are thought to attract natural enemies.
8. Plant pollen and nectar increase the life spans and fecundities of many parasitoids and predators, fostering greater herbivores mortality.

Conclusion

Insect-plant interactions have always been of interest to man but, owing to the need to feed the world's population in a sustainable and environmentally friendly fashion, such studies are taking on a new significance. By considering the third trophic level (natural enemies of herbivorous insects) when studying insect-plant interactions, not only can this help improve ecological understanding but it may enable us to improve biological control.

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Seed Production Techniques in Wheat

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Introduction

Wheat is the major staple food crop, providing almost half of all calories in the region West and Central Asia. Being next to rice, wheat constitutes one of the key sources of protein in least developed countries.It is most important food crop in India serving as staple food for more than 1 billion population. Quality seed of improved and high yielding wheat varieties has played key role in green revolution and made the country self-sufficient in food grains. For full exploitation of genetic potential of a variety, seed must have high genetic as well as physical purity; therefore, seed production requires systematic and technical efforts.

Land Requirement

Land to be used for seed production should be:

1. Fertile loamy black soil and the soil with good water holding capacity is appropriate for wheat cultivation.
2. Free from weeds and volunteer plants.
3. Field should be well drained, clean and levelled.
4. Previous cropping history of the field should be known to avoid contamination from volunteer plants.

Isolation Distance

Wheat is self-pollinated crop but 1-4% cross pollination occur. In general, is sufficient to isolate seed plots with a strip of 3mt all around but specific standards are available describing minimum isolation distance from different contaminants.

Standard isolation distance for foundation and certified seed:

Contaminants	Minimum Isolation distance (meters)	
	Foundation seed	Certified seed
Fields of other varieties	3	3
Fields of the same variety not conforming varietal purity requirement for certification	3	3

Specific seed standards for foundation and certified seed production

Factor	Maximum permitted (%)	
	Foundation seed	Certified seed
Pure Seed (minimum)	98 %	98 %
Inert matter maximum	2 %	2 %
Off-types	0.05	0.20
Other crop seeds (maximum)	10 /kg	20 /kg
Inseparable other crop plants	0.01	0.05
Total weed seeds (maximum)	10 /kg	20 /kg
Objectionable weed (Hirankhuri and Gullidanda) seeds (maximum)	2 /kg	5 /kg
Seeds infected with nematode galls of ear cockle and tundu disease(maximum)	None	None

Seeds infected with Karnal bunt (maximum)	0.05 % (by number)	0.25 (by number)
Plant affected by seed borne (loose smut)disease	0.10	0.50
Germination (minimum)	85 %	85 %
Moisture (maximum)	12 %	12 %
For vapour proof container	8 %	8 %

Climatic
Wheat crop requires cold and dry weather conditions. It grows best when temperature ranges from 21-24oC at vegetative stage the temperature should be slightly lower (16-20oC), while at grain filling stage slightly higher temperature (25oC for 4-5 days) with ample sun shine is required. If the weather becomes cool and it dews, the wheat plants grow many shoots and give more grains.

Source of Seed
Obtain Nucleus / Breeder / Foundation seeds from a source of approved by the seed certification agency.

Sowing Time
The varieties recommended for timely sown and late sown conditions can be sown at timely sown conditions (5-25November), but the varieties which have longer growth duration and are recommended for early seeding, should only be seeded early for its seed production.

Seed Rate and Spacing
The recommended seed rate for seed crop is 100 kg/ha. For timely sown and late sown condition recommended seed rate is 100 kg and 125 kg/ha respectively. In timely sown condition the row distance should be kept 20-22 cm, whereas for late sown condition it would be 18cm.

Sowing Method
1. The sowing should be done by seed drill instead of broadcasting, as it reduces seed rate, facilitates cultural practices such as mechanical weed control, spraying, roughing and inspection.
2. Depth of sowing should be 5cm
3. Seed drill should be well cleaned prior tousle
4. After sowing of one variety, seed drill should be clean again and then use it for sowing of another variety.

Fertilizer Requirement
In irrigated timely sown and late sown conditions, the doses of N. P. K. are150:80:60 and 100:60:40 kg/ha respectively. One third dose of nitrogen and complete dose of Phosphorus and Potash is applied at the time of sowing in these sowing conditions. In restricted timely sown conditions, complete dose of 60:40:20 kg/ha N.P.K. is applied at the time of sowing.

Irrigation
Total 5-6 irrigations are required. First at 20-25 DAS and thereafter at 20 days interval for wheat.

Field Inspection
Field inspection will help to produce high quality seed by controlling disease, pest and maintaining purity.1 st Field inspection tiller development stage (50-60 days after of sowing), 2 nd Field inspection Flowering-milking stage, 3 rd Field inspection milking stage-maturity stage.

Weed Control

weed control can be done by different Methods, viz., agronomic practices, mechanical control and chemical control. Chemical control is preferred over both because it is highly effective and economical. Commonly used weedicides and their doses are as follows.

Commonly used Herbicides:

Herbicide	Weed	Dose (per ha)	Time of application
Metribuzin	Broad and narrow leaves	250 gm (500 lit water)	30 days after sowing
Pendimethalin	Broad and narrow leaves	3.5-5.0 lit (700-750 lit water)	Immediately after sowing (0-2 days)
Metsulphuron	Broad and narrow leaves	20 gm (250-300 lit water)	30 days after sowing

Roughing

Roughing is the most important operation in seed production, it helps in maintaining genetic purity of variety. Two to three roughing are necessary at different growth stages. First roughing should be done during flowering, second should be just after completion of flowering and third would be done after the ear heads changes colour and start maturing.

Farmer has to rouge the wheat plant having morphological features different than the candidate wheat variety such as plants having differences in height, flowering time, leaf colour, waxiness, flag leaf length and orientation, colour of awns, unusual spike length, maturity time etc. Similarly, disease infected plants and objectionable weed plants should also be roughed out.

Disease Management

Loose smut: Seed treatment with Carboxin (75WP @ 2.5gm/kg seed) or Carbrndazim (50WP @ 2.5gm/kg seed) should be done.

Karnal bunt: Seed treatment with Thirum (2.5gm/kg seed) or two sprays of Trocodermaviridae@ 4kg/lit on 45th and 65th day would beeffective.

Rust disease: Propiconazole 25EC @0.1% or Tebuconazole 25EC @ 0.1% should be sprayed. Growing resistantvarietiesisthemostappropriate,economicalandeffectivewaytocontrolrustdisease

Varieties:

Rainfed	Harshita (HI 1531), JW-3020, Swapnil (JWS-17), JW 3173, Amrita (HI 1500), JW 3269, HD 4672
Irrigated late	HD 2864, HI 1454, JW 1202, DL 788-2, HD 2932
Irrigated Timely Sown	HD 2932, Snehil JW 1142,RAJ 3777, Malav Shakti (HI-8498), LOK-1, WH-147, GW 273, GW 173,
M.P.K.V, Rahuri	NIAW-301(TRIMBAK),NIAW-917(Tapovan),NIDW-15(Panchavati), NIDW-295(Godavari)

Harvesting, Processing and Storage

The most critical factors in harvesting are seed moisture content, mechanical damage and cleanliness of equipment. The most appropriate stage of harvesting is when grain moisture content is 20-25%. After seed crop is harvested, the seed needs to be dried and well cleaned.

During seed processing the raw seed is cleaned in series of steps from pre-cleaning, drying, air screen cleaning, length separation, gravity separation, seed treatment and bag weighing. After cleaning, seed is sent for bulk storage. The stored seed should have moisture content < 12% and relative humidity should not exceed 50-60%. During storage, insects should be controlled by combination of insecticides and fumigants.

Spray insecticide in storage room before keeping the seed and then fumigate with Aluminium Phosphide @ 2 tablets of 3gm /ton of seed.

Conclusion

Seed production is different from crop production. In quality seed obtained from foundation seed it having high physical and genetic purity. Improved verities should be multiplied and available to the farmers in short time.

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Aloe Vera: Review, How at Grow at Home and Benefits

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Abstract
The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The aloe vera plant, its benefit and steps to grow aloe vera at home for our need is briefly reviewed in this article.

Introduction
Aloe vera is a plant with height of almost 60–100 cm containing very short stem or stemless long leaves, and belongs to the family Liliacae. The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The name Aloe vera derives from the Arabic word “Alloeh” meaning “shining bitter substance,” while “vera” in Latin means “true.” 2000 years ago, the Greek scientists regarded Aloe vera as the universal panacea. The Egyptians called Aloe “the plant of immortality.” There are over 550 species of aloe grown around the world (World Checklist of Selected Plant Families, Royal Botanic Garden Kew, 2013). However, only two species are grown today commercially, with *Aloe barbadensis* Miller and *Aloe aborescens* Miller being the most popular. We can easily grow aloe vera at home to fulfil our need.

Growing Aloe Vera at Home
Items required:
Clay Pot
Aloe vera leaf
Soil
Hose
Organic fertilizer

Steps to Grow Aloe Vera Plant at Your Place
1. Cut the leaf at the base using a sharp, clean knife. Try to cut at a downward angle, towards the stem. The knife must be very clean, or you risk infecting the leaf.

2. Leave the leaf someplace warm, long enough for a film to form over the cut part. This can take as little a few days to as long as two weeks. This film will help keep the cut part from getting infected by the soil.[3] An infected Aloe Vera leaf won’t survive for very long.

Figure 1.0

3. Find a pot with a drain hole in the bottom. Like most plants, Aloe Vera likes water, but it hates to sit in it. If your pot does not have a drain hole, the soil will stay soaking wet. This can lead to root rot, which can kill a plant—including the hardy Aloe Vera.

4. Fill the pot with cactus soil, and dampen it with water. If you don't have any cactus soil, you can mix your own by mixing one-part sand and one-part potting soil.

5. Apply a good amount of aloe gel on your feet, massage until it gets absorbed and then put on socks to moisturize the feet. In winters you can add aloe vera gel to your foot cream or petroleum jelly for super soft feet.

Benefits of Aloe Vera

Aloe vera has been used to enhance the beauty of skin, hair, nails, lips, and eyes. However, with the improvement in cosmetology, it has been proved that Aloe vera is a very important component of cosmetics. It contains almost 20 amino acids, minerals like calcium, magnesium and sodium in sufficient quantities, enzymes, vitamins, polysaccharides, nitrogen and other components that make it a miracle beauty herb. Some of the most important applications of Aloe vera for purpose of Cosmetology are being explained here briefly.

1. Pigmentation: Melanin is a pigment which is responsible for the color of the human skin. Hyper gmentation is a situation in which large amount of melanin is synthesized. This generally happens due to excess exposure of the skin to the sun. In reaction to UV rays in sunbeams, the skin cells called melanocytes initiate to synthesize melanin.

2. Skin Eruption: Aloe vera containing creams are beneficial for skin eruptions. Aloe vera gels have been proved to be the best remedy for burns and wounds. Actually, cellular regeneration, anti-bacterial and anti-fungal activities of Aloe vera make it useful for skin eruption. Sclap and other Skin Problems Aloe vera is very valuable for skin disorders.

3. Itching and Blisters: Aloe vera also provides relief from itching and also helps to treat blisters. Aloe contains vitamin B_1, B_2, B_6, B_{12} and vitamin C that provide soothing and pleasing sensation to skin.

4. Skin Aging: Aloe vera initiates the synthesis of elastin as well as collagen. These proteins are essential for preventing the aging of the skin.

5. Acne: Aloe vera helps to eradicate acne scars by performing as an immune booster and an anti-inflammatory agent. Beauty products composed of Aloe vera may diminish the rigorousness of acne. It is also composed of the chemical ingredients which have the property to save the skin to initiate the acne.

6. Freshness: Aloe vera imparts the sensation freshness. It helps in increasing distribution of blood therefore providing easier oxygen exchange among the cells, hence giving them nourishment.

7. Sun-burns: Aloe Vera has an outstanding possession in diminishing the hurting of sunburn. For this purpose, it is rubbed directly on skin. The fresh fluid from the plant or Aloe vera containing after-sun creams may be used for sun-burns.

8. Moisturizing Agent: Aloe vera may also be used for softening and moisturizing the skin. There are so many products available in the market containing Aloe vera which may be used post-showering to obtain the skin in super soft shape. Aloe vera gel, cream or lotion applied on the face forms a delicious cover that helps to shield the skin from dust and other natural elements which may be injurious to the skin.

Conclusion

The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. It is utilized in functional foods especially for the preparation of health drinks with no laxative effects. Aloe vera is widely known for its beauty benefits. It works wonder for skin and hair and is often the key ingredient in many beauty products.

Moisturizing the skin and repairing damaged hair is one of the numerous benefits of aloe vera. As every like to look and be beautiful specially women in the world. Increasing demand for natural, herbal and ayurvedic beauty and personal care products over the years has led to heighten the competition in this area.

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Farming Without Soil....!!! Yeah, It's Hydroponic Farming

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What is this Hydroponic Mean...?

It is a practice of cultivating plants in water and nutrient medium without soil. Simply cultivation of plants in water using some technology that replaces soil. The word hydroponic is derived from a Greek word Hydro means "water" and Ponos means "labour" thus water working. It was popularized in 1920s by a scientist Dr. William F. Gericke from California.

Yes, A Plant Can Grow Without Soil

It's interesting right, we can grow and cultivate a plant without soil. This can be done by adding the required needs of plants like minerals and nutrients through water which balance temperature, moisture and providing constant supply of oxygen.

How does it Work...?

Carbon dioxide + water = glucose + water.

Why Hydroponic...? Here We Go with its Importance

1. Gives higher yield than other methods
2. It provides the exact needs of the plants than grown in a soil. That leads to speed up the growth and yield higher.
3. Can be grown indoor and outdoor. An eco-friendly method.
4. No soil pest attack and disease in spreader (nematode and others)
5. Roots absorbs energy what they directly from the nutrient rich medium
6. Can grow more plants in smaller area.
7. Can avoid the usage of pesticide and herbicide.
8. Any type of recycled water is used for hydroponic, so can save the waste water.

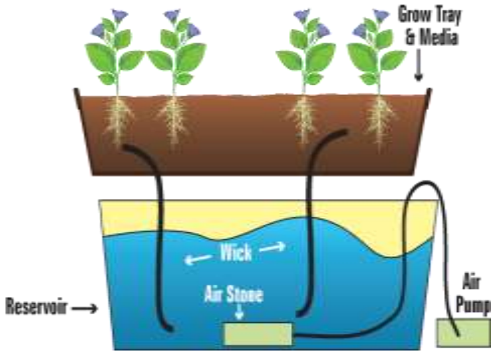
Types of Hydroponic System

There are about six types of methods in hydroponic with the same procedure in different ways.
Growing medium – rockwool, less weighted clay pallet, coconut fibre, vermiculite
Wick - tightly rolled up towels, cotton fabrics, that absorbs and draw off water (capillary action).

1. Wick System: It is the simplest way of hydroponic no need of any costlier and technical support. Growing tray is placed above the growing medium, where these two are fitted above the water reservoir with a small gap. And a wick is placed that connects the growing tray and water reservoir that do capillary action. Wick systems are passive in nature meaning the system works without the need for any motors, pumps, or moving parts, i.e.,

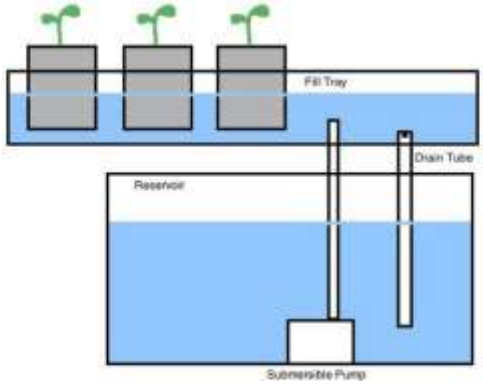
without any moving parts. If needed can keep stone inside the water reservoir like stones in the fish tank., is connected to an air pump outside that distribute oxygen to the plants.

Drawbacks: can't grow larger plants and only limited plants are grown.
Plants grown- leafy and herbs plants (non-fruiting plants).



EBB and Flow System (Flood and Drain System)

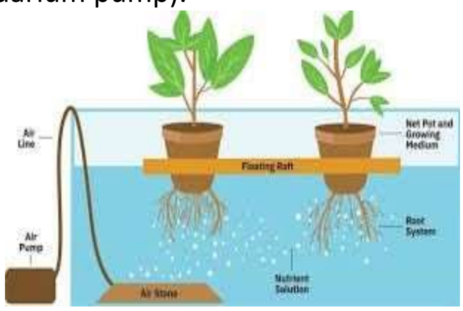
As like the wick method, plants are placed in a tray and kept in a container. The nutrient solution is mixed in the water reservoir and the pump is set up to drain in and drain out the water mixed with nutrient solution. The cycle is continued by placing the motor pump with the timer. Where the plant's roots are flooded with nutrient based water and later drained out. So that roots absorb more nutrients when dried that helps to grow faster.



Drawback: need to maintain timer, electricity, unbalanced ph level due to change in nutrient solution.
Plants grown: tomatoes, beans.

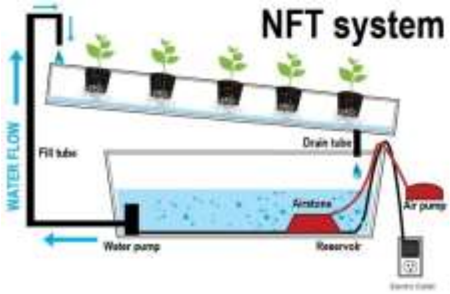
Deep Water Culture

The plant is suspended in a net tray that its root gets constant supply of water, oxygen and nutrients. Where plants are submerged in water. Air Pump is connected with the air stone to generate bubbles that give oxygen supply into the nutrient solution.(aquarium pump).



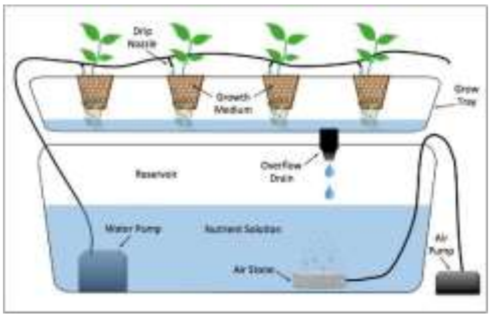
Nutrient Film Technique (NFT System)

Same like ebb and flow but different in configuration. The channel like film or tube is filled with nutrient medium where plants are planted in that. This channel is placed above the water container where the nutrient pump and air pump is placed inside reservoir to drain water in and out from the medium to reservoir. When the air pump is done the water drains into the nutrient medium which is placed above and comes back to the container when the channel is filled. It makes recirculating. Getting oxygen from air and nutrients from the medium helps to grow faster.



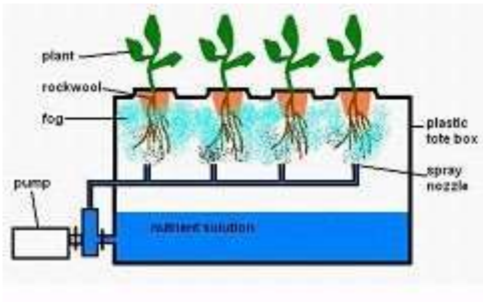
Drip System

It's for commercial purposes with a high budget. Need more skill and sets for larger scale. Where the same set up, simple changes were done. Where plant is planted in growing medium which is place above the container. Here when air is pumped, the water is passed through emitters. Where nutrients meet directly to plant through drip emitters.



Aeroponic

It is the highest tech set up. Where a nutrient pump is set up inside the reservoir mist up the nutrient to roots while it is suspended in the air. Aereponic is a wide topic that needs to be discussed separately, soon it will be updated.



Overall System Requirements

1. Ph – 5.8 – 6.4 or slightly acidic and Temp – 68-78-degree F.
2. Need to supply essential elements through nutrient solution like nitrogen, iron, copper, zinc, potassium, phosphorus, calcium and others.
3. Keep changing nutrient solution in reservoir for every 2 to 3 weeks.
4. Always go with an air pump that circulates oxygen to the solution.

Pros

1. High yield in small areas, eco-friendly in organic aspects.
2. Free of weeds helps to avoid herbicide. No worries about pest from soil.

3. Grow faster than other methods. Mainly for fodder crops.
4. Can give enough nutrients directly to the plants that gives faster and healthier food.

Cons

1. Need high investments and skills.
2. Have to maintain pumps and motors.
3. Daily attention is must and always have to supply fresh water.

All the cons are nothing if we are constructed in a high technology.

What can we grow? herbs, leafy veggies, strawberry, tomatoes, capsicum, beetroot and others.

We can grow by water bottle – yes by wick system.

What would be the cost? To start in big commercial farm – Rupees 2.5 cr/ unit; Minimum from home garden – Rupees 5000/ unit.

Based on the company services the set-up cost is varied, minimum 95 cent of area is recommended.

Our Local Service in Tamil Nadu

Coimbatore plays a vital research and role in hydroponic some companies are:
1. Neoponics.
2. Aquaponics.
3. Future farms.
4. City greens.
5. Hydrilla.

Technology grows in high trends but we have to start in best footsteps in farming that is highly eco-friendly and gives toxic free results.

“HYDROPONIC : THE FUTURE INNOVATION IN FARMING”

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Crop Diversification for Sustainable Crop Production

Article ID: 32304

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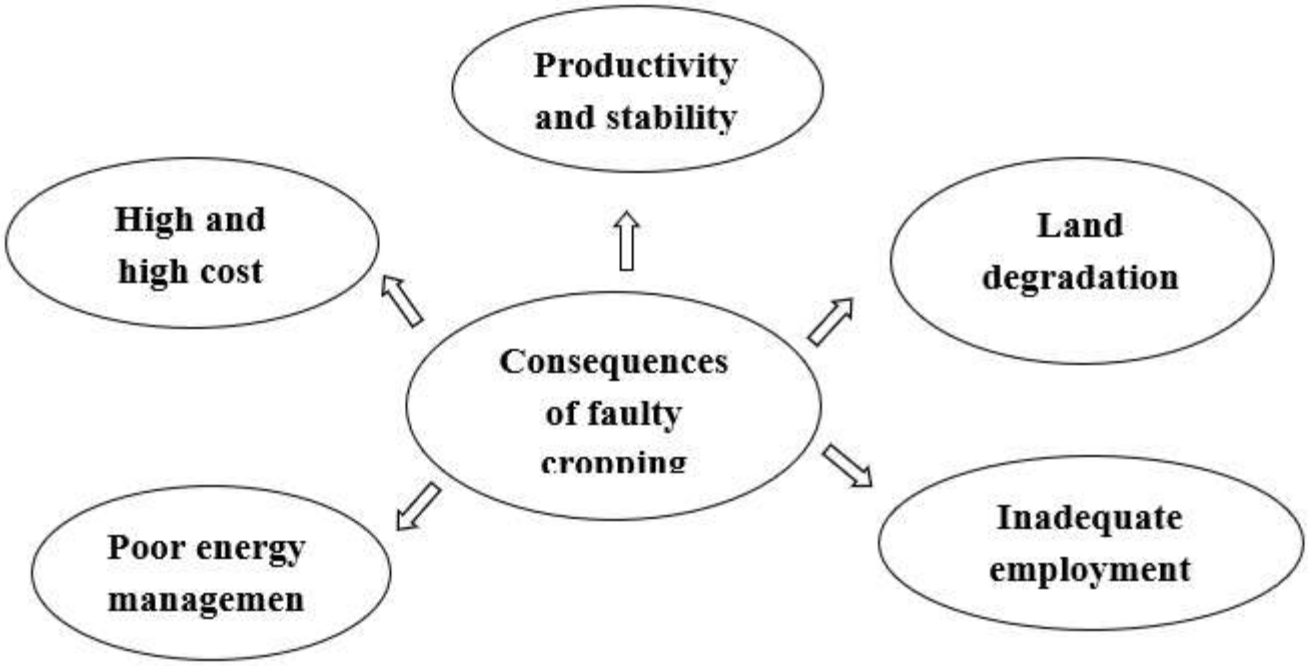
Introduction

India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. On the other hand, only 1.6 % of the farmers have operational land holdings above 10 ha and they utilize 17.4 percent of the total cultivated land. Due to diverse agro-climatic conditions in the country, a large number of agricultural items are produced. Broadly, these can be classified into two groups food grains crops and commercial crops. Due to the challenge of feeding our vast population and the experience of food shortages in the pre-independence era, 'self-reliance' in food grains has been the cornerstone of our policies in the last 50 years. Around 66 percent of the total cultivated area is under food grain crops (cereals and pulses). Concurrently, commercial agriculture developed for whatever reasons in the pre-independent phase also kept flourishing during the post independent period. Commercial agriculture not only catered to the domestic market but has also been one of the major earners of foreign exchange for the country.

Sustainable crop production is a way of growing or raising food in an ecologically and ethically responsible manner. This includes adhering to agricultural and food production practices that do not harm the environment, that provide fair treatment to workers, and that support and sustain local communities. Diversification in agriculture is defined as diversion of a sizable acreage from the existing crop system to some alternative crops/cropping systems/farm enterprises, while maintaining a general equilibrium of meeting the 4F needs (food, fodder, fiber and fuel), and simultaneously taking care of the basic soil health and productivity of the agro-ecosystem of the area at large. Crop diversification provides the farmers with a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to bring down the possible risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop diversification is also taking place due to governmental policies, thrust on some crops, market reforms, infrastructure development, government subsidies, certain other price related support mechanisms, higher profitability and stability in production also induces crop diversification. Crop diversification and growing of large number of crops are practiced in dry-land areas to reduce the risk factor of crop failures due to recurring droughts. Crop substitution and crop shift are also taking place in the areas suffering with some specific soil related problems. India economic security continues to be predicated upon the agriculture sector, and the situation is not likely to change in the foreseeable future. Even now, agriculture supports 58% of the population, as against about 75% at the time of independence. In the same period, the contribution of agriculture and allied sector to the Gross Domestic Product (GDP) has fallen from 61 to 19%. As of today, India supports 16.8% of world population on 4.2% of world water resources and 2.3% of global land. And per caput availability of resources is about 4 to 6 times less as compared to world average. This will decrease further due to further due to increasing demographic pressure and consequent diversion of the land for non-agricultural uses. Around 51% of India s geographical area is already under cultivation as compared to 11% of the world average. The present cropping intensity of 136% has registered an increase of only 25% since independence. Further, rainfed drylands constitute 65% of the total net sown area. There is also an unprecedented degradation of land (107 million ha) and groundwater resource, and also fall in the rate of growth of total factor productivity. This deceleration needs to be arrested and agricultural productivity has to be doubled to meet growing demands of the population by 2050.



Concept of Crop Diversification

1. A shift of a crop or cropping system to another crop or cropping system
2. Use of resources in best possible way by changing and modifying the degree, trend and time options of crop/cropping activities
3. A shift from less profitable and sustainable crop or cropping system to more profitable and sustainable crop/cropping system.

Need of Agriculture Diversification

The need of agriculture diversification is witnessed after the green revolution due to fluctuation in the price due to demand and supply equation under the WTO regulation for the market. In this case agriculture diversification proves to a good 53 shock absorber in the ups and downs of the market value of the farm products may ensure economic stability for the farming families. (Singh, and Miller 2009). Agriculture diversification is necessary due to some factors, which are stated below (Planning & Coordination Department, Government of Orissa).

1. To mitigate the adverse food situation.
2. Ensure constant flow of income.
3. Employment generation.
4. Alleviate hunger and malnutrition.
5. Mitigate ill effects of unusual weather.
6. Increase the income of the small and marginal farmers.

Advantages of Crop Diversification

Diversification is an unavoidable part of economy in the process of structural transformation from the primary to the secondary or any other sector of the economy. There are several benefits of agricultural diversification reported in the literature. In the short run these are:

1. Shifting consumption pattern: As consumers in developing countries become richer, food consumption patterns change noticeably. People move away from a diet based on staples to one with a greater content of animal products (meat, eggs and dairy) and fruits and vegetables. In turn, more dynamic farmers are able to diversify to meet these needs.

2. Improving food security: Diversifying from the monoculture of traditional staple crops can have important nutritional benefits for farmers in developing countries.

3. Increasing income: Crop diversification has the potential to grow the higher number of crops than the traditional way of farming consequently more crops gives more money to the farmers (Pingali and Rosegrant 1995, Von Braun 1995).

4. Nutrient recycling: Diversification helps in minimizing the adverse effect of the current system of crop specialization and monoculture nutrient recycling.

5. Stabilising income over seasons: As diversification involves higher number of crops in farms with respect to the season and started a continuous income generation system to gain the stability.

6. Generating employment opportunities: As diversification involves more than one enterprise including processing, leading to changes in the crop mix/croplivestock mix/crop substitution result s in significantly high demand for labour (Raju, 2005, Pingali and Rosegrant 1995, Von Braun 1995).

7. Alleviating poverty: Poverty reduction in the developing country is possible with high productivity and diversification in two ways such as, intensification in production and its impact on income while the second is diversification of the agricultural expanding production in high-value-added activities (often for export) sugar, maize, palm oil, fruits, vegetables, flowers, livestock, fisheries, etc. (Pingali and Rosegrant 1995, Von Braun 1995) 55.

8. Improving productivity of scarce resources (e.g., water); Diversification in agriculture has tremendous impact on agro socio-economic and uplifting of resource for poor farming communities. It generates income and employment for rural youth for the ultimate benefits of the farmers in the country (Singh, 2009).

9. Promoting export: Developing country farmers have had considerable success by diversifying crops that can meet export market demand. While concern about food miles, as well as the cost of complying with supermarket certification requirements such as for Global GAP may jeopardize this success in the long run, there remains much potential to diversify to meet export markets.

10. Environment: Improving environmentally sustainable farming systems through conservation and enhancement of natural resources. FAO‟s Plant Production and Protection Division works to strengthen global food security by promoting sustainable crop production intensification (SCPI), which aims at producing more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services.

Research and Developmental Support for Crop Diversification

Future agriculture will be much more knowledge and skill based rather than the traditional subsistence agriculture. In the wake of globalization and opening up of the global market, there will be much more opportunity for entrepreneurship development in agriculture. This also calls for paradigm shifts in research and technology development and also the transfer of technology for successful crop diversification. The research system not only needs to address the issues connected with continuance and indulgence and knowledge in the areas of emerging technologies but also create a cadre of scientists through the continuous upgrade of skills and human resource development. The researchers also need to popularize the technologies, impart knowledge and skills to the extension functionaries for the transfer of technologies to the farmers. This knowledge-based farming will call for much more interaction between the researchers, extension workers and farmers. The fruits of the innovative technologies should reach the farmers at the earliest and also spread in the quickest possible time.

Stages of Agriculture Diversification

As quoted by (Chaplin, 2000) the process of diversification of agriculture may pass through four stages.

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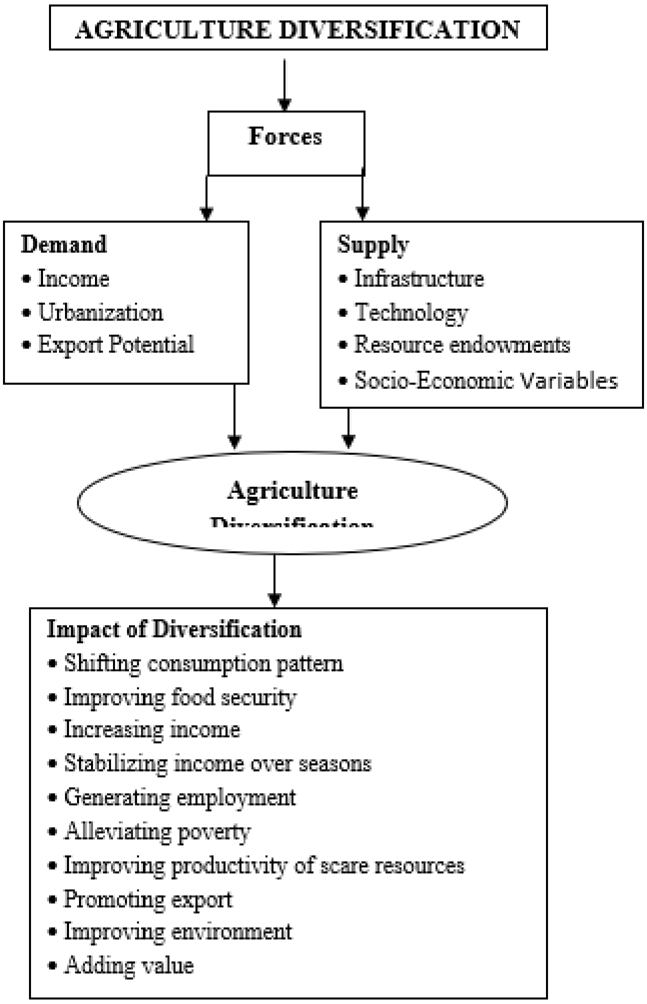
1. At the first stage the cropping system shifts from monoculture to multiple cropping. This phenomenon generally occurs in the developing countries and most of the third world countries are under this category.
2. At the second stage the farmers start more than one enterprise. For example, crops and animal husbandry, beside the number of crops in a year is more than one.
3. Thirdly, initiation of mixed farming.
4. In the last stage of diversification the activities which are incorporated are beyond the agricultural domain such as adding the value through the processing, packaging and producing by products e.g. jam, pickles etc.



Constraints in Crop Diversification

Crop diversification in the country is taking the form of increased areas under commercial crops including vegetables and fruits since independence. However, this has gained momentum in the last decade favouring increased area under vegetables and fruits and also to some extent on commercial crops like sugar cane, cotton and oilseeds crops specially soybean. The major problems and constraints in crop diversification are primarily due to the following reasons with varied degrees of influence:
1. Over 117 m/ha (63 percent) of the cropped area in the country is completely dependent on rainfall.
2. Sub-optimal and over-use of resources like land and water resources, causing a negative impact on the environment and sustainability of agriculture.
3. Inadequate supply of seeds and plants of improved cultivars.
4. Fragmentation of land holding less favouring modernization and mechanization of agriculture.
5. Poor basic infrastructure like rural roads, power, transport, communications etc.
6. Inadequate post-harvest technologies and inadequate infrastructure for post-harvest handling of perishable horticultural produce.
7. Very weak agro-based industry.

8. Weak research - extension - farmer linkages.
9. Inadequately trained human resources together with persistent and large-scale illiteracy amongst farmers.
10. Host of diseases and pests affecting most crop plants.
11. Poor database for horticultural crops.
12. Decreased investments in the agricultural sector over the years.

Conclusion

Crop diversification is one of the best options to increase farm income, leading to food, nutrition and ecological security, as well as poverty alleviation in developing countries. In order to attain the desired level of crop diversification and accelerate technological advancement in agriculture, paradigm shift in cropping system is necessary for attaining sustainable crop production. In the face of these new changes including the achievement of food self-sufficiency, the area shift that tended towards cereals in the immediate aftermath of the Green Revolution, has started moving in the opposite direction, i.e., from cereals to non-cereals.

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Agriculture Water Management Challenges in India and their Solution

Article ID: 32305

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Water is a key natural resource for human survival. Water plays a vital role in sanitation for our rural and urban communities. Water is also an important economic resource. It is necessary for all forms of agriculture and most of the industrial production processes (Merrett 1997; Kay et al. 1997). Water also provides a wide range of ecosystem and environmental services (Frederick 1993; Seckler et al. 1998). It is essential for assimilation of pollution caused by industrial effluents and domestic sewage.

Pressure on freshwater resources is increasing across the globe (WRI 1995; Brown et al. 1998). During the first 8 decades of this century, consumption of water increased fivefold, 75 percent of which was during the second half of the century (Frederick 1993). From a macro perspective, the overall fresh water availability across the globe remains more or less constant. But, from a micro-perspective, the freshwater supplies in many regions and localities are dwindling due to alterations in hydrologic balances, over-exploitation and increasing pollution of freshwater reserves.

Many third world countries are already facing serious water shortages (Brown et al. 1998; Seckler et al. 1998). Increasing freshwater scarcity is becoming a major constraint in producing food for growing world population, ecosystem protection, and maintaining health, social and food security and peace among nations (Postel 1996).

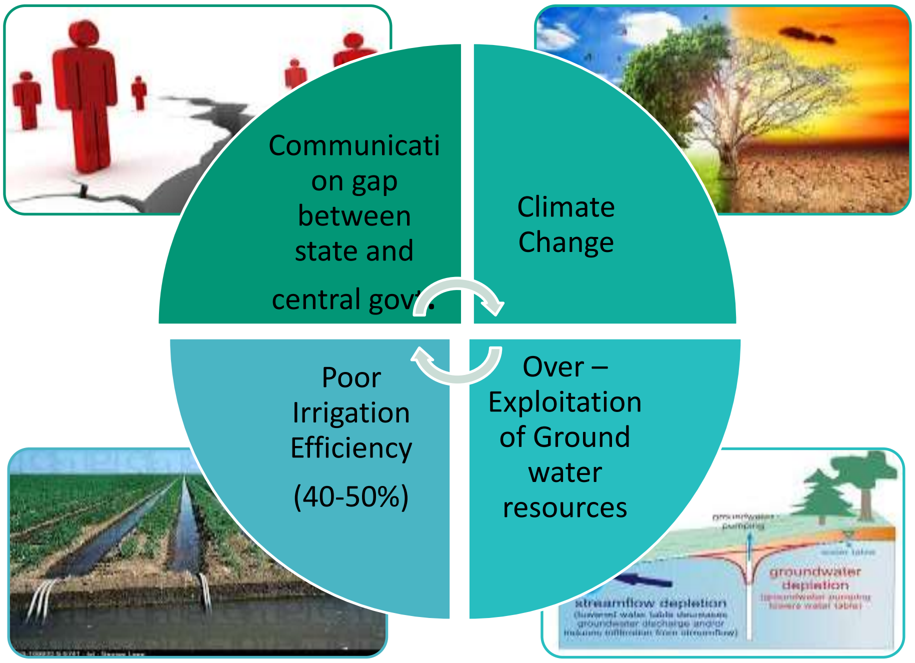

Water scarcity is possibly to pose the greatest challenge on account of its increased demand coupled with shrinking supplies due to over utilization and pollution. Water is a cyclic resource with abundant supplies on the globe. Approximately, 71 per cent of the earth's surface is covered with it but fresh water constitutes only about 3 per cent of the total water.

In fact, a very small proportion of fresh water is effectively available for human use. The availability of fresh water varies over space and time. The tensions and disputes on sharing and control of this scare resource are becoming contested issues among communities, regions, and states. The assessment, efficient use and conservation of water, therefore, become necessary to ensure development.

India accounts for about 2.45 per cent of world's surface area, 4 per cent of the world's water resources and about 16 per cent of world's population. The total water available from precipitation in the country in a year is about 4,000 cubic km. The availability from surface water and replenish able groundwater is 1,869 cubic km. Out of this only 60 per cent can be put to beneficial uses. Thus, the total utilizable water resource in the country is only 1,122 cubic km. Groundwater plays an important part in India's economy. It caters to about 85 per cent of rural demand, 50 per cent urban requirements and more than 60 per cent of our irrigation needs.

The scarcity of water in India affects hundreds of millions of people across the country. A major portion of the population does not have a reliable and constant means of getting water for their daily needs. In June 2019, 65% of all reservoirs in India reported below-normal water levels, and 12% were completely dry. Since tap water is unavailable in many cities including some megacities such as Chennai, residents are reliant on alternative water sources. The country has scattered public water pumps but a lot of them are located far away from cities and their water flow is intermittent and unpredictable. A lot of Indians are forced with the option of spending money to buy drinking water but the poor sections of the society are unable to afford it on a daily basis which creates a massive problem of water scarcity for the rural population of India.

Challenges to Water Management



The main challenges that India faces in managing its water resources. As the largest consumer of water and also the mainstay of the livelihoods of the majority of India's population, agricultural water use deserves special attention. It, then, proceeds to outline some of the inter-sectoral and cross-cutting problems, including on groundwater stress, hydroelectricity demands, and urban and industrial water demands.

The increasing challenge of climate change and shifting rainfall patterns are also highlighted. Farmers have, instead, turned to groundwater. There are an estimated 25 million groundwater pump sets in the country. The use of groundwater played an important part in the success of India's first green revolution. However, driven in part by poor electricity and water pricing and regulation, India has now reached an alarming stage where groundwater exploitation exceeds replenishment. Groundwater assessment units are considered "safe" if the withdrawal is less than 70 percent of the net available resource; "semi-critical" if the withdrawal is between 70 and 90 percent; "critical" if the withdrawal is between 90 and 100 percent; and "overexploited" if the withdrawal exceeds the replenish able amount of water by more than 100 percent. States like Haryana, Punjab and Rajasthan now draw more water than is annually replenished.

The following map shows the distribution of the abovementioned units across India. Some states have handled overexploitation better than others. The state of Gujarat, for instance, has managed to increase the level of groundwater through a combination of check dams (small water reservoirs made up of locally available materials to store water) and state policy6. In contrast, West Bengal has resorted to water mining (groundwater withdrawal from deep aquifers), and has subsequently exposed the local population to poisonous levels of arsenic water. The response to water challenges in the agricultural sector has to be a mix of increasing irrigation efficiency, improving groundwater management, and involving water users in water management functions. Irrigation efficiency is itself contingent on technology and institutions. There are a number of technological interventions that can target water to fields in the right amount and at the right time. These include drip irrigation, tensiometer (to measure soil moisture), and real time delivery of weather-related information to farmers (via cellphones). Institutional reforms should focus on understanding the different skill requirements for managing irrigation systems and for the operations (human resources, training, accounting, etc.) of irrigation departments. Moreover, water user associations, now about 57,000 in the country, should be involved at the field level working with irrigation officials to understand water availability, undertake crop water budgeting, and manage the on-farm systems. These interventions ought to run conjunctively for surface and groundwater resources, so that water resources are best utilized in a holistic manner.

Solution for Water Management

1. Mobilize the farmers of inter states for sharing grievance on water related issues and farming practices.
    a. It can help to devise the solution that could be beneficial for policy makers.
    b. Exchanging ideas of farming practices could help to other farmers.
2. Central government need to take initiative for making water policy with states.
    a. In India, every state has own water policy that lead to water disputes with neighbouring states, for example, Godavari, Krishna, Narmada and Ravi &Beas etc.
    b. Due to central government initiative water use policy should be made on the basin scale instead of state boundary.
3. Increase the efficiency of the current irrigation infrastructure due to introduction of modern irrigation technology.
    a. Canal should be lined.
    b. Farmers should encourage to adopt micro-irrigation, such as, drip irrigation and sprinkler irrigation.
4. Increase the water charge on electricity.
5. Introduction of agronomic practices such as, crop diversification, shifting date of sowing and sowing methods.
6. Introduction of solar pumping at large scale on affordable price.
7. Storage of flooded water in pond, check dam and recharge well.
8. Recycling of wastewater.

Conclusion

As water resources are declining steadily due to current farming practices as well as change in climate variability, there is urgent need to adopt sustainable water management system. Shifting date of sowing could be best option for farmers as weather is shifting since last decade. Since, in India, some proportion of agriculture land falls in canal irrigated area and majority of the canals are unlined, lining of canal system may save water up to 20-25% that lost via seepage. Apart from this, crop diversification, direct sowing, mulching and micro-irrigation system may be a good option to combat this problem.

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Crop Residue: Issues and their Management

Article ID: 32306

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Introduction

Eighty per cent of agriculture land in north-western occupied by a rice-wheat cropping system (~4.1 million ha). Concerns over groundwater withdrawals have led to a planting cycle that allows the rice crop to benefit from monsoon rains. This cycle creates a short period (~10 to 20 days) to harvest rice, manage rice crop residue, and wheat sowing. Many of the 2.5 million farmers in north-western India prepare land for wheat sowing by burning an estimated 23 million metric tons of rice residue in their fields each year.

After mechanical harvesting of rice, farmers in north-western India have different options for sowing wheat. All options include some combination of rice residue treatments (mulching by cutting and on-field distribution, baling and removal from the field, incorporation by tilling into the field, and on-field burning), land preparation (no additional preparation, rotavate, disc and tine harrow, and plank), and seeding of wheat (using Happy Seeders, conventional seeders, other zero-till seeders, and rotaseeders). The majority of farmers currently choose to burn rice straw, plow fields, and do wheat sowing using conventional seeders. India's Indo-Gangetic plains is known for burning of crop residue in the states like Punjab, Haryana, Uttar Pradesh and Rajasthan that are increasing soil as well as environmental pollution.

Crop residues have multiple uses on agricultural and allied sectors. Rice-wheat is the founder cropping system in Indo-Gangetic Plains (IGP) of South Asia which support food and energy source for a million. Burning and/or removal of crop residue are not economical rather than endanger to ecosystem functions. A multiple problem is faced by crop growers on managing residues at time of harvesting to proceed for next crop. However, by adopting some useful interventions, a sizeable quantity of primary plant nutrients can be supplemented in soil without sacrificing the economic return of targeted crop.

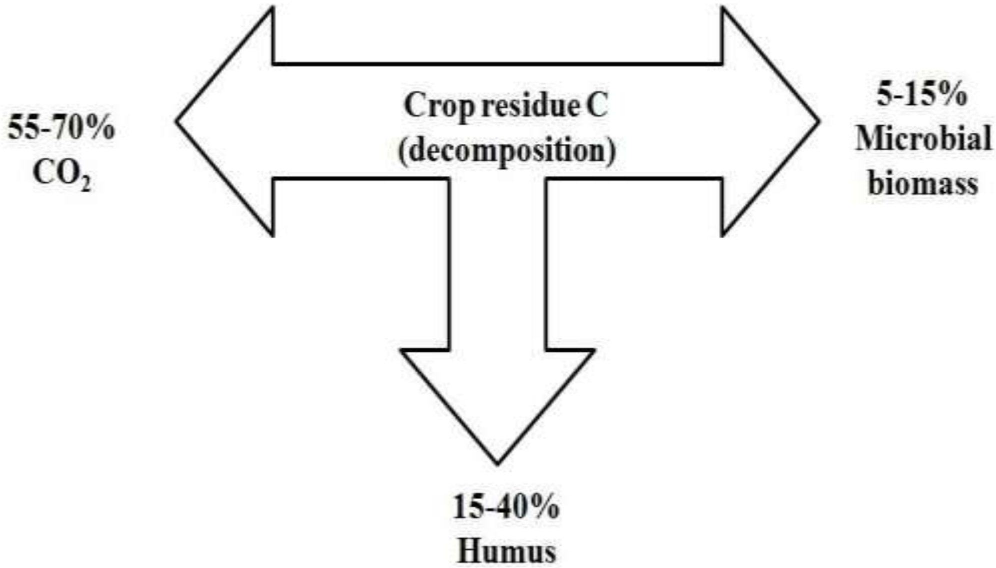

Fig. 1: Crop residue decomposition

Issue for Incorporation of Crop Residues

Crop residues have been incorporated immediately before planting the next crop, grain yields were lower than where residues are removed or burned, resulting in N immobilization, a problem that is attributable to the slow rates of residue decay. In rice-wheat cropping systems, too, management of rice straw, rather than wheat straw, is a serious problem, because there is very little turn-around time between rice harvest and wheat sowing. Other potential problems of residue incorporation just before rice transplanting include accumulation of phenolic acids in soil and increased CH_4 emission under flooded conditions. In this case, the timing of incorporation of crop residues is more important than the amount. Compared with the traditional method of wet incorporation shortly before planting of the next rice crop, the potential benefits of shallow incorporation shortly after crop harvest include accelerated aerobic decomposition of crop residues (about 50% of the C within 30-40 d), leading to increase N availability, and reduced CH_4 emissions. Early incorporation also allows additional time for phenol degradation to occur under aerobic conditions, thereby avoiding any adverse effect on germinating seeds and seedlings.

Fig.2: A view of crop residue burning after harvesting of rice crop.

Adverse Effects of Crop Residue Burning

1. Loss of nutrients: It is estimated that the burning of one tonne of rice straw accounts for the loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides, organic carbon. Generally, crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) and 20% of Potassium (K).

2. Impact on soil properties: Heat from burning residues elevates soil temperature causing the death of beneficial soil organisms. Frequent residue burning leads to complete loss of microbial population.

3. Emission of greenhouse and other gases: Crop residues burning is a potential source of Green House Gases (GHGs) and other chemically and radiative important trace gases and aerosols such as CH_4, CO, N_2O, NO_X, and other hydrocarbons.

4. Crop residues have been incorporated immediately before planting the next crop, grain yields were lower than where residues are removed or burned, resulting in N immobilization, a problem that is attributable to the slow rates of residue decay. In rice-wheat cropping systems, too, management of rice straw, rather than wheat straw, is a serious problem, because there is very little turn-around time between rice harvest and wheat sowing.

Management of Crop Residue

1. Control of burning of crop residue to prevent environmental degradation and loss of soil nutrients and minerals by promotion of in-situ management (incorporation in soil, mulching, baling/binding for use as domestic/industrial fuel, fodder) of crop residue.

2. Diversified use of crop residue for various purposes like charcoal gasification, power generation, as industrial raw material for the production of bio-ethanol, packing material, paper/board/panel industry, composting and mushroom cultivation, etc.

3. Capacity building and awareness about ill-effects of crop residue burning and its effective utilization and management; and

4. Formulation and implementation of suitable law and legislative/policy measures to curb the burning of crop residue.

Strategy

1. Promotion of technologies for optimum utilization and in-situ management of crop residue to prevent loss of invaluable soil nutrients, minerals and improvement of general soil health

2. Promotion of diversified uses of crop residue for various purposes viz. power generation, as industrial raw material for the production of bioethanol, packing material for fruits & vegetables and glassware, utilization for paper/ board/panel industry, biogas generation/composting and mushroom cultivation in Public-Private Partnership (PPP) mode

3. Capacity building of various stakeholders including farmers and extension functionaries under crop development programmes and organization of field level demonstrations on the management of crop residues in all programmes/schemes

4. Promotion of adaptive research for the management of crop residue and development of machineries for effective utilization of such residues; and

5. Formulation and implementation of necessary policy measures for control of crop residue burning through suitable laws/ legislation/ executive orders etc.

Table 1: Estimated utilization capacity of crop residues under existing ex situ management options:

Government policy	Estimated annual utilization of crop residues (Mt)
10% blend of crop residue biomass briquette in thermal power plant	53.5
New and renewable sources of energy policy (2012), Government of Punjab	1.2
Haryana Renewable Energy Development Authority (HAREDA)	0.6
Haryana Bioenergy Policy 2018	0.9
Ethanol production	1.5
Total utilization	57.7

Conclusion

Crop residues are not a waste. Crop residue burning is not desirable because of its serious environmental effects. The benefits of residue have led farmers to use minimum tillage to conserve crop residue. Residue management often takes place at harvest and planting times. Additional residue management options can be used in continuous. Rice residue is likely to have little adverse effects on N availability in the soil when it is allowed to decompose under aerobic conditions for at least 10 days before sowing of the next upland crop. But, rice and wheat productivity is not adversely affected when rice residue is incorporated for at least 10 d and preferably 20 d before the establishment of the succeeding crop.

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Uses Plant Growth Regulator in Vegetable Crops

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A growth regulator is an organic compound, can be natural or synthetic,

It modifies or controls one or more specific physiological processes within a plant but the sites of action and production are different. If the compound is produced within the plant it is called a plant hormone (e.g. auxin, which regulates the growth of longitudinal cells involved in bending a stem of a plant one way or the other).Substances applied externally also can bring about modifications such as improved rooting of cuttings, increased rate of ripening, easier separation of fruit from the stem, etc. A large number of chemicals tend to increase the yield of certain plants such as corn and sugarcane.

Classification of Plant Growth Regulators and Retardants

1. Auxins: (IAA, NAA, IBA, 2-4D, 4-CPA).
2. Gibberellins: (GA3).
3. Cytokinins: (Kinetin, Zeatin).
4. Ethylene: (Ethereal).
5. Abscissic acid: (Dormins, Phaseic Acid).
6. Phenolic substances: (Coumarin).
7. Flowering hormones: (Florigin, Anthesin, Vernalin).
8. Natural substances: (Vitamins, Phytochrome Tranmatic).
9. Synthetic substances: (Synthetic Auxins, Synthetic Cytokinins).
10. Growth inhibitors: (AMO-1618, Phosphon-D, Cycosel, B-999, Morphacting).

Auxins: these are organic substances which at low concentration (less than 0.001 m) promote growth along the longitudinal axis, but auxins also influence a wide range of growth and development responses.

Gibberellins: these substances are having gibbane ring skeleton capable of producing the same physiological responses as gibberellic acid. It was first isolated from the soil borne fungus Gibberella fujikuroi. The gibberellins are phytohormones which are active in regulating dormancy, flowering, fruit setting, and stimulating germination of seeds and extending growth of shoots.

Cytokinins: these are substances composed of hydrophilic group of higher specificity (adenine) and one lipophilic group without specificity. The cytokinins form a group of plant hormones having similar effects as those of GAs in breaking the dormancy of a wide range of seeds and in increased fruit set. These hormones mainly stimulate cell divisions and prevent chlorophyll degradation.

Absecisic acid (ABA): ABA is a naturally occurring sesquiterpene which regulate plant growth and metabolism in various ways and have been detected in nearly all plants. It is involved in the abscission of plant organs, retardation of vegetative buds, regulation of fruits repining and generally in reduction of growth.

Ethylene: it is the only gaseous hydrocarbon hormone which plays an important role in the ripening of fruits, inhibition of root growth, abscission and other growth processes. Unlike the other hormones, ABA and ethylene are not discovered through any interaction with fungi.

Brassinosteroids (BRs) are a class of polyhydroxysteroids that have been recognized as a sixth class of plant hormones and may have utility as an anticancer drug for endocrine-responsive cancers to induce apoptosis and inhibit growth. These brassinosteroids were first explored during the 70s, when Mitchell et al. reported promotion in stem elongation and cell division by the treatment of organic extracts of rapeseed (Brassica napus) pollen. Brassinolide was the first isolated brassinosteroid in 1979, when pollen from Brassica napus was shown to promote stem elongation and cell divisions, and the biologically active molecule was isolated. The yield of brassinosteroids from 230 kg of Brassica napus pollen was only 10 mg. Since their discovery, over 70 BR compounds have been isolated from plants.

Florigen (or flowering hormone) is the hypothesized hormone-like molecule responsible for controlling and/or triggering flowering in plants. Florigen is produced in the leaves, and acts in the shoot apical meristem of buds and growing tips.

24-Epibrassinolide is a type of brassinosteroid, a plant hormone. It is sold commercially in a white powder form for use in plant culture. 24-Epibrassionlide has been shown to improve plant functions in salt- and nickel-stressed environments, as well as increasing enzyme activity.

List of Plant Growth Regulators and their Important Uses in Vegetable Crops

Growth regulators	Conc. (mg/l)	Method of application	Crops	Attributes affected
Cycocel (CCC)	250-500	Foliar spray	Cucurbits, tomato, okra	Flowering, sex expression, fruit yield
Para - Chloro Phenoxy Acetic acid (PCPA)	50	Foliar spray	Tomato	Fruit set and Yield
Ethephon (CEPA)	100-500	Foliar spray	Cucurbits, okra and tomato	Flowering, fruiting, sex expression and yield
	2000	Post- harvest	Tomato, chillies	Fruit ripening
Gibberellic acid (GA)	10	Foliar spray	Water melon, tomato	Sex expression, fruiting , yield
Indole-3-Acetic acid (IAA)	10-15	Foliar spray	Okra, tomato, brinjal,	Seed germination, fruit set and yield
Naphthalene acetic acid (NAA)	0.2	Seedling roots	Tomato, brinjal, onion	Growth and yield
	10-20	Foliar sprays	Chillies and tomato	Flower drop, fruit set and yield
	25-30	Seed/ foliar	okra ,Tomato, brinjal, onion, cucurbits	Seed germination, growth and yield
Naphthoxy-Acetic acid (NOA)	25-100	Seed/ foliar	Tomato, okra	Germination, growth and yield
Silver nitrate	500	Foliar spray	Cucumber	Induction of male flower in gyn, lines
Silver thiosulphate	400	-	Musk melon	Induction of male flower in gynoecious lines
2,3-5, tri-iodobenzoic acid (TIBA)	25-50	Foliar sprays	cucurbits	Flowering, sex expression and yield
Tricontanol	2	Foliar sprays	Chillies and peas	Fruit set and yield

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Role of Plant Growth Hormones in Vegetable Production

The role of plant regulators in various physiological and biochemical processes in plants is well known. Growth regulators are known to affect:

1. Seed germination.
2. Seed dormancy.
3. Vegetative growth.
4. Nodulation.
5. Tuberization.
6. Fruit ripening and yield.

These can also be used for producing polyploidy and male sterility in order to overcome inter-species inculpabilities and for producing hybrid seeds.

Seed Germination: Pre- showing treatment of seed with growth regulators has been reported to enhance seed emergence.

In tomato, higher germination with GA3 at 0.5 mg/l, and 2,4-D at 0.5 mg/l is reported.

Soaking of seeds in ethephon at 480 mg/l for 24 h improved germination in muskmelon, bottle gourd, squash melon and watermelon at low temperature.

Seed Dormancy: Main problem has been potato where freshly harvested tubers fail to sprout before the termination of rest period. Chemicals which have been reported to break the rest period are GA, ethylene chlorhydrin and thiourea.

The treatment which has been used for breaking of dormancy in potato comprise the vapour treatment with ethylene chlorhydrin (1 liter per 20 q) followed by dipping in thiourea (1% sol.) for 1h finally in GA (1 mg/l) for 2 seconds.

Lettuce is another vegetable in which treatment with GA has been reported to break seed dormancy induced by high temperatures.

Flowering: Induction of flowering in plants which otherwise fail to flower has also been reported with the use of various plant growth regulators. Application of GA at 50 mg/l to young leaves of non- flowering varieties of potato, when floral buds had just formed, resulted in flower induction in all varieties. MH delayed flowering in okra . GA has been reported to induce early flowering in lettuce.

Sex Expression: The treatment with growth regulators has been found to change sex expression in cucurbits, okra and pepper.

Gametocides: Some plants growth regulators possess gametocidal actions to produce male sterility which can be used for F1 hybrid seed production. The chemicals which has been reported to show good performance are MH at 100 to 500 mg/l in egg plant, okra, peppers and tomato, GA3 in onion, 2,3- dichloroisobutyrate (0.2 to 0.8%) in egg plants, muskmelon, okra, onion, root crops, spinach and tomato and TIBA in cucumber, egg plants, onion, and tomato. GA at 100 mg/l can also be used for inducing male sterility in pepper.

Hybrid Seed Production: Growth regulators can be used as an aid in hybrid seed production. Use of ethephon has been used for producting temporary female lines in some cucurbits. Successful F1 hybrid in Butter-nut squash has been made by using female line produced with ten weekly sprays of ethephon Plant growth regulators have also been used for maintenance of gynoecious lines. In cucumber, GA3 sprays have been made to induce staminate flowers in gynoecious lines. Silver nitrate at 500 mg/l has been reported to be as effective as GA3 in inducing male flowers on gynoecious lines of cucumber . However, in muskmelon foliar sprays of Silver thiosulphate at 400 mg/l was found best for induction of male flower on gynoecious lines.

Fruit Set: Poor fruit set is a major problem in tomato, brinjal and chillies which is frequently caused by adverse weather conditions during flowering. Plant growth regulators have been reported to enhance fruit set under both normal and adverse weather conditions.

Parthenocarpy: Studies on use of growth regulators in many vegetables have shown an increase in the fruit size with their applications. The role of plant growth regulators in fruit development can also be seen from the fact that with their help it is possible to stimulate fruit development without fertilization (parthenocarpic). In brinjal, application of 2,4-d at 0.00025% in lanolin paste to cut end of styles or as foliar sprays to freshly opened flower cluster has been reported to induced parthenocarpy.

Fruit Ripening: Ethephon, an ethylene releasing compound, has been reported to induce ripening in tomato and pepper. Field application of ethephon at 1000 mg/l at turning stage of earliest fruits induced early ripening of fruits thus increasing the early fruit yield by 30-35%. Post-harvest dip treatment with ethephon at 500-2000 mg/l has also been reported to induce ripening in mature green tomatoes.

Fruit Yield

Tomato: Soaking of seed in NAA at 25-50 mg/l, GA at 5-20 mg/l and CIPA at 10-20 mg/l, 2 ,4-D, 0.5 mg/l or thiourea at 10-1 M have been reported to improve fruit yield in tomato.

Brinjal: Soaking of seedlings roots in NAA at 0.2 mg/l and ascorbic acid at 250 mg/l has been reported to produce higher fruit yield.

Chillies and Peppers: Foliar sprays of GA at 50 mg/l at fruit setting or planofix (NAA 10 mg/l) double sprays (at flowering and 5 week later) decreased flower shedding and gave better fruit yield in chillies.

In summary, one or the other plant growth regulator influences every phase of growth or development in plants. These roles could be individualistic or synergistic; promoting or inhibiting. Additionally, more than one regulator can act on any given life event in a plant. Along with genes and extrinsic factors, plant growth regulators play critical roles in plant growth and development. Factors like temperature and light affect plant growth events (vernalisation) via plant growth regulators.

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Phytoremediation Approaches for Restoration of Heavy Metal Contaminated Soils

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Introduction

Due to rapid industrialization and exponential growth of human population, mother nature is continuously depleting day by day and heavy metals from different point and non-point sources took the major role in making things worse. A recent estimation suggested that approximately, 250,000 sites amidst the EEA member countries were severely polluted and need urgent remediation (EEA 2007). In India, highly hazardous waste contributing states are Gujarat, Maharashtra, and Andhra Pradesh which donates about 80% of the total. So, these days, refurbishment of such damaged sites has turned out to be the utmost grave issue worldwide. Looking back in the past, traditional methods for renovation of besmirched spots have not only been confirmed as costly, dreary, and insufficient but also produce secondary wastes. However, plant mediated decontamination strategies, known as phytoremediation of polluted systems or sites, has many methodical and fiscal profits as it is a graceful and cost-effective approach.

Heavy Metal Contamination in Soils

Collectively, heavy metals can be found in earth crusts, rocks, soils, sediments, waters, and microbes with natural background concentrations. Anthropogenic sources like industrial waste, mining waste, cruse oils, agricultural waste such as fertilizers, pesticides etc , incineration, open dumps and many other sources directly or indirectly releases them in higher concentrations to the environment. Considerable amount of metals accumulates in sediment and ultimately enter into the food chain through water, plants or leaching into groundwater. Moreover, due to their persistency, they do not easily degrade and thereby taunting the environment severely. Exposure to these pollutants especially through dietary intake of plant-derived food and beverages, drinking water, or air can have long-term effects on human health e.g. damaging cell tissues, DNA damage, alter enzyme specificity and much more complex diseases.

Fig 1- Heavy Metal Contamination Sources

Phytoremediation Approaches

Phytoremediation ensues growing of floras on contaminated spots so that adulterating constituents are absorbed by plant root system and translocated and transported into numerous parts. Being a long-term process, it depends on several factors like climatic adaptability, rate of plant growth, and tolerance to edaphic environments, root system, confrontation to disease and pest, and time essential for attaining anticipated remediation results. Also, microbial interaction with xenobiotics have had a serious impact on the remediation tactics. Heavy metals especially, Ni, Pb, Cu, Zn etc. which results into toxic devastation in the ecosystem of both soil and water, have been reported to be identified and accumulated by a wide spectrum of plants. Different techniques and mechanisms used by the plant for remediation of contaminated sites and each are discrete from each other.

Phytodegradation

Phytotransformation or degradation is the capability of florae to collect and destroy the pollutants. Contaminants are tainted via internal enzymatic actions and metabolic progressions. Further, the metabolic processes for degradation are influenced by the amount and configuration of toxins, soil settings, and vegetal species. Several compounds can be detached off from the ecosystem by phytodegradation such as diluents in under groundwater, aliphatic , petroleum and aromatic components in muds, and unstable composites in the air. Plants involve certain enzymes to catalyze the process of degradation and convert heaviest components into carbon di oxide and water, for example, oxygenases have been recognized in plants and are capable to promote the dilapidation of aromatic and aliphatic hydrocarbons. 4 naturalized grasses (*Agropyron pectiniforme, Bromus inermis, Phleum pratense,* and *Poa pratensis*), 3 naturalized legumes (*Medicago sativa, Melilotus officinalis,* and *Trifolium repens*), two native forbs (*Artemisia frigida* and *Potentilla pensylvanica*), one native grass (*Bromus ciliatus*), and two native legumes (*Glycyrrhiza lepidota* and *Psoralea esculenta*) exhibit prodigious probability in extenuating heavy metal as well as crude oil contaminated soil.

Phytovolatilization

Plant's ability to mitigate the pollutants that have some tendency towards volatilization into the air from the upper parts of the plant like leaf stomata and stems or from soil due to plant root activities (indirect phytovolatilization). Phytovolatilization happens as the plants raise and extract the pollutants through their roots. Contaminants like Hg can pass inside the florae to the shrubberies and volatilize into the atmosphere. Also, methyl mercury can get volatilized from genetically modified tobacco plants into atmosphere with generally less toxic form.

Phytoextraction

Phyto sequestration or phytoaccumulation is the process where plants uptake the contaminants by the root system from soil or water and translocate and accumulate them in plant biomass such as shoots and leaves. Plant can sequester through root zone using physiological mechanism and thereby most of the pollutants first absorbed by the root system of plants and then transported through plant transport mechanisms to the aboveground tissues. The plant may store the toxicant into the cell vacuoles after converting them into less toxic forms or may process the contaminants through phytodegradation mechanisms and phytovolatilize in the plant's transpiration stream. Plants uptake bioavailable inorganic metals or elements such as As, Cd, Cu, Ni, Se, and Zn, which are often considered as environmental contaminants and also plant essential nutrients.

Rhizofiltration

Rhizofiltration is the procedure of eradicating intractable constituents or xenobiotics from water through plant root systems. Plant roots engage themselves in accumulating the pollutants in roots or aboveground biomass. This is particularly effective in wetlands where all the impurities in water are permitted to be engrossed by plants' roots. Contaminants like lead, uranium, chromium (III), and arsenic (V) can effortlessly be taken up by the roots. Hydroponically cultured vegetations can quickly eliminate heavy metals from aquatic bodies and collectively accumulates them in the roots and shoots. Plant's roots are able to absorb huge amount of Pb and Cr from soil-water or from water passing through the root zone of compactly mounting flora. Thayaparan et al.

(2013) observed that *Azolla pinnata* can confiscate Pb from water through rhizofiltration. The aerobic and anaerobic zones of wetlands encompassing root systems and deposits enable the sorption and precipitation of poisonous metals. Rhizofiltration comprises of innumerable mechanisms to eliminate the pollutants from water, viz., intracellular uptake, surface absorption, deposition in vacuoles, and translocation to the shoot or precipitation by plant exudates. So, like other phytoremediation approaches, rhizofiltration is also economic and negligibly troublesome environmentally.

Phytostabilization

Noxious components which drift via water, wind, leaching etc, may create chances of severe off-site contamination. Phytostabilization objectifies holding or restricting the toxins within the vadose zone or unsaturated rhizosphere. By this way, it is endorsed as a faithful practice to evade the off-site contamination. Microorganisms allied with roots may further augment the dilapidation of metals and organic contaminants due to restraints in movement of the pollutants. Metal poisons at leftover sites are explicitly phytostabilized. Plants either uptake or immobilize the pollutant, thereby reducing their mobility and transportation in the environment e.g. grasses, many herbaceous plants and wetland species having fibrous roots are normally utilized in the phytostabilization to regulate wholescale soil movement and/or avert pollutant migration. Scientists evaluated the potential of Festuca rubra L. for phytostabilization of Cu-contaminated soil using halloysite as an immobilizing agent. However, some soil amendments such as nutrient supply and immobilization of contaminants can enhance the process of phytostabilization. Microbes and root exudates perform a prolific role in this regard. Plant root exudates arouse bacteriological activity and biochemical alterations like mineralization of metals in the root zone. Also phytohydraulics can prevent migration of contaminants to the surface water.

Hyperaccumulating Plants	Metals
Echinochloa crusgalli	Pb, Cd, Cu
Populus nigra , Taraxacum officinale	Zn, Cu, Cd, Pb, Cr
Eichornia crassipes	Cr, As, Cd, Hg, Pb
S. cordifolia	Fe, Zn, Pb, Mn, Cu, Cd, Ni, and Cr
Typha caerulescens, Arabiodpsis Halleri	Zn, Cd
Pteris vittata	As
Astragalus racemose	Se
Hybanthus floribundus subsp adpressus,	Nickel
Iberis intermedia	Thallium
Zea mays	Zn, Cd, Pb

Table 1- List of Plants Hyperaccumulating Toxic Heavy Metals

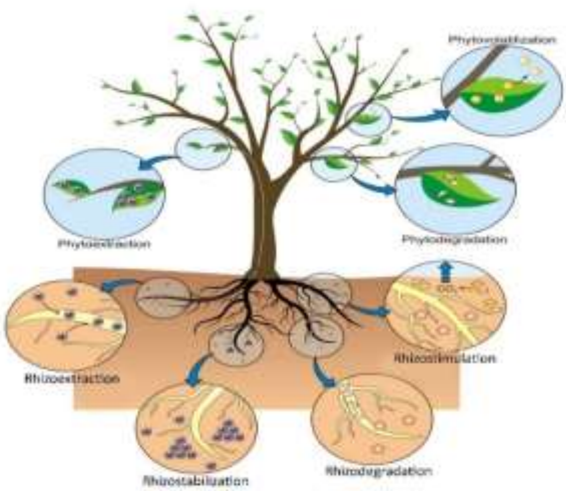

Fig 2- Phytoremediation Mechanisms in Brief

Conclusion

Phytoremediation is considered to be economical and beneficial to the ecosystem that was once devastated due to agricultural and mining activities, urban and logging industries & is valid for any hazardous biochemical contaminants in the milieu. Plants are self-sufficient to cleanse, restrain or eradicate pollutants at the time of their development by different biological processes. Further with progression in the arena of genetic recombination technology, like transgenic plants, can be influential in the phytoremediation tactics for remediating polluted environment. Future studies should be directed towards the combinatory approaches so that efficient remediation can be achieved under field conditions.

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[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.
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